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THE USE OF COLLABORATIVE MODELS TO IMPROVE THE
PERFORMANCE OF CONSTRUCTION SUPPLY CHAINS IN SOUTH
AFRICA

by

Neo Malose Masemeni

A dissertation submitted in the fulfilment of the requirements for the
degree

MAGISTER TECHNOLOGIAE: CONSTRUCTION MANAGEMENT

in the

Faculty of Engineering and the Built Environment

at the

UNIVERSITY OF JOHANNESBURG

Supervised by Prof. C.O. Aigbavboa
Co-Supervised by Prof. D.W. Thwala
THE USE OF COLLABORATIVE MODELS TO IMPROVE THE PERFORMANCE OF CONSTRUCTION SUPPLY CHAINS IN SOUTH AFRICA

Neo Malose Masemeni

Supervised by Prof. C.O. Aigbavboa
Co-Supervised by Prof. D.W. Thwala

A DISSERTATION submitted in fulfilment of the requirements for the awarding of the degree Magister Technologiae in Construction Management in the Faculty of Engineering and the Built Environment, Department of Construction Management and Quantity Surveying at the University of Johannesburg, Republic of South Africa.

Johannesburg, May 2016
DECLARATION

I, NEO MALOSE MASEMENI, do hereby declare that the work undertaken in this dissertation is a direct result of my own investigation, research and effort, with the exception of the references and acknowledgements made in the body of the report. This dissertation has never been previously submitted for an equivalent or higher qualification at any other educational institution.
ACKNOWLEDGEMENTS

This research could not have been possible if it were not for the support and assistance I received from certain individuals that played an instrumental role throughout my academic journey. I would like to give sincere thanks to the following people and institutions:

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- Professor Wellington Didibhuku Thwala, for giving valuable advice and guidance while the study was being undertaken.
- The University of Johannesburg’s STAKON, for their assistance with the statistical data analysis. In particular Mr AG Kududzai for the many hours spent assisting me in interpreting the data collected.
- My friends and colleagues for assisting with the distribution of questionnaires.
- The respondents, from the different construction backgrounds for taking the time to complete the research questionnaire.
- My family, for their support and encouragement. My parents, Elizabeth Ramasela Masemeni and Lesiba Ezekiel Masemeni. Exceptional thanks to my wife, Maria Nkatsana Masemeni and my son Kgatlisho Tshimoloho Masemeni. Ke rata gole lebogiša kudukudu.
- Lastly, God, Almighty, for giving me that ability and resources to complete and share this research with the construction globally.
DEDICATION

Ke rata go lebiša di tebogo tša Research yaka go koko Anna Raisibe Seloana le rakgolo Adam Malose Masemeni bao ba i thobeletšego boroko bjo bogolo. Dithekgo le mafolofolo ao ba mphilego onatshepidišong ya dithuto tšaka, ke i kgantsa e bile ke tla fela ke ba gopoladinakong tsohle bophelong bjaka. Moya wa lena o robale ka khutšo.
ABSTRACT

Construction supply chains around the world are known for their fragmented and adversarial methods, sometimes making contracting relationships very difficult to administer. The study intended to evaluate collaborative project management techniques to improve the overall performance of construction supply chains in South Africa. Secondary data on the subject matter was attained from articles in research journals, research books and other academic publications. A quantitative research method was adopted for the study. The research made use of primary data solicited from self-administered, open-ended questionnaires. These questionnaires were completed by industry professionals namely; contractors, consultants and clients that are or have been involved in large construction projects. To round up the research, case studies were used to shed light on some undertakings with collaborative models. Some of the challenges faced in construction supply chains are corruption, price-oriented selection methods, lack of commitment from other parties, unrealistic deadlines, selection of contract and pricing strategy, high stress levels, complex nature of projects, adversarial (aggressive) relationships, lack of trust, and the unpredictable nature of projects.

The study revealed that for the project to be deemed a success, commonly practitioners focus on the time taken, the quality of workmanship of the finished commodity and the overall cost of the project compared to the planned cost. For the collaboration to work, practitioners need be mindful of the dynamics in the construction supply chain. These dynamics need to be nurtured through the duration of the project. In this study the most important factors for facilitating successful collaborative models were identified as good leadership, effective communication, top management support, adequate resources and a knowledgeable client. Selection of the correct team is also important. The quality of previous work, the ability to deliver on time, experience with similar work, technical ability and effective and efficient decision making should be the parameters used in the selection of the ideal partner. A paradigm shift to more innovative means of undertaking construction projects is desperately needed. Compared to the fragmented style of construction supply chains, a paradigm shift in the direction of more collaboratively structured construction supply chains will ensure that overall success is achieved. The study recommends that collaborative models and the philosophies associated with them be incorporated across all forms of construction supply chains.
Key words: Collaborative Models, Integrated Construction Supply Chains, Project Improvement, Partnering, Alliancing, South Africa
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<tbody>
<tr>
<td>ACA</td>
<td>Australian Constructors Association</td>
</tr>
<tr>
<td>AGANAO</td>
<td>Auditor-General of the Australian National Audit Office</td>
</tr>
<tr>
<td>AMT</td>
<td>Alliance management team</td>
</tr>
<tr>
<td>AUS$</td>
<td>Australian Dollar</td>
</tr>
<tr>
<td>BAU</td>
<td>Business as usual</td>
</tr>
<tr>
<td>BIM</td>
<td>Building Information Modelling</td>
</tr>
<tr>
<td>CCC</td>
<td>Construction Coordination Committee</td>
</tr>
<tr>
<td>CIDB</td>
<td>Construction Industry Development Board</td>
</tr>
<tr>
<td>CII</td>
<td>Construction Industry Institute</td>
</tr>
<tr>
<td>CM</td>
<td>Construction management</td>
</tr>
<tr>
<td>CMP</td>
<td>Collaborative modelling processes</td>
</tr>
<tr>
<td>CSC</td>
<td>Construction supply chain</td>
</tr>
<tr>
<td>CSCMP</td>
<td>Council of Supply Chain Management Professionals</td>
</tr>
<tr>
<td>CSF</td>
<td>Critical success factors</td>
</tr>
<tr>
<td>CW</td>
<td>Collaborative working</td>
</tr>
<tr>
<td>D&amp;C</td>
<td>Design and construct</td>
</tr>
<tr>
<td>DEA</td>
<td>Department of Environmental Affairs</td>
</tr>
<tr>
<td>GCC</td>
<td>General Conditions of Contract</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>HK$</td>
<td>Hong Kong Dollar</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication technologies</td>
</tr>
<tr>
<td>JBCC</td>
<td>Joint Building Contracts Committee</td>
</tr>
<tr>
<td>KPI</td>
<td>Key performance index</td>
</tr>
<tr>
<td>MTRC</td>
<td>Mass Transitt Railway Corporation – Tseung Kwan O Extension</td>
</tr>
<tr>
<td>NBSC</td>
<td>National Bureau of Statistics of China</td>
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</table>
NEC  New Engineering Contracts
NMA  National Museum of Australia
PAB  Project Alliance Board
PM  Project manager
PMP  Project-based management processes
PPP  Public-private partnership
RC  Relational contracting
SAIP  Stafford Area Improvement Programme
SC  Supply chain
SCM  Supply chain management
SHEQ  Safety, Health, Environment and Quality
TCP  Traditional construction processes
TKE  Tseung Kwan O Extension
UK  United Kingdom
US$  United States of American Dollar
USA  United States of America
W  Kendall’s coefficient of concordance
WCML  West Coast Main Line
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CHAPTER ONE: BACKGROUND OF STUDY

1.1 Background

Working collaboratively in any environment is important for any production related activity and the benefits that come with such a practice are many. The construction industry has for many years been plagued by disputes which have led to some form of arbitration or litigation proceedings. Such occurrences have resulted in parties feeling hard done with large sums of money being spent on settling both simple and complex matters. In an attempt to remedy the situation as well as improve other areas of construction innovative models have been developed and implemented with some degree of success. With this in mind it is worth mentioning that even with the plethora of information on collaborative models in construction only a handful of projects utilise these models, while *inter alia*, insufficient experience and adversarial relations have seen practitioners failing to implement these models successfully in their projects.

Collaborative working offers both ‘soft’ and ‘hard’ benefits for the project and the supply chain as whole. The soft benefits are attributable to the individuals making up the project team. Some of these benefits include; a less disruptive, more enjoyable working environment, less paperwork and people being more helpful (Cheung and Rowlinson, 2011). The hard benefits are those that are concerned with the project performance in general. These include improvements in time cost, quality and health and safety (Masemeni, 2011). Benefits may even span beyond those mentioned above depending on the objectives set by project partners.

Collaborating in construction projects involves a wide range of operations some are complex, yet some are simple to understand and implement. For complex situations such as large project teams or a wide range of cultural backgrounds each scenarios must be treated as an intricate process. It is quite often the case that partnering as a procurement strategy is simply paid lip service with no actual steps being taken to integrate it in the project delivery strategy (Chan, Chan and Ho, 2003).

Construction is an interrelated process and hence the quality of communication must be high and must not deteriorate to the disadvantage of all concerned. For this reason much time must be spent on this critical part of the relationship to ensure that all avenues of communication are explored and exploited to their fullest extent. Constant communication between all
members of the supply chain is a necessity for knowledge exchange and importantly reinforce the relationship. The mediums of communication must be based on sound principles of learning, joint problem solving and information exchange. Partnering provides an open, direct and timely line of communication on a small scale (single project) as well as a large scale (the industry as a whole). This is why partnering is not only beneficial to the client and contractor in one project but equally beneficial to construction industries throughout the world (Chan et al., 2003).

It is the major players that are most influential in the supply chain. It is therefore imperative that these individuals/organisations familiarise themselves with the various collaborative models available to them. This is necessary in order exploit, as far as possible, the benefits of collaboration to better manage all areas of the project. Working in an environment conducive to information exchange and learning will firmly shape a “win-win” environment and stimulate the diminishing of adversarial patterns. Therefore this chapter provides a background of the study of collaborative models in the construction industry in general before introducing the use of these models in South Africa.

1.1.1 Current state of the construction industry

Construction projects are by their very nature temporary in duration and this is governed by the start and end dates of relationships formed in these projects. One of the biggest challenges in maintaining a long-term relationship in the construction industry is the simple matter of the “set up” (or nature) of the industry”. The building of trust is severely owing due to the short window of time made available by the nature of the industry. In addition to the nature of the industry, the constant changing of project personnel from one project to another further frustrates and negatively affects the formation of long-term relationships (Briscoe et al. 2004).

In South Africa collaborative models are very seldom used to roll out projects, more especially in small and medium scale projects. Over the last decade, however, client organisations have increased the idea of relationship-based approaches to procure their projects (Yeung, Chan and Chan, 2009).

For years parties to a project have relied on the contract to execute works and bind others together. This very often results in conflict as parties rely on the contract to extricate
themselves from compromising situations (Cheung et al., 2003). No contract is full proof, many loopholes exist and on many occasions these loopholes are exploited resulting in unfair rulings. When conflict arises the project becomes unpleasant to work on and parties are not happy to be there. This can prove disastrous in the long run. Contracts furnish certain parties with “powers” and therefore do not provide an effective climate in which co-operation can flourish (Eriksson, 2008). Power is an issue included in this complex relationship, the success of which is dependent on its possessor. Power as we know it can be problematic if it is not deployed responsibly and therefore should not be seen as a luxury but a responsibility. Informal relations such as those of relational contracting require that the “power possessor” refrain from exercising his/her powers to get his/her way, as this can hinder the aspiration of a “win-win” atmosphere (Faisol, Dainty and Price, 2005).

Normally stakeholders do not desire working together. Stakeholders are more interested in looking after matters that maximise themselves economically with little and at times no consideration for their fellow associates. Most of the procurement systems used in the industry have been designed for adversarial confrontations between stakeholders (Naoum, 2003). This is created by the rigid manner in which the contract procedures have been prepared, promoting a hostile environment instead of mutually establishing sound objectives.

1.1.2 Supply chain management

In order for organisations to operate successfully they need to have fit and well oiled (integrated) systems in place from the beginning of the production line right up to utilisation. For the sake of this research study the aforementioned system will be referred to as the supply chain. For many years people have been trading by simply exchanging goods and services for some form of remuneration, creating a supply chain in its basic form. Advances due to the ever-changing environment of economics have led to more involved and complex supply chain models. According to Crandall, Crandall and Chen (2010) the first supply chain models involved a few steps in mobilising products from one point to another (from point production to point of consumption). The history of supply chains (SC) goes back over 2000 years ago with advances between 1275 and 1295 by Marco Polo of Vietnam (Crandall et al., 2010). Recent history suggests that supply chain management (SCM) systems were formalised by the manufacturing industry with the aim of creating long term relationships with suppliers and improving quality by streamlining activities in a production chain (Vrijhoef and Koskela,
Akintoye, McIntosh and Fitzgerald (2000) also suggest that the manufacturing industry has been at the forefront of research and development in SCM.

Supply chain management in the construction industry has not been around for very long when compared to other industries, with initiatives only since the late 1980s and early 1990s (Vrijhoef and Koskela, 2000). The concept is still an emerging one in the industry which is why few SCM models have been practised to date. Partnering, alliancing and incentive-based contracting have been recognised by Love, et al. (2004) as SCM initiatives in the construction industry. Collaboration is central to alliancing and partnering. According to Akintoye et al. (2000) SCM provides a platform for collaborative workings in the construction industry even though the practice is in its early stages of development.

1.1.3 Collaborative models in the construction industry

Also referred to as relational contracting, there are two collaborative models predominantly used in the construction fraternity. Although similar these models can be arranged in various ways. Partnering and alliancing are both underpinnings of relational contracting, defined by Rahman and Kumaraswamy (2004a:148) as “a socio-legal philosophy that requires all project participants to belong to a single (project) organisation representing a core element of mutual cooperation and team-working”.

Below are definitions of the various collaborative techniques used in the construction industry:

- **Partnering**: A commitment on a long-term basis, with the intention of achieving specific business objectives through maximising each team member’s input (Chan et al., 2003).
- **Alliancing**: A system that relies on multiple organisations coming together and generating new knowledge so that parties are able to solve mutual problems under adverse conditions and in complex times (Davis and Walker, 2009).
- **Joint venture**: An ad hoc arrangement whereby two or more organisations combine resources (skills capital, expertise, knowledge and property) creating an association of shared risks and rewards (Construction Industry Development Board, 2004).
- **Sub-contracting**: The practice of employing the services of additional individuals or companies, referred to as the sub-contractor, to assist with completing the project on
behalf of the main contractor. The main contractor is still responsible to oversee the work done by the sub-contractors, to ensure execution within the required parameters.

- **SCM:** The co-coordinating of customers, supplies, third-party service providers, and intermediaries through planning and managing of all activities in the project in a collaborative manner (Crandall et al., 2010).

Collaborative teamwork is central to relational contracting, alliancing and partnering. In the traditional sense, partnering places emphasis on and welcomes back business operating the “old-fashioned” way, with a return to the basics in business relationships (Pheng, 1999). Davis and Walker (2009) discovered that themes connected to relationship development in the construction industry closely relate to those of construction partnering and alliancing established by other authors. According to Rahman and Kumaraswamy (2004b) approaches such as partnering, alliancing, joint venturing and long-term contracting all relate to a collaborative working environment and form the underpinnings of relational contracting. To further support the similar features of the two (partnering and alliancing) are the critical success factors. Mutual factors between the two include trust, communication, top management support and commitment from participants.

### 1.2 Problem statement

The construction industry is known to be highly competitive in nature. In South Africa the industry exists in a very dynamic and volatile environment resulting in tension and problems arising between individuals both inside and outside of project teams. The construction industry and construction projects in particular are characterised by poor communication and a lack of trust and commitment which shape the adversarial, disjointed set up of the industry. Despite changes and advances (technology, project delivery systems) being made in the construction industry, parties remain cynical about their associates’ motives. Traditional procurement practices have proven to be ineffective in encouraging an integrated team with high levels of collaboration. The benefits of resource sharing, learning and teamwork are lost to the adversarial state of the industry, impeding the success of projects, discouraging a “win-win” environment and making the project an unpleasant place in which to be involved.

This calls for a paradigm shift in the way projects are pursued in the construction industry. Partnering, alliancing, and relational contracting focus on relieving the situation by focusing on solutions rather than adversity and legal clashes. Collaborative workings can be used to
stimulate a ‘win-win’ environment in construction. Therefore the problem investigated in this study is the poor degree of integrated supply chains in South Africa focusing on why collaborative models are not popular and determining how such models can be promoted as part of the project delivery strategy.

1.3 Research questions

The following questions were used to guide the researcher to evaluate the use of collaborative models in the industry:

1. What are the critical success factors for the successful implementation of projects in South African construction supply chains?
2. What obstructions and challenges is the industry subjected to with regards to implementing collaborative models?
3. What are the contributing factors to the fragmentation of construction supply chain in the South African construction industry?
4. What are the factors that positively affect the success of collaboration in construction supply chains?
5. What qualities should industry practitioners look for in an organisation when selecting a potential alliancing or partnering associate?

1.4 Objectives of the study

The objectives identified in this research are as follows:

- To identify what the critical success factors for the construction supply chain are;
- To identify what obstructions and challenges construction supply chains encounter in implementing collaborative models;
- To identify factors that influence the fragmented/disjointed nature of construction supply chains;
- To identify factors that influence the success of collaboration in construction supply chains; and
- To identify qualities that industry practitioners should look for in an organisation when selecting a potential alliancing or partnering associate.
1.5 Significance

It is not very clear why the South African construction industry does not make use of collaborative models. Literature and case studies in the country are also scarce. For this reason the country finds itself falling behind and losing out on the benefits that accrue from the use of collaboration. This research aims at increasing the awareness of construction industry practitioners regarding the practice of collaboration in projects with the intention of encouraging a paradigm shift in order to encourage practitioners to use such models. The research will promote collaboration in contracts by providing the benefits of collaboration, minimising adversities in the industry, identifying the critical success factors and suggesting ways of selecting ideal partners.

1.6 Methodology

The methodology proposed for this research includes a mix of primary and secondary data. A review of literature constituted the secondary data. Literature on collaboration in construction such as partnering, alliancing and models alike was reviewed, with a focus on improving the traditional manner in which stakeholders undertake their respective activities. Information from literature was gathered in order to address the research objectives. To assist the literature review previous construction projects from around the world and South Africa in the form of case studies were examined. These were used to draw lessons learnt and successes which resulted from the application of such models. Once sufficient information was obtained from literature, primary data was gathered using questionnaires distributed to industry practitioners with experience in large construction projects in Gauteng, South Africa. Statistical tools were used to analyse, interpret and present the data. The sample was made up of consultants, contractor representatives, suppliers and clients.

1.7 Limitations

The research was subjected to the following limitations:

The value of using collaborative models is appreciated around the world. However literature on the use of these models in Africa is desperately scarce, therefore most of the literature and case studies used in this study came from regions outside of Africa. This made it difficult for the researcher to provide a perspective from an African point-of-view.
The questionnaire was designed to be completed by the main stakeholders of the construction supply chain (i.e. client, consultants and contractors). This is contradictory to the spirit of supply chain integration; however, as the main stakeholders, they provided a reasonably accurate data base. The endeavour to solicit responses from other stakeholders would have been non-feasible for this study.

The province of Gauteng in South Africa is considered the economic capital of South Africa and boasts some of the most prestigious construction projects. The respondents for the study were mainly based in Gauteng.

1.8 Chapter outline

Chapter 1 – Introduction

This chapter introduces the study by providing an overview of the various collaborative techniques used to carry out construction projects globally. In this chapter advice on the problems to be investigated, the significance, as well as a summary of the methodology to be adopted for the study are presented.

Chapter 2 – Literature review: Supply chain management and construction project management

This chapter reports on secondary data which has been accumulated on supply chain management as well as project and construction management techniques and models used in the construction industry. The chapter seeks to establish a foundation upon which the remainder of the study is based.

Chapter 3 – Literature review: Forms of collaborative modelling in the construction industry

This chapter reports on the reviewed literature on the various collaborative models available in the industry. It highlights some of the benefits of using such models with emphasis on factors to consider when executing collaborative models. The literature review also addresses the research objectives identified earlier.
Chapter 4 – Case studies

This chapter identifies projects from around the world as well as in South Africa in which some form of collaboration to execute the contract was applied. The case studies are unpacked in detail to highlight the value of collaboration in construction supply chains and to draw lessons learnt from the use of collaborative models.

Chapter 5 – Research methodology

This chapter identifies and outlines the participants who were involved in the research. Selected personnel from various organisations provide feedback based on their experience and knowledge. The chapter also identifies, explains and motivates the various methodologies and statistical tools adopted for the study.

Chapter 6 – Data analysis and interpretation

This chapter presents the results obtained from the survey to be conducted with the selected stakeholders involved in undertaking construction projects. The data was evaluated statistically and presented to give meaning to the data collected from the open-ended questionnaires that were distributed to the respondents. Descriptive statistics were used to analyse and interpret the data collected.

Chapter 7 – Discussion of findings

This chapter provides discussions on the findings of the research based on the research questions. The data presented in the previous chapter 6 was used to compare what was revealed in the literature review and therefore comparisons were drawn in respect of answering the research questions of the study.

Chapter 8 – Summary conclusions and recommendations

This chapter highlights the conclusions on the data collected and reports against the research objectives of the study. Recommendations are made on the use of collaborative models as well as recommendations for further research.
1.9 Conclusion

The construction industry is known to be highly competitive in nature. The industry exists in a very dynamic and volatile environment, both inside and outside of project team tension and problems tend to arise between individuals. Collaboration in construction has proven to be beneficial in many dimensions of the supply chain, yet in South Africa these models have hardly been explored as a means to execute the contract. This chapter provided information on background literature on supply chain management and some of the most popular collaborative models found in the industry. The chapter is a starting point for the remainder for this study as it identified the problem statement, research objectives significance, methodology and limitations of this study. The chapter concluded by identifying and outlining each of the chapters in this study.

The next chapter will discuss supply chain management and how it relates to construction project management; in the form of a comprehensive literature review.
2.1 Introduction

Construction has come a long way since being formally acknowledged as an industry and respectable profession. Having earned its reputable professional status when put up against other industries in the world such as commerce, marketing and media, significant malaise still exists within the industry. The problems that are identified and addressed in this study are those that pertain directly to construction projects as a result of insufficient application of collaborative models, and hence gives shape to the industry as we know it. The construction industry as well as the organisations and individuals that make up this industry are known to be aggressive, disjointed and competitive. It is these characteristics (and more) that give the construction industry the adversarial state that distinguishes it from others. The adversarial position that the construction industry has taken is the result of many negative experiences in projects today. These include poor performance, low productivity at both site and off-site level and adverse competition between parties (Bygballe, Jahre and Swärd, 2010). According to the CIDB (2004) inherent problems in the South African construction industry stem from the fragmented mediums in which projects are delivered. Fragmentation and adversarial attitudes together hinder performance on an individual and joint level and drastically restrict prospects for innovation.

Collaboration in projects has been identified by many authors as an effective answer to this threat to the industry (Bayliss et al., 2004; Chan et al., 2003; Chan et al., 2004; Davis and Walker, 2009; Emuze and Smallwood, 2014; Davis and Love, 2011; Walker and Hampson, 2003). Innovative models can be arranged for current procurement systems being practised in order for individuals and organisations to divert from a fragmented environment and reorient themselves to more of a “win-win” environment (Broft, Badi and Pryke, 2016; Chan et al., 2003; Chan et al., 2004).

Relational contracting (or collaboration) is dependent on all participants acting as one unit, with a mutual interest of successfully delivering the project within the set project parameters. These projects parameters may differ from client to client and hence from project to project. Participants must be able to create an environment of trust, flexibility, transparency and a culture of sharing in the “pains and gains of the project” (Walker and Hampson, 2003).
transition is not an easy one and is therefore important and advisable to identify and involve all project participants at the initial stage of the project (Australian Constructors Association, 1999). It is worth noting that the selection of the most suitable participants at the initiation stage of the project may be faulty because the importance of selection is imperative for the success of the project. Therefore the selection of project participants must be determined through a multi-criteria evaluation exercise (Bendaña, Del Caño and De la Cruz, 2008; Watt et al., 2010; Wang et al., 2007). The project team must be selected according to the organisations and individuals that will provide the best value to the supply chain in terms of abilities (i.e. skill, knowledge, experience, technical ability) and a proven track record of successfully working collaboratively.

This chapter will unpack literature on the origins of supply chain management and how this fits in with the construction supply chain. Supply chain management and construction project management are introduced in this chapter as the supports to collaboration in the construction industry. Literature on the state of the construction industry is unpacked, highlighting systems used, some of the main stakeholders in the construction supply chain and the obstructions and problems encountered in these settings.

2.2 Overview of supply chain management

In order for organisations to operate successfully they need to have fit and well oiled (integrated) systems in place from the beginning of the production line right up to utilisation. For the sake of this research study the aforementioned system will be referred to as the supply chain. For many years people have been trading by simply exchanging goods and services for some form of remuneration, creating a supply chain in its basic form. Advances due to the ever-changing environment of economics have led to more involved and complex supply chain models. Clients and contractors are faced with the challenge of surviving in very competitive environments at all stages of the construction supply chain, compelling them to adopt suitable strategies (Cox and Ireland, 2002). According to Crandall et al. (2010) the first supply chain models involved a few of steps of mobilising products from one point to another (from point production to point of consumption). The history of supply chains (SC) goes back over 2000 years ago with advances between 1275 and 1295 by Marco Polo of Vietnam (Crandall et al., 2010). Recent history suggests that supply chain management (SCM) systems were formalised by the manufacturing industry with the aim of creating long-term relationships with suppliers and improving quality by streamlining activities in a
production chain (Vrijhoef and Koskela, 2000). Akintoye et al. (2000) and Bygballe et al. (2010) also suggest that the manufacturing industry has been at the forefront of research and development in SCM. According to Pryke (2009), the emergence of SCM at a strategic level came after the economic recession of the early 1990s when many businesses around the world were searching for ways in which they could simultaneously add value and reduce costs. The growth of SCM has seen industries such as agriculture, food, mining, retail and, more recently, construction applying similar principles to procure and provide goods and services.

It is owing to increased competition thanks to the expansion of global markets that many businesses have had to look for alternative and innovative approaches to stay on top of their game. Hence the introduction of supply chain management as a field of study in the manufacturing industry to streamline and pay careful attention to supplies’ products, transportation of produce, customers and end users. Competition has increased to such an extent that organisations have realised competition has shifted from an organisation-to-organisation perspective to a supply-chain-to-supply-chain perspective (Ayers, 2010). The collaborative power that comes with supply chain management ensures that organisations remain efficient and effective in business through the successfully making and distributing commodities.

The Council of Supply Chain Management Professionals (CSCMP) was previously known as the Council of Logistics Management (CLM). According to Ayers (2010), the name change came about after the acceptance of SCM as a broadening discipline. According to Pryke (2009), SCM is still a recent phenomenon and it is argued that its ideologies related very closely to those in logistics, since logistics involves the mobilisation of physical commodities from one place to another. Pryke (2009) goes further to say that organisations tend to transpose the definitions of SCM and logistics. This now brings us to the definition of SCM.

Many definitions on SCM are provided in literature. These may cause problems in understanding the philosophy of SCM and not all are the same. Ayers (2010) argues that there is no clear-cut definition of SCM, stating that the interpretation of SCM is unique to each organisation. Organisations may choose to look at SCM from different viewpoints (from a narrow to a broad point-of-view, depending on the organisation). Before defining supply
chain management the Oxford Advanced Learner’s Dictionary of Current English (2010:1500) defines a supply chain as:

“The series of processes involved in the production and supply of goods, from when they are first made, grown, etc. until they are bought or used”.

For this study the definition of supply chain management of Council of Supply Chain Management Professionals’ (CSCMP) will be used. CSCMP defines SCM as follows:

“The planning and management of all activities involving souring and procuring of resources by converting and mobilizing of activities. In addition to that it involves the co-ordinating of customers, supplies, third-party service providers, and intermediaries in a collaborative manner”.

In the broad sense of the term, SCM encompasses all the activities which relate to a particular project, product or service. This includes all the resources that need to be allocated at the different stages of the cycle leading up to final delivery upon completion. Resources includes all personnel, equipment and capital involved in the successful delivery of the project, product or service. The basic idea of SCM is the realisation of the interdependency of the components making up the supply chain (activities, resources, knowledge, etc.) in order to make improvements to the configurations and control the supply chain (Vrijhoef and Koskela, 2000).

2.3 Supply chain management in project and construction management

There have been calls by many authors around the world for the strengthening of collaboration within the construction industry in order to eliminate the severe ailments that disrupt the order of business. Because it is often the case that individuals in the construction supply chain work in isolation until such time that they are obligated to consult one another, collaboration in the form of collaborative models has received limited attention and only recently been recognised as a manner of procuring projects. It is because of this and many other reasons that the construction industry in still trailing behind other industries (such as the manufacturing industry) with regard to the implementation of the principles of SCM. In the United Kingdom (UK) Naoum (2003) states that clients in both the public and private sectors have realised the need for the construction industry to look at ways of imitating some of the
practices of the manufacturing industry. In countries such as the UK (Akintoye et al., 2000; Briscoe and Dainty, 2005) and Australia (Love, Irani and Edwards, 2004) SCM has been practised with some degree of success to address issues relating to cost reduction, dispute resolution, as well as steering continuous improvement initiatives. Many papers on SCM in the construction make reference to the Latham Report. In this report (Constructing the Team) Latham (1994) addresses problems which emerge in the construction supply chain.

Supply chain management (SCM) in the construction industry has not been around for as very long when compared to other industries, with initiatives in the late 1980s and early 1990s (Broft, et al., 2016; Vrijhoef and Koskela, 2000; Segerstedt and Olofsson, 2010). The concept is still an emerging one in the industry which is why a few SCM models have been practised to date. Partnering, alliancing and incentive-based contracting have been recognised by Love, et al. (2004) as SCM initiatives in the construction industry. Collaboration is central to alliancing and partnering. According to Akintoye et al. (2000) and Xue, Shen, and Ren (2010) SCM provides a platform for collaborative workings in the construction industry even though the practise is in its early stages of development.

Ever since the introduction of SCM in the industry alongside collaborative models such as partnering, relational contracting and alliancing many projects have benefited by implementing its principles. These principles play a pivotal role in simulating seamless production lines similar to those of the manufacturing and agricultural industries. There has appeared a need for the industry to move towards the use of supply chains similar to those of industries such as the manufacturing and automotive industries. These industries have proven track records in attaining excellent end products thanks to SCM. Naoum (2003) suggests that the construction industry can improve client satisfaction significantly by adopting some of the practices of the manufacturing industry. SCM in the construction industry is aimed at integrating inter- and intra-organisational business processes (Love, et al., 2004; Bygballe et al., 2010). This is especially important for the construction supply chain as it involves a host of organisations, all with different but equally important roles to play in the success of the construction project. Briscoe and Dainty (2005) undertook an empirical investigation into the problem of trying to integrate construction supply chain in the UK. In their investigation of three case studies the two authors realised that the manner in which projects run differs from client to client and hence different problems that were encountered in each case study were unique in that regard. Briscoe and Dainty (2005) identified divergence of interests and lack of
trust amongst the participants as the factors undermining the successful integration of the supply chain. Many researchers (Walker and Hampson, 2003; Briscoe and Dainty, 2005; Pinto, Slevin and English, 2009; Dewulf & Kadefors, 2010) have stressed the need for trust in successfully delivering the project. Vrijhoef and Koskela (2000) suggest that in order to achieve an integrated SC management must find a way to interface site activities with the supply chain. This can be achieved by evaluating the impact of site activities on the supply chain with the aim of reducing the time taken to complete activities as well as the cost incurred in undertaking these activities.

Vrijhoef and Koskela (2000) suggest that SCM is fundamentally based on a flow view of productions similar to a production line of a product being manufactured in a factory, meaning that each activity is not independent but rather the focus is on the total flow of activities. The construction industry differs from the manufacturing industry and hence things are done differently. Attempts have been made by researchers to compare the construction supply chain (CSC) to that of other industries and in doing so some of the ideas and principles have been transpose in an attempt to improve construction supply chains. More recently Segerstedt and Olofsson (2010) mention that the boundary between the construction and manufacturing industries is still unclear and fuzzy. In the case of factories that produce construction plant, the question is whether they fall under construction or manufacturing. According to Vrijhoef and Koskela (2000), the construction SC is characterised by the following elements:

- Materials are delivered on site and the product is produced using these materials.
- It is a temporary, once-off organisation with project teams being re-arranged with every new project.
- Every project results in a new type of product (prototype) with little repetition of previous workings.

In the manufacturing industry, however, the traditional choices of manufacturing a particular product can be as follows (Segerstedt and Olofsson, 2010):

- make-to-stock,
- assemble-to-order,
- make-to-order and
The most commonly used configuration in the construction industry is the engineer-to-order where the client states what he/she requires in his brief (“order”) and the consultants and contractor design and build (“engineer”) to the client’s brief. The make-to-order system is rarely exercised in the construction industry as it carries with it considerable risk to the system integrator (the person/organisation to take first ownership of the product). Van der Merwe and Basson (2006) explain that like the manufacturing industry construction projects have a two-phased process of a purchasing transaction or service delivery nature, however management is often faced with the complexity of the transaction being exacerbated by the manner in which physical and intellectual assets are delivered in construction projects. Vrijhoef and De Ridder (2005) explains that, unlike in construction, manufacturing demand and supply systems comprise more desirable qualities of homogeneity, as these systems are better aligned and uniform.

Effective SCM is most beneficial to large companies with many suppliers, complex products and highly valued clients with large purchasing budgets. The aforementioned are all characteristics of the construction industry. The knowledge areas of project management and supply chain management relate very closely to those of the construction industry. Ayers (2010) identified the following similarities within the knowledge areas of both project management and supply chain management:

Table 2.1 - Knowledge areas in project management and supply chain management (Ayers, 2010)

<table>
<thead>
<tr>
<th>Project Management</th>
<th>Supply Chain Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Integration Management</td>
<td>Designing SCs for Strategic Advantage</td>
</tr>
<tr>
<td>Project Scope Management</td>
<td>Implementing Collaborative Relationships</td>
</tr>
<tr>
<td>Project Time Management</td>
<td>Forging SC Partnerships</td>
</tr>
<tr>
<td>Project Cost Management</td>
<td>Managing SC Information</td>
</tr>
<tr>
<td>Project Quality Management</td>
<td>Removing Cost from the SC</td>
</tr>
<tr>
<td>Project Human Resource Management</td>
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<td>Project Communication Management</td>
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<td>Project Risk Management</td>
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<tr>
<td>Project Procurement Management</td>
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</table>
The table above (Table 2.1) shows how closely related the different knowledge areas in the two disciplines of project management and supply chain management are. These functions are to be executed by the most suitable individual/organisation preferably at a project management level.

The first task of Designing SCs for Strategic Advantage requires the project manager to look at procurement and distribution as more than just a controlled activity but as a strategic advantage tool. Implementing Collaborative Relationships involves focusing on the internal collaborative strength of the organisation. The need to work as a cooperative unit is a sine qua non for any intended partnerships with external players. Forgoing SC Partnerships is effectively, the creation of partnerships with external organisations for reasons that will contribute towards the success of the project. Managing SC Information involves the establishment of information systems that ensure that supply chain processes are supported through the effective and efficient distribution of information between organisations making up the SC. The last task involves the Removal of Costs from the SC so as to create value and maintain a competitive advantage (Ayers, 2010). From the definition of SCM in general and the above literature on SCM in construction it is now possible to define construction supply chain management as:

Supply chain management is a collaborative approach of strategically streamlining the flow of activities, through an integrated network of organisations working towards producing a quality construction product.

2.4 Overview of current state of construction supply chains

Inherent problems in the day-to-day running of construction projects have left the industry with some undesirable qualities. Infamous for its non-glamorous, aggressive environment, the construction industry can be very heavy on one’s physical and mental well-being. Lueng et al. (2008) goes as far as saying that over the past 20 years literature has shown that when measured against those of other professions, construction practitioners indicated high levels of stress. It is clear from literature that relationships in the industry are far too complex to contain without difficulties. De Blois et al. (2001) suggest that complexities are as a result of, inter alia, the multiple and dynamic roles of participants, the ephemeral nature of projects and the divergence of views. No one project is exactly the same as another. Projects differ and hence successes of projects will not be the same. This further adds to the list of
complexities and difficulties experienced in the industry (Chueng et al., 2008; Cox and Ireland, 2002; Vrijhoef and Koskela, 2000). According to Chueng et al. (2008), Cousins (2002) and Palaneeswaran et al. (2003) contracting parties in the past have shown signs of aggressive and opportunistic behaviour. As a result projects are stereotyped to be fragile, fragmented and adversarial in nature resulting in; a discouraged “win-win” environment (Chan et al., 2004; Chueng et al., 2008, Cousins, 2002), obstructing co-operation (Faisol et al., 2005), ineffective team formation, lack of transparency and mistrust (Baiden, Price and Dainty, 2006), negatively affecting project success (Tang et al., 2009; Masemeni, 2011; Vrijhoef and De Ridder, 2005; Xue et al., 2010).

One of the industry’s salient characteristics is the large pool of role players, giving it the sizeable nature for which it is known. The industry can be divided into two; the site and the supply chain (Vrijhoef and Koskela, 2000). At site level the industry is associated with the contractor and the employment of personnel to undertake the actual construction of the structure at hand. The site aspect of construction provides a situation where most people are involved when compared to other stages of the supply chain. At the supply chain level the industry is made up of all “white collar” activities. These are all the activities which take place at pre-construction, construction and post-construction stages of the project. The supply chain aspect of construction is where the major role players come in to complete the project team. Depending on the size of the project the role players stated above refers to; *inter alia*, the client, consultants (engineer, architect, project manager, and the like), and the contractor representative. Dolio (2003) refers to these three parties as the key members in the construction endeavour. For the sake of this study stakeholders that will be looked at will not be limited to the aforementioned three; instead the study is concerned with collaboration at a supply chain level, across traditional organisational lines. Even at supply chain level construction projects involve interaction between many individuals from the various organisations.

In South Africa the procurement system most commonly used by the public and private sectors is that of design, tender and build. In other countries such as the UK (Segerstedt and Olofsson, 2010), Canada (De Blois et al., 2011) and China (Bayliss et al., 2004; Chan et al., 2004) this is also a popular choice amongst clients in both sectors. Sometimes referred to as the traditional system as a result of its continued use around the world, this procurement system does have its shortfalls like any other. The traditional system has been identified as
one of the causes of the adversarial state of the construction industry, making it one of the salient barriers to SCM success in the industry and prompting the need for collaborative workings (Australian Constructors Association (ACA), 1999; Naoum, 2003; Chan et al., 2004, Chan et al., 2006). In fact one might even go so far as saying current procurement systems (with collaborative models as the exception) have been designed to facilitate adversarial occurrences (Naoum, 2003; Chan et al., 2004). The main characteristics of the traditional system are: (i) delivery of the project in a sequential order, (ii) a big part of the design is completed before the commencement of the construction, (iii) the responsibility of the project is apportioned between the consultants and the contract with little chance of either parties giving input to the other’s activities, and (iv) consultants are normally promised reimbursements for savings made while the contractor is paid for work done (Masterman, 2002). These are just some of the characteristics that make it difficult for partnering to take place. Chan et al. (2004) go on to say that one of the flaws in the traditional, design tender and build system is the confrontational arrangement encouraged by the contractual structure, hence promoting a “in-lose” environment. Literature on relationships in the construction gives the impression of a gloomy status quo in the industry, going against the values and visions of a collaborative approach.

2.5 Stakeholders involved in the main construction supply chain

System integration of construction demand and supply chains requires high levels of role integration between parties. The client takes up the demand role while consultants, the main contractor, sub-contractors and suppliers each take up their respective service/commodity provider roles as supply integrators. Other stakeholders may include regulatory authorities (environmental, health and safety bodies), trade unions, media, lobby groups and users/tenants. The integration of these two roles make up what is referred to as the construction demand and supply system integration (Vrijhoef and De Ridder, 2005). It is often the case when referring to construction project stakeholders that many “smaller” role players are overlooked when coming to acknowledging them as contributors to the construction venture. Despite the fact that Doloi (2013) draws attentions to the client, main contractor and consultant as the main stakeholders, it is crucial to the project that all stakeholders (regardless of function or size) are clearly identified in the project. This comes as no surprise as there is a general lack of consensus regarding which party had the major
influence with regards to the success of the project. According to Vrijhoef and De Ridder (2005) construction clients play a dominant role in determining the successful integration of the project. However, this is contradictory to the views of Cox and Ireland (2002) who state that because of clients’ unfamiliarity with the construction industry resulting in “adhoc” construction policies, they are at a disadvantage when it comes to dominance in the project. Cox and Ireland (2002) go on to say that the contractor is in actual fact the major integrator of the supply chain. This is also advocated by Briscoe and Dainty (2005) who explain the important link that the contractor forms between the client and the other sub-contractors. Bygballe et al. (2010) state that the contractor, as the major driver of the contract, controls to a large degree the change and the adoption of new concepts in the industry although it must be noted that depending on the nature of the project one must appreciate that there are external stakeholders (indirectly involved) who affect the outcome of the entire project. An understanding of the powers and influences of each stakeholder over others and at which precise moment of the project will dictate the degree of understanding of the end-user’s requirements (Cox and Ireland, 2002; Yang et al., 2010). One such technique of stakeholder identification and degree of influence determination is illustrated by Yang et al. (2010) using an Australian construction project as a case study. By asking “conventional” project participants to nominate groups and individuals who influence activities and to what degree, Yang et al. (2010) were able to identify all stakeholders as well as determine their degrees of influence.

2.5.1 The client

A construction endeavour has to have a starting point and, more often than not that starting point is with the client. The client sees a need to pursue a construction project with the idea of securing some sort of value. This can be for anything from, inter alia, income generation, convenience, improving systems/operations, leisure or in the case of some public projects, social responsibility. Clients of the construction industry coming from all sectors of the economy - from commercial, agricultural, state/government even organisations within the industry - require buildings or infrastructure at some point. By definition construction clients are “individuals or organisations that commission a building or an infrastructure” (De Blois et al., 2011:4). From this definition it is clear that there is no particular requirement (except for the fact that one needs something to be built) in order to qualify as a construction client. However, individuals and organisations differ, and so clients are able to be distinguished and
categorised. The most common and probably the easiest way to identify a client is either by private or public sector. However it is also possible to have a combination of the two sectors venturing into one project such ventures are referred to as Private Public Partnerships (PPP).

In large and more complex projects where the client is an organisation (as oppose an individual or small company) one needs to take into consideration other stakeholders – who also fall under the “client” category (and are affected in some way by the initiated construction venture). On a project team the party taking up the role of the client is usually acting on behalf of many clients, users and other stakeholders (De Blois et al., 2011; Vrijhoef and De Ridder, 2005). A typical example is the construction of a public park; the client in a situation such as that would include the general public in addition to the municipality initiating such a development. So other project personnel need to keep this in mind when carrying out their respective roles. Often client organisational structures have complex components comprising people and departments not sharing similar interests and views (Briscoe et al. 2004; Masterman 2002). This can be frustratingly difficult for those project members whose objective it is to make the client happy in all domains.

The client being the initiator of the construction endeavour, it is important for those affected to know and understand the background of the client. This is important for the other project members as they want to secure work from a client that will benefit their respective organisation with as little trouble as possible. As mentioned earlier, clients can be classified as either private or public; however, researchers have further broken down other ways of distinguishing one client from another. Masterman (2002) suggests the following typology of determining the client taking part in a construction endeavour: public or private client, reasons for pursuing the construction (commercial, industrial, selling or leasing purpose), the type of business the client is involved in and finally, the experience of the client with construction projects. When a contractor or a consultant is seeking work from a client, common sense suggests that they look for a client who exhibits positive attributes. In addition, Masterman (2002) states that industry practitioners prefer experienced construction clients to naïve ones because they possess the following characteristics:

- Have a firm knowledge, understanding and appreciation of the happening of a construction project;
- Are involved regularly at the various stages of the project;
• Putting a clear and well-prioritised construction brief;
• Having better management and control of project stakeholders; and
• Employing appropriate professional teams for the various construction disciplines.

2.5.2 Contractor

The team of constructors is conventionally referred to as the contractor, principal or main contractor. The role of this member of the project team is to interpret the client brief, ideas and drawings and other documentation put together by the principal agent with the help of other stakeholders. This interpretation will result in a building or infrastructure of some form. The relationship between the client and the contractor is compared to that of an employee and an employer (Lueng et al., 2008) and, as such, the contractor takes on the due responsibility to make sure the product is built to the satisfaction of the client. This does not come as an easy task as the contractor is probably the one organisation that will have the most individuals being involved in the project. Given the labour intensive nature of construction activities contractors, are employers of large pools of people. Therefore as elsewhere around the world and with respect to this research, South African contractors are a major source of employment.

In the early 2000s contractors ran their business fairly simply with little attention being paid to innovative ways of doing business (Cox and Ireland, 2002), as a major “integrator” of the supply chain (Briscoe and Dainty, 2005; Bygballe et al., 2010; Cox and Ireland, 2002). In recent times, however, contractors have had to deal with a variety of management functions. Functions include, inter alia, interacting with various professionals in the consulting teams and the client, as well as managing their own performance through the labour force. The ACA (1999) points out the importance of the contractor in making sure that their staff and respective sub-contractors are properly selected, aligned, trained and monitored for the duration of the contract. On commencement of the construction of works the contractor has the responsibility to monitor the construction site until such time as it is handed over to the client. A timeline schedule (programme of works) which will help in tracking progress, reporting and controlling of works must be produced by the contractor as evidence of competence. Given the complex nature of projects now-a-days the contractor needs to select appropriate methodologies and techniques to ensure the successful execution of works. The contractor takes on a considerable responsibility because the success or failure of the project is dependent on the performance of the contractor, i.e. the contractor is accountable for
making the programme work (finishing in time), working with what is being paid (within cost), working with the design team to deliver a quality product (quality) and completing the project with no harm to personnel (health and safety).

In recent times sub-contracting by large contractors has become very popular in the delivery of the project. In some instances it has been observed that most of the work is in fact performed by sub-contractors with the main contractor co-ordinating the works (Cox and Ireland, 2002; Perera, Davis and Marosszeky, 2011; Uher and Loosemore, 2004). In extreme cases the contractor will take on the sole role of managing works all done through sub-contracting. This is referred to as management contracting (Masterman, 2002). Sub-contracting results in an additional point of management for the contractor as the quality, time and cost of the project will be a reflection of the contractor’s work and not that of the sub-contractor. The main contractor is responsible for the sub-contractor’s performance and therefore liable for any failure resulting from the sub-contractors actions (Arditi and Chotibhongs, 2005). The contractor has to ensure that the relationship with the sub-contractors is conducted at the best possible level without diminishing the profits of either party. According to Cox and Ireland (2002), the introduction of another party in the form of sub-contracting increases the possibility of adversarial behaviour due to some parties wanting to earn better profits at the cost of others. Consequently such a relationship (between main contractor and sub-contractor) must be nurtured as it holds beneficial or detrimental value for the project. With that said, the relationship approach as well as the qualities of the contractor and client interface can be appropriately extended to strengthen the operational equilibrium between the contractor and the sub-contractor relationship (Palaneeswaran et al., 2003).

The use of traditional procurement systems has been the result of frequent short-comings in construction supply chains. One such short-coming is the involvement of other stakeholders at an early stage of the project (in particular the contractor). In South Africa this is very often the case with the contractor having little influence in the design, with the design team having the majority of influence (Van der Merwe and Basson, 2007). The separation of the design and building of the construction project modus operandi by the sequence of traditional contracts obstructs the integration of knowledge exchange between contractors and designers (Song, Mohamed and AbouRiz, 2009). According to Baiden et al. (2006), in construction supply chains the design is treated as a separate unit from the construction resulting in parties working towards individually defined goals, bringing about possible conflict between the
parties. Early contractor involvement is a scenario where the main contractor, with his wealth of knowledge and experience, is brought in to join the client and other designers earlier (than normal) to assist the two parties with the design. It must be noted, however, that introducing a contractor at an early stage may be considered untimely and against the spirit of competitive tendering as it will result in only a handful of contractors being considered for selection. Allowing for contractor input early on restricts and relieves problems relating to teamwork and adversity as well as assisting in achieving other project parameters (Baiden et al, 2006; Briscoe et al., 2004; Chan et al., 2004; Eriksson, 2008; Mosey, 2009; Song et al. 2009).

2.5.3 Consultants

When a construction project is being carried out, the client has to take the decision of assembling the team to undertake the works. At this point the client must transfer roles by assigning tasks and responsibilities to the various personnel each with particular areas of expertise. Since clients (in most cases) are unfamiliar with construction from a professional point of view they employ the services of construction professionals in the form of consultants (Leung et al., 2008; Lu and Yan, 2007). The term consultants refers in actual fact to a host of different professionals ranging from those that originate from the construction industry and those who come from other fraternities. Consultants play an important role in serving the project team; by matching the gap of knowledge of the client with the experience of contractors. The consultants collaborate both as a unit to put together construction documentation as well as working with the contractor to provide such documentation to the contractor to aid in the interpretation of the client’s brief into a tangible commodity. It is up to the consultants to look after the interests of the client and in doing so they need to have monitoring tools in place so as to be able to control the contractor’s performance. Palaneeswaran et al. (2003) recommend the use of the following controlling and motivating tools in order to monitor the performance of the contractor: performance reports, warning letters, and bonuses or penalty schemes.
2.5.4 Project manager

The use of project managers in construction projects is a recent practice, with the architect having acted as the principal agent in the past. The client organisation has to make the decision as to what extent to make use of external services providers to integrate and manage the construction process (Cox and Ireland, 2002). The services of a project manager (PM) are pursued in larger, more complex construction projects where the extra cost of such a service can be justified by the client (Fewings, 2013). The client’s appointment of the PM is based on the following PM qualities: easy to work with, reliable and realistic (Fewings, 2013). As the first appointment made by the client, the selection of the PM must be a well-considered process, making use of consultations with legal personnel and other construction professionals (Fewings, 2013; Gould and Joyce, 2003). Once appointed, the PM assumes the position of project leader acting on behalf of the client. In some instances the client is advised not to make contact with the other professionals, so the PM acts as the middleman with the other professionals referring to the PM as the client.

It is the main responsibility of the PM to ensure that the client is satisfied at all times; pre, during and post construction, even though it may require some compromise from the side of the client in order to make certain things work. The PM is someone who has a technical background in construction (Fewings, 2013). As leader he/she must be knowledgeable on the roles of all the other professionals involved and be able to get along with everyone before expecting them to get along with each other. Open and constructive communication channels must be maintained between the project members and it is the PM who is to ensure this. The PM plays a crucial role of integrating the construction supply chain by managing the project through delegating and monitoring of all the professionals.

2.5.5 The design consultants

The client forms the basis upon which project activities can be determined followed by embarking on the assembling of the consultant professionals. The design team has the role of interpreting and assisting the client with the project scope, the preparation of drawings as well as other documentation to be used by the contractor to build (Gould, 2002). The consultants have a duty among themselves of ensuring they integrate as a unit to come up with designs that can be co-ordinated with each other. Once the client’s brief has been
understood by the different consultant professionals, a logical sequence of information transfer must be drawn up in the form of a design-planning scheme (Love et al., 2004). The design team involves the services of the architect and the engineers, depending on the nature of the project either one of these two groups can take on the role of lead designer. On more commercial or residential construction projects the architect will layout the concept of the building following which the engineers design the building systems. However on more industrial infrastructure and heavy engineering projects the engineers take on the role of lead designer with the architect taking care of the aesthetics to make the final product more pleasing to the eye (Gould and Joyce, 2003).

2.6 Stimulus of construction supply chains failures: conventional tools of improving performance

Project failure can be attributed to many factors and literature on this matter is vast. Literature has reported causes relating to poor contractor performance, design defects, vague or ambiguous briefs, inappropriate risk management, corruption, poorly integrated supply chains, inexperienced or incompetent personnel, poor communication and lack of trust. Failure in construction terms is cited by Love (2013) as, the inability of a constructed infrastructure or a piece of constructed infrastructure to carry out its intended purpose as per design or construction requirements. Based on literature on the subject and for the purpose of this research the following three types of failures are identified:

- Design failure,
- Construction methodology failure, and
- Project management failure.

From the three above mentioned project failures each one can be associated with a particular group of stakeholders involved in the construction supply chain. Design failure suggests that this is failure caused from an error in the design by a member(s) of the design team. Construction methodology failure is the application by the main contractor of inappropriate procedures and techniques during construction (Ren, Shen and Xue, 2013). Project management failures are more traditional, commonly caused failures and transpire as a result of improper use of project management tools. Based on the nature of failures, the
consequences may be fatal (Love et al., 2013), costly (Doloi, 2013; Ren et al., 2013) or a frustrated client.

2.6.1 Design failure

Except in special cases most problems encountered in construction supply chains are attributed to size and complexities. Design errors are no exception. Client requirements are becoming increasingly complex (Ren et al., 2013) requiring great design ingenuity from the design team in order to attain the desired masterpiece. Love et al. (2013) suggested that as project size increases so does the possibility of errors. Normally errors remain incognito until such time that the main contract’s staff will point-out an error after which the designer (architect or engineer) will remedy the matter by issuing a revised drawing or a variation. Industry practitioners must be conscious of the fact that design errors are not only identified at construction; defects occur throughout the lifecycle of the building. According to Love et al. (2013), errors by designers are a common occurrence in the industry, by even the most experienced and competent individuals. Design errors generally emerge as a result of one or a combination of the following:

- Mistake,
- Non-compliance, or
- Slips and lapse of attention.

Attempts can be made to try and decrease the probability of designers making errors by conducting peer checks prior to construction, implementation of a constructability analysis, building information modelling (BIM), benchmarking, or using collaborative models (Love et al., 2013).

2.6.2 Construction methodology failure

Contractor selection literature places great emphasis on the contractor’s technical ability to perform the desired tasks (AGANAO, 2000; Bendaña et al., 2008; Kumaraswamy, Palaneeswaran and Humphreys, 2000; Rahaman and Kumaraswamy, 2005; Ren et al., 2013;
Watt et al., 2010; Zhang, 2004). The contractor who is selected must show competence by providing staff with the necessary skills and experience to carry-out the intended construction, having taken complexity into account. Failing to do so can have a detrimental effect on the intended project outcomes. However as in design failure making an error or the selecting of an incorrect construction methodology can happen to even the most competent and experienced contractor. Construction supply chains are dynamic in nature; increasing needs of the client, introduction of new technologies and materials, new construction approaches and collaboration with personnel of different nationalities have been cited as some of the difficulties experienced by construction practitioners in applying proper construction methodologies (Ren et al., 2013).

The contractor must have a method statement in place for each major task. The method statement must illustrate the sequence of works, material and resources to be used and duration (with a start and end date) for a particular task. According to Illingworth (2000): when drafting the method statement the following two considerations need to be accounted for:

- Only certain construction methods are suitable to achieve synergy in the construction works.
- Although many options exist to carry out an activity, resource requirements and other considerations will steer one to a particular method.

Other factors to consider are (Ren et al., 2013): technical constraints, client and design needs, the costs of method, machinery required, material required, available resources, company strategy, and workload of individuals. Ren et al. (2013) revealed the following salient issues, *inter alia*, in the selection of appropriate construction methodologies on site:

- Lack of experienced and trained staff by the contractor;
- Poor quality material to compensate for lower tender prices;
- Poor communication between personnel (at site and project level); and
- Weak collaboration ties between the designers and the contractor staff.
By addressing the above weaknesses the contractor will be able to enjoy the benefits of selecting the correct methodology of construction. This will, in turn, benefit the project as a whole.

2.6.3 Project management failures

Construction supply chains are characterised by uncertainties, multiple stakeholders, dynamism, contracts, fragmentation and confrontational behaviour amongst other challenges. Trust, communication and conflict management all become vulnerable owing to these features. This places a mammoth task on the project manager as it is his responsibility to regulate the day-to-day affairs of the project (Burke, 2011). Contracts have, to large degree, shaped the construction industry in both a good and bad way. Compulsory to every project, contracts regulate and influence behaviour and ensure that parties are treated fairly. It is important for the project to establish influences that can bring about successful outcomes at the end of the project. These influences are referred to as critical success factors (Cheng and Li, 2002). Although some factors are those that apply to social norms, identification of critical success factors and their barriers in project management has helped practitioners tackle project failures (Akintoye et al., 2000; Cheng and Li, 2002; Love et al., 2004; Xue, 2010), although some have proven difficult to overcome successfully. Creative mechanisms such as the establishment of a key performance index, benchmarking and continuous improvement exercises have also been identified as tools for addressing and limiting construction supply chain failure (Love et al., 2004; Yeung et al., 2009; Walker and Hampson, 2003). What all the literature on improving project performance has in common is; the integration of the supply, highlighting the importance of working collaboratively.

2.7 Conclusion

Supply chain management (SCM) is a practice that is supported by many industries on a global scale. The history of supply chains goes back over 2000 years ago, with the principles first being introduced in the manufacturing industry in the 1990s. Other industries, including the construction industry, followed suit. SCM is fundamentally based on a flow view of activities, meaning that each activity is not independent but rather a focused view on the total flow of activities. Because inherent problems in the construction industry have become more complex, SCM and construction project management are complementary techniques that can be rearranged to improve construction supply chains. One of the salient characteristics of the
industry is the large pool of role players, giving it the sizeable nature for which it is known. System integration of construction demand and supply chains is desperately necessary to realise project success. All stakeholders need to be identified with the main stakeholders steering progress to the benefits of all affected.

Project management tools which seek to address project failures are in abundance. Some of these techniques include, *inter alia*, key performance index, critical success factor identification, benchmarking and continuous improvement exercises. The study identified design failure, construction methodology failure a project management failure as the forms of failures common to construction supply chains. Most failures encountered in construction supply chains are attributed to size and complexities. Each of the main stakeholders is susceptible to failures and therefore the responsibility lies with everyone.

The next chapter will unpack the different collaborative options that practitioner have at their disposal in the construction industry.
CHAPTER THREE: FORMS OF COLLABORATIVE MODELLING IN THE CONSTRUCTION INDUSTRY

3.1 Introduction

People work together in construction supply chains all the time, however, when no system is in place to control and regulate interactions between members in the project team, problems begin to arise and hence the philosophy (of collaboration) is simply given lip service with stakeholders failing to integrate the philosophy into the procurement system. Working collaboratively essentially means every individual from the various organisations making up the project team is committed and offers support towards making the project a success. Partnering in projects works best under such conditions. The salient principle of the various forms of collaboration is to build and sustain an integrated team or entity (virtual or physical) that works simultaneously towards a common goal (Xue et al., 2010).

There are various collaborative models available in the construction industry (Partnering, alliancing, joint venture). All are clearly different but share varying degrees of mutual cooperation and objectives. Relational contracting (RC) in construction is one such philosophy that covers all collaborative approaches regardless of the duration of the collaboration. Based on the recognition of mutual benefits and a win-win environment, it encompasses a complete philosophy of the value chain, identifying and linking interdependent components. According to Faisol (2005), relational contracting was first introduced by Macaulay in 1963. Over the past two decades the concept has been advocated by many authors in literature (Anvuur and Kumaraswamy, 2016; Davis and Walker, 2009; Rahman and Kumaraswamy, 2002; Rowlinson and Cheung, 2003; Faisol, 2005; Walker and Hampson, 2003).

This chapter gives a theoretical review and conceptual perspective of the various collaborative models available for use by industry practitioners. Previous work on the subject has been used to provide a perspective on achieving integrated construction supply chains (CSCs), relational contracting, collaborative modelling, sustaining a collaborative working environment and factors facilitating successful collaboration.

3.2 Achieving integrated construction supply chains

Working collaboratively is nothing new to the construction industry, the problem arises when no system is in place to control and regulate interactions between members in the project
team. This results in the philosophy (of collaboration) simply being given lip service with no significant steps taken to integrate it into the procurement system. Working collaboratively essentially means every individual from the various organisations making up the project team is committed and offers support towards making the project a success. Figure 3.1 illustrates collaboration from two schools of thought: as a working model or as an operational model. There are various forms of collaborative working models these include, \textit{inter alia}, teamwork, joint venture, partnership and project alliance. In the case of operational model this relates to the delivery system used to undertake the project (such as partnering or alliancing). The salient principle of the various forms of collaboration is to build and sustain an integrated team or entity (virtual or physical) that works simultaneously towards a common goal (Xue \textit{et al.}, 2010). There are various ways that this can be engineered in to the project so as to take full advantage of collaboration in contracts. Eriksson (2008) suggests the following “tools” to encourage a proactive, collaborative environment: an area for dispute resolution and relational discussions, mutual objectives, a joint IT database, regular team building initiatives and a combined project office on site.

Partnering along with other collaborative models is greatly dependent on a healthy application of social norms. The project team as a whole must first be motivated to work collaboratively in order to be committed, so that each team member is able to realise the value of a team with such striking qualities. In some cases aspiring to work collaborative means individuals within the project team waive their common rights of action (alliancing), unless of course in dire circumstances (Koolwijk, 2006). According to Davis and Walker (2009), working together as a team of committed members prompts effective team formation allowing for an effective learning environment. Davis and Love’s (2011) proposed model for alliance contracting focuses on team members working together not only to achieve prescribed project goals but also to stimulate reflective learning and mutual trust.

Sharing at a project strategic level entails the sharing of resources for the well-being of the project. Sharing of resources and collaboration should be at the heart of the relationship, be it sharing of physical resources or intangible resources (such as intellectual know-how, processes and systems). The primary focus should be to attain a competitive advantage by improving the process for all firms concerned (Cousins, 2002). Collaboration relies on sharing of resources and experiences. In joint venturing for example, Hughes, Williams and Zhaomin (2012) explain how entities pool their resources and form one single entity to
undertake a project. The power of exchanging knowledge in the team is only realised when everyone is willing to share their knowledge with the rest of the project team. This can only be achieved if the team is working together (Love et al., 2004). This will make it easier to resolve issues both around the table and outside on site, through the use of joint problem solving.

![Figure 3.1 - Development of CW in construction projects](image)

Source: (Xue et al., 2010)

Joint problem solving allows people to speak their mind and therefore express themselves more explicitly (Davis and Walker, 2009). Transparency plays an influential role in building a team. “Playing with your cards close to your chest”, creating the illusion of a collaborative environment is not only misleading but it may prove disastrous for the future of the relationship (Davis and Walker, 2009). Showing transparency in one’s workings infuses trust in the team. According to Briscoe et al. (2004) transparency comes as a result of increased openness and trust. Transparency is the one of many steps in achieving trust in the project. Trust is dependent on members of the team consistently volunteering to taking up roles, doing things correctly and giving valuable advice to other members of the team.
Figure 3.2 - Conceptual framework for ‘relationally’ integrated construction supply chains. Source: (Palaneeswaran et al., 2003)
A team that is able to work in a collaboratively structured manner with the presence of trust shows sign of strong interdependency. An empirical study undertaken by Rahman and KumaraSwamy (2005) indicated the importance of trust when embarking on a collaborative contract in construction. The study intended to determine the critical factors for successfully carrying out collaboration in the construction industry. In the study mutual trust was established as the most essential factor. As such, it is worth noting that mutual trust brings about mutual dependency (Vrijhoef and Koskela, 2000; Cousins, 2002; Cheng et al., 2003). A project that consists of a team that shows strong lines of interdependency will ensure that obstacles in the supply chain are overcome more effectively and in doing so reducing the chances of common, intrinsic project overruns. In joint problem solving people must be allowed the opportunity to speak their minds on issues at hand as well as feel comfortable in doing so. If there is no trust, members of the team will be reluctant to give input and the team is positioned negatively, losing out on the benefits of collective problem solving. In order to create an environment where everyone is trusting and trustworthy (interdependent), a shift in culture for the construction industry is of utmost importance, the failure of which may result in collaboration ending up as nothing but a long distant dream. Collaboration in the industry has been identified to improve organisational performance and stakeholders’ working relationships (Xue et al., 2010).

3.3 Relational contracting

Partnering is the most commonly used teamwork approach in the construction industry. In fact, in the UK the term “partnering” is often replaced with collaboration (Hughes et al., 2012). This could be seen as incorrect because even though partnering is collaboration, collaboration is not limited to partnering alone. There are various collaborative approaches available (such as, partnering, alliancing, joint venture). All are clearly different but share varying degrees of mutual co-operation and objectives. Relational contracting (RC) in construction is one such philosophy that covers all collaborative approaches regardless of the intended duration of the collaboration arrangement (short, medium or long-term). Based on the recognition of mutual benefits and a win-win environment it encompasses a complete philosophy of the value chain, identifying and linking interdependent components. Considerable improvements can be made to the manner in which the project is delivered by taking advantage of relationally integrated contracts. Relational contracting is dependent on
repetitive interaction between stakeholders and the application and incorporation of social norms to execute the contract. According to Faisol (2005), relational contracting was first introduced by Macaulay in 1963. Over the past decade the concept has been advocated by many authors in literature (Davis and Walker, 2009; Rahman and Kumaraswamy, 2002; Rowlinson and Cheung, 2003; Rahman and Kumaraswamy, 2004a; Rahman and Kumaraswamy, 2004b; Faisol, 2005; Walker and Hampson, 2003). Relational contracting is the umbrella term given to contracts which promote the use of collaboration to undertake projects, and the creation of a project culture where every party involved benefits in one way or another. In literature various terms are used but all serve the same purpose and hence share the same underlying principles, namely: relational contracting, relationship contracting, and relationship-based contracting. The Australian Constructors Association (1999:4) defines relationship contracting as, “a process to establish and manage the relationships between the parties that aims to: remove barriers; encourage maximum contribution; and allow all parties to achieve success”.

The manner in which traditional contracts are rigidly structured obstructs problem-solving endeavours and parties find themselves having to revert back to their contracts on occasions to relieve themselves from troublesome situations. Honesty and communication are consequently hampered, while confrontation and adversarial relations become the order of the day (Cheung et al., 2003). RC is not a stand-alone form of contract. It is, however, a multilateral relationship of good standing targeted at the successful execution of the contract (Rowlinson and Cheung, 2002) and the elimination of unfavourable conditions. Working on the basis of a charter (which is not legally binding), relational contracting encourages the use of non-legal mechanisms to solve problems, with the contract only being consulted in instances where situations escalate adversely (Rahman and Kumaraswamy, 2004a; Rahman and Kumaraswamy, 2005). Therefore non-legal and informal mechanisms play a vital role in facilitating the relationships making up the contract. Bayliss et al. (2004) determined that in a single project informal structures can result in a cost saving for the project, in that communication will be more efficient resulting in a reduction in written correspondence and for a large-scale project meaningful savings can be appreciated. Partnering is a form of RC, for example that is not a contract per se, but rather a commitment and open communication endeavour to establish and sustain non-adversarial relations (Cheung et al., 2003). According to Rahman and Kumaraswamy (2002), RC considers a relationship to be a contract, replacing formal proceedings of contracting with informal gestures or (if you preferred) a
“gentleman’s” agreement, the feasibility and achievability of which is dependent on all parties’ ability to recognise and realise the benefits of maintaining this mode of governance. Informal governance mechanisms relate to relationship building while formal relate to economic gain (Dewulf and Kadefors, 2010). This is where the strength of RC comes in: the addition of relationship building as an essential parameter for measuring the project performance. The participants are able to benefit in many ways, including financially.

As discussed in the previous chapter the construction industry houses an ample number of professionals who come together through sometimes difficult to comprehend systems of works. The complex nature of the industry has given rise to increased transactions and dealings requiring better handling of relationships in the project team. As such, construction projects are often faced with complexities and uncertainties. This is where risk allocation and contract conditions require meticulous attention to ensure projects do not fail in this regard. Rahama and Kumaraswamy (2002) associate undertakings in the industry with high risk, complexities and multiparty interactions. They go on to say that RC is the best route towards mitigating problems relating to uncertainties and complexities while simultaneously improving relationships in the different set-ups unique to each individual project. In addition to improvements to the relational aspect of the project, RC has been empirically proven to generate improvements in quality of works, better time control and substantial time reductions (Ghaffari, 2015).

Flexibility in the contract is an essential component in achieving total cohesion in the team. Although this is not something that can be specified in a contract it can be engineered by the manner in which individuals interact with and react to one another. The structures of relational contracts are such that the output of firms are not explicitly detailed and is therefore dependant on the firms’ voluntarily acting in the best interest of the team (Darrington and Howell, 2011). Voluntary acts add to flexibility in the contract which subsequently contributes towards the contracts informal features. Informal aspects are an important part of the project (Bygballe, 2010), especially in times of highly complex problems. Taking on a proactive stance towards problems as opposed to a reactive is ideal; however, it must be noted that the construction industry is inherently dynamic hence many of the problems which do occur are unforeseeable. Flexibility in the contract works hand-in-hand with informal relations, the existence of both in the contract allowing for parties to overcome unexpected problems in their many forms. According to Rahman and Kumaraswamy (2008), traditional
contracts are static in nature and do not support the facilitating of contractual incentives and flexibilities. The principles embedded in RC offer the contract, _inter alia_, contractual incentives as well as improved relationships by soothing transactional friction and facilitating flexibilities (Anvuur and Kumaraswamy, 2016; Ghaffari, 2015; Ling, Rahman and Ng, 2006; Rahman and Kumaraswamy, 2008).

Phua and Rowlinson (2003) determined that the selection of the most ideal procurement route is not an automatic passage to success and that in addition, co-operation and collaboration are two major determinants of success. Cheung _et al._ (2003) also established that projects which lacked co-operation were subjected to considerable inefficiencies. Co-operation has to do with the development of interpersonal communication, improved trust and the maintenance of a good and healthy team spirit (Anvuur and Kumaraswamy, 2016; Rahman and Kumaraswamy, 2005). RC focuses on the building of a single team and targeting inefficiencies to achieve optimal project performance.

### 3.4 Collaborative modelling

Project success is governed by many variables, and while some variables may be seen to be important determinants of success, this may not be the case in other projects. Success is dependent on a number of factors determining the project specifications, namely; project size, the participants making up the project team and the mutual objectives that steer the project. The increase in project size with the expectation of attaining results, in actual fact results in a complex CSC. This plus the increased use of sub-contracting to carry out trades by main contractors hinders the process of an integrated and collaborative team (Briscoe and Dainty, 2005). Over the years researchers have investigated and identified the critical success factor in construction projects. Construction industries around the world are becoming more and more aware of the positive impact that collaboration has in projects, and as a result collaboration has come up in literature as one of the critical success factors in construction projects (Phua and Rowlinson, 2003; Xue _et al._, 2010). As in many interdependent processes working in a joint fashion will more often than not render the process successful. This is why there is such a desperate need for a shift in the traditional undertaking of projects in the industry.

Collaboration begins with a consensual acceptance of project goals beyond those put forward by the client. This can only be attained if the project stakeholders are motivated and want to
work in a collaborative manner. According to Phua and Rowlinson (2003), it is the individuals making up the project team - the amount of interaction between themselves and efforts taken to work jointly - that determine the degree of success or failure of the project. However, Xue et al. (2010) suggest construction projects are characterised by individualism with stakeholders showing no motivation to work together. Consequently the disjointed set up of the industry is further exacerbated by the manner in which contracts and clients’ incentive systems are set-up in the industry (Darrington and Howell, 2011). This indicates a firm deflection from the spirit of partnering, alliancing, joint venturing and SCM. The motivation to work collaboratively and the kind of attitude people have towards the concept is *sine qua non* in order for partnering, alliancing, joint venturing and SCM and the collaborative venture to prevail.

As mentioned earlier, collaborative models for the construction industry have been developed and advocated by different authors. Collaboration in the industry can be instigated as a formal process or informal process. Rahman and Kumaraswamy (2004b) recommend that relational contracting (collaborative model) should be a process involving a mix between social (informal) and legal (formal) philosophies. The application of social norms such as (mutuality, solidarity and flexibility) is critical to the success of the SC (Faisol et al., 2005). Xue et al. (2010) differentiates partnering and alliancing as being informal and formal respectively. The two are accepted in the industry as common project delivery mechanisms with the former being the more popular of the two in both literature and practice. An empirical study by Masemeni (2011) revealed the value that a mix between informal and formal interactions between project stakeholders may have on the success of the project. Collaboration can therefore take the form of a formal or informal process but ideally preferred is a mix of the two. Xue et al. (2010) suggest that collaboration in the construction industry can be examined from two viewpoints: (i) as a working model and (ii) as a delivery system. The former is concerned with the various collaborative models available to the construction industry (partnering, alliancing and joint venturing) while the latter deals with the three development processes: (i) traditional construction processes (TCP), (ii) project-based management processes (PMP) and (iii) collaborative modelling processes (CMP).
3.4.1 Partnering

A construction site can at times be an unpleasant place to be in given the complex nature in which it operates. Many practitioners can relate to this. Normally stakeholders are not very keen on team integration (Xue, 2010), rather preferring to look after their own interests, by looking to maximise opportunities, sometimes even at the expense of others. This has a negative knock-off effect on projects and the industry as a whole which can potentially lead to many problems. This is why status quo transformation is necessary. Partnering is one such technique that can help transform existing mind sets in the industry. Partnering in the construction sense can be seen as a project management technique that seeks to effectively create a nurtured environment where two or more organisations harmoniously co-exist. In literature the most commonly acknowledged project benefits of using partnering as a procurement route include; a reduction in the risk of time and cost overruns as well as continuous support between participants. Although partnering has been identified as an innovative answer, along with its great potential of project success it must be noted that partnering is not always the answer to all construction problems. According to Hughes et al. (2012), the terms; ‘partnering’, ‘alliancing’ and ‘joint venturing’ are interchangeable. However, the three processes are vastly different. Problems in the construction industry differ and those that are able to be addressed through the use of collaborative models such as partnering must be solved using such. Partnering can be disrupted and hence unsuccessful if it is misunderstood and hence undertaken under the incorrect prescription or set of guidelines (Cheng and Li, 2002; Chan et al., 2003). The application of partnering can be ineffective if done so by inexperience individuals. This has been identified as one of the major causes of failure of collaboration in the construction industry (Chan et al., 2003). Proper execution of these types of contracts is also noted by Rahman and Kumaraswamy (2002) who state that relational contracts are expected to work properly in any environment, provided they are properly administered.

The emergence of partnering came after a need was seen to better manage particular processes in areas such as those of the construction industry. In the construction industry some of the first countries to introduce and implement partnering as a procurement approach were Australian, Japan and the USA (Rowlinson and Cheung, 2002; Naoum, 2003) with much literature on the subject coming from the same countries. In the USA the approach was first introduced by the U.S. army corps in the mid- to late 1980s. Literature on the subject
suggests that the approach seems most popular in China seeing as extensive research on the topic is being done by researchers such as Bayliss et al. (2004), Cheng and Li (2002), Cheung et al. (2003), Chan et al. (2003) and Chan et al. (2004). Partnering was introduced in Japan in the mid-90s in the form of a health care facility where the partnering arrangement was adapted through a design and build contract. Popularity in Australia grew in the 1980s while in South Africa very little literature has been recorded on the subject. Figure 3.4 shows the results on the number of publications from different regions in the world. This raises concern seeing as the South African industry, with only one publication is suffering from similar problems as those encountered in other countries. Van der Merwe and Basson (2006) established through empirical research that the discipline of construction project management can embrace the strategies and techniques employed in partnering and apply them to the South African construction industry to render gratifying results. The country has a great deal to gain from exploiting the benefits that come with collaboration in projects and if it is to adopt more relationally orientated contracts, partnering is the first step towards attaining that, seeing as partnering has been identified by Rahman and Kumaraswamy (2002) as a good example of practicing relational contracting.

Figure 3.4 - Papers related to CW published by country or region (Xue et al., 2010)
According to Chueng et al. (2003), the goal of partnering is to improve relations between stakeholders on both a short-term basis (single project) and a long-term basis (multi-projects). It is regarded as an effective way for management to improve quality, programme and reduce clashes. Individuals are required to provide support to their fellow associates, thereby creating an environment of commitment and mutual support, necessitating the abandoning of traditional procurement habits (Briscoe and Dainty, 2005).

The success of the relationships within a partnering arrangement is determined by the manner in which the organisations treat each other. In order to enforce a successful partnering relationship objectives and goals of the project must be mutually agreed on, problem-solving mechanisms must be determined, inter-firm trust established and maintained, and benchmarking exercises and continuous and measurable improvement initiatives incorporated into the team’s culture (Rowlinson and Cheung, 2002; Naoum, 2003).

Definitions for partnering are many; however, the underlying themes correlate. Partnering is about looking out for one’s own interests and equally doing so for those of other stakeholders making up the team (Bygballe et al., 2010). It is very difficult to work and think collaboratively when individuals look to gain at the expense of others. The notion is that when everyone works together to help share pain-gain, the team is placed at an advantage to achieve set project targets. Rowlinson and Cheung (2002:10) define partnering as “a structured management approach to facilitate team working across contractual boundaries”. The creation of a ‘virtual’ organisation comes about by the coming together of a multitude of individual organisations forming an inter-organisation with unlimited collaborative lines.

The complexities that come with the concept of partnering are often misunderstood and as a result what partnering is and what it is intended to achieve can become somewhat confused. In literature the concept is interpreted in different ways. Partnering may be seen from a philosophical outlook, with a particular set of beliefs (Naoum, 2003). From a SCM point-of-view partnering is taken as a relationship model (Chueng et al., 2003), although it is conventionally looked at from a functional point-of-view such as that of Chan et al. (2004) who explain partnering to be the formation of good relationships between parties to a construction contract, with the goal of minimising job costs and schedule overruns. The most often cited definition of partnering is that of the Construction Industry Institute (CII). The CII’s (1991:5) definition of partnering is the following:
A long-term commitment by two or more organisations for the purpose of achieving specific business objectives by maximising the effectiveness of each participant’s resources. This requires changing traditional relationships to a shared culture without regard to organisation boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other’s individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services.

The benefits that come with partnering are many. Stakeholders are in a position where they can re-orientate themselves from the traditional ways of construction to a more win-win scenario allowing for improved problem solving and fostering synergistic teamwork. Partnering as a project implementation venture has the potential to improve generic project success in more ways than one can imagine. It encourages an integration of the entire project team and in doing so creates a competitive advantage for the project team as opposed to conventional project delivery mechanisms. Generally partnering seems to be between the client and the contractor (Chan et al., 2003; Bygballe et al., 2010). This notion could be provoked by a number of reasons. For example, Akintoye (2000) declared that contractors concentrate more on the client than their suppliers and therefore have more arrangements with the client than the suppliers. On the other hand Briscoe and Dainty (2005) suggested that clients tend to keep an arm’s length relationship with suppliers and sub-contractors, preferring rather to communicate with them via the main contractor. The inclusion of suppliers in the partnering agreement will ensure a well-coordinated and integrated system with the main contractor, allowing for the development of trust and resulting in improved project performance (Bygballe et al., 2010). The inclusion of other stakeholders is key in exploiting the benefits of partnering.

The use of the traditional methods in undertaking projects has been put under the spotlight in recent years, with the intention of identifying their shortcomings. The selected procurement system can affect a numbers of factors, including the flow of information. Literature suggests that the use of traditional procurement strategies is the biggest cause of the adversarial and fragmented state of the construction industry. In fact, Naoum (2003) goes as far as saying that most procurement strategies are designed to be adversarial, relying heavily on contractual procedures to undertake the project, while Chan et al. (2004) and Hauck et al. (2004) point out that the way in which the traditional (design-tender-build) is configured is the cause of
conflict among stakeholders, severely obstructing project success. It is because of these negative inherent features that projects are subjected to low productivity, poor performance and reduced competitiveness (Australian Constructors Association, 1999; Chan et al., 2004; Chan et al., 2006; Bygballe et al., 2010; Xue et al., 2010). Partnering is opposed to doing business under such conditions. In this way stakeholders feel as equally vital to the completion of the project as the next member and importantly, client satisfaction is more of a certainty and the likelihood of securing future work is promising.

3.4.2 Alliancing

Partnering and alliancing are regarded as two commonly used ways of doing business collaboratively in the construction industry. Subsequently confusion between the two is common as a result of the misuse of the terms in literature and practice. The main similarity between partnering and alliancing is that they both seek to do business in a collaborative environment, implemented through integrated supply chains. The major difference is the manner in which the contracts are executed. The latter is inherently complex with the contract being executed formally; therefore arrangements are expressed in the form of binding contractual obligations (Xue et al., 2010; Davis and Love, 2011). Unlike in partnering where the principal contract between stakeholders gives the client the advantage of reverting back to the contract should the partnering agreement fail, alliancing is seen as a formal approach to collaboration in business (Anvuur and Kumaraswamy, 2007). Partnering is therefore not a contract as such but rather a commitment and open communication endeavour to establish and sustain non-adversarial relations (Cheung et al., 2003). Walker and Hampson (2003) state that the two concepts can be distinguished by certain components that make up the relationships which exist in each, under the following categories:

- The amount of trust and commitment;
- The extent to which the relationship is looked after and not forced upon the stakeholders by the conditions of contract;
- The manner in which the relationship is developed, taken care of and maintained as a good part of the overall contract;
- The extent to which openness/ transparency is maintained throughout the duration of the project; and
- The manner in which ‘gain and pain’ are shared.
In a report by the Auditor General of the Australian National Audit Office (AGANO) (2000), alliancing is suggested as a form of contracting process that delivers, within a guarded time frame, and a cost-effective way of sharing project risks and rewards. The report goes on to explain that the process uses an integrated team employing the services of key stakeholders (i.e. the architect, the project manager, building and services contractors, and other parties) most likely to have an effect the outcome of the project.

The construction industry appears to have been slow in grasping and realising the benefits that come with alliancing. In literature the approach appears to be most popular in Australia, while partnering seems more popular in the Northern Hemisphere (USA, UK and Japan). Much like the application of SCM principles, the first recorded business alliances were in the manufacturing and automotive industries (Walker and Hampson, 2003). By forming alliances what organisations are essentially doing is creating a project team extending beyond traditional organisational boundaries – sharing all losses and profits, risk and rewards – in a ‘supreme’ collaborative manner. In doing so, individually the very same organisations establish a competitive advantage of furthering their business with clients and customers. Alliancing is especially beneficial in projects that appear to be extreme in terms of complexity, and in situations where a mix of traditional construction and non-construction related professions are required to achieve common ground. This is because alliancing provides a platform for high levels of performance across a wide range of expertise in various construction and engineering related fields (Walker and Hampson, 2003).

Alliances transpire through well documented processes, requiring that resources extending beyond organisational lines from initiation, through implementation, right up to the conclusion of the contract. According to Anvuur and Kumaraswamy (2007) alliancing is best described as an intense form of partnering, where successes and downfalls are contractually linked between the team members and governed by the performance of the project. In alliancing members accept a state of “joint” risk rather than “shared” risk (Hauck et al., 2004). This implies that no member of the alliance can profit from the project without the other members profiting in a similar fashion, no party can make “extra-profits” by shifting cost to another party; and alliance members take collective ownership of the risks. Likewise when one member incurs a loss as a direct result of the project the short fall affects the entire alliance. The fundamental objective of alliancing is that everyone benefits collectively or no-one benefits at all. Parties are motivated to develop mutually favourable incentive-based
strategies and therefore co-operate in a manner not seen in any traditional form of contracting in the construction industry. Alliancing seeks to achieve whole-hearted unity between the members by creating a virtual company, achieving collaboration at its highest degree (Walker, Hampson and Peters, 2002). It is thanks to this distinct feature that alliancing has been so successful and had consequently increased in popularity around the world.

Alliance projects in the construction industry are arranged in such a manner that failure of the process is limited as far as possible. Unlike in partnering where a non-binding charter is drawn up to informally regulate the process (Hauck et al., 2004), alliance projects are made-up of various role players who ensure the smooth running of the venture from inception to conclusion. Under alliancing contracts the process is governed by a project alliance board to ensure decisions are unanimously agreed upon. A virtual organisation is created to ensure the construction initiative is governed by a structured group of individuals from the various organisations which have taken up various roles in the alliance. The board is created to establish a governance structure fit for decisions to be taken in a rational manner, creating an

Table 3.1 - Levels of leadership for Alliance Organisational Structure

<table>
<thead>
<tr>
<th>Level</th>
<th>Title</th>
<th>Personnel</th>
<th>Duties and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project alliance board (PAB)</td>
<td>Senior personnel from various alliancing organisations</td>
<td>*Corporate governance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>*Develop policy and delegation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>*Monitor and manage performance of AMT</td>
</tr>
<tr>
<td>2</td>
<td>Alliance management team (AMT)</td>
<td>*Alliance Manager</td>
<td>*Provide leadership and direction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Deputy Alliance Manager</td>
<td>*Integrate public sector organisations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Project Managers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Senior Designer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*SHEQ Manager</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Alliance Coach</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Services coordinator</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Integrated Project Team</td>
<td>All operational staff</td>
<td>Individual projects</td>
</tr>
</tbody>
</table>

Source: (Rowlinson, 2006)
atmosphere that is fair and just. This board is referred to as the project alliance board (PAB), comprising natural persons holding executive positions in their respective organisations. An alliance manager is appointed to co-ordinate the alliance (or more than one alliance) similar to how a construction project manager would conventionally roll out projects. Table 3.1 shows a typical structure of an alliance project.

Projects where alliancing is used as a form of project delivery are normally highly complex or have great prestigious value to the public. For that reason clients of alliancing projects are normally government or large private sector clients involved in hi-tech engineering projects. Case studies where alliancing has been the preferred choice for project delivery have rendered illustrious results. For example, in Australia an offshore oilfield was constructed in 20 per cent less time than targeted, 4 per cent below budget (A$ 13 million to be exact = US$ 10 million) and evidently no compromise on safety (Walker and Hampson, 2003).

3.4.3 Project and Strategic partnering/alliancing

It is difficult to give a clear definition and understanding of partnering (Walker et al., 2002; Naoum, 2003). This is exacerbated by the plethora of information on partnering globally resulting in many definitions being given in literature and causing confusion as to what partnering in construction is. Two forms of partnering generally exists, namely project partnering and strategic partnering. Generally the idea is that project partnering as the term suggests is project specific, that is, a partnership agreement is entered into for a single purpose. At the end of the project the relationship is normally dissolved with the intention of creating a new partner agreement elsewhere. Strategic partnering, on the other hand, deals with partnering on more than one project and it is therefore concerned with building long-term relationship alliances. According to Cheng and Li (2002), project partnering looks at short-term benefits, therefore focusing on project performance, while strategic partnering looks at long-term benefits, focusing on strategic goals. Project partnering seems to be the popular choice between the two largely favoured approaches because of the short nature of relationships and tender procedures in the construction industry (Bygballe et al., 2010). Construction projects are characterised as being once-off with interaction only going on for a
limited duration of time usually governed by the contract period. This being the case, it is worth noting that in long-term relationships benefits that recurring interactions between stakeholders encourages joint working, making partnering easier with time (Bygballe et al., 2010).

The difference between project and strategic alliances is very similar to that of partnering even though the two relational contracting strategies (partnering and alliancing) differ significantly. Project alliances are legally enforceable agreements which have a definite predetermined end which expectedly is the project completion date (Rowlinson and Cheung, 2003), while according to Keniger, Hampson and Peters (2000), strategic alliances are ongoing mutually beneficial business agreements which extend beyond one particular project.

### 3.5 Sustainable collaborative project environment

It is imperative that when individuals from different organisations within the project setup come together, they get along and are able to co-exist both within their respective organisations and across organisational boarders. Working together prompts team formation, allowing for an environment conducive to communication exchange and learning. The first step in establishing a collaborative working scenario is the relationship. At its very basic a collaborative relationship is made up of three stages: formation, application and completion (Bayliss et al., 2004; Cheng and Li, 2002; Van der Merwe and Basson, 2007). Even though the aforementioned stages (as determined by Cheng and Li, 2000 and Van Der Merwe and Basson, 2007) were established for a partnering form of collaboration, for the purpose of this study it is taken that the same procedure applies to collaborative models in general. Using these stages of relationship development the intention is to determine and elaborate on features on how to best sustain a collaborative project environment by establishing (at formation stage), maintaining (at application stage), and finally concluding a successful collaboration (a completion stage).

1. **Formation** – This is the agreement, implicitly or explicitly, between the parties to establish an informal relationship with the intention of achieving mutually agreed upon goals and objectives.
(2) Application – This is the implementation of the informal relationship to achieve the mutually agreed goals and objectives; and

(3) Completion/Reactivation – Once the project has been discharged the parties may choose to re-enter into another partnership or choose to dissolve it.

Cheng and Li., (2002) go further to say that during these stages the success of the relationship depends on certain critical factors. At each stage various activities need to be performed on a project management level:

1. Formation - team building, facilitator appointment and formulation of partnership agreement, selection of associates
2. Application – partnering goal achievement and joint problem solving, identification of critical success factors, identification of KPIs and benchmarking exercises; and
3. Completion/Reactivation – long term commitment, continuous improvement and partnering experience.

3.5.1 Selection of associates

Construction projects can be described as the coming together of various designated organisations for the purpose of implementing a construction venture for a mutual client. In large multi-million rand projects this description is more involved and the inclusion of a socio-legal element such as RC further complicates matters. For example the word ‘various’ becomes ‘multitude’, ‘contractor’ becomes ‘principal contractor’, ‘client’ becomes ‘major entity’ and consultants are referred to in their respective professions. So the description may then develop into something along the following lines: “the coming together of a multitude of designated organisations for the implementation of a large construction or engineering venture for a major public or private entity (or a combination of both types of entities)”.

Generally RC is advised and initiated for construction and engineering contracts which are large in scope. Large construction and engineering projects are characterised by large, complex networks supplying material, components and a host of other construction and engineering-related services. Transactions in such projects should place emphasis on cooperation as opposed to competition to govern the relationships which exist within them (Eriksson, 2008). The client and contractor are often mistaken to be the only organisations involved in the partnering arrangement (Chan et al., 2003; Bygballe et al., 2010). Normally
the client and the contractor are the largest organisations in terms of size when it comes to other organisations making up the project team and hence new concepts and innovations are likely to be driven by them. This dyadic relationship focus results in the exclusion of other important stakeholders in the project. Depending on the nature and scope of the construction venture the collaborative model selected must be championed by a well-documented, value-driven selection of all salient organisations making up the project team (including *inter-alia*, consultants, suppliers and sub-contractors). This is the first step in the relationship development and hence it takes place at the formations stage of the process.

As mentioned before RC offers the contract contractual incentives that seek to soothe transactional friction and facilitate flexibilities. Rahman and Kumaraswamy (2005) acknowledge that not everyone can show the relational qualities of being able to work under such flexible and collaborative settings. It may also be difficult for the project team to achieve the kind of cultural transformation stimulated by RC if incompatible associates are selected (Rahman and Kumaraswamy, 2004a). These are the type of individuals/organisations who will later on prove to be a concealed impediment to the target of a win-win scenario for the project. This can happen in many ways, the most common being contractors tendering on a low price with the intention of securing the project, only to later make up incurred losses through claims and variations. Another case could be one where organisations falsify their abilities in order to secure work after which they find themselves in unfavourable, compromising positions. Such cases of opportunism are an occasional occurrence in the international construction scene (Jagtap, and Kamble, 2015) and have been the unfortunate cause of many dispute cases. As such, these mentioned circumstances are completely against what collaboration seeks to achieve. Partnering, alliancing and SCM all encourage a complete and equal multiple actor project participation environment. The key question is who to select to be part of the venture (Bygballe *et al.*, 2010).

Literature on the selection of partnering/alliance associates advocate the use of a wide range of tools and techniques. However, to single out one as the most reliable would be a brick short of a load. It is therefore the intention of this study to encapsulate some of the salient features from the work of various authors on the subject and present a comprehensive review of how best to select ideal parties for a collaboratively modelled construction contract. Zhang (2004) established that contractor selection methodologies can be used as a starting point for the selection of parties to make up a concessionaire agreement. By making use of elements used
in the route of main contractor selection especially in large projects, the client can adjust criteria to suit the respective trade or service which he seeks. One of the biggest consensuses with regards to selection, especially when coming to contractor selection, is that of low bid selection.

Watt et al. (2010) uncovered the fact that while there are many criteria on firm selection for construction services, no individual criterion or group of criteria has been reported as being more important than another. Bendaña et al. (2008) and Watt et al. (2010) suggest the use of variables extrapolated by weightings to provide better insight in the selection process. Because prerequisites differ from client to client, the client can exercise his/her discretion by weighting categories differently to what best meets his/her needs. This method of selection can therefore be recognised as a quantitative method of selection as opposed to qualitative selection because it makes use of figures and a set of pre-determined equations as per the value solicited by the client. According to Wang et al. (2007), quantitative standards for the selection of partnering/alliance associates are not exercised enough in construction. Selection approaches sometimes exercise objective opinions which may give the process artificial elements making it just, and hampering the strength of the selection process as a whole. In their model Wang et al. (2007) sought to establish a contract price based on the price submitted by the contractor and that of client with the contractor being rewarded or penalised for savings or overruns respectively. Therefore selection of the contractor would be done with the confidence of no hidden agendas because the price is determined by the contractor and not the client. Table 3.2 shows the different models that are available in selecting associates for a collaboratively structured project.

Selection of partnering/alliance associates should be steered by the intended outcomes of the project with regards to the cultural tone to be taken up by the team. Low price selection must be avoided where possible as this can be seriously detrimental to the relationship, significantly hampering flexibility and innovation, and subsequently compromising the success of the project (Cheung et al., 2003; Love et al., 2004). Alliancing project stakeholder selection is completely against price-oriented selection. Selection must be derived from value determined across a wide range of key performance criteria driven by projection objectives.
### Table 3.2 - Selection models for selecting CSC stakeholders

<table>
<thead>
<tr>
<th>Reference(s)</th>
<th>Model</th>
<th>Stakeholder(s) to be selected</th>
<th>Quantitative/ Qualitative</th>
<th>General features</th>
</tr>
</thead>
</table>
Multi –criteria selection  
Multiple-staged tender evaluation                                                                                                                                   |
| Wang et al. (2007)    | Combined radix determination          | Contractor                    | Quantitative              | Value and performance requirement assessment  
Sticking a balance between price and value                                                                                                                               |
| Rahman and Kumaraswamy (2005) | Relational Selection                 | All main stakeholders         | Qualitative               | Multi –criteria selection  
Provides selection criteria for each party  
(supplier, client, consultant and contractor)  
Recognises a need for a paradigm shift away from neo-classic styles                                                                                               |
| Zielina (2010)        | ELECTRE method                        | Sub-contractors               | Quantitative              | Multi –criteria selection  
Algorithmic generation selection                                                                                                                                          |
| Bendaña et al. (2008) | Fuzzy – control approach              | Contractor                    | Qualitative and Quantitative | Application of mathematical techniques  
Multi – criteria selection  
Single step process  
Highly complex     |
set down at the beginning of the project. The unique nature of complex projects such as public private partnership (a form of partnering and relational contract) requires a great deal of commitment, with risk spread widely across the team. Projects such as these require a best value approach in selecting the concessionaire to improve the prospect of a seamless production line particularly when delivering the project under intense difficulties (Zhang, 2004). Value expands across a wide spectrum and essentially seeks to satisfy the needs of the client as far as possible. Since value is generated through meeting the needs of the client, for this to be recognised, a thorough evaluation of all candidates must be carried out. Associates must be sought by way of competitive selection as well as multiple-tender criteria evaluation (Zhang 2004; Watt, 2010). This will ensure that the highest value is sought from the project, through the elimination of organisations which may hamper the course.

The process of identifying potential associates should be driven by factors that will ensure the smooth running of operations on a day-to-day basis. Candidates should be able to show the client and project initiator their abilities and competencies which will prove to be essential towards attaining this. For example suppliers must show that they have the ability and competency to provide quality products and cost benefits, as well as the ability to simplify the order process and construction process as a whole. However, the client is also tasked with the responsibility of making sure the project is attractive to potential stakeholders by securing the most suitable organisations to do the job by way of competitive tender processes. Akintoye et al. (2000), for example, identified that in addition to cost benefits, contractors prefer to work collaboratively with clients who have competencies in simplifying various processes in construction (tendering and designing). This further emphasises the importance of a competitive tender approach for the selection of all major stakeholders in the supply chain.

RC governance structures focus on, inter alia, mutual trust, altruism and long term social exchange, which is why the potential members should possess qualities which would benefit the relationship in this regard. Rowlinson and Cheung (2002) argue that a selection process which acknowledges a performance and relational orientated approach will facilitate an impeccable relational contracting environment conducive to collaborative teamwork. Literature from various authors has suggested similar criteria which are aimed at the selection of ideal associates to take up various key roles in a relational contracting set-up. Generally project success is driven by a mix of hard factors, time, quality and cost being the most frequently prescribed in both industry and academia. Relational/soft factors relate to factors
such as creativity, innovation, teamwork abilities and the like. In RC both hard and soft capabilities are weighed up to when considering the services of various firms to complete the team. Rahman and Kumaraswamy (2004b) present this very well in their empirical study where the two most important factors in the selection of consultants for a collaborative type project, technical capabilities and joint problem solving abilities, are hard and soft factors respectively.

Walker *et al.* (2002), Walker and Hampson (2003), Rahman and Kumaraswamy (2005) and Anvuur and Kumaraswamy (2007) share the ideology that the selection of RC associates must be based around the outcome of the project. These authors highlight the paramount importance of selecting associates based on their expertise and performance. However, one may come to the conclusion that perhaps this philosophy should not be restricted to alliancing or partnering type contracts only and should extend across all forms of construction contracting. A thorough evaluation of all parties concerned must be carried out. Professional selection must be guided by the idea that the team must be assembled in such manner that they complement one another and do not have contradictory technical and personality traits (Anvuur and Kumaraswamy, 2007). Although a perfect fit would be the ideal situation, very few, if any, projects can claim such a distinct achievement. To ensure compatibility the project team can make use of a project induction for the all stakeholders. According to Rowlinson *et al.* (2006), project inductions are necessary for all types of RC given their unique nature to the contracting governance approach. Individuals without a knowledge of RC can use this as a platform to familiarise themselves with the various processes involved in undertaking a relational contract.

**3.6 Factors facilitating successful collaboration**

Literature on critical success factors (CSF), key performance index (KPI) and benchmarking share a similar theme with regards to the identification of variables. But before unpacking these, it is necessary to understand how construction supply chain performance is measured at the close-out of the project. Conventionally, projects are measured according to performance in cost, time and quality. This may seems rather superficial considering how involved construction supply chains are. In addition to the conventional three parameters, performance of construction supply chains should include: health, safety and environment, functionality
and client satisfaction (Egemen and Mohamed, 2005; Hauck et al., 2004; Han et al., 2012; Yeung et al., 2009). According to Han et al. (2012), there are two forms of performance measurement, namely quantitative (which can be determined objectively – such as cost, time, health, safety and environment) and qualitative (which is determined subjectively – such as quality, functionality). To do well in all the aforementioned parameters can be considered quite a feat, but this is where the role of the project manager is put to the test.

Identification and selection of what project parameters to select provides a starting point from which other management techniques can be implemented. CSFs are those factors which will help steer the supply chain into achieving the identified project parameters. Authors have come up with many CFS for the construction supply chain: effective communication, trust, conflict resolution, top management support, creativity, collaborative working, performance measurement and early stakeholder involvement (Akintoye et al., 2000; Bayliss et al., 2004; Chan et al., 2004; Cheng and Li, 2002; Xue et al., 2010). Doloi (2013) came up with five factors which, if not paid careful attention, contributed to projects running over budget: project planning and monitoring, effective site management, contractors’ efficiency, design efficiency, and communication. The use of KPI and benchmarking exercises during the project provides a check against which project performance can be measured and helps facilitate continuous improvement (Yeung et al., 2009). It must not be seen as a display of project vulnerability but rather as continuous learning and adaptation exercise, working towards improving the supply chain (Love et al., 2004).

The success of the relationship is not governed by the contract it is a team effort and does not rest solely in the arms of an organisation. Commonly referred to as critical success factors (CSFs), these ‘variables’ provide a guideline on how best to sustain a climate of appropriate comfort for all involved. Generally the CSFs of a project in totality are factors which define the project outcome: they influence the project significantly and provide a constitution on which project success can be referred. CSFs in RC look at areas that if paid careful attention, can enhance project success by leveraging the technical benefits of collaborative working. These success factors also help in shaping the culture of the project. Walker and Hampson (2004:184) explain project culture as simply “the way things are done around here”. Project culture comprises many elements and ideologies which are sourced from the coming together of the different organisations. This difference in culture provides an environment where innovation and creativity can flourish. It is during the application stage of the relationship
(taken from the aforementioned stages of relationship development) that the success factors need to be considered to ensure relationship sustainability, and in the same way, contract sustainability.

When looking at RC literature there are very few occasions in which co-operation and collaboration are not emphasised as major determinants of success. The two are compatible; the existence of one is dependent on the other. The success in discussion is not primarily that of the project but rather that of the project as a result of a successfully orchestrated relationship. The well-being of the relationship can be facilitated by identifying a set of important variables that, when considered throughout the phases of the project, will boast positive outcomes. Once the team is established a charter must be formulated, the contents of which must include recognition of these variables. Even though collaboration is being increasingly recognised as a CSF in construction projects (Xue et al., 2010), CSFs for collaboration have been extensively researched over the past decade as well. Various authors from many countries around the world have presented findings from studies relating to elements that can be used to enhance the project by means of relationship-based considerations.

Repetitive interaction between stakeholders and the application of social norms to execute the project are indispensable as far as RC is concerned. The level of interaction and joint efforts determine to a large extent the level of co-operation and commitment individuals contribute to a project team therefore, Phau and Rowlinson (2003) state that the success and failure of a project is considerably influenced by the individuals making up the team. Working jointly in a project environment ensures the formation of a firm team, one that is resilient to miscellaneous disruptions. Problem-solving and decision-making are common in construction project teams and the manner in which stakeholders go about negotiating and solving problems reflects the collaborative strength of the team (Hauck et al., 2004). Regular meetings and workshops are essential for the collaborative status quo. To maintain the spirit of teamwork it is suggested that review meetings are held on a monthly basis. These meetings must be used to check, monitor and echo the principles underpinning the collaborative venture (Bayliss et al., 2004).

Transactional costs are severely stretched at the hands of adequately adopted disputes resolution mechanisms. This defining feature can often be taken for granted and overlooked
when drawing up a contract with parties feeling they have the necessary legal resources should a situation warranting such action arise. This view towards problem-solving should be considered on a last resort basis as the financial repercussions for such proceedings can be crippling. Agreeing on a protocol to handle disputes and problems is imperative for the survival of relationships. As an alternative, stakeholders should negotiate dispute resolution processes prior to the commencement of the project. According to Naoum (2003), in order to eliminate adversarial aspects embedded in construction projects as far as possible, this should be the first step towards drafted the partnering agreement. In RC parties look for mutually satisfactory solutions through joint problem-solving (Chan et al., 2004). This should be done in a skilful manner so as to avoid the breaking down of interactions and consequently damaging the relationship (Faisol et al., 2005). Headed by competent personnel the task of establishing the most suitable procedure must be guided by a set-by-set route. Chan et al. (2006) suggested the following route to resolve a dispute:

(1) Communicate of the dispute to all parties concerned;
(2) Resolve the dispute at the lowest possible level;
(3) Establish level of urgency and severity; and finally
(4) Agree on the duration and resolve within an agreed timeframe.

Once consensus is reached at a particular stage of the process then the next level of resolution can be considered.

Quite often construction contracts are full of binding clauses, which are commonly written in a legal jargon leaving some individuals bewildered and resulting in misinterpretation of clauses. Contracts are conventionally prepared with rigid systems for different activities undertaken during the execution of the project (such as claims, tendering and queries). According to Rahman and Kumaraswamy (2002), traditional contracting does not make adequate provision for contractual incentives and flexibilities. RC looks to shy away from the current modus operandi to being able to adjust policies and practices to suit multiple scenarios. Flexibility in the contracts needs to be looked at, not with the intention of “taking the easy way out”, but rather to allow for adjustments in the events of unforeseen changes in the future. Given the complex and unpredictable nature of construction contracts, the procurement route and the relating contracts selected should be flexible enough to allow for adjustments to accommodate these uncertainties (Rahman and Kumaraswamy, 2004a; Faisol, 2005). This can also be linked to group resilience, defined by Rowlinson et al. (2006:3) as
“the ability to handle unpredicted or unexpected change”. Low group resilience essentially
means that should an unexpected incident occur, the team would be adversely affected and as
a result would be less effective in neutralising this change (Rowlinson et al., 2006). Mobilising contractual flexibilities will not only improve relationships but also soothe any
transactional instabilities (Rahman and Kumaraswamy, 2008).

3.6.1 The role of trust

As in any business transaction trust is a prerequisite without which the transaction will be
ambivalent. In a social context the relationship between individuals is governed with some
degree of trust to steer its existence. Relationships, no matter what the motive are, are hard
and very often mismanaged. Relationships have many dimensions, trust being one of them.
According Cote and Latham (2006) the performance of a dyadic relationship between
organisations is heavily dependent on the trust factor. The same principles apply in
construction with literature on the subject illustrating this. According to literature trust, is
understood to be a complex issue affected by many factors. At a personal, organisation, inter-
organisational as well as international level trust is a multilevel phenomenon (Xue et al.,
2010). This makes it difficult to single out a definition for trust. Walker and Hampton (2003)
state that trust has many layers of complex meanings, simplifying it as confidence -
confidence that others’ actions are consistent with their words.

Trust has proven to be an intangible tool in eradicating inherent malaises in the construction
industry. According to Dubois and Gadde (2002) construction supply chains are characterised
by complexities which are as a result of uncertainties, interdependencies and inefficient
operations. This is where trust the value of trust is found to be irreplaceable. Trust has been
identified as an effective tool in eliminating inherent problems relating to adversarial
behaviour, restricting supply chain integration and subsequently undermining the success of
the project (Akintoye et al., 2000; Briscoe and Dainty, 2005; Khalfan, McDermott and Swan,
2007; Naoum, 2003). Low trust impacts negatively on the speed at which things can be done
and increase the cost at which things are done. High trust has an opposite effect (Covey,
2006). Ultimately trust is one such tool that must be exploited as far as possible to improve
project success across all spheres of the construction supply chain.

Evidently trust is not something one can acquire in a short space of time, much of work goes
into obtaining trust from someone, particularly in construction projects where the process is
threatened by short-term objectives created by the project settings. In an empirical study Emuze and Smallwood (2014) identified short-term objectives as a major threat to the success of the project. The building of trust is acquired over a period of time and largely controlled by the number of times individuals and organisations come into contract (Cote and Latham 2006; Khalfan et al., 2007). Therefore the more time that is spent interacting with one another on a project, the easier it becomes for trust to flourish.

The construction supply chains are dependent on the synergy of activities from the beginning to hand over. As the basic concept of SCM suggests, CSCs are based on the interdependence of the supply chain to improve the configuration and control of processes (Vrijhoef and Koskela, 2000). Mutual dependence and the need to co-operate are evidently a part of the CSC, given its complex coalescence of activities. Mutual dependency is when the parties are dependent on each other in getting things done. If the parties understand the ins-and-outs of dependency, the options of collaborative workings will be limitless (Cousins, 2002). Interdependence is controlled by linking activities – for example, the construction cannot commence without a design, people completing tasks on time and a reliance on specialists to help out on certain activities (Khalfan et al., 2007). This will culminate in what is referred to by Rahman and Kumaraswamy (2004a: 149) as mutual trust, “a social relation characterised by both parties being both trusting and trustworthy”.

In this research three types of trusts will be discussed according to the work of Covey (2006), Khalfan et al., (2007) and Pinto et al., (2009): character trust, competence trust and intuition trust. The first two (competence trust and integrity trust) are driven by creditability and the latter is emotionally driven.

**Character trust:** This is the root of all trust (Covey, 2006). This type of trust relies on people communicating and performing their duties openly and honestly. It is also referred to as ethical trust as it has to do with the parties willingness to look after one another’s interests (Pinto et al., 2009). Khalfan et al. (2007) established that individuals at more senior levels are responsive to how others carry themselves and maintain high levels of “professionalism”. Should a party or individual act in a manner which is in any way suspected to be in “bad-spirit”, then this type of trust will be essentially lost.

Covey (2006) identified two core elements relating to character trust, as shown in figure 3.5:
Figure 3.5 - Core elements of character trust (Covey, 2006)

**Competence trust:** This is having faith in a party’s ability to undertake a task effectively (Pinto et al., 2009). This type of trust is built on reputation and has an impact on whether others are comfortable with a particular individual or organisation performing a particular activity (Khalfan et al., 2007). This type of trust is, however, easily lost if the performing party fails to execute a task as expected by the receiving party. For example, a contractor is selected to undertake a particular project based on competent trust bestowed on him by the client and his representatives.

Covey (2006) identified two core elements relating to competence trust as shown in figure 3.6:
**Intuition trust:** Looking back to the complexities mentioned earlier, this type of trust is especially susceptible to the dissolving of trust as it is more of a ‘gut feeling’ and is therefore emotionally driven. According to Pinto *et al.* (2009), should an individual make a call based on this type of trust, they will use any or both of the previously mentioned types of trust to defend their decision.

Trust is governed by the manner in which one acts, thus people make a decision and behave in a particular way based on what they perceive from the actions of previous encounters. People are unique, no one person is the same as another. Our actions, however affect people and in the case of a project, our actions affect the people in the project team. Trust has unlimited benefits for the supply chain should it be paid careful attention. Trust promotes high levels of ethical standards and reduces tension in the supply chain (Rowlinson and Cheung, 2002). Trust also limits the need to establish a monitoring system to continuously check on one another as well as reducing the need to refer to the formal contract (Cote and Latham, 2006; Rowlinson and Cheung, 2002). It is evident that optimal CSC effectiveness is achievable through a strong supply chain with an active relationship based on trust. Consequently communication now comes into play. Trust is gained through ways in which personnel communication with each other (Pinto *et al.*, 2009; Dewulf and Kadefors, 2010;
Khalfan et al., 2007). Coincidently project success is dependent to a great degree on communication. Stakeholders must exchange information openly and honestly and the information given must be accurate in that it must give a true reflection of the matter (Khalfan et al., 2007).

3.6.2 The role of effective communication

For many interrelated processes communication is an invariable imperative, the absence of which may lead to the complete failure of a venture. The same applies to collaboration, RC or any procurement route chosen for that matter. It is expected that while undertaking the project parties will exchange much information, which is why it is such an important part of the venture. Communication and information flow between the parties in the project is critical for sustaining long-term relationships (Briscoe et al., 2004). Although in the beginning of the project communication channels may be distorted, improvements will be made with time. As the project commences the people making up the project team interact more frequently. At the same time communication channels are being re-enforced allowing, for problems to be tackled with greater confidence. Relational contracting is dependent on learning and joint problem solving (Walker and Hampson, 2003; Davis and Walker, 2009), activities which cannot occur without communication.

3.6.3 The role of key performance indicators

Key performance indicators (KPIs) are variables that are selected to provide information on the performance of something, while benchmarking is the process of continuous learning and adaptation that results in the improvement of an organisation. Establishing (KPIs) and undertaking benchmarking exercises for the overall performance of a project team is not common practice in projects, even less so in smaller projects. However undertaking the project with the guidance of established KPIs and benchmarking exercises can do more good than it can do harm. These are effective tools in tracking the general position of the project at any given time during the application stage of the collaboration allowing for improvements and adjustments to be made where shortfalls are identified. Looking at project performance from different aspects as opposed to the conventional quality, duration and financials ensures that the team takes on a proactive stance in terms of adversity. Yeung et al. (2009) and Cheung et al. (2003) provide quantitative methodologies for measuring performance, using
similar variablesto be scored and providing a base on which informed decisions can be made on the way forward.

3.7 Conclusion

Given the competitive nature of economic circles in which many firms participate around the world construction related processes need to adopt more innovative ways of conducting business. Collaborative models provide an avenue for successes to be enjoyed by all stakeholders affected by the construction endeavour. Supply chain management techniques have equipped the industry with some tools on how to do business which ensure that projects are rolled out with better success rates.

This chapter provided a comprehensive look at how collaborative models have the ability to facilitate construction supply chains’ moving away from traditional and sometimes flawed ways of doing the job. This chapter also provided an outlook on factors facilitating successful collaboration, relational contracting, collaborative modelling, achieving integrated construction, selecting partners for a collaborative endeavour and sustaining a collaborative working environment.

In the next chapter the researcher reports on data gathered from case studies that made use of collaboratively structured models to deliver the construction supply chain.
CHAPTER FOUR: CASE STUDIES OF COLLABORATIVE MODELS

4.1 Introduction

This chapter discusses data obtained from previous construction projects where a collaborative model was selected as the preferred approach of carrying out the scopes of the projects. The chapter reports on both international and South African projects focusing on the background of each country in which the projects were undertaken, the scope of works and the various collaborative instruments used to assist with the collaborative venture. The chapter also draws on the similarities of the different cases studies particularly in relation to the South African case study.

4.2 Case Study One: Australia – National Museum of Australia

Alliancing predominantly is a commercial model which entities utilised in the past to maximise performance outcomes equally to the benefit of all involved. This inimitable feature was what the Australian Parliamentary committee looked to exploit to successfully deliver a national building which held great prestige value to the people of Australia. At the time that the project was being explored alliancing was not a popular tool for delivering projects, more especially one of such great heritage and financial significance. The construction of the National Museum of Australia (NMA) was first announced by the government of Australia in 1996 after extensive investigations and studies were undertaken to support its execution. It was decided to locate this important piece of Australia heritage in Canberra situated on Acton Peninsula. With an initial estimated cost of Au$155.4 million (US$120 million) in those days such a project would be normally expected to take well over five to six years to complete, which in the eyes of the Australian government was not the preferred duration.

Being an incredibly important building for the people, the NMA needed to stand-out and embody great aesthetic features of the highest quality, which meant complex designs and eccentric specifications were to be expected as part of the package. Such complexities could only be achieved using an unconventional construction project model. The government of Australia then came to the agreement that a project of such complexities required a suitable procurement system and one such system appropriate to meet the set parameters of cost, time and quality was determined to be project alliancing. (AGANO, 2000)
4.2.1 The Australian construction market: background

As is the case in most developing and developed countries the construction industry contributes an enormous part towards the fiscal spent of that particular country. In terms of revenue the Australian construction industry contributed 6.7 per cent towards the country’s gross domestic product (GDP) and accounted for just over 7 per cent of the country’s employment in the early 2000s (El-Higzi, 2002). Currently the construction industry of Australia contributes in the region of 6.9 per cent and 10 per cent of the country’s employment (Thorpe, 2013). Although at a decline with regards to percentile contribution, in both periods in time it is evident that the industry is a major driver of the economy and an effective employment generator.

Like many construction supply chains in the world the Australian construction industry is to a large extent project based and short-term in nature, resulting in a fragmented project culture. El-Higzi (2002) categorises the different sectors of the industry in one of three groups; residential, non-residential and engineering projects, all of which have varying degrees of competition and evident profit margins. El-Higzi (2002) further identifies different groups of stakeholders involved in the running of projects in the Australian construction industry. According to El-Higzi (2002), the industry consists of the following groups:

- Government and statutory authorities which regulate environmental matters;
- Network of suppliers providing services ranging from build material suppliers; manufacturers and fabricators, retailers and other construction related activities;
- Main project-based participants in the form of consultants (quantity survey, architect, engineer, project manager, etc.) and contractors;
- Financial people, real estate agents, building managers and owners; and
- Technology-driven structures such as government and education sector with the objective of preserving the industry’s long-term technical development and support.

4.2.2 NMA – The project

Construction of the NMA officially began in February of 1999. However the project suffered some start-up delays (not unusual in the construction industry) resulting in the project date being shifted four month further from mid-August 1999 to mid-December 1999. Situated in Acton, this master piece is made up of the design and construction of a brand new facility for
the Commonwealth Department and Communications and Art and was developed as national gift to the people of Australia (Duyshart et al., 2003). With the budget at Au$155.4 million (US$ 120 million) this was a category “large” construction project. This estimate was made up of the following: design development accounted for the sum of Au$ 5 million (US$3.8 million; Au$146.9 million (US$ 112 million) from the cabinet; the ACT government contributed Au$ 3 million (US$ 2.3 million) with Au$ 0.5 million (US$ 0.3 million) coming from an advisory committee (AGANO, 2000).

The NMA was not to be an ordinary building. The building was used to showcase some of Australia’s greatest talent in the form of architecture, interior design and construction techniques. The building is expediently situated on the banks of Lake Burley Griffin on a tract of land that covers 11 hectares in size. The building area was to be approximately 6600m² in area with a stand-out feature of a sculptural loop, 30 m high at the entrance. Another great feature and a popular scene for the museum was the arrangement of trees and a grass area with water surroundings known as the Garden of Australian dreams. (http://www.nma.gov.au/about_us/the-building)

### 4.2.3 Stakeholders and structure of the alliance

Of the identified and reported forms of collaborative modelling alliancing it the least used and reported forms. There are many reasons for this, including the fact that it has traditionally

been a commercial tool of doing business and the degree of complexity which the model brings with it is considerable. Commercial buildings internationally have used alliancing to carry out their projects. However, this modelling approach is still in the embryonic stages of development globally. Construction of the NMA according to a report by AGANO (2000) was one of the first construction projects by the Australian government to use alliancing to assist in the execution of the contract, while Hauck et al., (2004) suggest that this was the first major construction project in the world to use this form of contracting.

The structure of the alliance was for obvious reasons not as per the conventional construction team mentioned earlier in this report. The project involved the services of many traditionally non-construction professionals. One such appointment was that of the Australian National Audit Office to perform auditing services. The chief purpose of this auditing entity was to ensure that the government’s Public Works requirements were complied with as well ensuring that effective project management were practised throughout the project. (AGANO, 2000) Much of the project’s success is owed to this auditing entity which ensured that a host of requirements were considered, including the risk and reward schemes. For example when taking up to do the project all stakeholders who stood to gain financially from the project collectively put their profitability at risk. This is where alliancing differs significantly from other forms of collaborative models in that all parties benefit and endure the same gains and pains. The alliance agreement in this particular supply chain provided that any cost savings relished in the project would be apportioned 70/30 between the alliance and the client respectively (AGANO, 2000). This was administered through a compulsory open book accounting approach (Hauck et al., 2004).

A high performance alliance team was put together for the NMA. The team was assembled with individuals who would be based primarily on the construction site and all would function from one building, resulting in exceptionally high levels of relationship building, communication and co-operation (Hauck et al., 2004; Keniger et al., 2000). The function of promoting co-operation and integration was fulfilled by an entity referred to as the Construction Coordination Committee (CCC). The architect, contractor and museum exhibition designers were highlighted as the three most important actors (or stakeholders) in the project which is normally the case in construction projects of this nature. However the government went to great lengths in ensuring the inclusion all stakeholders, as far as holding
hearings with the general public between December 1997 and February 1998 (AGANO, 2000). This was done to get buy-in from all affected parties.

The three identified key project participants were all made up of different organisations and were expected to deliver their respective services as joint venture partners. Selection processes for all participants involved extensive and complex sessions of proposals, interviews and workshops (AGANO, 2000; Hauck et al., 2004).

Figure 4.2 - Alliance Structure for NMA Construction Project
Source: (AGANO, 2000)

This type of involved selection procedure is rare in traditional construction projects or even in partnering forms of contracts. Figure 4.1 shows the structure of the NMA alliance team, illustrating the different organisations that came together to deliver the piece of infrastructure.

4.2.4 Dispute resolution and negotiation style

Construction supply chains involve the on-going process of negotiating to solve problems and come to a decision. Undertaking a collaboratively orientated contract means that parties must be willing to compromise on certain matters for the greater benefit of the supply chain.
Grievances are normal in any transaction, what is important is how parties revert back to return the transaction to where it had been before the grievance was brought to light.

Stakeholders interacted using a unique style of negotiation for the NMA project. A principled style of negotiation was used and favoured by the alliance team. Decisions were made based on merit as opposed to a bargaining process. This style seemed to be very effective as no industrial action was experienced throughout the duration of the contract and conflict between stakeholders was easily dealt with and reduced. At the end of the project members of the Alliance team were pleased with the negotiation style adopted for this project comparing it to the best BAU (Business as usual) negotiation style (Hauck et al., 2004; Keniger et al., 2000).

### 4.2.5 Lessons learnt

As this was one of the first attempts to use alliancing on such a large scale construction project, the risks of making this decision were high. But with high risks came greater rewards as this project paved the way forward for the global construction industry to embrace alliancing as an effective project delivery route. The NMA was completed one day before the intended date, on budget and at a high level of quality. These are some of the lessons learnt in the undertaking of this historical building:

- Without disregarding the benefits and successes that traditional contracting has achieved in the past and still achieves to date, alliancing for this project was able to demonstrate that objectives are far more likely to be attainable when the two (alliancing and traditional contracting) are put against each other.
- It is generally the case that between cost, time and quality one is compromised at the expense of another. The alliance team in this project however, provided a scheme of financial incentives to mitigate for this common malaise. Financial incentives were identified early on in the project to promote and reward “best for project” behaviour in order to achieve targets in cost, quality and time.
- Sensitive functions (audits, selection of contractors and negotiations,) were outsourced to professional firms to ensure compliance, openness and fairness.
4.3 Case Study Two: China/ Hong Kong - Tseung Kwan O Extension

It is no secret that today’s China is one of the most technologically advanced nations in the world. It therefore comes as no surprise that such a country is home to some of the finest infrastructure ever built by man. Qi and Chen (2014) reported that since the early 2000s construction companies in the Chinese construction industry have been able to make great advances through innovations in technology and management making the industry more productive and profitable. The Chinese are no strangers to the use of collaborative models, in fact most papers on construction partnering have been sourced from this particular country [Bayliss et al., 2004; Cheng and Li, 2002; Cheung et al., 2003; Chan et al., 2003; Chan et al., 2004] (also see Figure 3.1). In this particular case study the use of partnering played a critical role in the delivery of a major transportation railway system which took just under a decade to materialise.

4.3.1 The Chinese construction market: background

About 30 years ago the Chinese construction industry re-examined at their policies in construction and ever since then the industry has grown at a rapid pace. According to Zou, Zhao and Liao (2007) in 2003 the Chinese construction sector accounted for the employment of over 35 million people in the country. This figure has since grown considerably owing to the growth of the industry in the years that followed. In 2010, 2011 and 2012 the percentile contribution towards the GDP increased substantially when compared to a decade earlier with the industry’s contribution standing at 6.6 per cent, 6.8 per cent and 6.8 per cent each year respectively [National Bureau of Statistics of China (NBSC), 2014]. Despite China being the second largest economy in the world (in 2014), construction firms from the country are so pervasive that it is the largest and most competitive construction sector in the world (Liu et al., 2013; Qi and Chen, 2014).

Stress levels in construction supply chains have been studied closely in recent years (Bowen, Edwards and Lingard, 2013; Chan et al., 2012; Leung et al., 2008). In these studies it has been established that practitioners work in highly aggressive and stressful environments. It comes as no surprise, having been branded the largest and most competitive construction market globally, that practitioners in the Chinese construction industry are constantly under duress, (Chan et al., 2012) emphasising the need for collaboratively structured supply chains.
Clients are mostly private in China and therefore the public sector does not play as big a role as in other regions of the world.

4.3.2 Mass Transit Railway Corporation – Tseung Kwan O Extension (MTRC-TKE) – The project

Construction of the Tseung Kwan O Extension (TKE) was first proposed in the late 1980s by the client Mass Transit Railway Corporation (MTRC). Due to feasibility reasons relating to population statistics at the time, implementation was put on hold until 1997. At that point (in 1997) the population between the towns of Tseung Kwan O and Kwun Tong was forecast to reach in the region of 300,000 in 2002 (the expected date of completion). Between 1997 and late 1998 planning, design and contract drafting took place, succeeded by construction which began in 1999. During the pre-construction period MTRC saw a need to have a well-integrated and co-operative project structure. Valued at HK$18 billion (US$ 2.3 billion) a project of this magnitude required some of the most sophisticated means of operations and management. Even with its enormous size it was not until later on in the project that the MTRC Project Division opted for the use of partnering to deliver the infrastructure (Bayliss et al., 2004; Sorton, 2004).

The project was made up of multiple sections, many of which were specialist works, resulting in intricately executed processes. Some works could only be carried-out at night in an attempt to minimise public disruptions during peak times. The scope of the project included the construction of five new train stations and covers a distance of 12.4 km of rail, most of which runs underground as well as other axillary buildings. One of the major activities undertaken in the project was “cut and fill” of earth material (most of which was volcanic rock) with ground water posing one of the biggest challenges. When completed the project was to be able to handle 8500 people between the two routes per hour. (Sorton, 2004)

4.3.3 Structure of the MTRC-TKE partnering team

Construction of the MTRC-TKE started off as would any major project, with a strict legal framework protecting the interests of all parties. In the beginning the structures of the project
were flawed. Firstly, because of the decade-long prolonged start, the works commenced superficially, with an implied notion of working collaboratively. Also, no structure had been established to regulate interaction between the contractors, consultants and the client. Having realised the importance of working co-operatively to complete the scope of works MTRC assembled a team of researchers to investigate partnering as a model to assist the process. The team of researchers presented findings on how partnering would benefit the project and how to fuse it into the project structure. In the findings it was concluded that the partnering process would be adopted with the aim of achieving cost effectiveness, time certainty, improved communication and a proactive problem solving stance. The partnering process was only introduced after construction had commenced. To acquaint members of the team with the process the clients’ project division decided that the commercial aspect would succeed the relational aspect of partnering agreement (Bayliss et al., 2004).

The MTRC-TKE project set a precedent for collaboration in the construction world. The project involved the awarding of packages to many international construction and non-construction organisations. The organisational structure of the contract comprised a coalition of 12 major civil and building contractors, most of which had international experience. Construction packages were awarded for all major works. Each station would have one particular contract package, awarded to one construction entity or a joint venture between two or three entities. For instance, the main contractor of the Yau Tong Station which included; site establishment, foundations, concrete structure and finishes as the scope (valued at H$ 500 000 = US$ 60 000) was awarded to Kumagai Gumi Ltd., a major Japanese construction company. On the other hand the joint venture of Paul Y and CREC completed the Tiu Keng Leng station and tunnels works with a package estimated at H$ 100 000 (US$13 000). The mechanical and electrical packages for the MTRC-TKE project had more components and more contractors than the civil and building works, with a pool of 16 contractor packages awarded in total. (Bayliss et al., 2004; Sorton, 2004).

### 4.3.4 Partnering Agreement - MTRC-TKE project

The strength of any partnering or alliancing agreement lies in the compilation of standards and principles that the members agree to uphold throughout the duration of the project. These standards and principles are normally incorporated in what is referred to as the partnering
charter. For the MTRC-TKE project the client required that all participating contractors agree to sign the partnering charter, specific to this project. According to Bayliss et al., (2004) the MTRC-TKE partnering charter highlighted the mission, goals, objectives and measurement parameters for the project. Some of the main concerns included; relationships based on co-operative behaviour, effective dispute resolution, reduction in wastage and effective quality control. In addition the charter also stipulated the expected completion duration of the project.

Partnering contracts require that parties come up with incentive structures that are arranged differently to traditional contract structures (Dewulf and Kadefors, 2010). An important part of any business transaction is the manner in which benefits flow between the interested parties. The strength of incentive structures in construction supply chains has been significant in reinforcing collaboration. In addition the incentive structure can be used to enhance trust between the contractors and clients in a partnering agreement (Brensen and Marshall, 2000). In consultation with the contractors the client ensured that consensual incentive agreements were secured for the MTRC-TKE project. In the incentive agreement the client (MTRC) pursued identified the risks associated with the project from both the contractors’ and the client sides. A formula was then agreed upon so that savings or loses made (on the target cost) would be apportioned accordingly between the concerned parties. This resulted in value management initiatives constantly being implemented to ensure that savings were made, to the benefit of all concerned (Bayliss et al., 2004).

4.3.5 Lessons learnt

By making the decision to set up a group of researchers to investigate the option of incorporating partnering into the construction contract, the experience of the client proved to be a key factor in the success of the MTRC-TKE partnering agreement. The client also made use of the services of external facilitators. The functions of these facilitators included, *inter alia*, facilitating regular partnering workshops, publishing a newsletter relating to the partnering agreement, running monthly partnering review meetings, implementing and monitoring incentive structures and organising informal, social functions.
Partnering workshops were used to establish and reinforce the partnering charter to all key participants.

A review meeting was held on a monthly basis. In these meetings project participants were each handed a questionnaire to assess the contract partnering status with regard to 13 variables: job satisfaction, trust, honesty, financial objectives, cooperation, programme, safety, resources, communication, quality, waste minimisation, third parties’ needs, and dispute resolution.

Social functions were held occasionally. Such functions were highlighted to assist in the development of interpersonal communication, trust and maintaining a prolific team spirit.

4.4 Case Study Three: United Kingdom – Stafford Area Improvement Programme

Despite being amongst the most developed regions globally, the United Kingdom (UK) is no different to the rest of the world with regard to traditional contracting weaknesses which plague many other construction industries around the world. Literature on collaborative modelling in the UK has been highlighted by several authors namely Akintoye (2000), Briscoe and Dainty (2005), Naoum (2003) and Segerstedt and Olofsson (2010). These researchers highlight the advances that have been made regarding the integration of construction supply chains in and around the UK. Collaboration was identified as an imperative in the delivery of the Stafford Area Improvement Programme. Through the help of another collaborative contracting custodian (from Australia) the decision was taken by the client, Network Rail, to execute the world’s most busiest railway line improvement project as an alliance project. This alliance form was the first of its kind in the UK after weaknesses in the way previous alliances were being implemented were identified. The alliance was labelled as; a “Pure alliance model”, an employer/contractor relationship different to any other, a first to the UK rail industry and based on one unified agreement where all parties share the benefits and the risks (Cole, 2013; Fitzpatrick, 2013).
4.4.1 The Stafford Area Improvement Programme (SAIP) - The Project

Figure 4.3 - Artists impression of the Stafford Area Improvement Programme Carriage

The aim of the Stafford Area Improvement Programme (SAIP) was to upgrade the railway line between Crewe and Stafford in order to increase the railway’s capacity to carry passengers between the two regions. The SAIP forms part of the West Coast Main Line (WCML) which was first operational to the public in 1838. Delivery of the SAIP project is estimated at £250 million (US$ 360 million), making the upgrade the biggest upgrade the WCML had undertaken to date. The SAIP has been recognised as a Nationally Significant Infrastructure Project, meaning that the project met the requirements deemed necessary to have disruption to the public to ensure the successful completion of the project.

The alliance formed for implementing the SAIP was tasked with delivering the following:

- Track work,
- Signalling,
- Telecommunication,
- Civil construction (including structures and earthworks),
- Pipeline diversion and
- Highway alterations.

The project was allocated three phases. The first phase started in April 2013 and the third phase is expected to be complete in December 2017. Below (Table 4.1) is details of the
phases of the SAIP [Cole, 2013; Fitzpatrick, 2013; Network Rail (2013); Stafford Area Improvement Programme (SAIP), United Kingdom (n.d.)].

### 4.4.2 The alliance agreement

After careful consideration the client Network Rail investigated at great lengths the dimensions of alliancing in order to understand and exploit the benefits to their fullest extent. According to Network Rail (2013) the formation of an alliance was the preferred option based on the following:

- Project involved high levels of risks, uncertainty, interdependency and complexity,
- To enhance interaction between designers, contractor and client,
- There were great implications for the transferring of risk and
- To ultimately improve project outcomes

Table 4.1 - The Stafford Area Improvement Programme construction details (Source: Cole, 2013; Fitzpatrick, 2013).

<table>
<thead>
<tr>
<th>Phase</th>
<th>Estimated value (£ million)</th>
<th>Time frame</th>
<th>Description of works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase I</td>
<td>£ 4</td>
<td>April 2013 – April 2014</td>
<td><strong>Line Speed Upgrade:</strong> overhead line, track realignment and new signals</td>
</tr>
<tr>
<td>Phase II</td>
<td>£ 82</td>
<td>January 2014 – Mid 2015</td>
<td><strong>Stafford Re-signalling &amp; Enhancements:</strong> replacement of ageing signalling and telecommunications equipment and reconfiguration of the stations’ to allow platforms to be used for trains running in either direction</td>
</tr>
<tr>
<td>Phase III</td>
<td>£ 100</td>
<td>Mid 2014 – December 2017</td>
<td><strong>Norton Bridge Grade Separation:</strong> 10 km of new rail line, 11 bridge structure’s, 4 river diversions, 4 pipeline diversions, 650000 m³ of earthworks, footbridges to replace foot crossings</td>
</tr>
</tbody>
</table>
‘Overarching alliance agreement with underlying works’ and ‘Stand-alone alliance agreement’ are two forms of agreements which were studied and chosen to undertake the SAIP. The latter originates from Australians and is regarded as the newest form of alliance agreement. The former on the other hand, was adopted from previous railway projects in the UK and was fused to incorporate some of the unique features that the SAIP Network Rail consisted of (2013).

4.4.3 Selection of the SAIP alliance team – the Staffordshire Alliance

The alliance team which was tasked to undertake the SAIP included the following entities: Atkins, Laing O’Rourke, Volker Rail and Network Rail. Together these are referred to as the Staffordshire Alliance. Kumaraswamy et al., (2000) highlight the value of using multiple-stages when selecting the most ideal participant for the collaborative construction supply chain. A similar point of view was shared for the multi-stage tender process used to select the alliance associates to make up the Staffordshire Alliance. Based on a set of prescribed qualities and capabilities a handful of designers and contractors were shortlisted by Network Rail to make up potential teams. Organisations were then asked, to form pre-alliances and put together bids for a final tender with the support of Network Rail personnel (see Figure 4.4 below).

![Figure 4.4 - The Stafford Area Improvement Programme Selection Process](source: Network Rail, 2013)
The alliance formation of Atkins, Laing O'Rourke, Volker Rail and Network Rail was as the most suitable (Cole, 2013; Network Rail, 2013).

**4.4.4 Lessons learnt**

Comments were solicited from high ranking personnel from the various organisations making up the alliance - all of whom made very positive comments regarding the project. This suggests that the collaborative endeavour received support from top management. This is imperative for any project of this nature.

At one stage the project was estimated at £940 million (US$ 1.3 billion). The expertise from the alliance helped reduce the initial figure dramatically to £250 million (US$ 360 million); therefore great savings were made thanks to the use of collaboration.

Stakeholder inclusion played a vital role in the project. From pre-construction stage all stakeholders including the public were engaged as part of the projects requirement to be granted a Development Consent Order. Other stakeholder inclusion efforts included; a stakeholder communication plan, introductory letters, customer leaflets, public information centres, bespoke letters of notification and a dedicate community relations support structure.

In order to maintain high standards across all facets of the project the alliance looked to measure areas relating to the project, but also focusing on areas that had no direct financial impact. These areas included; a collaborative culture, a health safety and environment, sustainability, operational railway performance, community and stakeholder management, quality and workmanship, governance and milestone completion.

**4.5 Case Study Four: South African Case study: Department of Environmental Affairs (DEA) Headquarters**

**4.5.1 Overview public-private partnerships (PPP) in South Africa**

Collaborative tools relating to Africa have rarely been studied in academia. Although it is still not clear as to what extent these type of models have been practised in CSC on African soil one thing is certain, namely that very little has been done when compared to countries such as those mentioned in earlier case studies. Africa is a continent with an abundance of developing economies. Economies such as those of South Africa, Ghana and Nigeria are amongst the
most thriving and attractive developing economies. Economies such as these provide a desirable breeding-ground for partnering projects between public and private sectors. Such projects are popularly referred to as public-private partnerships (PPP) and are most popular in developing countries; with stable and sizable macro-economies (Sharma, 2011).

South Africa’s isolation from the international scene saw the country trailing behind in the use of innovative construction models (PPPs in particular) which were being practised around the world. It was only after the apartheid period that PPPs were developed to assist the government and in particular municipalities in the delivery of infrastructure services (Hlahla, 1999). An inter-departmental team was appointed in April, 1997 to facilitate and develop institutional reforms, policy and legislation on the use of PPPs in South Africa, marking the beginning of what has been (to date) a fruitful series of projects (PPP Unit, 2014). This supports Sharma’s (2011) observation that PPPs have helped developing countries improve the quantity and quality of public infrastructure.

The first PPP projects in South Africa began in 1997 with the improvements to the N3 and N4 toll roads as well as the construction of two maximum security prisons. Since then PPP models have been used to roll out infrastructure projects in many of the following sectors:

- railways,
- airport,
- health,
- energy,
- education,
- accommodation, and
- water and sanitation.

Landmark projects include the:

- Gautrain: 80 Km mass rapid railway system linking Pretoria and Johannesburg, largest PPP in South Africa to date.
- Department of Environmental Affairs (DEA) Headquarters: the first building to achieve a six (6) green star rating in South Africa, marking the beginning the government’s commitment to green building and sustainable development.
4.5.2 Department of Environmental Affairs (DEA) Headquarters – The project

Figure 4.5 - Artists impression of the Department of Environmental Affairs Headquarters

4.5.3 Selection of the DEA Headquarters consortium

Selection of an appropriate consortium took a period of 12 months and a further period of 18 months of negotiation before construction commenced in May 2012. Bid documents for the construction of the DEA Headquarters were first submitted in 2009 with submissions coming from four of the following consortiums:

- Murray & Roberts
- Group 5
- Basil Read, and
- Imvelo Concession – Aveng Group

The selection process for the project had multiple stages (initiation, submission, selection and negotiation). This supports the findings of Kumaraswamy et al., (2000), namely that multiple stage selection is important for selection in these types of models. In 2010 Imvelo Concession
was announced the preferred bidder succeeding which negotiations on the terms of contract took place. According to Imvelo Concession the bid documents took three months to prepare and submit done once. Imvelo concession consisted of the following companies:

- **Aveng Grinaker-LTA** is part of The Aveng Group of companies, one of the leaders in infrastructure developments on the African continent. Although this entity’s reputation is built on its ability to build distinct infrastructures, for this particular project they had to take responsibility for the overall design as well (landscape, structural, architectural, electrical, and the like.). Aveng Concessions are specialist PPP contractors and were responsible for putting together the winning bid. For the sake of the PPP structure Aveng Grinaker-LTA was identified as the D&C contractor.

- **Tiso Group** is an all-woman, black-owned finance-house. Because of the dimensions of the PPP agreement this group played an instrumental role in achieving the set targets for community development.

- **Old Mutual** is one of the biggest investment companies in South Africa with portfolios in, *inter alia*, long-term and short-term insurance, property and facilities management. However, for this PPP agreement Old Mutual provided the function of facilities management.

- **ABSA** is a major finance house in the country; ABSA was used as the most suitable salient financer contributing 80 per cent towards the finances of the project.

- **National Treasury** was indirectly part of the Imvelo Concession, through their association with the client. Their involvement, however, is included as an investment sum of R300 million in Imvelo concession to assist in financing the endeavour.

### 4.5.4 Private – public partnership (PPP) agreement

As suggested by the title, PPP is a type of partnering where the parties to the agreement come from two sectors of the economy (namely private and public). In the case of the DEA headquarters a partnering agreement was made between the Department of Environmental Affairs (a publically owned and run entity) and Imvelo Concession (a privately owned and run entity). According to Walker and Hampson (2003) PPP is a collaborative model because
features emanate from alliancing and partnering projects in order to create the project delivering entity. When construction projects are undertaken this way risks are mostly carried by the concession entity. However as in all collaborative models if executed properly, PPPs will generate prolific rewards to the benefit of all parties concerned.

In 2010 Imvelo Concession entered into an agreement to; finance, design and construct (D&C) the aforementioned project for the DEA. In the same contract it was agreed that upon completion, Imvelo would take on the rights to operate the commodity (i.e. the buildings to be constructed) on behalf of the DEA. The duration of the operational period was 25 years from occupation of the premises. This type of PPP agreement is referred to as a design-build-operate (DBO) (Masterman, 2002). When Imvelo Concession was awarded the contract it was agreed by all parties concerned that the DEA would take on occupancy of the premises on 01 August 2014. This date was cast in stone, failure to meet the deadline would result in penalties for Imvelo Concession. Although this type of (penalty oriented) contracting is against the spirit of a win-win scenario, according to Imvelo Concession (2014) working towards a set milestone is essential in any construction project. Once construction is completed (from 01 August 2014) Imvelo Facilities Management (Imvelo FM), which is owned by the Imvelo concession group, are to take on the role of running the premises from day-to-day up to and including 31 July 2039 (a total period of 25 years). For this service Imvelo FM receives an agreed premium.

The contracting parties were bound by both informal and formal ties: informal in that communication channels played a key role in getting the job done and took preference over formal lines of communications. The latter, on the other hand, indicates that parties were being regulated by a contract drawn up by legal personnel specialising in this form of construction model. The bi-lateral agreement comprised legal representation, with each party employing the services of different legal firms. Imvelo Concession used the services of Levison while the DEA employed their own government-sourced legal team. This is not unusual as collaborative models, because of their unaccustomed nature and complexity, will always require the use of external service providers, particularly in the field of law.

The manner in which dispute resolution is undertaken is an important part of the collaborative agreement (Ling et al., 2006). For the IC a PPP fast-track dispute resolution agreement was drawn up with all consulting firms contracted to the consortium (i.e. architectural, structural,
mechanical, and electrical engineering firms). The function of this resolution agreement was to ensure that disputes do not exist for too long such that the project performance is obstructed in any way.

4.5.5 Incentive structure

In PPP forms of constructions the use of incentive structures can be abstruse in that the price and dates negotiated at tender are cast in stone. As such the parties are not motivated to perform for any additional perks other than those agreed on at the negotiation stage. This was the case in the DEA PPP agreement. Incentive structures are important for motivating parties to maintain their commitment to complete the “exchange” (Ling *et al*., 2006) and to reinforce the spirit of collaboration (Bresnen and Marshall, 2000). Unfortunately in PPP incentives are not easy to incorporate because of the high-risk nature of the agreement. Fortunately for the Imvelo Concession this contradictory factor did not affect the spirit of collaboration as there was an ambient flow of information across all parties and ultimately no cost overruns and no delays were experienced.

4.5.6 Challenges faced and lessons learnt

Facing challenges is an on-going *status quo* in construction projects; the PPP for the DEA was no different. Some of the challenges faced served as lessons for dealing with projects appropriately in the future. Some of the changes were beyond the control of any individual; however, as the consortium chosen it was up to Imvelo concession to mitigate any problems, ameliorate the challenge and steer the *status quo* to the benefit of the project.

*Training*

Personnel from Imvelo had previously only been exposed to traditional contracting strategies to deliver a construction project and as a consequence were unfamiliar with the PPP practice. To remedy this all key personnel from Imvelo concession underwent workshops (over two separate days) to assist in establishing an understanding of the legal framework of PPP projects. Even with this parties still experienced difficulties with the uncharted, unconversant nature of a PPP environment. Therefore more mentoring and education is necessary.
As part of community engagement Imvelo was tasked with employing the services of local businesses and individuals. This proved a problem in that many businesses and individuals in the region lacked the required level of competence to achieve the standards set by IC. Training was provided to local businesses and individuals and at the conclusion of the project the community engagement requirement set by government had been exceeded.

**Industrial action**

South Africa has in recent years been plagued by labour disruptions in all sectors of the economy. Although there were many instances where problems were encountered due to strikes, one distinct period of industrial action took place that affected construction of the DEA headquarters. In August of 2013 the construction industry was hit by industrial action for the duration of three weeks. As a result (post-strike) Imvelo Concessions had to increase resources in an attempt to make up for lost time all at their own cost (as per PPP agreement).

**Vis major**

A similar case beyond the control of Imvelo Concession was that of seasonal rain. Although this was allowed for in the initial contract and programme, no-one was able to foresee the heavy rainfalls experienced in early-to-mid 2014. According to Imvelo Concession (2014) this was the largest amount of rain experienced in the region in years. Although it is impossible to mitigate time lost due to rain (*vis major*), it was the responsibility of Imvelo concession to accelerate with the intention of completing the building on the agreed date of 01 August 2014 (without adjusting the contract, as would be the case in traditional contracting).

**Stakeholder involvement**

The DEA, as a government entity is accompanied by politically driven individuals. While politicians may not fully understand the running of construction firms, as a client (DEA) Imvelo had to respect, engage and negotiate intermittently with community members, community leaders and politicians alike, to avoid major disruption.
Incentive structure

IC also experienced problems which are normal in traditional contracts. IC encountered problems with electrical and mechanical consultants who were responsible for designs, as such it was impossible to complete the dependent tasks. Sub-contractors also proved to be a challenge, by performing poorly.

As mentioned earlier, incentives are important motivators (financial or otherwise). Therefore a structure must be in place where parties within the concession are encouraged to fulfil their obligations without any obstructions.

4.6 Similarities between case studies

Although construction projects very seldom have identical elements from one project to the next, there were certain circumstances in which the above projects shared similarities. These include, *inter alia*, the following:

- Application of collaborative models was done to undertake a prestigious or high value (financial or otherwise) building or infrastructure.
- The use of collaborative construction models was not the first choice in delivering the project.
- Projects involved the services of many non-traditional construction professionals.
- Joint venturing took place between firms providing similar services (such as contractors, architects, and the like).
- Incentive structure were put in place to motivate performance to achieve set targets.
- The time taken between initial proposals to construction start date can take many years.
- Collaborative models are particularly popular in railway projects.
- It is a multi-staged selection process.

4.7 Conclusion

This chapter provided case studies of past construction projects that made use of collaborative means to carry out the project. In each case study some of the significant
features of each project were highlighted, particularly those that assisted in the overall success of the project.

The methodology of the research study will be explained and unpacked in the chapter to follow.
CHAPTER FIVE: RESEARCH METHODOLOGY

5.1 Introduction

This chapter gives an insight into the research methodology used for the study by providing information relating to the geographical footprint of the study that was undertaken and the population selected for the study. The chapter explains, with substantiation, the selection of the different techniques and instruments used in the study, in particular, the research method, research design, sampling data collection and data analysis. The validity and reliability are outlined and the research questionnaire for the study is discussed.

5.2 Research rationale

Conducting research on a matter should be based on solving some form of problem and attaining some form of significance from the exercise, failure of which may render the endeavour a futile exercise. Sometimes referred to as the research purpose or significance, the research rationale must entice the reader to want to learn more on the topic. According to Taylor (2005) the basic reason why all research is undertaken is to solve problems and expand knowledge across all facets of the universe. By studying existing literature the researcher is able identify a gap and therefore diagnose a research problem (Welman, Kruger, and Mitchell, 2005).

From the literature review it is clear that participants in construction supply chains (around the world, including South Africa) co-exist in an environment that has unpleasant relations. Seemingly this has shown to have a destructive impact on interactions between individuals and, even worse to be harmful to the success of projects in as a whole. Plentiful research has been conducted on collaborative models around the world, especially in first-world regions such as the UK, USA, Australia and China. However South Africa has had very little research done in this area. From this observation the researcher developed the research questions and research objectives (through problematisation and gap-stopping) and the dimensions of the research were subsequently determined (Alvesson and Sandberg, 2013). Therefore the purpose of this research is to improve the performance of South African construction supply chains. This should be achieved to increase the success rate of projects, where everyone in the construction involved, from inception to utilisation, is satisfied with and proud of the accomplishment, and accomplishing this through the applications of collaborative principles.
5.3 Research methods

Kothari (2004) provides three pairs of ways of distinguishing research; analytical or descriptive, applied or fundamental and qualitative or qualitative.

Analytical research deals with the critical analysis of information already available on a particular matter. This type of research is particularly helpful in learning from past events and planning appropriately for the future (Taylor, 2005). This is why it is sometimes termed *historical research*. Descriptive research on the other hand, is concerned with fact finding and the conducting of surveys for the purpose of diagnosing a particular phenomenon. For that reason descriptive research can be said to be interested in solving existing, present day problems (Taylor, 2005). According to Amaratunga *et al.* (2002) this method is commonly used by construction industry researchers.

Applied research is concerned with finding a solution to a particular problem in a scientific way. Taylor (2005) argues that in essence, applied research is not a method per se but is more of an approach to the way a particular problem is solved. However, fundamental research is research which already has a wide base of application and hence has an already existing knowledge base.

The most common way of distinguishing research is by either qualitative or quantitative. According to Davies (2007), when carrying out research to solicit people’s opinions, experiences, feelings and/or behaviours, either one of these two paths can be followed, irrespective of the nature of the matter.

5.3.1 Quantitative method

The manner and design in which researchers execute research differ; however what all research studies have in common is that they follow one of either two paths (or a combination of both). Of the two distinct paths, historically the quantitative method was the more popular option and accepted as the more likely source of credible results (Blanche, Durrheim and Painter, 2006; Taylor, 2005). Occasionally referred to as the positivist method, many researchers have supported the positivist paradigm in undertaking research. According to Blanche *et al.* (2006) this is what made the quantitative method the more preferred choice.
The positivist approach is concerned with measuring and observing a particular matter in an objective way. Positivist researchers believe that research should be dictated by quantifiable processes as opposed to the unpredictable nature of human beings’ behaviour (Biggam, 2008). As such, this study is determined to establish, from practitioners’ previous experiences, the current state of relations in construction supply chains. This is in line with the affirmation of Amaratungu et al. (2002) that the quantitative method is an appropriate instrument for examining behavioural components in the construction industry. The researcher sought to consolidate data from individual industry practitioners to provide mutually exclusive ways of improving project outcomes by applying and using collaborative models. This must be presented in an objective manner so that people other than the researcher agree on the findings. To achieve this Welman, et al. (2005) advise the researcher to have a detached stance and let the numbers do the resulting.

While there is a vague difference from one author to another regarding the varying degree of specificity of the use of the quantitative methods, there is, however, consensus regarding the fundamental constituents. For research to be considered and constituted as a quantitative method of research the data must be presented objectively, in an unbiased fashion, without influence from any secondary party or the researcher him/herself. To accomplish this successfully flexibility is strictly limited. This is a salient feature of the quantitative approach. Amaratunga et al. (2002) have amplified quantitative research as an extreme form of empirical data collection, based on ideas that are not only justified by the extent to which they can be validated but the application of facts attained. Davies (2007) and Biggam (2008) consider this method to be scientific in nature, requiring the skill of making sure the information gathered will be relevant to the research questions by means of calculated procedures.

Another feature which distinguishes the quantitative method is the use of numerical data to evaluate and present the findings. Seeing as mathematics can be used to tell a story that is universal in its interpretation, the use of numbers to evaluate the finding is accepted to be an objective and reliable answer to the question posed or the problem being investigated. The findings shall be deemed objective and therefore true because the numbers say so (Davies, 2007; Welman et al., 2005). Researchers on the use of the quantitative method concur that since the use of the method will yield numerical data, examination will evidently be carried out using statistical tools. In this study the researcher relied on the data generated from
questionnaires to help numerical come up with the findings. (Taylor, 2005; Welman et al., 2005).

The results obtained from a quantitative research can be particularly strong, more especially when a large sample is utilised. Quantitative research methodology has always been at the forefront of establishing the true value of the matter, allowing for flexibility in the manipulation of the way data is handled by way of statistical analysis, comparative analysis and the recollection of data over again in order to strengthen validity. Seeing that measuring is an essential constituent of quantitative research the researcher must take advantage of exploiting the most effective ways of obtaining these measures. Ways to solicit data when conducting a quantitative research are many, they include, *inter alia*, the following:

- Standardised tests,
- Questionnaires,
- Personality tests,
- Surveys, and
- Interviews (Amaratunga, 2002; Taylor, 2005).

### 5.3.1.1 Strengths and weaknesses of the quantitative method

Much like any processes, quantitative research needs to be handled with vigilance and applied with an understanding of its advantages. The popularity of using this method comes with many researches having owed their success to the strengths of the quantitative approach. The strengths of quantitative research are the following:

- It allows for coverage and comparison of a range of different situations.
- The research is stable and easy to control because it focuses on answering questions asked based on a set of possible answers.
- Based on the sample being studied, findings will be considered a precise measure of the overall population, resembling a true occurrence (this is strengthened when a large sample is used).
- Findings are generalisable.
- Data collected is quantifiable and presented numerically making for ease of interpretation.
- Data collected is objective and unbiased.
• It provides an effective way of validating or rejecting the hypothesis.

The weaknesses of quantitative research are as follows:

• Because some statistical tools are labelled weak (Doloi, 2013) - other, more advance statistical tools require a highly sagacious level of ingenuity for implementation.
• There is limited flexibility in the interpretation of data.
• Its use in behavioural science is limited, since data collection does not cover the full range of human behaviour.
• Depending on the mode of data collection, a large sample size could result in a costly and time-consuming exercise.

5.3.2 Qualitative method

Whereas some research methods place a strong emphasis on the gathering and manipulating of data numerically, the qualitative method of research works in the exact opposite way. This multi-layered approach is concerned with naturalistic words and observations to express reality and describe people’s situations (Amaratunga, 2002; Taylor, 2005; Welman et al., 2005). As opposed to quantification and measurement the qualitative method describes and interprets the situation of peoples experience and feelings in realist, human terms. Hence researchers using this method look to study the natural setting of the matter by presenting their understanding of feelings, experiences or phenomena that take place in the “real world” (Blanche et al., 2006). Because of this distinction researchers tend to unwillingly express the qualitative method as an antagonist of the quantitative/ positivist paradigm by referring to the former as an anti-positivist paradigm, with others also noting it as a phenomenologist, interpretive or realism approach. This is, however, misleading as the two methodologies can be successfully fused and used to work mutually.

In the context of the construction industry it is difficult to obtain a clear definition of qualitative research. By definition the word qualitative is, “concerned with how good something is, rather than how much of it there is” (Oxford, 2010:1198). The word ‘qualitative’ according to Denzin and Lincoln (1994:4), “implies an emphasis on processes and meanings that are not rigorously examined, or measured in terms of quantity, amount, intensity or frequency”. Phenomenologist researchers believe the universe exists through subjective experiences of people’s external environments (Blanche et al., 2006). The
researcher becomes a part of what is being studied with the data collected deemed subjective, produced by the minds of the respondents. It is worth appreciating that qualitative research helps with the identification and generation of further, unknown variables. In a single quantitative research study qualitative data can help validate, enhance, explain and/or re-interpret the data as well as help in developing hypotheses in a new area of study (Amaratunga, 2002; Blanche et al., 2006). From this qualitative research can therefore be accepted as a useful adjunct of quantitative approach (Leydens, Moskal and Pavelich, 2004).

Validation of data obtained from the qualitative technique is not carried out in the same conventional way as data sourced through from quantitative techniques. Taylor (2005) suggests that two parameters, namely: reliability and validity, should be met for the study to be qualitatively successful. Taylor (2005) goes on to suggest ways of ensuring that this is achieved. The researcher must explore more than one avenue of sourcing data, have others assist in reviewing information and be neutral when presenting the data by presenting only what was reported and nothing else. This highlights the importance of handling data received from respondents, especially seeing that most qualitative data is collected by face-to-face interactions. Data collection in qualitative research is collected from the following:

- Observations,
- Interviews,
- Focus groups, and
- Documentation.

Qualitative research is predominantly used in social science to examine the human behavioural aspect of the study ventured. In construction, however, substantial advances have been owed to the application of this method. A major feature of the qualitative approach is how it presents a “real life” view of the situation by looking at natural occurrences in an ordinary, natural setting (Amaratunga, 2002; Leydens et al., 2004). This is particularly beneficial to construction supply chains to allow for improvements to be made where relationships in the past were observed to be inherently adversarial. The following features of qualitative research can be of advantage to the construction industry:
The process of qualitative research is flexible in nature because the data is rich and complex, resulting in interpretive and descriptive data analysis.

Data collected deals with people’s impressions, making it more interesting as it cannot be expressed in numerical terms.

It assists in the identification of unknown variables and the development of hypotheses.

Qualitative research is a powerful means of study since data is collected over a substantial period of time.

The nature of qualitative research is such that it has been labelled ‘subjective’. This is largely attributed to the researcher using his/her own discretion to arrive at an answer based on what the respondents have provided. Since the manner in which human beings comprehend processes in the world is different, qualitative research is exposed to be weak in that regard.

5.4 Research design

The course of the various operations involved in the research is conducted through the guidance of a well-structured research design. In this, the steps involved in undertaking research must be highlighted. When putting together a research report, data plays a critical role, as the entire research revolves around the use of data. Data must be acquired, analysed and eventually presented in the form of a report. Conventionally research is guided by a research design to help establish a practical sequence on how the research will be undertaken. The research design must be manipulated in such a way that the research questions will be answered as far and as effectively as possible. As a result the design serves as a framework for the activities which will work towards bridging the interface between the research process and the research questions (Blanche et al., 2006). As such, the instruments which will be used to complete the research process will be governed by the elements of the design approach. A collection of literature suggests the route to be followed in the research process (see figure 5.1 below).
5.5 Data Collection

5.5.1 Secondary data

When a researcher makes use of information from other individuals, agencies or institutions this information is classified under secondary data. This is seen in numerous research studies, taking the conventional route of undertaking a literature review. It is recommended by researchers to review previous research literature on a particular matter prior to doing the write-up of the study. The literature review in research is what constitutes secondary data. It is defined by Blanche et al. (2006) as the identification and analysis or review of the
literature and information related to what is intended to be, or has been, studied. Importantly, the literature review must capture the attention of the reader by familiarising him/her with how the study fits in a particular knowledge area (i.e. putting the study into context). In recent years countries such as Australia, the UK, China and the USA have championed the use of collaborative models in construction; hence much of the literature has come from these countries. Few studies have been undertaken in South Africa, prompting the researcher to endeavour to stimulate increased awareness of such models to improve supply chain performance and ultimately improve project performance. In order to support this endeavour, literature was integrated from various sources: journal articles, academic books from the library, Internet searches and past dissertations.

While examining the literature, the researcher identified a universal problem with the way construction supply chains operate in a culture of antagonism, with some practitioners being completely oblivious of the failures that emerge from maintaining this status quo. Once the research objectives were generated the researcher pursued the task of exploring available literature with the intention of addressing these objectives.

5.1.2 Case studies

Case studies can be used to support the anecdotal nature of literature. The literature review provides a foundation for understanding the problem and putting the research into context. This is why it is important that the case studies chosen by the researcher for this study relates to the literature collected. The researcher has selected the use of case studies to strengthen the industry’s interest in the application of collaborative models in CSCs by illustrating some of the benefits which the use of such models can yield (Blaxter, Hughes and Tight, 2006; Swanborn, 2010).

The options according to which case studies can be conducted vary so too are the data sources. Swanborn (2010) distinguishes three levels at which data can be collected when conducting a case study: micro-level (persons/ interpersonal), meso-level (institutional/ organisational) or macro-level (community/ provisional/ national/ international). For the purpose of this study (and the research topic) the researcher elected to conduct case studies at a meso-level, based on individual construction projects where a collaborative construction
model was used to roll-out the project. The following process was applied in selecting cases for the research (Swanborn, 2010):

![Case study selection process diagram]

**Figure 5.2 - Case study selection process**  
Source: (Swanborn, 2010)

The manner in which data was solicited in the case studies differed. For the international case studies data was sourced mainly from articles and contract documentation which were made available on the Internet by various organisations which were affiliated to the particular projects. Data for the local case study was solicited from contract documentation, the Internet and, most importantly, in-depth interviews with three individuals that were key stakeholders in executing the contract. For the interviews the researcher formulated questions based on the roles of each stakeholder and the degree to which the research study would be fulfilled.

### 5.1.3 Primary data

Primary data is original data which the researcher collects first-hand for the purpose of the study concerned. Researchers have an ample variety of primary data collection tools at their disposal. The researcher used a quantitative method of collecting and analysing the data in this study. Keeping in mind issues relating to, *inter alia*, sampling, measuring, analysis, questionnaires and population selection of an appropriate collection tool to complement the research is vital. This important part of the research must embody well-constructed, meaningful variables which are measurable with relative ease. In order to attain this, the researcher took the following steps in ensuring this was fulfilled (Vanderstoep and Johnston, 2009; Welman *et al.*, 2005):
• From the research objectives the researcher formulated measurable items (Variables).
• The researcher ensured that the measured items were of a high quality (Validity and Reliability).
• The researcher had to select the most suitable way of gathering information from appropriate participants for the study (Questionnaire).

5.2 Variables

Measuring in research terms refers to the assignment of numbers to attributes in order to represent that particular attribute in quantitative terms, be it in relation to another attribute or the attribute in insolation. It is important to understand how measurement was done in order to ascertain the concerned matters of the study. The way in which numbers were assigned by the researcher had to be generally understandable by and agreeable to the general research field. The process needed to be clear and standard. The attributes had to relate to objects in the world, with a focus on particular features along various dimensions (Blanche et al., 2006). The conversion of an abstract concept into a measurable item is not a straight forward task. It requires a thought process in establishing what instrument of measurement will be suitable to attain the desired (Welman et al., 2005). The first step is conceptualisation. During this stage the researcher theoretically and conceptually defined the constructs (variables) in order to match the attributes under measure. This stage was subsequently followed by the operationalisation stage. At this stage the researcher had to establish the appropriate measurement instrument or procedure in which the attributes were examined and presented in order to capture the meaning of the abstract concept (Blanche et al., 2006; Vanderstoep and Johnston, 2009).

Data collection is centred on the study of universal indicators that collectively define the construct. A variable according to Vanderstoep and Johnston (2009), is a construct that can take the form of two or more distinct values. Variables define the features of the study and provide a good way of establishing relationships between constructs. Generally variables are recognised as either independent or dependent. The former are normally used to diagnose the observed effect of the problem being studied. Using independent variables the endeavoure to understand the basis and the resultant effect of the independent variable on other variables. A dependent variable works inversely, in that it seeks to establish how that particular variable has been affected by the independent variable. Authors sometimes make reference to four
kinds of variables (Blanche et al., 2006; Vanderstoep and Johnston, 2009; Welman et al., 2005). However, only two of those identified were to be used in this research study:

Nominal/ categorical variables: These kinds of variables do not necessarily have a quantitative value, they represent a particular group. The researcher used this kind of variable to establish respondents’ occupations, the nature of the projects, the level of management, and the like.

Ordinal variables: These are similar to nominal variables, but quantitative in nature because numeric values are used to reflect differences in groups and allow for rankings to be made. The researcher made use of this kind of variable to rank factors such as factors affecting projects performance, frustration factors, collaboration factors, and the like.

5.3 Validity and reliability

Quantitative research involves the measuring of peoples’ thoughts, behaviours and attitude and the process of assigning numerical value to such attributes can prove to be questionable if not carefully carried out. To ensure the quality of measurement researchers need to make sure that measures are both truthful in reflecting the construct and consistent in yielding results across different settings (Vanderstoep and Johnston, 2009). In research these two concepts are referred to as testing validity and reliability. The two are precision enablers for the measurement of constructs. Validity relates to the extent to which the measures fulfil their intended function. Therefore validity ensures that the measures do what they claim to measure. Alternatively, reliability relates to the extent to which the measure yields the same results over repeated trials. In essence reliability would mean that if a study would be done on a single group of individuals on distinctly separate occasions, one would generate the same results over and over (Blanche et al., 2006; Vanderstoep and Johnston, 2009).

5.4 Questionnaire

To complete the task of collecting primary data the researcher took to the field to solicit data from industry practitioners by way of self-administered surveys. The selection of this approach was primarily based on respondents being able to complete the survey on their own unlike with observation or interviews. There are numerous ways of collecting primary data. However, the use of questionnaires is the more popular choice for primary data collection. In
the case of this study the researcher selected the distribution of questionnaires as a more astute choice because of the following reasons:

- Data can be collected in a more efficient manner. This is because normally industry practitioners are very busy people and may not always have the luxury of time-consuming exercises such as interviews.
- Quantitative analysis is strengthened with an increase in respondents, by means of questionnaires, because of their ease of distribution, allow for invitation of far more participants to the survey.
- Respondents can enjoy anonymity because they do not come into physical contact with the researcher.
- As opposed to interviewing questionnaires have proven before to be a relatively inexpensive exercise as they eliminates costs such as travelling or making telephone calls (Vanderstoep and Johnston, 2009; Welman et al., 2005).

Many other benefits fit the use of questionnaires but the researcher has taken the following weaknesses into account which are associated with the use of questionnaires.

- There is no control over the conditions under which the respondents complete the questionnaires, whether they are under duress or simply that they are too busy to complete the questionnaire.
- As is the case with many questionnaires, some may be completed unsatisfactory, resulting in some questionnaires being invalid.

These are weaknesses which exist in the construction industry given the high stress levels that practitioners endure on a day-to-day basis (Bowen et al., 2013; Leung et al. 2008). This can result in a poor response rate for the study. To compensate for this potential weakness the researcher needs to select a large sample and in this sample the researcher had to identify reliable construction practitioners who could appreciate the value of the study (Welman et al., 2005).

The questionnaire design for this study was allocated three sections. The three sections of the questionnaire were answered using closed-ended questions, so the respondents had a range of possible answers from which they could choose. Nominal data was used to solicit elementary,
categorical information about the respondents, while ordinal and interval data used scaled questions to solicit more abstract information which can be expressed as quantities. To assess responses a five-point Likert scale was used to present interval data. The Likert scale is a very popular instrument for assessing the degree of agreement on a particular factor in quantitative research.

The first section (section A) was designed to provide the researcher with the demographic background of the respondents. Avoiding sensitive questions (such as race and gender) the researcher solicited information that when consolidated provided an understanding on the topology of the sample (Welman et al., 2005).

Section B was used to answer some research questions over and above what was identified in the literature review. The researcher used the questions to elicit information from the respondents about fragmented state of construction supply chains and reasons thereof. Collaboration being the theme of the section respondents provided information on factors affecting collaboration and how collaboration can benefit the performance of the supply chain. This section also provided ways of selecting the best suited parties to collaborate with in the supply chain.

Using scaled questions the last section (section C) addressed issues relating to construction supply chain performance in South Africa. In this section the researcher solicited information about how supply chains perform with regard to conventional project parameters. Furthermore, industry practitioners responded on which factors affect performance, what challenges they faced within the supply chain and to what degree (extent).

5.5 Target population

The target population refers to the group of individuals which the researcher has identified as having the qualities necessary to generate the data to fulfil the needs of the study (Blanche et al., 2006; Welman et al., 2005). Below is a list of organisations identified as the target population:

- Clients,
- Contractor representatives,
- Consultants, and
• Suppliers.

5.6 Sampling

Primary data requires that the researcher place particular groups, organisations or events under study. These entities are commonly referred to as the population. The research population refers to the study object (in its entirety) in which the researcher is interested and to which the study can be generalised. In this instance the population comprised all key industry practitioners involved with construction supply chains (i.e. clients, contractor representatives and consultants). The sample is the group of individuals who participated in the study concerned. Since the population is established, the sample must be selected as a “deliberated” represent of the population (Vanderstoep and Johnston, 2009; Welman et al., 2005). The sampling frame would then be all those industry practitioners eligible for sampling in the industry.

Regardless of the nature of the research (quantitative or qualitative), sampling is one technique that cannot be left out of the research process. Selection of the sample size was based on the following considerations:

• Confidence in the sample to provide an accurate representation of the population;
• Accuracy required for estimates made for the sample;
• The type of analysis to be used; and
• The accessibility of population (Welman et al., 2005).

The sample selected played an important role of giving answers to the research problem and research objectives. Sampling is conventionally done in either one of two strategies, namely random sampling and non-random sampling. For this study random sampling was used. This simply means that any industry practitioner involved in a construction supply chain has the possibility of participating. Equal likelihood is the notion governing all forms of random sampling. In contrast the latter strategy would mean others in the population are not selected for participation in the study. This can be based on characteristics needed for the study or the availability to participate (Vanderstoep and Johnston, 2009).
In *simple* random sampling all subjects have exactly the same possibility of being selected and the selection of each subject is completely independent of the preceding and succeeding one (Blanche *et al.*, 2006). A *stratified* sampling technique was adopted for this study. Using this technique the researcher created subgroups (strata) for each of the subjects. The rationale behind this is the identification of three key construction supply chains stakeholder groups in the literature review (i.e. clients, contractor representatives and consultants). Subsequently this formed the three groups with each stratum being more homogeneous than the population in its entirety. The researcher then proceeded to use random sampling to draw subjects from each stratum (Welman *et al.*, 2005).

### 5.7 Geographical area of the study

The study was undertaken in the province of Gauteng, South Africa. The province of Gauteng in South Africa is considered the economic capital of South Africa and boosts some of the most prestigious construction projects. The respondents for the study were based mainly in Gauteng.

### 5.8 Data analysis

#### 5.8.2 Descriptive statistics

Once data is collected from the questionnaires the researcher used descriptive statistics to interpret the measurements of the variables. Since the sample taken represents a much larger population of supply chains in South Africa, the use of descriptive statistics helped the researcher to quantitatively capture the state of collaboration throughout all construction supply chains in the country. That is to say, descriptive statistics provides a “concentrated version” of affairs of the entire population (Argyrous, 2011).

It will not be possible to identify relationships between measured variables if they have not been given numerical values. This is where the importance of descriptive statistics comes in. It is advocated as the first step towards more advanced means of statistics to be used to present the data collected (Argyrous, 2011; Cohen and Lea, 2004).
The computation of the mean item score (MIS) is the most commonly used and favoured tool of descriptive statistics (Cohen and Lea, 2004; Vanderstoep and Johnston, 2009). It is commonly used to measure central tendency. However, in this study which used the Likert scale described earlier, the mean item scores were used to rank various matters relating to performance and collaboration of CSC as well as help in the computation of the *standard deviation*. The mean item scores allowed the researcher to compare various variables according to three groups of respondents (clients, consultants and contractors) as suggested by Chan *et al.* (2003). Standard deviation is used to determine the average degree of dispersion in a set of values (Blanche *et al.*, 2006).

**Computation of mean item score**

Mean = sum of all observations / total number of observations

Presented symbolically as:

\[
\mu = \frac{\sum X_i}{n} \quad \text{Equation 1.0}
\]

Where:

\(\mu = \text{mean or average}\)

\(X_i = \text{number selected by respondents}\)

\(n = \text{total number of respondents}\)

Adapted from Cohen and Lea (2004)

**Computation of standard deviation**

\[
\sigma = \sqrt{\frac{\sum (X_i-\mu)^2}{n-1}} \quad \text{Equation 2.0}
\]
Where:

\[ \sigma = \text{standard deviation} \]

\[ X_i = \text{number selected by respondents} \]

\[ \mu = \text{mean} \]

\[ n = \text{total number of respondents} \]

Adapted from Cohen and Lea (2004)

**Computation of percentage score**

\[ p = \frac{\sum x}{y} \times 100 \]  
*Equation 3.0*

\[ p = \text{percentage (\%)} \]

\[ x = \text{number selected by respondents} \]

\[ y = \text{total number of respondents} \]

5.8.3 **Test for commonality – Kendall coefficient of concordance**

Since human beings differ in thought the researcher sought to identify the degree to which the respondents agree on particular subject matters. *Kendall’s coefficient of concordance* is a technique used by researchers (Chan *et al.*, 2003; Doloi, 2013). It uses numerical values to measure the extent of agreement between different parties on the rankings within individual groups. According to Chan *et al.*, (2003:131), “a high or significant value of \( W \) indicates that different parties are essentially applying the same standard in ranking”. Using *Kendall’s coefficient of concordance* the researcher validated the degree of agreement among the three individual groups as well as collectively with regards to the ranking of the various subject matters in Sections B and C.
Computation of Kendall’s coefficient of concordance

\[ R = \sum_{i=1}^{k} R_{ij} \]

\[ U = \sum_{j=1}^{n} R_{j}^2 \]

\[ W = \frac{12U - 3k^2(n-1)^2}{k^2n(n-1)} \]  

Equation 4.0

Where:

\( W \) = Kendall’s coefficient of concordance

\( n \) = number of attributes;

\( k \) = number of respondents in the sample.

Adapted from Doli (2013)

The value of \( W \) will range between 0.000 and 1 with one representing perfect agreement and zero representing complete disagreement. This means that a \( W \)-value which is closer to 1.00 exemplifies that there is consensus on the subject. Conversely, when there is a complete lack of consensus within a particular group on the ranking of a subject matter the \( W \)-value will lean towards zero.

5.9 Conclusion

This chapter highlighted the research framework and design selected for the study. In particular the chapter looked at the rationale for this study and the quantitative method
selected. Furthermore the chapter highlighted the research design, the questionnaire design, data selection techniques and the data analysis instruments that were adopted.

The following chapter will report on the data collected.
CHAPTER SIX: ANALYSIS AND INTERPRETATION OF DATA

6.1 Introduction

This chapter presents the data collected from the open-ended questionnaires that were distributed to the respondents. Descriptive statistics were used to analyse and interpret the data collected on the use of collaborative models to improve the performance of South African construction supply chains.

6.2 Data collection

Data was collect from construction industry practitioners, individuals who are constantly involved in the construction supply chain process. Respondents were identified by gathering information from current projects and selecting names from the professional project lists. A total of 378 questionnaires were distributed to potential respondents between November 2014 and April 2015. Most of the questionnaires were distributed by electronic mail while some were hand delivered. A total 107 questionnaires were returned, signifying an response rate of 28 per cent. Of the 104 questionnaires received 23 of them were compromized to the degree that they could not be used for analysis bringing the total of usable questionnaire to 84, therefore the response rate was in actual fact 22 per cent. This is in line with “the norm of 20-30 per cent which pertains to most questionnaire surveys in the construction industry” as suggested by Yang et al. (2011:905)

6.3 Section A: Demographic background of respondents

In order to establish the validity of each respondent the researcher needed to ask questions that would help determine whether each respondent had the ability and experience to answer the remainder of the questionnaire appropriately.

Of the 84 respondents used for this survey, 48 per cent came from contractor organisations. In total clients made up 29 per cent of the respondents; 24 per cent were clients in the private sector, while 5 per cent were clients in the public sector. Consultants made up a percentile total of 11 per cent were consulting engineers, 2 per cent were consulting architects, 3 per cent were consulting quantity surveyors while only 1 per cent were project management
consultants. The remaining 6 per cent came from other organisations, namely building suppliers.

Experience in the construction industry is an important factor in estimating the degree of knowledge that one possesses: as such the researcher tried to determine the experience of the sampled group to establish how knowledgeable the sample group was. A total 32.1 per cent of the respondents had between one and five years of experience involved in construction supply chains. Respondents with between six to ten years of experience made up 29.8 per cent, those with between 11 and 15 years of experience made up 17.9 per cent, those with between 16 and 20 years of experience made up 6 per cent and those with 21 years of experience and more made up 14.3 per cent. From this information the researcher determined that the experience of the respondents was balanced enough to produce impartial and reliable results.

Figure 6.1 - Respondents’ organisational profile
The researcher gave the respondents the choice between four common sectors of the construction industry: build, civil, road and earthworks, and specialised engineering. The respondents were instructed to choose which sector they worked in and were not restricted to select one. The majority of the respondents, namely 82.1 per cent, were involved in the building sector of construction, 23.8 per cent were involved in the civil construction sector, 16.7 per cent were involved in roads and earthworks, and 2 per cent were involved in the specialist engineering sector of construction. A total of 6 per cent were in other sectors of the construction industry and also played an instrumental role in the construction supply chain. These respondents were involved in sectors such as building renovations, electrical and
instrumental, and railway construction and maintenance.

Figure 6.3 - Respondents’ sector profile

The researcher asked the respondents to indicate their highest level of education. The majority of the sample (54%) had bachelor’s degrees. The respondents with diplomas made up 25 per cent followed by 13.1 per cent with grade 12 (and grade 12 equivalents). Of the respondents, 4.8 per cent had master’s degrees and 2.4 per cent had not completed high school.

To ensure that respondents come from all levels of management the researcher asked the respondents to indicate at which level of management they were currently placed. The research revealed that 51 per cent of the respondent were currently working at an operational level of management while 42 per cent of the respondents were in middle and senior levels of management and 6 per cent was made up of respondent in executive management positions.
Table 6.1 shows the respondent’s ranking of the factors that influence construction supply chains to be fragmented in the South African construction industry. Overall the respondents ranked corruption as the biggest contributor of fragmented CSCs with a mean score of 3.85 and a standard deviation (SD) of 1.384. Second was price-orientated selection method with a mean of 3.81 and a SD of 0.963; lack of commitment from other parties was third (mean = 3.81, SD=0.963); unrealistic deadlines was ranked fourth (mean = 3.77, SD=0.949); while selection of contract and pricing strategy was ranked fifth (mean = 3.62, SD=0.877). The table further shows that overall the three least influential factors were identified as; short-term nature of projects (mean = 2.95, SD=1.150), organisational cultural differences (mean = 2.87, SD=1.095) and individual cultural differences (mean = 2.73, SD=1.16). Overall Kendall’s co-efficient of concurrence (W) was 0.108.

The client group ranked selection of contract and pricing strategy (mean = 4.00) and price-orientated selection method (mean = 3.96) as the biggest contributors to fragmented CSCs (W = 0.072). The consultant groups identified lack of commitment from other parties and corruption as the biggest contributors with mean scores of 4.13 and 4.00 respectively (W = 0.272). The contractor group however identified unrealistic deadlines and price-orientated
selection as the biggest contributors to fragmented CSCs with means scores of 3.87 and 3.84 respectively ($W = 0.118$).

**Table 6.1** - Factors that influence fragmentation of construction supply chains in South Africa

<table>
<thead>
<tr>
<th>Fragmenting Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Corruption</td>
<td>1</td>
<td>3.85</td>
<td>1.384</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price-oriented selection methods</td>
<td>2</td>
<td>3.81</td>
<td>0.963</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of commitment from other parties</td>
<td>3</td>
<td>3.81</td>
<td>0.975</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrealistic deadlines</td>
<td>4</td>
<td>3.77</td>
<td>0.949</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selection of contract and pricing strategy</td>
<td>5</td>
<td>3.62</td>
<td>0.877</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High stress levels</td>
<td>6</td>
<td>3.54</td>
<td>0.950</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex nature of projects</td>
<td>7</td>
<td>3.51</td>
<td>1.047</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adversarial (aggressive) relationships</td>
<td>8</td>
<td>3.50</td>
<td>0.976</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of trust</td>
<td>9</td>
<td>3.49</td>
<td>1.114</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unpredictable nature of projects</td>
<td>10</td>
<td>3.38</td>
<td>0.917</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too many stakeholders involved</td>
<td>11</td>
<td>3.37</td>
<td>1.159</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunistic behaviour</td>
<td>12</td>
<td>3.31</td>
<td>1.086</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclusion of stakeholders in phases of the project</td>
<td>13</td>
<td>3.19</td>
<td>1.217</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inter-personal dynamics</td>
<td>14</td>
<td>3.17</td>
<td>0.889</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term nature of projects</td>
<td>15</td>
<td>2.95</td>
<td>1.150</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural difference</td>
<td>16</td>
<td>2.87</td>
<td>1.095</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
The respondents were asked to rank the factors which assist in fostering collaboration in CSCs in South Africa. Table 6.2 revealed that overall the respondents ranked good leadership as the most important factor that helped with fostering a collaborative environment with a mean score of 4.40 and a standard deviation (SD) of 0.746. This was followed in second place by effective communication with a mean score of 4.33 and a SD of 0.750. Top management support was ranked third (mean = 4.21, SD 0.746); fourth was having adequate resources (mean = 4.19, SD = 0.814) and fifth was a knowledgeable client (mean = 4.07, SD = 0.967). The three least influential factors which contributed to fostering a collaborative environment in CSCs were open book accounting/ transparency (mean = 3.51, SD = 0.871), incentive and risk sharing (mean = 3.42, SD =0.934) and stakeholder inclusion (mean =3.39, SD = 1.064). Overall Kendall’s co-efficient of concurrence (W) was 0.126.

Individually the groups were in agreement on the ranking of the two most influential factors, these being good leadership and effective communication. The clients’ group had a mean score of 4.29 and 4.25 respectively (W = 0.115); consultants’ groups had a mean score of 4.33 and 4.47 respectively (W = 0.144); while the contractors’ group had a mean score of 4.49 and 4.33 respectively (W = 0.166).
Table 6.2 - Factors that foster collaboration of construction supply chains in South Africa

<table>
<thead>
<tr>
<th>Collaboration Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Good leadership</td>
<td>4.40</td>
<td>1</td>
<td>0.746</td>
<td>1</td>
</tr>
<tr>
<td>Effective communication between stakeholders</td>
<td>4.33</td>
<td>2</td>
<td>0.750</td>
<td>2</td>
</tr>
<tr>
<td>Top management support</td>
<td>4.21</td>
<td>3</td>
<td>0.746</td>
<td>3</td>
</tr>
<tr>
<td>Adequate resources</td>
<td>4.19</td>
<td>4</td>
<td>0.814</td>
<td>4</td>
</tr>
<tr>
<td>Knowledgeable client</td>
<td>4.07</td>
<td>5</td>
<td>0.967</td>
<td>6</td>
</tr>
<tr>
<td>Mutual trust</td>
<td>4.02</td>
<td>6</td>
<td>0.931</td>
<td>9</td>
</tr>
<tr>
<td>Proactive and enthusiastic client</td>
<td>3.94</td>
<td>7</td>
<td>0.961</td>
<td>9</td>
</tr>
<tr>
<td>Acting in line with objectives</td>
<td>3.92</td>
<td>8</td>
<td>0.881</td>
<td>5</td>
</tr>
<tr>
<td>Efficient conflict resolution system</td>
<td>3.87</td>
<td>9</td>
<td>0.991</td>
<td>6</td>
</tr>
<tr>
<td>Positive attitude and commitment of stakeholders</td>
<td>3.86</td>
<td>10</td>
<td>0.894</td>
<td>11</td>
</tr>
<tr>
<td>Motivation to work collaboratively</td>
<td>3.86</td>
<td>11</td>
<td>0.852</td>
<td>6</td>
</tr>
<tr>
<td>Joint problem solving</td>
<td>3.76</td>
<td>12</td>
<td>0.913</td>
<td>13</td>
</tr>
<tr>
<td>Knowledge transfer</td>
<td>3.76</td>
<td>13</td>
<td>1.025</td>
<td>14</td>
</tr>
<tr>
<td>Formal contract</td>
<td>3.74</td>
<td>14</td>
<td>1.131</td>
<td>14</td>
</tr>
<tr>
<td>Flexibility to adopt change when required</td>
<td>3.70</td>
<td>15</td>
<td>0.967</td>
<td>12</td>
</tr>
<tr>
<td>Experience with work in collaborative models</td>
<td>3.60</td>
<td>16</td>
<td>0.893</td>
<td>17</td>
</tr>
<tr>
<td>Regular monitoring of the collaborative process</td>
<td>3.51</td>
<td>17</td>
<td>1.114</td>
<td>14</td>
</tr>
<tr>
<td>Open book accounting/ transparency</td>
<td>3.51</td>
<td>18</td>
<td>0.871</td>
<td>20</td>
</tr>
</tbody>
</table>
The researcher undertook to establish what factors would attract construction practitioners in South Africa to using more collaboratively structured approaches. The respondents were asked to rank benefit factors that would influence them to use more collaboratively structured models. The results have been tabulated in table 6.3 below. Overall the respondents ranked meeting project deadlines as the most influential factor that would encourage them to use more collaboratively structured models with a mean score of 4.33 and a standard deviation (SD) of 0.750. The respondents ranked joint problem solving as the second most influential factor with a mean of 3.93 and a SD of 0.847; job satisfaction was ranked third with a mean score of 3.89 and a SD of 0.957; ranked forth was shared profit with a mean score of 3.79 and a SD of 0.995 and fifth was job continuity with a mean score of 3.79 and a SD of 0.837. Overall the respondents ranked the three least influential factors as shared risk (mean = 3.63, SD = 0.889); improvements to health and safety (mean = 3.57; SD = 1.067) and flexibility in the use of the contract (mean = 3.50; SD = 0.988). Overall Kendall’s co-efficient of concurrence (W) was 0.099 with a 0.000 level of significance.

Individually the group shared consensus regarding the ranking of meeting project deadlines as the most influential factor that would encourage the use of more collaboratively structured models with relatively high mean score: clients = 4.21, consultants = 4.47 and contractors = 4.36. The client respondents ranked shared profit (mean = 4.17) and joint problem solving (mean = 3.92) second and third respectively. The consultants group ranked reduction in dispute and conflict (mean = 3.87), job satisfaction (mean = 3.83) and job continuity (mean =
3.83) second and joint third respectively. The contractor group ranked joint problem-solving (mean = 4.07) and job satisfaction (mean = 4.00) as second and third respectively.

**Table 6.3 - Factors influencing the use of more collaborative projects**

<table>
<thead>
<tr>
<th>Benefit Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Meeting deadlines</td>
<td>1</td>
<td>4.33</td>
<td>0.750</td>
<td>1</td>
</tr>
<tr>
<td>Joint problem solving</td>
<td>2</td>
<td>3.93</td>
<td>0.847</td>
<td>3</td>
</tr>
<tr>
<td>Job satisfaction</td>
<td>3</td>
<td>3.89</td>
<td>0.957</td>
<td>5</td>
</tr>
<tr>
<td>Shared profit</td>
<td>4</td>
<td>3.79</td>
<td>0.995</td>
<td>2</td>
</tr>
<tr>
<td>Job continuity</td>
<td>5</td>
<td>3.79</td>
<td>0.837</td>
<td>8</td>
</tr>
<tr>
<td>Reduction in dispute and conflict</td>
<td>6</td>
<td>3.77</td>
<td>0.910</td>
<td>4</td>
</tr>
<tr>
<td>Learning environment</td>
<td>7</td>
<td>3.68</td>
<td>0.880</td>
<td>6</td>
</tr>
<tr>
<td>Shared risk</td>
<td>8</td>
<td>3.63</td>
<td>0.889</td>
<td>10</td>
</tr>
<tr>
<td>Improvements in Health and Safety performance</td>
<td>9</td>
<td>3.57</td>
<td>1.067</td>
<td>6</td>
</tr>
<tr>
<td>Flexibility in the use of the contract</td>
<td>10</td>
<td>3.50</td>
<td>0.988</td>
<td>9</td>
</tr>
<tr>
<td>Number of respondents (n)</td>
<td>84</td>
<td>24</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Kendall’s co-efficient of concordance (W)</td>
<td>0.099</td>
<td>0.062</td>
<td>0.264</td>
<td>0.116</td>
</tr>
<tr>
<td>Level of Sig</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Std D = Standard deviation

Although the use of collaborative models in South Africa is still unfamiliar territory for industry practitioners, this is not to say that people do not see value in working together rather than in isolation. Therefore the respondents were asked to indicate to which degree each area of the construction project would benefit from the move from traditionally disjointed contracting styles to the use of more collaborative structured models. Table 6.4 below presents the findings based on the respondents’ ratings. Overall the respondents ranked time of expected completion as the area that would most benefit from the use of collaborative
models with a mean score of 4.3 and a standard deviation (SD) of 0.797. This was followed by cost estimate at second with a mean score of 4.24 and a SD of 0.952; quality standard was ranked third overall (mean = 4.17; SD = 0.916), frequency of disputes was ranked forth (mean = 3.87; SD = 0.991); fifth was functionality of the infrastructure (mean = 3.80; SD = 0.847). Health and safety was ranked as the factor that would least benefit from the use of collaborative models with a mean score of 3.70 and a SD of 1.039. Overall Kendall’s co-efficient of concurrence (W) was 0.157 with a 0.000 level of significance.

**Table 6.4 - Project parameters that would benefit from the use of collaborative models**

<table>
<thead>
<tr>
<th>Project Parameters</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Time of expected completion</td>
<td>1</td>
<td>4.33</td>
<td>0.797</td>
<td>2</td>
</tr>
<tr>
<td>Cost estimate</td>
<td>2</td>
<td>4.24</td>
<td>0.952</td>
<td>1</td>
</tr>
<tr>
<td>Quality standards</td>
<td>3</td>
<td>4.17</td>
<td>0.916</td>
<td>3</td>
</tr>
<tr>
<td>Frequency of disputes and conflict</td>
<td>4</td>
<td>3.87</td>
<td>0.991</td>
<td>4</td>
</tr>
<tr>
<td>Functionality of infrastructure</td>
<td>5</td>
<td>3.80</td>
<td>0.847</td>
<td>6</td>
</tr>
<tr>
<td>Health and Safety</td>
<td>6</td>
<td>3.70</td>
<td>1.039</td>
<td>5</td>
</tr>
<tr>
<td>Number of respondents (n)</td>
<td>84</td>
<td>24</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Kendall’s co-efficient of concordance (W)</td>
<td>0.157</td>
<td>0.182</td>
<td>0.248</td>
<td>0.147</td>
</tr>
<tr>
<td>Level of Sig</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Std D = Standard deviation

The respondents were asked to rank the factors which obstruct the use of collaborative models in South African CSCs (see table 6.5). The study reveals the overall biggest obstruction to be inexperience with collaboration with a mean score of 3.81 and a standard deviation (SD) of 0.963. This was followed in second place by corruption with a mean of
3.77 and a SD of 1.283. In third was a lack of faith in the benefits of collaboration with a 
mean of 3.70 and a SD of 1.117; a lack of commitment to the process was fourth with a mean 
of 3.68 and a SD of 1.055, while fifth was overdependence on others with a mean of 3.65 and 
a SD 0.912. The three least influential factors which obstructed the use of collaborative 
models were cultural barriers (mean = 2.95; SD = 1.211), cost of training to implement the 
collaborative process (mean = 3.43; SD = 0.985) and inherent aggressive nature of the 
industry (mean = 3.60; SD = 0.933). Overall Kendall’s co-efficient of concurrence (W) was 
0.076 with a 0.000 level of significance.

Individually the respondent groups ranked the factors differently. The consultant group 
ranked lack of commitment to the process as the biggest obstruction to implementing 
collaboration (mean = 4.00). This was followed by misunderstanding of collaborative processes (3.99) and overdependence on others (means = 3.87) in second and third respectively. Kendall’s co-efficient of concurrence (W) for the consultants’ group was 0.235 with a 0.000 level of significance. The client group ranked the inexperience with collaboration, corruption and inherent aggressive nature of the industry as the biggest obstructions to the use of collaboration with mean scores of 3.96, 3.87, and 3.79 respectively. Kendall’s co-efficient of concurrence (W) for the clients group was 0.039 with a 0.000 level of significance. The contractor groups’ ranking of the three biggest obstructions was similar to the overall ranking. First obstruction was revealed to be inexperience with collaboration with a mean score of 3.76, second was corruption with a mean score of 3.73 and third was a lack of faith in the benefits of collaboration with a mean score of 3.69. Kendall’s co-efficient of concurrence (W) for the contractors group was 0.087 with a 0.000 level of significance.

Table 6.5 – Factors obstructing collaboration in construction supply chains in South Africa

<table>
<thead>
<tr>
<th>Obstruction Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Inexperience with collaboration</td>
<td>1</td>
<td>3.81</td>
<td>0.963</td>
<td>1</td>
</tr>
<tr>
<td>Corruption</td>
<td>2</td>
<td>3.77</td>
<td>1.283</td>
<td>2</td>
</tr>
<tr>
<td>Lack of faith in the benefits of collaboration</td>
<td>3</td>
<td>3.70</td>
<td>1.117</td>
<td>5</td>
</tr>
<tr>
<td>Conditions</td>
<td>Number of respondents</td>
<td>Kendall’s co-efficient of concordance (W)</td>
<td>Level of Sig</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------</td>
<td>------------------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Lack of commitment to the process</td>
<td>4</td>
<td>0.076</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Overdependence on others</td>
<td>5</td>
<td>0.039</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Misunderstanding of collaborative concepts</td>
<td>6</td>
<td>0.235</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Distrust from past experiences</td>
<td>6</td>
<td>0.087</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inherent aggressive nature of the industry</td>
<td>8</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of training to implement the collaborative process</td>
<td>9</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural barriers</td>
<td>10</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conditions of contracts are used on almost every construction construct to regulate and apportion risk between all stakeholders. The researcher undertook to establish which contracts are predominately used in South African CSCs (see table 6.6). Overall the Joint Building Contracts Committee (JBCC) was the most frequently used contract by the respondents with a mean score of 3.46 and a standard deviation of 1.443 followed by the FIDIC with a mean score of 2.37 and a SD of 1.287. The General Condition of Contracts (GCC) was the third most used suite of contract with a mean score of 2.29 and a SD of 1.358; leaving the New Engineering Contracts (NEC) as the least used with a mean score of 2.13 and a SD of 1.342.
Table 6.6 - Conditions of Contracts Used By Respondents

<table>
<thead>
<tr>
<th>Contracts</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Joint Building Contracts</td>
<td>1</td>
<td>3.46</td>
<td>1.443</td>
<td>1</td>
</tr>
<tr>
<td>Committee (JBCC)</td>
<td>2</td>
<td>2.37</td>
<td>1.287</td>
<td>2</td>
</tr>
<tr>
<td>FIDIC</td>
<td>3</td>
<td>2.29</td>
<td>1.358</td>
<td>3</td>
</tr>
<tr>
<td>General Conditions of Contracts (GCC)</td>
<td>4</td>
<td>2.13</td>
<td>1.342</td>
<td>4</td>
</tr>
<tr>
<td>New Engineering Contract (NEC)</td>
<td>4</td>
<td>2.04</td>
<td>1.342</td>
<td>4</td>
</tr>
<tr>
<td>Number of respondents (n)</td>
<td>84</td>
<td>24</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Kendall’s coefficient of concordance (W)</td>
<td>0.203</td>
<td>0.153</td>
<td>0.381</td>
<td>0.197</td>
</tr>
<tr>
<td>Level of Sig</td>
<td>0.000</td>
<td>0.004</td>
<td>0.001</td>
<td>0.000</td>
</tr>
</tbody>
</table>

*Std D = Standard deviation

To further understand the degree of collaboration in South African CSCs the researcher asked the respondents to indicate how frequent they had been involved in construction supply chains which made use of the various collaborative models available. Table 6.7 shows Subcontracting as the most frequently exercised means of collaboration by the respondents with an overall mean score of 3.43 and a SD of 1.547, this was followed in second by Joint Venturing with a mean of 2.49 and a SD of 1.349. Partnering and alliancing were the least used collaborative models, coming in third and forth with mean scores of 2.08 and 1.65 respectively.
Table 6.7 - Collaborative models used by respondents

<table>
<thead>
<tr>
<th>Collaborative models</th>
<th>Overall Rank</th>
<th>Mean</th>
<th>Std D</th>
<th>Clients Rank</th>
<th>Mean</th>
<th>Std D</th>
<th>Consultants Rank</th>
<th>Mean</th>
<th>Std D</th>
<th>Contractor Rank</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-contracting</td>
<td>1</td>
<td>3.43</td>
<td>1.547</td>
<td>1</td>
<td>3.17</td>
<td>2.27</td>
<td>1</td>
<td>3.96</td>
<td>2.27</td>
<td>1</td>
<td>3.96</td>
</tr>
<tr>
<td>Joint venturing</td>
<td>2</td>
<td>2.49</td>
<td>1.349</td>
<td>2</td>
<td>2.42</td>
<td>2.60</td>
<td>2</td>
<td>2.49</td>
<td>2.60</td>
<td>2</td>
<td>2.49</td>
</tr>
<tr>
<td>Partnering</td>
<td>3</td>
<td>2.08</td>
<td>1.194</td>
<td>3</td>
<td>2.33</td>
<td>2.13</td>
<td>3</td>
<td>1.93</td>
<td>2.13</td>
<td>3</td>
<td>1.93</td>
</tr>
<tr>
<td>Alliancing</td>
<td>4</td>
<td>1.65</td>
<td>0.990</td>
<td>5</td>
<td>1.62</td>
<td>1.93</td>
<td>5</td>
<td>1.56</td>
<td>1.93</td>
<td>5</td>
<td>1.56</td>
</tr>
<tr>
<td>Relationship contracting</td>
<td>5</td>
<td>1.60</td>
<td>0.889</td>
<td>4</td>
<td>1.88</td>
<td>1.47</td>
<td>4</td>
<td>1.60</td>
<td>1.47</td>
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<td>1.60</td>
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<tr>
<td>Number of respondents (n)</td>
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<td>84</td>
<td>24</td>
<td>15</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kendall’s co-efficient of concordance (W)</td>
<td>0.242</td>
<td>0.126</td>
<td>0.205</td>
<td>0.411</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of Sig</td>
<td>0.000</td>
<td>0.000</td>
<td>0.015</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Std D = Standard deviation

The study went on to ask the respondents what factors they considered when selecting potential collaboration partners for the CSC. Table 6.8 below reveals overall quality of previous work as the most influential factor when selecting a potential partner with a mean score of 4.49 and a standard deviation (SD) of 0.736. This was followed by ability to deliver on time with a mean of 4.43 and a SD of 0.749. In third was experience in similar work with a mean of 4.32 and a SD of 0.853; fourth was technical ability with a mean of 4.30 and a SD of 0.861; effective and efficient decision making was fifth with a mean score of 4.21 and a SD of 0.822. The three least influential factors were revealed to be political issues (mean = 3.27; SD =1.216), litigation/ dispute handling history (mean = 3.62; SD = 0.890) and special requirements (mean score = 3.71; SD = 1.071). Overall Kendall’s co-efficient of concurrence (W) was 0.120 with a 0.000 level of significance.

Individually the client group ranked ability to deliver on time as the most influential factor when selecting a potential partner with a mean score of 4.21. This was followed by technical ability (mean = 4.13) and experience in similar work (mean = 4.08) in second and third
respectively. The consultant group ranked ability to deliver on time (mean = 4.60), quality of previous work (mean = 4.60), effective and efficient decision making (mean = 4.20 and technical ability (mean = 4.20) as the top factors that are influential when selecting a potential partner. The contractor group ranked similarly to the overall groups. The contractor group identified quality of previous work (mean = 4.69), experience with similar work (mean = 4.51) and ability to deliver on time (mean = 4.49) as that most influential factors when selecting a potential partner (see table 6.8).

**Table 6.8 – Factors Influencing Selection of Collaboration Partner**

<table>
<thead>
<tr>
<th>Selection Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of previous work</td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Ability to deliver on time</td>
<td>1</td>
<td>4.49</td>
<td>0.736</td>
<td>4</td>
</tr>
<tr>
<td>Experience in similar work</td>
<td>2</td>
<td>4.43</td>
<td>0.749</td>
<td>1</td>
</tr>
<tr>
<td>Technical ability</td>
<td>3</td>
<td>4.32</td>
<td>0.853</td>
<td>3</td>
</tr>
<tr>
<td>Effective and efficient decision making</td>
<td>4</td>
<td>4.30</td>
<td>0.861</td>
<td>2</td>
</tr>
<tr>
<td>Financial stability of the organisation</td>
<td>5</td>
<td>4.21</td>
<td>0.822</td>
<td>9</td>
</tr>
<tr>
<td>Attitude towards teamwork</td>
<td>6</td>
<td>4.15</td>
<td>0.857</td>
<td>5</td>
</tr>
<tr>
<td>Solid organisational structure</td>
<td>7</td>
<td>4.07</td>
<td>0.916</td>
<td>12</td>
</tr>
<tr>
<td>Mandatory insurances in place</td>
<td>8</td>
<td>3.98</td>
<td>0.878</td>
<td>9</td>
</tr>
<tr>
<td>Price (tendered) or</td>
<td>9</td>
<td>3.95</td>
<td>0.968</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3.93</td>
<td>0.889</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Amount of work the organisation is currently undertaking</td>
<td>11</td>
<td>3.88</td>
<td>0.924</td>
<td>8</td>
</tr>
<tr>
<td>Creativity and innovation</td>
<td>12</td>
<td>3.87</td>
<td>0.875</td>
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<tr>
<td>Approach to negotiation</td>
<td>13</td>
<td>3.85</td>
<td>0.843</td>
<td>6</td>
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<tr>
<td>Reputation and popularity in industry</td>
<td>14</td>
<td>3.81</td>
<td>0.843</td>
<td>16</td>
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<tr>
<td>Health and Safety consideration and previous records</td>
<td>15</td>
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<td>1.095</td>
<td>13</td>
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<td>Organisation’s line of communication</td>
<td>16</td>
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<td>Any special requirements</td>
<td>17</td>
<td>3.71</td>
<td>1.071</td>
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<td>Litigation/dispute handling history</td>
<td>18</td>
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<td>Political issues</td>
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<td>1.216</td>
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<tr>
<td>Number of respondents (n)</td>
<td>84</td>
<td>24</td>
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<tr>
<td>Kendall’s Coefficient of concordance (W)</td>
<td>0.120</td>
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<td>0.218</td>
<td>0.173</td>
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<td>Level of Sig</td>
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</tr>
</tbody>
</table>

*Std D = Standard Deviation
6.5 Section C: Construction project performance

This section addresses issues relating to construction supply chain performance in South Africa. The researcher used this section to solicit information on how supply chains perform with regards to conventional project parameters. Industry practitioners responded regarding which factors affect performance and what challenges they faced within the supply chain and to what degree (extent).

The respondents were first asked to indicate what factors had the most influence in determining a successful project. The table below (table 6.9) revealed that overall the most influential factor in determining the success of the project was the time taken to complete the project with a mean score of 4.54 and a standard deviation (SD) of 0.667. This was followed by the quality of workmanship with a mean score of 4.39 and a SD of 0.761. The cost of the project was third with a mean of 4.30 and a SD of 0.967; and in fourth place with a mean score of 3.93 was health, safety and environmental compliance (SD = 0.902). The functionality of the infrastructure constructed (mean = 3.90) and the frequency of dispute (mean = 3.77) were considered the least influential factors at fifth and sixth respectively. Overall Kendall’s co-efficient of concurrence (W) was 0.170 with a 0.000 level of significance.

Individually the client group ranked time taken to complete the project as the most influential factor to the success of the project with a mean score of 4.33, while frequency of disputes was ranked as the least influential factor with a mean score 3.63 (W = 0.137). The consultants’ group ranked quality of workmanship as the most influential factor with a mean score of 4.53 (W = 0.252). Health, safety and environmental compliance was ranked as the least influential factor with a mean score of 3.53. The contractors’ group ranked time taken as the most influential factor with a mean score of 4.64. The contractor group also ranked frequency of disputes and conflict as the least influential factors with a mean score of 3.91 (W =0.185).
Table 6.9 - Outcomes influencing the success of the project

<table>
<thead>
<tr>
<th>Outcome of Project</th>
<th>Overall Rank</th>
<th>Mean</th>
<th>Std D</th>
<th>Clients Rank</th>
<th>Mean</th>
<th>Rank</th>
<th>Mean</th>
<th>Consultants Rank</th>
<th>Mean</th>
<th>Contractor Rank</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time taken to complete the project</td>
<td>1</td>
<td>4.54</td>
<td>0.667</td>
<td>1</td>
<td>4.33</td>
<td>2</td>
<td>4.53</td>
<td>1</td>
<td>4.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of workmanship</td>
<td>2</td>
<td>4.39</td>
<td>0.761</td>
<td>2</td>
<td>4.29</td>
<td>1</td>
<td>4.60</td>
<td>2</td>
<td>4.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of project</td>
<td>3</td>
<td>4.30</td>
<td>0.967</td>
<td>3</td>
<td>4.25</td>
<td>3</td>
<td>4.27</td>
<td>3</td>
<td>4.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health, Safety and Environment compliance</td>
<td>4</td>
<td>3.93</td>
<td>0.902</td>
<td>4</td>
<td>3.92</td>
<td>6</td>
<td>3.53</td>
<td>4</td>
<td>4.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functionality of the infrastructure constructed</td>
<td>5</td>
<td>3.90</td>
<td>0.952</td>
<td>5</td>
<td>3.83</td>
<td>4</td>
<td>3.80</td>
<td>5</td>
<td>3.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of disputes and conflict</td>
<td>6</td>
<td>3.77</td>
<td>0.883</td>
<td>6</td>
<td>3.63</td>
<td>5</td>
<td>3.60</td>
<td>6</td>
<td>3.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of respondents (n)</td>
<td>84</td>
<td>24</td>
<td>15</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kendall’s coefficient of concordance (W)</td>
<td>0.170</td>
<td>0.137</td>
<td>0.252</td>
<td>0.185</td>
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</tr>
<tr>
<td>Level of Sig</td>
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<td>0.001</td>
<td>0.002</td>
<td>0.000</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

*Std D = Standard deviation

The respondents were asked to indicate which elements within the categories/ disciplines as identified by the researcher influence the overall success of the project. The categories were identified as construction management, teamwork, design, as well as safety, health, environment and quality (SHEQ).
Table 6.10 identified factors that relate to the construction management discipline of the project. Under these categories overall the respondents ranked contract documentation clarity as the most influential factor with a mean score (MS) of 4.33 and a standard deviation (SD) of 0.826. This was followed by contract documentation selection with a MS of 4.12 and a SD of 0.999. Third was selection of appropriate project partner with a MS of 4.04 and a SD of 0.950, fourth was project complexity (MS = 3.99, SD = 0.843) and fifth was conflict resolution (MS = 3.94, SD = 0.923). Corruption (MS = 3.81, SD = 1.237), insurance and risk management (MS = 3.79, SD = 0.958) and dispute occurrence (MS = 3.60, SD = 0.880) were ranked as the least influential factors under the construction management discipline of project success. Overall Kendall’s co-efficient of concurrence (W) was 0.063 with a 0.000 level of significance.

Table 6.10 - Critical success factors: construction management (CM)

<table>
<thead>
<tr>
<th>CM Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultant</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract documentation clarity</td>
<td>1 4.33 0.826</td>
<td>1 4.29 1</td>
<td>4.47 1</td>
<td>4.31</td>
</tr>
<tr>
<td>Contract documentation selection</td>
<td>2 4.12 0.999</td>
<td>6 3.83 2</td>
<td>2 4.27 2</td>
<td>4.22</td>
</tr>
<tr>
<td>Selection of appropriate project partner</td>
<td>3 4.04 0.950</td>
<td>2 4.04 5</td>
<td>3.87 3</td>
<td>4.09</td>
</tr>
<tr>
<td>Project complexity</td>
<td>4 3.99 0.843</td>
<td>7 3.67 3</td>
<td>4.20 3</td>
<td>4.09</td>
</tr>
<tr>
<td>Conflict Resolution</td>
<td>5 3.94 0.923</td>
<td>5 3.88 6</td>
<td>3.80 5</td>
<td>4.02</td>
</tr>
<tr>
<td>Negotiation policies</td>
<td>6 3.85 0.963</td>
<td>2 4.04 9</td>
<td>3.07 6</td>
<td>4.00</td>
</tr>
<tr>
<td>Corruption</td>
<td>7 3.81 1.237</td>
<td>4 3.92 4</td>
<td>3.93 9</td>
<td>3.71</td>
</tr>
<tr>
<td>Insurance and Risk management</td>
<td>8 3.79 0.958</td>
<td>7 3.67 7</td>
<td>3.53 7</td>
<td>3.93</td>
</tr>
<tr>
<td>Dispute occurrence</td>
<td>9 3.60 0.880</td>
<td>9 3.58 8</td>
<td>3.27 8</td>
<td>3.71</td>
</tr>
</tbody>
</table>
The next category for which the respondents were asked to rank success factors was factors that related to team work. Table 6.11 shows how the respondents ranked this particular category. Overall the respondents ranked planning as the most influential factor with a mean score (MS) of 4.50 and a standard deviation (SD) of 0.685. Second ranked was good leadership (MS = 4.45, SD = 0.701), followed by competence of parties (MS = 4.31, SD = 0.676). Ethics (MS = 4.08, SD = 1.055) and regular meetings (MS = 3.94, SD = 0.883) were ranked fourth and fifth respectively. The least influential factors as identified by the respondent were stakeholder inclusion (MS = 3.43, SD = 1.056), educational background (MS = 3.35, SD = 1.114) and background of individuals (MS = 3.29, SD = 1.013). Overall Kendall’s co-efficient of concurrence (W) was 0.302 with a 0.001 level of significance.

Table 6.11 - Critical success factors: Teamwork (TW)

<table>
<thead>
<tr>
<th>TW Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Planning</td>
<td>1</td>
<td>4.50</td>
<td>0.685</td>
<td>2</td>
</tr>
<tr>
<td>Good leadership</td>
<td>2</td>
<td>4.45</td>
<td>0.701</td>
<td>1</td>
</tr>
<tr>
<td>Competence of parties</td>
<td>3</td>
<td>4.31</td>
<td>0.676</td>
<td>3</td>
</tr>
<tr>
<td>Ethics</td>
<td>4</td>
<td>4.08</td>
<td>1.055</td>
<td>6</td>
</tr>
<tr>
<td>Regular meetings</td>
<td>5</td>
<td>3.94</td>
<td>0.883</td>
<td>4</td>
</tr>
<tr>
<td>Communication policy</td>
<td>6</td>
<td>3.82</td>
<td>0.824</td>
<td>5</td>
</tr>
<tr>
<td>Stakeholder inclusion</td>
<td>7</td>
<td>3.43</td>
<td>1.056</td>
<td>8</td>
</tr>
<tr>
<td>Educational</td>
<td>8</td>
<td>3.35</td>
<td>1.114</td>
<td>9</td>
</tr>
</tbody>
</table>

*Std D = Standard deviation
Table 6.12 identified factors which relate to the design aspect of project success. Overall the respondents ranked the buildability of the design as the most influential factor to the success of the project under the design discipline with a mean score (MS) of 4.31 and a standard deviation (SD) of 0.850. Second was design errors and mistakes (MS = 4.21, SD = 0.793) followed by the use of appropriate construction methodology (MS = 4.14, SD = 0.809). Quality of material specified (MS = 4.13, SD = 0.788) and integration of the designs (MS = 4.13, SD = 0.818) were ranked fourth and fifth respectively, while specification discrepancy (MS = 4.11, SD = 0.878) was ranked as the least influential factor to the design aspect of project success. Overall Kendall’s co-efficient of concurrence (W) was 0.018 with a 0.008 level of significance.

Table 6.12 - Critical success factors: Design

<table>
<thead>
<tr>
<th>Design Factors</th>
<th>Overall</th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
<td>Mean</td>
</tr>
<tr>
<td>Buildability of design</td>
<td>1</td>
<td>4.31</td>
<td>0.850</td>
<td>3</td>
<td>3.96</td>
<td>1</td>
<td>4.67</td>
</tr>
<tr>
<td>Design errors, mistakes</td>
<td>2</td>
<td>4.21</td>
<td>0.793</td>
<td>4</td>
<td>3.92</td>
<td>3</td>
<td>4.40</td>
</tr>
<tr>
<td>Use of appropriate construction</td>
<td>3</td>
<td>4.14</td>
<td>0.809</td>
<td>6</td>
<td>3.88</td>
<td>2</td>
<td>4.47</td>
</tr>
</tbody>
</table>
methodology

Quality of material specified

<p>| | | | | | | |</p>
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<thead>
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</thead>
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<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
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<td>4</td>
<td>4.13</td>
<td>0.788</td>
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<td>4.00</td>
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</table>

Integration of design

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</thead>
<tbody>
<tr>
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<td>Std D</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
</tr>
<tr>
<td>4</td>
<td>4.13</td>
<td>0.818</td>
<td>1</td>
<td>4.25</td>
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<td>4.27</td>
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</tbody>
</table>

Specification discrepancies

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</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
<td>Mean</td>
<td>Rank</td>
</tr>
<tr>
<td>6</td>
<td>4.11</td>
<td>0.878</td>
<td>4</td>
<td>3.92</td>
<td>6</td>
<td>4.13</td>
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</tbody>
</table>

Number of respondents (n)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>84</td>
<td>24</td>
</tr>
</tbody>
</table>

Kendall's co-efficient of concordance (W)

<p>| | |</p>
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<tr>
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Level of Sig

<p>| | |</p>
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</thead>
<tbody>
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<td>0.012</td>
</tr>
</tbody>
</table>

*Std D = Standard deviation

The respondents were asked to rank the critical success factors for safety, health, environment and quality. Table 6.13 reveals that, according to the respondents overall the occurrence of accidents is major determinant of project success with regards to SHEQ with a mean score (MS) of 4.19 and a standard deviation (SD) of 0.950. Workers’ health (MS = 4.14, SD = 0.984) was ranked as second, while a secure working environment (MS = 3.90, SD = 0.859) was ranked third. The least important factor was identified as environmental impact (MS = 3.71, SD = 1.036). The overall value for Kendall’s co-efficient of concordance was 0.118 with a level of significance of 0.00.

**Table 6.13 - Critical success factors: Safety, Health, Environment and Quality (SHEQ)**

<table>
<thead>
<tr>
<th>SHEQ Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Occurrence of Accidents</td>
<td>1</td>
<td>4.19</td>
<td>0.950</td>
<td>2</td>
</tr>
<tr>
<td>Workers’ health</td>
<td>2</td>
<td>4.14</td>
<td>0.984</td>
<td>1</td>
</tr>
<tr>
<td>Secure working environmental</td>
<td>3</td>
<td>3.90</td>
<td>0.859</td>
<td>3</td>
</tr>
<tr>
<td>Environmental</td>
<td>4</td>
<td>3.71</td>
<td>1.036</td>
<td>4</td>
</tr>
</tbody>
</table>
The last question of the questionnaire looked to establish what factors created challenges for construction practitioner in the day-to-day running of the project. As shown in Table 6.14 the major factor with which construction practitioners are faced with according to the respondents is lack of top management support with a mean score (MS) of 4.23 and a standard deviation (SD) of 0.866. The second major challenge with a MS of 4.20 and a SD of 0.902 was identified as unrealistic deadline. This was followed in third by a lack of commitment (MS = 4.13, SD = 0.861) and a high workload in fourth (MS = 4.07, SD = 0.875). The fifth ranked factor was communication barriers with a MS of 4.06 and a SD of 0.896. The overall value for Kendall’s co-efficient of concordance was 0.077 with a level of significance of 0.000.

Individually the clients group also ranked a lack of top management support as a major factor that challenged construction practitioners with a mean of 4.29. This was followed by unrealistic deadlines, a lack of commitment and communication barriers with mean scores of 4.08, 4.04 and 4.04 respectively \( (W = 0.074, \text{ level of significance} = 0.00) \).

The consultants’ group ranked unrealistic deadlines as a major factor that created a challenge in projects with a mean score of 4.20. The consultants group ranked a lack of top management and a lack of commitment from other parties as the next major factors with mean scores of 4.13 each. The value for \( W \) was 0.165 with a 0.008 level of significance.

The contractors’ group ranked a lack of top management support as the biggest challenge facing practitioners with a mean score (MS) of 4.29. Second ranked was unrealistic deadlines (MS = 4.27), with lack of commitment from other parties ranked as third (MS = 4.18). The contractor value for \( W \) for these factors was 0.065 with a 0.002 level of significance.
Table 6.14 - Factors creating challenges for construction practitioners

<table>
<thead>
<tr>
<th>Factors</th>
<th>Overall</th>
<th>Clients</th>
<th>Consultants</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td>Mean</td>
<td>Std D</td>
<td>Rank</td>
</tr>
<tr>
<td>Lack of top management support</td>
<td>1</td>
<td>4.26</td>
<td>0.866</td>
<td>1</td>
</tr>
<tr>
<td>Unrealistic deadline</td>
<td>2</td>
<td>4.20</td>
<td>0.902</td>
<td>2</td>
</tr>
<tr>
<td>Lack of commitment from other parties</td>
<td>3</td>
<td>4.13</td>
<td>0.861</td>
<td>4</td>
</tr>
<tr>
<td>High workload</td>
<td>4</td>
<td>4.07</td>
<td>0.875</td>
<td>7</td>
</tr>
<tr>
<td>Communication barriers</td>
<td>5</td>
<td>4.06</td>
<td>0.896</td>
<td>4</td>
</tr>
<tr>
<td>Excessive working hours</td>
<td>6</td>
<td>4.01</td>
<td>0.885</td>
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<tr>
<td>Bureaucracy</td>
<td>7</td>
<td>4.00</td>
<td>0.892</td>
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<tr>
<td>High stress levels</td>
<td>8</td>
<td>3.87</td>
<td>0.902</td>
<td>8</td>
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<tr>
<td>Frequent disputes</td>
<td>9</td>
<td>3.75</td>
<td>0.917</td>
<td>9</td>
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<tr>
<td>Unpleasant relations with other personnel</td>
<td>10</td>
<td>3.75</td>
<td>0.930</td>
<td>9</td>
</tr>
<tr>
<td>Number of respondents (n)</td>
<td>84</td>
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<td></td>
<td>24</td>
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<tr>
<td>Kendall’s coefficient of concordance (W)</td>
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<td>0.074</td>
<td>0.165</td>
<td>0.065</td>
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<td>Level of Sig</td>
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<td>0.006</td>
<td>0.008</td>
<td>0.002</td>
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</tbody>
</table>

*Std D = Standard deviation
6.6 Conclusion

This section revealed the results of data collected from three groups of construction practitioners, namely clients, consultants and contractors. To allow for comparisons to be made between the different groups the data was presented collectively with all groups consolidated as well as individually with each respective group.

From the data collected the next chapter will give meaning to this data in relation to the research questions and objectives and also discuss some significant findings made in the study.
CHAPTER SEVEN: DISCUSSION OF FINDING

7.1 Introduction

This chapter provides discussions into the findings of the research based on the research questions. The data presented in the previous chapter (Chapter six) will be used to compare what was revealed in the literature review and therefore comparison can be done in respect of answering the research questions of the study.

7.2 Research Question 1

What are the critical success factors for the successful implementation of projects in South African construction supply chains?

What one person may perceive as successful may not necessarily be accepted as successful to someone else. This is a subject that will keep generating different results depending on regions and more importantly, different preferences. Han et al. (2012) mentioned that project success differs from one professional to another: for an architect success is dependant mostly on aesthetics while for a structural engineer it would be the integrity of the infrastructure in question. The researcher undertook to establish which project outcomes CSC were particularly emphasised by the various groups within the CSC when determining the success or alternatively, the failure of the project.

The study revealed that overall time taken to complete the project was the most important factor to consider when weighting the success of the project (with a mean score of 4.54). The client and contractor groups similarly ranked “time taken to complete the project” as the most important project outcome (mean = 4.33 and 4.64 respectively) with the consultants ranking it second (mean = 4.33). The study also revealed that time, cost and quality are still the most valued project outcomes in the construction industry with all three groups ranking these outcomes as such. The values for $W$ revealed that all groups were in agreement with regard to the ranking of these project outcomes (see Table 6.4).

Trying to define project success accurately is an elusive exercise particularly in an industry such as construction where complexities are the order of the day. Authors on the subject tend to divide factors based on a particular area within the project. For example, Han et al. (2012) explains that “Belassi and Tukel (1996) categorise project success factors into factors related
to the project, factors related to the project manager and team members, factors related to the organisation, and factors related to the external environment”. Therefore the researcher for this study decided to categorise the success factors relating to project functions in the CSC, namely: construction management, teamwork, design and safety, health, environment and quality (SHEQ) to make it more relevant to CSCs in South Africa.

7.2.1 Construction management

The researcher undertook to establish what construction management factors best determine the success of the project. Overall the respondents ranked (i) “contract documentation clarity”, (ii) “contract documentation selection” and (iii) “selection of appropriate project party” as the most important CM factors to the success of the CSC. “Corruption”, “insurance and risk management” and “dispute occurrence” were ranked as the least important factors to the success of the project. However overall $W$ was relatively low at 0.063 with a level of significance of 0.000

7.2.2 Teamwork

Teamwork relates to the manner in which the members of the CSC work collaboratively in order to realise the success of the project. The researcher undertook to determine which teamwork factors best determine the success of the project. Overall the respondents ranked (i) planning, (ii) good leadership and (iii) competence of parties as the most important teamwork (TW) factors. Individually the groups also ranked the top three factors similarly. Overall the least important TW factors were identified as stakeholder inclusion, educational background and background of individuals. Overall $W = 0.302$ (level of significance = 0.001), for clients $W =0.271$ (level of significance = 0.004), for consultants $W = 0.509$ (level of significance = 0.000) and for contractors $W =0.305$ (level of significance = 0.000 ). The value of $W$ is significant across all groups; therefore this is interpreted as agreement in the ranking of the TW factors overall and individually in each group.

7.2.3 Design

Because of the increase in complexities of client requirements, design plays an integral role in successfully rolling out a project. Design errors have resulted in many catastrophes in CSCs across the world and errors by designers are a common occurrence in the industry (Love et al., 2013). The researcher undertook to establish what design factors best determine
the success or subsequently the failure of a project. Overall the respondents ranked (i) “buildability of the design”, (ii) “design errors and mistakes” and (iii) “use of appropriate construction methodology” as the most important design factors. The values for $W$ are significantly low owing to the fact that this is a rather controversial subject in CSCs.

7.3 Research Question 2

What obstructions and challenges is the industry subjected to with regards to implementing collaborative models?

7.3.1 Inherent challenges in construction supply chains

Inherent problems in the day-to-day running of construction projects have left the industry to contend with some negative factors. Stakeholders are faced with the challenge of surviving in very competitive environments at all stages of the construction supply chain, compelling them to adopt suitable strategies and make changes to suit current practices. The respondents were asked to identify to what degree various factors created challenges in the CSC. Since CSCs are made up of different groups it is expected that challenges will differ from one group to another. Therefore the researcher undertook to identify which factors each group considered to be the most challenging in their line of responsibilities (see Table 6.14).

Client

The client group ranked (i) “lack of top management support”, (ii) unrealistic deadline” and (iii) “excessive working hours” as the most important factors contributing to challenges with mean scores of 4.29, 4.08 and 4.08 respectively. “High stress levels”, “frequent disputes and unpleasant relations with other personnel” were ranked as the least contributing factors. Test for commonality revealed $W$ to be 0.074 with a 0.000 level of significance.

Consultants

The consultant group ranked (i) “unrealistic deadline”, (ii) “bureaucracy” and (iii) “lack of top management support” as the biggest contributors of challenges in the CSC with means scores of 4.20, 4.20 and 4.13 respectively. As in the case of the client group discussed earlier “high stress levels” and, “frequent disputes and unpleasant relations with other personnel”
were also ranked as the least contributing factors. The test for commonality revealed $W$ to be 0.165 with a level of significance of 0.008

**Contractors**

The group of contractors ranked (i) “lack of top management support”, (ii) unrealistic deadline” and (iii) “high workload” as the biggest contributors of challenges in the CSC with means scores of 4.29, 4.27 and 4.20 respectively. Bureaucracy, “frequent disputes” and “unpleasant relations with other personnel” were ranked as the lowest contributors of challenges in the CSC. Test for commonality revealed $W$ to be 0.165 with a level of significance of 0.0065.

7.3.2 Obstruction to collaboration in construction supply chains

While it is widely agreed that collaboration can be the solution to many of the problems encountered in construction supply chains, one must understand that it cannot solve all problems. The views on collaboration are normally positive but failures have been experienced using these models. For one, Naom (2001) states what partnering is and what it aims to achieve can be somewhat of a confusing concept even to the most experienced of practitioners.

According to Van der Merwe and Basson (2006) collaborative models are yet to find their place in South African CSCs. Respondents were asked to rate to what extent factors were obstructing the implementation of collaborative models in South Africa, with the intention of identifying what barriers are restricting such models from being implemented in this particular country.

The respondents revealed that inexperience with collaboration and corruption are the biggest contributing factors that restrict the use of these models. Individually, clients and contractors also concurred in ranking the two factors first and second respectively. However, consultants ranked misunderstanding of the collaborative concept and lack of commitment in the collaborative process as the two impediments to collaboration.
The values of $W$ for the clients and contractors were relatively low at 0.039 and 0.087 respectively, indicating that agreement on the ranking of the factors was inconsistent between the two groups. Compared to the two groups (clients and contractors), consultants had a much higher value for $W$ (0.235). This is therefore interpreted as greater consensus on the ranking of the factors. One can attribute these results to the fact that unlike clients and contractors, consultants find themselves enjoying inter-organisational relations within the project more frequently. Therefore the consultants cannot put emphasis on “inexperience with collaboration” as a barrier in their group of practitioners.

### 7.4 Research Question 3

What are the factors that contribute towards construction supply chains being fragmented?

There is a general consensus on construction supply chains being fragmented. This is shared across most construction industries around the world. South Africa is no different. When asked to rate the various factor causing construction supply chains to be fragmented respondents identified the top factors to be corruption, price-oriented selection methods, a lack of commitment from other parties, unrealistic deadlines and the selection of contract and pricing strategy. Corruption is a serious malaise with which construction supply chains around the world are having to contend. In China Zou et al. (2007) mentioned that corruption has been the root of many tendering irregularities. In South Africa six of the biggest construction firms were under investigation for collusion for in stadia construction for the 2010 Football World Cup. Therefore it comes as no surprise that this factor was ranked the biggest contributor of fragmentation in South African construction supply chains. The least contributing factors to CSCs being fragmented were inter-personal dynamics, the short-term nature of contracts, and organisation and individual cultural differences.

The values for Kendall’s co-efficient of concordance ($W$) were: overall $W = 0.108$, clients $W = 0.072$, consultants $W = 0.272$ and for contractors $W = 0.118$, all with a level of significance of 0.0001. A high or significant value of $W$ indicates that different parties are essentially applying the same standard in ranking. Therefore for this subject the consultants have a higher degree of agreement than any of the other groups.
7.5 Research Question 4

What are the factors that positively affect the success of collaboration in construction supply chains?

There are various factors which contribute towards the success of construction supply chain collaboration. South Africa in particular is unique in that such models are not predominately used. In order to promote the use of such models in South African construction supply chains the researcher identified factors which could assist in the successful implementation of collaborative models. When asked to rate the influence of factors which foster collaboration in construction supply chains overall the respondents ranked: (i) good leadership, (ii) effective communication, (iii) top management support, (iv) adequate resources and (v) knowledgeable client as the top five factors. A similar investigation in Hong Kong was carried out by Cheng and Li (2002). Their tests revealed top management support, mutual trust and communication as the most important factors in the collaboration process. The researcher’s results were similar to other authors’ results, in particular those of Akintoye et al. (2000), Bayliss et al. (2004), Chan et al. (2004) and Rahman and Kumaraswamy (2008).

Experience with working in collaborative models, regular monitoring of the collaborative process, open book accounting, incentives, risk sharing and stakeholder inclusion were ranked as the least influential factors to fostering success in construction supply chains. The findings by the researcher challenge some of the findings in literature. Literature on SCM, for example, makes critical reference to the inclusion of all stakeholders affected by the process or project. Other salient contradictions are the benefits of incentives and risk sharing. According to Ling et al. (2006), incentives are one of the most critical operational arrangements that collaborative models offer to users, in that collaborative models provides a platform for effective incentive structures to be arranged (mutual future planning, risk sharing and financial rewarding). Similar views are expressed by Anvuur and Kumaraswamy (2007), Rahman and Kumaraswamy (2008) and Xue et al. (2010). This goes further to reinforce the contention that construction practitioners in South Africa do not have experience in the use of collaborative models hence the appreciation will be different to region where for such models are used more regularly.

To identify how each of the groups (contractors, clients and consultants) ranked the collaborative factors, the researcher used Kendall’s co-efficient of concordance to test for
commonality. From Table 6.2 the consultants were the only group that ranked effective communication as more important than good leadership. Also important to note is the consensus among all three groups with regards to the ranking of the top five factors. This is also supported by the value Kendall’s co-efficient of concordance \((W=0.126)\). To test commonality in each group \(W\) revealed that there was agreement in each of the stakeholder groups (client \(W=0.116\), consultant \(W=0.144\), contractor \(W=0.166\)).

### 7.6 Research Question 5

What qualities should industry practitioners look for in an organisation when selecting a potential alliancing or partnering associate?

Many of the problems which arise in CSCs are as a result of poorly assembled teams. The results of this; the construction industry has had to contend with an adversarial and fragmented culture which continues to fester, resulting in the unfortunate predicament in which some supply chains find themselves in. This is why it is so important that various factors are weighted when making a selection of the ideal mix of stakeholders for the CSC.

Literature provides for various techniques to assist in the application of selecting various stakeholders in the CSC. Some techniques are widely viewed as flawed, for example price based selection. Some techniques which claim to be more accurate are very complex, time consuming and not user-friendly. One such example is the fuzzy approach technique for contractor selection advocated by Bendaña et al. (2008). The researcher undertook to understand what selection factors industry practitioners consider when making their choice of partner for the supply chain (see Table 6.8). Overall the respondents identified (i) quality of previous work, (ii) the ability to deliver on time, (iii) experience with similar work, (iv) technical ability and (v) effective and efficient decision making as five of the most important factors to evaluate and consider when selecting a potential partner. When looking at the groups individually, consultants and contractors had the same top five factors.

Similar results were generated by Rahman and Kumarswamy (2005). In their study technical ability, ability to deliver on time, experience in similar work, quality of work and approach to
joint decision making came up as the most common factors to consider when selecting a potential partner.

In this study the respondents ranked health and safety considerations and records, organisational lines of communications, any special requirements (such as, BBBEEE requirements), litigation/ dispute history and political issues as the least important factors to consider when selecting a potential collaboration partner. What was an important factor to note was selection based on price tender. Overall this factor was ranked at 10 which was midway in the table. This can be interpreted as: although price-orientated selection has been the result of many ills in the industry, the reality is that price is still a strong consideration yet not the most important.

Kendall’s co-efficient of concordance was used test for commonality. The test revealed that agreement of the ranking was relatively low in comparison to the groups individually, particularly in comparison to the consultants and contractors groups. Overall \( W = 0.120 \), client \( W = 0.055 \), consultants \( W = 0.218 \) and contractors \( W = 0.173 \).

### 7.7 Conclusion

This chapter provided discussions relating to the research questions on the use of collaborative models in improving the performance of construction supply chains in South Africa. The critical success factors of construction supply chains (CSCs) were and the causes of fragmented CSCs, factors that affect the success of collaboration and qualities of potential collaborative partners were discussed to answer the research questions.

With respect to the research objectives, the next chapter will provide conclusions and recommendations of the study.
CHAPTER EIGHT: SUMMARY CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This study was undertaken to improve the performance of construction supply chains (CSCs) through the use of collaboratively structured models. The study was centred around five research objectives which were directed at addressing the use of collaborative models in South African construction supply chains. This chapter concludes on the data collected in both the literature review and the research questionnaire in order to address the research objectives. Recommendations are also provided on the subject of collaboration in South African CSCs.

8.2 Research Objective One

The first research objective was to identify what the critical success factors for the construction supply chain are.

8.2.1 Data generated in the research questionnaires

The study identified that construction practitioners believe that project success is mainly focused around the following three factors:

- Time taken to complete the project;
- Quality of workmanship; and
- Cost of the project.

However, the above factors are inadequate because there are more factors that affect and contribute to the project success. The study identified three other themes under which project success can be achieved, namely team work, construction management design and health and safety. These themes are part of the day-to-day experience in a basic construction supply chain. Overall, the following factors were identified as the most critical to the success of the construction supply chain under each of the aforementioned themes:

- Construction management
  - Contract documentation clarity;
  - Contract documentation selection; and
- Selection of the appropriate project party.
- Teamwork
  - Planning;
  - Good leadership; and
  - Competence of parties.
- Design
  - Buildability of the design;
  - Design errors, mistakes; and
  - Use of appropriate construction methodology.
- Health and Safety
  - Accidents;
  - Workers’ health; and
  - Secure working environment.

8.3 Research Objective Two:

The second objective for the study was to identify what obstructions and challenges construction supply chains have in implementing collaborative models.

8.3.1 Date reviewed in Literature

Problems in the day-to-day running of construction projects have left the industry to contend with some negative factors. Stakeholders are faced with the challenge of surviving in very competitive environments at all stages of the construction supply chain, compelling them to adopt suitable strategies and make shifts to suit current practices. Many researchers have identified various challenges relating to the performances of CSCs, *inter alia*, poor contractor performance, design defects, vague/ambiguous briefs, inappropriate risk management, a lack of top management support, corruption, poorly integrated supply chains, inexperienced-incompetent personnel, poor communication and a lack of trust.

Cheung *et al.* (2003) identified barriers related to rigid tenders processes, misunderstanding of partnering processes, and a lack of knowledge, experience and commitment in adopting partnering as challenges.

Mbachu and Nkado’s (2007) identification of fractured relations in the South African construction industry traced back to, *inter alia*, the divergence in the views of project
stakeholders. Phua and Rowlinson (2003) identified that in-grouping and out-grouping influenced co-operative behaviour in a bad way. They go on to say that the disjointed nature of the construction industry is a result of professional alliances, where construction professionals are singled out according to their area of knowledge (in-grouping). This creates a synthetic barrier for relationship success by dividing the construction professionals, separating them from other organisations.

8.3.2 Data generated in the research questionnaires

The respondents were asked to identify to what degree various factors created challenges in the CSC. Since CSCs are made up of different groups it is expected that challenges will differ from one group to another. Therefore in the study the factors of each group were identified to consider what the most challenging factors in each field of practice were (see Table 6.14):

According to the client group of practitioners lack of top management support, unrealistic deadline and excessive working hours are the most important challenges faced in the CSC. High stress levels, frequent disputes and unpleasant relations with other personnel were seen as the least challenging factors.

The consultant group ranked unrealistic deadline, bureaucracy and lack of top management support as the biggest challenges in the CSC. Similar to the client group, high stress levels, frequent disputes and unpleasant relations with other personnel were seen as the least challenging factors.

The group of contractors identified a lack of top management support unrealistic deadlines and high workload as the biggest contributors of challenges in the CSC. However, bureaucracy, frequent disputes and unpleasant relations with other personnel were identified as the lowest contributors of challenges in the CSC.

Overall inexperience with collaboration remains the biggest constraint in the application of collaborative models in CSCs, followed by corruption. Individually, clients and contractors also shared consensus in ranking the two factors first and second respectively. However, consultants ranked misunderstanding of the collaborative concept and lack of commitment in the collaborative process as the two impediments. Other barriers identified included a lack of faith in the benefits of collaboration, a lack of commitment to the process and
overdependence on others (see Table 6.5). Therefore there is a gap in the industry that needs to be filled to educate practitioners on the use of collaborative models, while at the same time getting practitioners to confidently apply such models in their projects. Corruption in construction is an issue that most countries around the world struggle to contain, therefore stronger, more punitive measures need to be in place to put an end to this corrupt culture which is poses a threat to the industry.

8.4 Research Objective Three:

The third objective for the study was to identify factors that influence construction supply chains to be fragmented.

8.4.1 Date reviewed in literature

Construction supply chains are environments where multiple stakeholders with different expectations and influences need to be consolidated. Relationships between stakeholders and the project need to be efficiently managed in order for the project to be successful. However, according to the manner in which CSCs are currently run this is still elusive. In literature it is extensively conveyed that CSCs are fragmented in nature, affecting projects negatively. Many researcher also advocate that supply chain integration is the way forward in curbing project failure.

The vast numbers of stakeholders that make up the CSC add to the pool of complexities that plague the project. Contracting styles often obstruct supply chain integration, requiring the application of prime contracting frameworks and agreements. Traditionally procurement systems in construction have been structured for once-off contracting. This weakness has resulted in many stakeholders working in silos and exclusively looking out for their own. For example, the design stage of the project is traditionally treated as a separate activity to the construction phase and therefore designers do not exploit the benefits of involving the contractor. This type of contracting style promotes a culture of opportunistic behaviour. Parties lack a sense of solidarity and are therefore left feeling either inferior or superior toward other parties. Such conditions can prove detrimental to all stakeholders in the relationship.

Other identified factors contributing towards fragmented CSCs were:
Lack of flexibility in contracting style; did not operate seamlessly, members work disjointedly within their individual organisations; working distance- not co-locating; blame culture; dominance over other culture; relationship not formed early on in the project; swerved project goal. (Baiden et al., 2006).

Adversarial relationships; distrust; failure to share risk; cultural barriers; lack of commitment and lack of communication (Chan et al., 2003). Adversarial relationships, conflicting demand and supply nature of industry; complex structures of power in the materials, labour, equipment and professional services marketplaces; and party dominance. (Cox and Ireland, 2002).

Stakeholder selection; traditional contract selection and pricing strategy selection; opportunism; risk - responsibility management styles; incentive/disincentive arrangement; and conflict and dispute management (Palaneeswaran et al., 2003).

8.4.2 Data generated in the research questionnaires

Guided by the factors highlighted in literature the researcher took the country’s construction industry background into consideration and identified twenty factors which could be hampering supply chain integration in construction. From Table 6.1, overall, of the twenty identified factors by the researcher, the top ten factors which contribute towards fragmentation in CSCs as deduced in the data from the respondents were identified as:

- Corruption,
- Price-orientated selection methods,
- Lack of commitment from other parties,
- Unrealistic deadlines,
- Selection of contract and pricing strategy,
- High stress levels,
- Complex nature of projects,
- Adversarial (aggressive) relationships,
- Lack of trust, and
- Unpredictable nature of projects.
The results above are a reflection of the problems which are causing harm to the South African construction industry in general. These are factors with which many practitioners do battle on a recurring basis. Therefore a compulsory paradigm shift will be the answer to engineer CSCs to be more collaborative in their contracting style.

8.5 Research Objective Four

Research objective four was identifying what factors influence the success of collaboration in construction supply chains.

8.5.1 Date reviewed in Literature

Critical success factors relating to any subject in construction are very popular. This is because extensive research has been conducted on the subject. Researchers have endeavoured to discover ways of establishing an ideally structured collaborative CSC. Most researchers have shared consensus on which features best aid in establishing a coalesced team. These may be listed as follows:

- Mutual trust,
- Open communication,
- Top management support,
- Good leadership, and
- Sharing culture.

Mutual trust is the process in which people within the CSC are both trusting and trustworthy. This is a prerequisite for any transaction. From the literature three types of trust were considered as applicable in a CSC setting (Khalfan et al., 2007; Pinto et al., 2009). These were identified as competence trust, integrity trust and intuition trust. Competence trust relates to a party having faith in the abilities of another party. Integrity trust is based on honesty and keeping an open book on matters. Intuition trust is emotionally driven and is governed by ‘gut feel’.

Worth noting is that trust and open and effective communication are interdependent, i.e. trust is an enabler of open and effective communication and open and effective communication is
an enabler of trust, the two are not mutually exclusive. For effective communication the parties are required to participate in an environment that is conducive to information to be exchanged successfully.

A willingness to commit to the collaborative process must be supported across all lines of the organisations involved in the CSC. Ling et al. (2006) explain that without support from top management it is impossible to share complementary resources such as knowledge, technology, information, skills, and capital specific to the project. Sharing is at the heart of collaboration in CSCs.

Good leadership is another essential component to the collaborative process. The team needs to be led at all times to ensure that everyone is aligned and moving in the same direction.

8.5.2 Data generated in the research questionnaires

In order to promote the use of such models in South African construction supply chains the researcher identified factors which could assist in the successful implementation of collaborative models. Overall the respondents identified the following critical success factors:

- Good leadership;
- Effective communication;
- Top management support;
- Adequate resources;
- Knowledgeable client;
- Mutual Trust;
- Proactive and enthusiastic client;
- Acting in line with objectives;
- Efficient conflict resolution system; and
- Positive attitude and commitment of stakeholders.

Experience with working in collaborative models, regular monitoring of the collaborative process, open book accounting, incentives, risk sharing and stakeholder inclusion were ranked as the least influential factors to fostering success in construction supply chains. The findings by the researcher challenge some of the findings in the literature. Literature on SCM for example, makes critical reference to the inclusion of all stakeholders affected by the
process or project. Other salient contradictions are the benefits of incentive and risk-sharing. According to some sources, incentives are one of the most critical operational arrangements that collaborative models offer to users and collaborative models provide a platform for effective incentive structures to be arranged.

8.6 Research Objective Five:

The last objective for this study was identifying what qualities practitioners should look for in an organisation when selecting a potential alliancing or partnering associate.

8.6.1 Date reviewed in Literature

Not all organisations have the necessary abilities to work collaboratively. Therefore authors in literature have come up with distinctive models all suggesting the most effective way of selecting the different parties with which to conduct business with in a CSC setting. Some of the prominent models identified include the following:

- The fuzzy control technique by Bendaña et al. (2008) – used to select the most suitable contractor;
- Relational selection technique by Rahman and Kumaraswamy (2005) – used to select supplier, client, consultant and contractor;
- Combined radix by Wang et al. (2007) – used to select all main parties; and
- ELECTRE method by Zielina (2010) – used to select sub-contractors.

The aforementioned models all make use of mathematically generated figures to quantitatively support the selection of various parties to the supply chain. Although these are highly respected techniques in academia they are highly complex and not user-friendly for practice.

Contractor selection is the most researched topic as opposed to the other stakeholders in the CSC. However, sufficient work has been done to assist practitioners with identifying what qualities to look for when selecting. The selection of potential stakeholders should be steered by the intended outcomes of the project and should be driven by factors that will ensure the smooth running of operations. Low price selection must be avoided as this can be seriously detrimental in all areas, negatively affecting the success of the project. Both hard and soft
factors need to be weighed up to seek out the services of various stakeholders to make up the CSC.

### 8.6.2 Data generated in the research questionnaires

Many of the problems which arise in CSCs are as a result of poorly assembled teams. The results of this; as the construction industry has had to contend with an adversarial and fragmented culture which continues to fester, resulting in the unfortunate state in which some supply chains find themselves. The study revealed what selection factors industry practitioners should consider when making their choice of partners for the supply chain. Overall the respondents identified the quality of previous work, the ability to deliver on time, experience with similar work, technical ability and effective and efficient decision making as five of the most important factors to evaluate and consider when selecting a potential partner. The least important factors to consider were highlighted as: health and safety considerations and records, organisational lines of communications, any special requirements (for example BBBEEE requirements), litigation/ dispute history and political issues.

### 8.7 Conclusion

This study adopted an integrate approach (literature review, case study and exploratory survey) to address the gap in collaborative modelling in the South African construction industry. Through the use of literature from related articles, case studies and research questionnaires the study strived for improving construction supply chains through the use of more collaboratively structured project teams. Compared to the business-as-usual, fragmented style of construction supply chains, a paradigm shift in the direction of more collaboratively structured construction supply chains will prove to be beneficial in attaining overall better value for the project.

Construction industries around the world play a pivotal role in driving global economies. In developing countries this phenomenon is even more evident. Africa is a continent with many such developing countries thus providing an attractive breeding ground for infrastructure development. Supply chain management practices originated in the manufacturing industry and today it is these principles that have enabled success in many other industries. The principles of supply chain management have been used to provide a platform on which collaborative models can be practised in the construction industry.
Several collaborative models are available for use by construction practitioners with the most popular being partnering and alliancing. It must be noted, however, that working collaboratively has always happened in construction supply chains; the problem arises when there is no system in place to assist and facilitate relational transactions. Project management is an important function that ensures that these transactions are nurtured from the beginning of the project until the end. Collaboration should be a mix of formal and informal exchanges.

8.8 Recommendations

Collaboration in South African construction supply chains (CSCs) is poorly presented as a model within the contract. A shift to more integrated CSCs is desperately needed so that construction projects can benefit from the contributions of such models. The following recommendations are suggested:

- Collaborative models should be adopted across more construction projects in South Africa.
- Incentive structures need to be formulated into the construction contracts so that practitioners can be motivated to work collaboratively to meet the client’s needs.
- Increase awareness on collaboration in construction supply chains should be created through, training and development of practitioners on the use of collaborative models.
- A facilitator specialising in collaboration in CSCs, needs to be appointed at the beginning of the project to ensure that the collaborative process is maintained throughout the duration of the contract.
- Collaboration and the inclusion of all stakeholders must take place early on in the project development.
- Stricter regulations need to be instituted to curb corruption in construction.
- Top management from all organisations involved in the construction project need to support the integration of the collaborative element into the conditions of contract.

8.9 Recommendations for further research

Collaborative models in South African CSCs are virtually non-existent. To further exacerbate the lack of implementation very little literature relating to collaboration in South African CSCs is available. The researcher recommends that research can be conducted on the following topics:
• The inclusion of all stakeholders in the project planning.
• The use of incentive structures as a driving tool to achieve project success.
• Incorporation a project charter into the project.
• Collaboration to improve the expansion into green building practices.
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To whom it may concern

Dear Sir/ Madam

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

You are humbly invited to participate in this research survey. Please accept this invitation to contribute to the industry’s body of knowledge. This research survey will form part of a study in the fulfilment of a Master’s in Technology: Construction Management degree at the University of Johannesburg through the Faculty of Engineering and the Built Environment, Department of Construction Management and Quantity Surveying. The study you are about to take part in is titled, The use of collaborative models to improve the performance of construction supply chains in South Africa

The study requires that data be acquired from industry practitioners, like yourself in order to establish ways to support construction supply chain performance by improving project delivery to the satisfaction of all stakeholders affected. You and your company have been identified as appropriate candidates and are kindly requested to respond to the questionnaire.
The information acquired in this study will be used for strictly statistical analysis. Your name and the name of your company are not required: you will remain anonymous and the information you provide will be treated with strict confidence.

Your participation in this research will give perspective on the abovementioned topic and will provide a platform for further research, seeing that it is one which has not been extensively investigated in the South African construction industry. Please answer the questions as accurately and as truthfully as possible.

Answering this questionnaire will take approximately 20 minutes.

Should you wish to ascertain the findings of the study once complete, you are welcome to contact N.M. Masemeni at: 082 792 4490 or at: 200817041.student@uj.ac.za alternatively Prof C. Aigbavboa at: +2711-559-6398 or at: caigbavboa@uj.ac.za. The faculty will gladly send you a summary of the results.

Thank you in advance for your co-operation.

Kind regards

N.M. Masemeni (Researcher)    Dr C. Aigbavboa (Supervisor)     ProfD.W. Thwala
(Co-Supervisor)
APPENDIX B

QUESTIONNAIRE ON THE USE OF COLLABORATIVE MODELS TO IMPROVE THE PERFORMANCE OF CONSTRUCTION SUPPLY CHAINS IN SOUTH AFRICA

INSTRUCTIONS:
PLEASE ANSWER THE FOLLOWING QUESTIONS BY CROSSING (X) ON THE RELEVANT BLOCK OR WRITING DOWN YOUR ANSWER IN THE SPACE PROVIDED.

EXAMPLE of how to complete this questionnaire:

Your gender? If you are female:

<table>
<thead>
<tr>
<th>Male</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>2</td>
</tr>
</tbody>
</table>

Section A – Respondent background

This section of the questionnaire is aimed at obtaining the background information of the respondents. This information will allow for comparisons to be made between the various stakeholders. The information supplied will be treated with confidence.

To which organisation in the construction supply chain do you belong?

<table>
<thead>
<tr>
<th>Public sector client</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private sector client</td>
<td>2</td>
</tr>
<tr>
<td>Consultant: project manager</td>
<td>3</td>
</tr>
<tr>
<td>Consultant: architect</td>
<td>4</td>
</tr>
<tr>
<td>Consultant: engineer (electrical, mechanical, structural, etc.)</td>
<td>5</td>
</tr>
<tr>
<td>Consultant: quantity surveyor</td>
<td>6</td>
</tr>
<tr>
<td>Contractor</td>
<td>7</td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
</tr>
</tbody>
</table>

Please specify others ..............................................................................................................................................

How many years of experience do you have working in the construction industry?

| 1 – 5 years | 1 |
| 6 – 10 years | 2 |
| 11 – 15      | 3 |
What is the nature of the project(s) you are involved in? (You can select more than one)

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>1</td>
</tr>
<tr>
<td>Civil</td>
<td>2</td>
</tr>
<tr>
<td>Road and Earth works</td>
<td>3</td>
</tr>
<tr>
<td>Specialist engineering (marine, oilfield, etc.)</td>
<td>4</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
</tr>
</tbody>
</table>

Please specify for others ……………………………………………………………………….

Indicate the number of projects you (personally) are currently working on?

………………………………..

What is your highest level of education?

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal education</td>
<td>1</td>
</tr>
<tr>
<td>Primary school</td>
<td>2</td>
</tr>
<tr>
<td>High school</td>
<td>3</td>
</tr>
<tr>
<td>Grade 12 (or equivalent)</td>
<td>4</td>
</tr>
<tr>
<td>Diploma</td>
<td>5</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>6</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>7</td>
</tr>
<tr>
<td>Doctoral degree</td>
<td>8</td>
</tr>
</tbody>
</table>

Please specify for others ……………………………………………………………………….

At what level of management are you currently working?

<table>
<thead>
<tr>
<th>Level of Management</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational</td>
<td>1</td>
</tr>
<tr>
<td>Management</td>
<td>2</td>
</tr>
<tr>
<td>Fragmenting factors</td>
<td>NI</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----</td>
</tr>
<tr>
<td>FRF1 Opportunistic behaviour</td>
<td>1</td>
</tr>
<tr>
<td>FRF2 Adversarial (aggressive) relationships</td>
<td>1</td>
</tr>
<tr>
<td>FRF3 Short-term nature of projects</td>
<td>1</td>
</tr>
<tr>
<td>FRF4 Corruption</td>
<td>1</td>
</tr>
<tr>
<td>FRF5 Price-oriented selection methods</td>
<td>1</td>
</tr>
<tr>
<td>FRF6 Inter-personal dynamics</td>
<td>1</td>
</tr>
<tr>
<td>FRF7 Cultural difference (individual)</td>
<td>1</td>
</tr>
<tr>
<td>FRF8 Cultural difference (organisational)</td>
<td>1</td>
</tr>
<tr>
<td>FRF9 Selection of contract and pricing strategy</td>
<td>1</td>
</tr>
<tr>
<td>FRF10 Unrealistic deadlines</td>
<td>1</td>
</tr>
<tr>
<td>FRF11 Lack of commitment from other parties</td>
<td>1</td>
</tr>
<tr>
<td>FRF12 High stress levels</td>
<td>1</td>
</tr>
</tbody>
</table>
Below is a list of factors which could foster collaboration in construction supply chains. In your experience how influential is each factor in fostering collaboration in construction supply chains?

<table>
<thead>
<tr>
<th>Collaboration factors</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF1 Top management support</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF2 Adequate resources (Financial, operational, etc.)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF3 Mutual trust</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF4 Effective communication between stakeholders</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF5 Efficient conflict resolution system</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF6 Positive attitude and commitment of stakeholders</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF7 Motivation to work collaboratively</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF8 Good leadership</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF9 Acting in line with objectives</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF10 Flexibility to adopt change when required</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF11 Joint problem solving</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF12 Open book accounting / transparency</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF13 Incentive and risk sharing</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF14 Regular monitoring of the collaborative process</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>CF15 Formal contract</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
CF16  Knowledgeable client (on construction processes)  1  2  3  4  5
CF17  Proactive and enthusiastic client  1  2  3  4  5
CF18  Stakeholder inclusion  1  2  3  4  5
CF19  Experience with work in collaborative models  1  2  3  4  5
CF20  Knowledge transfer  1  2  3  4  5

In your experience to how can the following influence the use of more collaborative projects in construction supply chains?

<table>
<thead>
<tr>
<th>Benefit factors</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td>BF1 Shared risk</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF2 Shared profit</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF3 Job satisfaction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF4 Joint problem solving</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF5 Reduction in dispute and conflict</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF6 Job continuity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF7 Learning environment</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF8 Flexibility in the use of the contract</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF9 Improvements in Health and Safety performance</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>BF10 Meeting project deadlines</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

In your experience how can collaboration influence the performance of the following project parameters?

<table>
<thead>
<tr>
<th>Project parameters</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPP1 Cost estimate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PPP2 Time of expected completion</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PPP3 Quality standards</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PPP4 Functionally of infrastructure</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PPP5 Health and Safety</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>PPP6 Frequency of disputes and conflict</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

To what extent do the following factors hinder/obstruct the use of collaborative models in construction supply chains?
<table>
<thead>
<tr>
<th>Obstruction factors</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td>OF1 Inexperience with collaboration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF2 Cost of training to implement the collaborative process</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF3 Inherent aggressive nature of the industry</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF4 Corruption</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF5 Misunderstanding of collaborative concepts</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF6 Overdependence on others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF7 Cultural barriers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF8 Distrust from past experiences</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF9 Lack of commitment to the process</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OF10 Lack of faith in the benefits of collaboration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

How frequently have you been in a construction project using the following conditions of contracts?
Please indicate using the 5-point Likert scale for each item where:
1 = Never (N)
2 = Seldom (S)
3 = Occasionally (OC)
4 = Often (OF)
5 = Always (A)

<table>
<thead>
<tr>
<th>Condition of contracts</th>
<th>N</th>
<th>S</th>
<th>OC</th>
<th>OF</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>COC1 Joint Building Contracts Committee (JBCC)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>COC2 General Conditions of Contracts (GCC)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>COC3 FIDIC</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>COC4 New Engineering Contract (NEC)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
How frequently have you been in a construction project using the following collaborative models to work through the contract in the past three (3) years?

<table>
<thead>
<tr>
<th>Collaborative model</th>
<th>N</th>
<th>S</th>
<th>OC</th>
<th>OF</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCM1 Partnering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCM2 Alliancing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCM3 Joint venturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCM4 Relational contracting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCM5 Sub-contracting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you were to adopt a collaborative model for a construction project to what extent would the following factors influence your choice of partner? Please indicate using the 5-point Likert scale for each item where:

1 = Not at all influential (NI)
2 = Slightly influential (SI)
3 = Moderately influential (MI)
4 = Very influential (VI)
5 = Extremely influential (EXI)

<table>
<thead>
<tr>
<th>Selection factor</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1 Litigation/ dispute handling history</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF2 Ability to delivery on time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF3 Quality of previous work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF4 Effective and efficient decision-making</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF5 Organisation’s line of communication (Bureaucracy)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF6 Solid organisational structure</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF7 Experience in similar work</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF8 Financial stability of the organisation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF9 Amount of other work the organisation is currently undertaking</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF10 Price (tendered) or value of project</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF11 Technical ability</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF12 Attitude towards teamwork</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF13 Approach to negotiation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF14 Creativity and innovation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>SF15 Health and Safety consideration and</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Section C – Construction project performance

This section of the questionnaire explores industry practitioners’ understanding of how construction supply chains perform.

To what degree do the following parameters influence the outcome of construction projects? Please indicate this according to the 5-point Likert scale for each item: where,
1 = Not at all influential (NI)
2 = Slightly influential (SI)
3 = Moderately influential (MI)
4 = Very influential (VI)
5 = Extremely influential (EXI)

<table>
<thead>
<tr>
<th>Outcome of project</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP1 Cost of project</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OP2 Time taken to complete the project</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OP3 Quality of workmanship</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OP4 Functionality of the infrastructure constructed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OP5 Health, Safety and Environment compliance</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>OP6 Frequency of disputes and conflict</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
In your experience to what extent do the following factors influence the successful performance of construction supply chains?

<table>
<thead>
<tr>
<th>Category</th>
<th>Factors</th>
<th>NI</th>
<th>SI</th>
<th>MI</th>
<th>VI</th>
<th>EXI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contract Management</strong></td>
<td></td>
<td></td>
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In your experience to what extent do the following factors create challenges for project participants?

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THANK YOU FOR TAKING THE TIME TO READ THIS RESEARCH