Improving the efficiency and performance of the supply chain in the construction industry

Submitted in fulfilment of the requirements of the degree of Doctor of Philosophy in Management Sciences Specialising in Leadership and Complexity
In the Faculty of Management Sciences at the Durban University of Technology

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SUPERVISOR: _ **DATE: 17/03/2020**

Declaration by student

I, Lewis Tsuro, declare that this dissertation is solely my own work and has never been submitted for any degree qualification in the past. Except where stated otherwise, by reference or acknowledgment, the work presented is entirely my own.

Signature Date 17/03/2020

ABSTRACT

The interconnectedness of the supply chain, project management and leadership are key to an operational model being developed in the supply chain of the construction industry. There are numerous challenges that are said to inhibit the smooth operation of supply chains in construction projects; however, considered through the lens of systems thinking and a soft systems methodology (SSM), the definition or cause of a problematic situation is often not clearly defined. The aim of this study was to apply SSM in relation to the supply chain processes of a construction site in Rosebank, Johannesburg, in the Gauteng province of South Africa critically, in order to determine how to make possible changes for incremental improvement of the efficiency and performance of the supply chain processes. A descriptive research framework was performed, where purposive sampling was used to recruit a sample of managers, sub-contractors and workers involved with supply chain tasks on the chosen construction site. To gather the necessary data, open-ended questions were presented through face-to-face interviews with the sample; after which, the data was analysed in two stages: Phase One involved the qualitative thematic analysis of the interview transcripts, and Phase Two required performing SSM on the data.

A wide spectrum of themes was deciphered from the study, following the SSM analysis, which confirmed that the definition and cause of a problematic situation is often not clearly defined; and indeed, there is often not even consensus on whether a problem exists to begin with. A key example of the 'messiness' of the supply chain of this project was observed in the case of aspects such as handling, scheduling, procurement, storing and safety, where despite the numerous comments describing their strengths in the project's supply chain, these aspects were also noted by numerous individuals to be problematic in the supply chain as well.

In deciphering exactly why the project's management was failing to overcome the challenges on the project supply chain, this research ascertained how the soft characteristics of the project managers (PMs) had limited the effectiveness of the supply chain on the project. Specifically, it was found that issues with the vision, risk-taking, emotional intelligence, trust, self-awareness, supportiveness, communication and motivation to the subcontractors and workers had limited the effectiveness of the supply chain on the project by causing worker-related problems; manager-specific problems; and reduced project efficiency. The results of this study therefore concurred with the literature that there was a need for the PMs on the site to employ

a more worker-centred style of management, to be able draw the most from the workers. It was argued here, though, that while suggestions in the literature call for a PM to be a 'servant' of the worker, the priority for this project should instead have been more towards striking a balance between the current principles of client focus, and Servant Leadership. It was also argued here that PMs clearly needed to improve communication skills to enhance the efficiency of the project, or to make future undertakings more efficient and smooth running.

Finally, at the culmination of the SSM, a model for change was developed to help cope with the numerous internal and external inhibitory factors surrounding the project site; whereby, changes that were noted that were the most feasible changes, requiring the least effort and producing the most benefit, were for the management to negotiate a later hand-over time for the project; and to have the workers work over-time to strive to complete the project faster. It was also recommended that equipment efficiency should be increased; to recycle the space on the site; for aspects of the site management to become less autonomous; for the management to check work quality and ensure work adherence; to provide earlier communications on delivery; for the management to ensure work understanding across the site; and for the management to perform more forward planning. Indeed, such changes should, theoretically at least, be immediate changes that could be made on this, or any construction project, and would tentatively draw instant tangible results without requiring considerable financial outlay, stakeholder buy-in, or managerial approval. Consequently, SSM has proven to be a powerful means of measuring the supply chain processes of a new office construction project in Rosebank, Johannesburg.

DEDICATION

I would like to dedicate my dissertation to my beloved brothers and sisters, mostly for their continued love of education, and for their continuous appetite to search for better ways of living in our times. I would also like to dedicate this dissertation to our parents, John and Margaret Tsuro, who planted the seed of a love of books in us; though they did not have that chance themselves. To God, I offer continuous praise and thanksgiving for all my family.

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LIST OF ABBREVIATIONS

BBBEE	Broad-Based Black-Economic Empowerment
CEPC	Complexity and emergent properties
CLT	Complexity Leadership Theory
CPSC	Construction project supply chain
PESTLE	Political, economic, social, technological, legal and environmental
PM	Project Manager
PMs	Project Managers
QFD	Quality function deployment
ROI	Return on investment
SSM	Soft Systems Methodology
UNDP	United Nations Development Programme

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CHAPTER ONE
INTRODUCTION

1.1. INTRODUCTION

Outsourcing is a component of almost every construction project, because construction projects are typically very large, and their delivery timelines are generally very tight (Yong Seng, Mehdi Riazi, Mohd Nawi and Ismail 2018: 155). In construction, generally, the main contractor would outsource a number of issues in which they were not specialists, so they could focus on improving the performances of their key speciality areas, while also reducing costs (Emuze and Julian Smallwood 2014: 294; Vrijhoef and Koskela 2000: 171). There is a lot of work that is done by subcontractors on behalf of the principal contractor, such as electricians, carpenters, builders, and more; and these subcontractors would also have foremen and managers on-site, depending on the size of the job (Thwala and Phaladi 2009: 533).

The supply chain has many players; and currently, the literature does not seem to elaborate much on the relationships of management with subcontractors, especially in the planning phases of projects (Venselaar, Gruis and Verhoeven 2015: 1-8). The term procurement seems to dominate the supply chain, but it is only one of the components of the supply chain (Croxton, Garcia-Dastugue, Lambert and Rogers 2001: 13). The current supply chain management systems have also been focusing solely on the contractor, while ignoring other important players (Zlatanovic 2015: 15).

There are numerous challenges that are known to inhibit the smooth operation of supply chains in construction projects, which can be categorised as either external challenges, which occur on a macro-scale, or internal challenges, which occur on a smaller, site-specific scale (Yüksel 2012: 53; Vrijhoef and Koskela 2000: 171). The researcher's personal interest in project management was ignited by the work that he has had to do as priest family in the Roman Catholic Church. In most circumstances, the researcher found himself being asked to oversee, or act as the project sponsor on a number of the Church's projects. Brushing shoulders with a number of service providers gave the researcher the interest to want to understand more, and to see how leadership affected different components of the projects.

The aim of this study was to apply a Soft Systems Methodology (SSM) in relation to the supply chain processes of a construction site in the Gauteng province of South Africa critically, in

order to determine how to improve the efficiency and performance of the supply chain processes of construction projects in the region.

This research generated a model to enable better results in construction projects for all stakeholders, by addressing all of the soft issues that relate to the project's supply chain, such as trust, communication, and reliability; and it is anticipated that this will have an immense impact on the successes of future construction projects.

1.2. BACKGROUND TO THE RESEARCH AREA

The construction industry employs large numbers of people at a time in any given project (Ball 2014: 23), and there is a need to understand how leadership and operational issues in the supply chain of construction projects impact either positively or negatively on the success of construction projects (Venselaar et al. 2015: 1-8). When looking at the supply chain, though, one needs to understand the complexity of logistics in the construction industry. Construction is very clearly a project-orientated industry; hence, there are peculiarities that affect the life span of the project, and the associated complexities of the project.

Project managers (PMs) lead projects, and their influence depends on their ability to direct and drive teamwork through his or her leadership (Lloyd-Walker and Walker 2011: 385). The project's management very often experiences cost overruns, which are a cause for concern; and, in some respect at least, point to shortfalls in the supply chain or lack of proper supply chain processes at work (Baloyi and Bekker 2011: 54-55). One also has to think of the necessary investment in human capital, which would be an issue of consideration for learning and promotion of work for small and medium enterprises (Thwala and Phaladi 2009: 535-536).

There is always a need to rely on information between project participants, in order to achieve the goals of a project, requiring that the mode of communication and the channels to be followed should be very clear to the project team (Gómez-Ferrer 2017: 2). Communication is either formal or informal. In addition, there are also directions of flow of communication within a project; where the communication may flow in various directions (Zulch 2016: 3-4). While both formal and informal communication can follow these directions of flow, informal communications that flow through the project process, such as hearsay or rumours, can result in major problems, such as project participants concluding their own views, or making

decisions that could affect the delivery and performance of various aspects of the project (Hoezen, Reymen and Dewulf 2006: 1).

Planning is especially important in construction supply chains, since there are typically lengthy lead times for the different materials, and materials must be supplied in the correct quantities and at the correct time, to complete the various stages of work (Mahamid 2016: 27). Therefore, the sequences in which these different kinds of work must be done, and by whom, necessitates a comprehensive plan to be drafted in order to avoid extensive delays (Kerzner 2017). In projects, a general trend is that subcontractors, such as logistics companies, are not involved in the design phase, but there are suggestions that if they were to be part of the design team, this would improve the relationships of all the participants (Errasti, Beach, Oyarbide and Santos 2007: 251-252).

Leadership is broad and extensive in the literature from three major perspectives: administrative, adaptive and enabling leadership (Galuska 2014: 34-38). The whole essence of being a leader in a complex world is often viewed through the lens of systems thinking, as it relates to project management. Adaptive leadership is enhanced by systems thinking appreciation is indicated in the literature that is there through supply chain management. Traditionally, project management seems to have been primarily focused on return on investment (ROI) and performance goals (Lloyd-Walker and Walker 2011: 385). Research by Palaima and Skaržauskienė (2010: 330), for instance, has argued that there is an integral relationship between systems thinking and leadership performance in the complex world of modern business.

Thus, the understanding around time, cost, budget and acceptable quality performance dimensions, are what many principal contractors focus on (Larsen, Shen, Lindhard and Brunoe 2015: 04015032). There have, however, been new trends of knowledge generation around project management, which are accepting that systemic leadership is a component or character of project management that needs to be considered (Akintoye, McIntosh and Fitzgerald 2000:

159); particularly in the case of construction project risk management (Loosemore and Cheung 2015: 1325).

1.2.1 The role of systems methodologies in research

One system of research that has been developed over the past four decades for solving management problems is the Soft Systems Methodology (SSM). Developed by Checkland and Scholes (1999; 2001) and Wilson (1990; 2001) through a systematic process of action research, it culminated in "an approach for tackling problematic, messy situations of all kinds". SSM provides a set of tools to identify and attempt to improve "soft", or poorly defined problems (Checkland and Poulter 2010: 191), which can be challenging to comprehend because of the interpersonal and political areas involved with the situations (Kayaga 2008: 273). These dilemmas are often evolving, socially complicated, and difficult to define, as they consist of many interdependencies that can lead to unintended consequences, while frequently having no obvious solutions (Australian Public Service Commission 2012).

Core components of systems approach as found in literature are: (1) system thinking is about the process, relationships, context issues and interconnectedness. (2) Project seeks to bring order to a project of tested principles and practises. They tend to underplay context and relationships. (3) One turn to systems thinking to develop project leadership skills, qualities and approaches as opposed to mere project management approaches (Dr Stan: Workshop 2: 2016).

This is contrary to "hard" problems, which can often have more easily formulated solutions (Brenton 2007: 12). SSM is therefore an action-oriented process of inquiry into problematic situations in which users learn their way from "finding out about the situation, [and] taking action to improve it" (Checkland and Poulter 2010: 191). SSM is, however, particularly useful in the analysis of complex problematic situations where there may be conflicting opinions on the definition of the problem, and how it should be addressed (Wilson and Van Haperen 2015). As noted by Checkland and Poulter (2010: 191), since this approach to tackling problematic situations is so all encompassing, its applications are extremely broad. It is therefore possible to use it in problematic situations arising in the construction industry; and in particular, in relation to supply chain problems that have been inhibiting the construction industry in South Africa from performing more efficiently and effectively, but which may not have hard and

clearly defined solutions. The research topic of this study was about improving the efficiency and performance of the supply chain in the construction industry, which meant understanding the role that human capital and leadership in the supply chain of the construction industry plays in driving project performance. A SSM was useful as it helped to unpack some of the complexity found in the supply chain of the construction industry on a construction site in Oxford road in Rosebank in the Gauteng province of South Africa.

1.3. OVERVIEW OF THE RESEARCH PROBLEM

The construction industry is a vibrant and busy sector of the economy; and there is an ongoing critique of supply chain management that applies to construction projects as the industry evolves. There are numerous challenges that are known to inhibit the smooth operation of supply chains in construction projects, which can be categorised as either external challenges, which occur on a macro-scale, or internal challenges, which occur on a smaller, site-specific scale (Yüksel 2012: 53; Vrijhoef and Koskela 2000: 171). On a typical site, supply problems could arise from two angles — mainly the supply chain processes or from the supply chain itself, which range from a lack of information sharing, to the reliability of the deliveries of the required materials (Thunberg, Rudberg and Karrbom Gustavsson 2017: 91-92). Opinions differ, though, as to which of these angles is more significant in improving the efficiency of the supply chain in construction projects, and what steps should be taken to overcome these issues.

Yet, Vrijhoef and Koskela (2000: 172) are of the opinion that there is much more that could be done to understand the supply chain area of construction projects, such as: what happens at the construction site, what entails the supply chain, what activities should be performed off-site before the actual work begins, and what needs to be done in the supply chain to manage the efficiency and effectiveness of construction sites. There are, therefore, many characteristics affecting projects in the construction industry supply chain, which are not properly explored; and at best, are only broadly understood, with variability among projects making a single solution for all projects impossible. Various subcategories of problems exist, though, as outlined here.

1.3.1 Outsourcing problems

The supply chain has many players; and currently, the literature does not seem to elaborate much on the relationships of management with subcontractors, especially in the planning phases of projects (Venselaar et al. 2015: 1-8). The term procurement seems to dominate the supply chain, but it is only one of the components of the supply chain (Croxton et al. 2001: 13). The current supply chain management systems have also been focusing solely on the contractor, while ignoring other important players (Zlatanovic 2015: 15). However, outsourcing is a component of almost every construction project, because construction projects are typically very large, and their delivery timelines are generally very tight (Yong Seng et al. 2018: 155).

There are a number of challenges experienced in the supply chains of construction sites that could be contributed to internal factors. For instance, an active industry will always be seeking growth, and the people involved in the industry would want emancipation for a better living (Grant 2017: 245). As a result, there are numerous internal challenges experienced in construction project supply chains (CPSC); many of which are complex because they deal with complexities that are brought about by outsourcing within the supply chain. This has made it exceptionally difficult for projects to fully comprehend and plan for any single eventuality, where variability among projects makes a single solution for all projects impossible.

Outsourcing parts of projects to subcontractors brings with it a reduction in the control of those elements of the project; while outsourcing also brings with it the need for networking among the subcontractors, which might impact the way things are done (Lizarralde and Massyn 2008: 1; Mbachu 2008: 471). For instance, new dynamics are often introduced as a result of concerns that may develop over trust between the project manager (PM) and the outsourced logistics organisations (Ke, Cui, Govindan and Zavadskas 2015: 349; Mbachu and Nkado 2007: 39).

1.3.2 Communication

Next, at the centre of any project on a construction site is the PM, who is supposed to maintain constant communication with the project team. There arises from this a dynamic challenge of ineffective communication, which also embraces the type of leadership that the project stakeholders are exposed to (Zulch 2016: 3). There is therefore a need to understand the dynamics that are involved with leadership being centralised in one person in a project — the

PM. The dynamics are affected by how good the PMis with the different qualities needed to lead successful projects, as this has a significant effect on the efficiency and speed with which the project can be executed. The problem is, therefore, that specific issues arise out of the duties of the project's management and into the area of the supply chain's management, which affects the success or failure of a construction project.

1.3.3 Poor planning

When it comes to supply chain management, one of the problems that is frequently argued on construction sites is poor planning and scheduling, which occurs as a result of the insufficient involvement of all participants, from the onset of a project (Bankvall, Bygballe, Dubois and Jahre 2010: 389). Planning becomes a central constraint if it is not adhered to, because its main purpose is to ensure that each of the tasks of the project happen according to a pre-set schedule. Failing with planning means that projects could devolve over time, leading to significant dissatisfaction, and a scrambling for resources, as the primary contractors and subcontractors compete with each other to complete their work on time (Kerzner and Kerzner 2017). Failing in planning, therefore, is a primary cause for increased costs and penalties, which may be incumbent upon those that have failed to plan and execute their projects correctly (Subramani, Sruthi and Kavitha 2014: 1).

In addition, looking at the supply chain process of construction projects, there is a challenge because everything seems to focus only at the end stage of the supply chain (Behera, Mohanty and Prakash 2015: 1332). A construction project is complex from the onset, but a lot of detail of the supply network is left out, which does not bring all parties' participation and contribution to the fore — only that of the main contractor (Vidalakis, Tookey and Sommerville 2011: 66). Waugh and Luke (2011) are of the belief that planning needs to involve all participants from the start, which increases the emphasis on trust, because communication lines must be opened, and everyone must know what their responsibilities are, and what they are expected to do for the project to be on-time, on-quality and on-budget. It was considered in this study, therefore, how planning has affected the supply chain operations of the construction site.

1.3.4 Poor knowledge management

When looking at modern projects, there have been traditional ways of considering project success: time, cost and quality (Nixon, Harrington and Parker 2012: 204). Yet, there is a

growing belief that this approach is insufficient for measuring project success or failure. There is also a need to bring the project management team's leadership style into focus as it contributes significantly to the success or failure of the project, as well as its efficiency and performance levels. Project sites therefore need to facilitate the establishment and management of learning environments as a key part of supply chain learning, but more suitable models need to be developed to aid with this process (Khalfan and Maqsood 2012: 300-301).

The challenge among many construction projects in South Africa is that there is little documentation taking place to detail the informal innovation that is continually occurring in the industry (Ramazani and Jergeas 2015: 41). One can clearly realise, though, how much learning is needed in the construction industry, and how important it is to understand and document the factors generating success or failure on construction sites (Walker and Walker 2016: 115). Learning from three of the major international clusters of construction innovation — The UK, Australia and Sweden —, there is definitely a significant amount of good to be generated from the collaboration of academics with various practitioners on construction sites, which would result in the development and documentation of more knowledge (Serpella, Ferrada, Howard and Rubio 2014: 653; Ojiako, Chipulu, Marshall, Ashleigh and Williams 2015: 47). There is always a disparity, though, for people in the developing world, such as in South Africa, because often, a large amount of construction is done without proper knowledge management, or any documentation and understanding on the factors that have led to the success or failure of the project (Joslin and Müller 2015: 1377).

1.3.5 Conflicts of interest

Sometimes, there can be conflicts between the participants of a construction project due to the need for the sharing of resources and costs (Lee, Han, Jang and Jung 2017: 1). There could, for instance, be issues of concern because some subcontractors would want to keep their suppliers and resources to themselves (Jelodar, Yiu and Wilkinson 2015; 89; Bowen, Akintoye, Pearl and Edwards 2007: 134). This conflict over resources, and the supply of these resources, therefore presents a potential factor driving the success or failure of supply chains in South African construction projects (Mok, Shen and Yang 2015: 446). However, ways of dealing with such conflicts of interests have not been properly explored; and indeed, it is not even fully agreed whether there is in fact a universal problem with conflict of interest, or how best to resolve these complexities on every project, to satisfy the needs of all involved.

1.3.6 Collusion and corruption

Collusion is one inherent aspect of projects in South Africa, which is known to affect the performance of CPSCs; whereby, there is a tendency for some members of projects to be involved with other suppliers, resulting in a lack of fairness in the decision-making process (Bowen et al. 2007: 134). One would therefore need to be very frank about the project team, such that freedom and communication should exist without fear of negative outcomes resulting on any of the participants of the project for voicing any such concerns about collusion (Oke, Aigbavboa and Zacharia 2017: 342). It is clear, though, that since collusion is occurring in many construction projects, this ability to address collusion is certainly not being provided.

Another major problem with the supply chain of the construction industry exists with corruption, where it is already estimated that $1.5 trillion is exchanged through corruption, globally, every year (Bowen, Edwards and Cattell 2012: 886). In South Africa, too, it is considered to be experienced at every level of construction projects, in different forms (Le, Shan, Chan and Hu 2014: 02514001). As a result, a general understanding is that up to 25% of the project budget can be spent on corruption activities just trying to ensure that the process runs smoothly (Bowen et al. 2007: 631). However, there is much to be understood in attempting to define the reasons that corruption exists in the construction industry, and in the supply chain specifically; or even whether there is a problem, and what steps should be taken to overcome these issues. There is also no clear link drawn between the efficiency of a project, and whether corruption indeed leads to an increase in efficiency, or rather hampers the project's process.

1.3.7 Nepotism

In the case of nepotism, while it is a known issue among construction projects, it is not always easy to discern, because there are often family businesses in construction projects meaning that it often happens that related family members and acquaintances occupy all the top management positions of the construction site (Aigbavboa, Oke and Tyali 2016). The private sector seems not to have problems with nepotism because family businesses are there. Conversely, the public sector it will be easy to interpret it that way as everyone hopes to get a fair chance on getting a job. However, this can be an issue of concern if it is not well-managed (Bowen et al. 2007: 643). One might also wonder which one is the larger challenge to projects, when considering between nepotism and collusion, particularly when it comes to decision-making in supply chain contracts.

1.3.8 Problem statement

As noted here, the range of external and internal issues affecting construction supply chains is broad; and at times, it is difficult to clearly quantify and address. Indeed, often even the cause of the problems — and in fact whether there even is a problem — is the subject of debate. The uniqueness of the construction industry is that most of the time, projects are not repeated, meaning that designers must continuously come up with something different, which makes it difficult for the same suppliers to be involved in the supply chain. There is, however, an understanding that supply chain management is generally guided by three major ideals: trust, commitment and collaboration (Khalfan and Maqsood 2012: 300), and this is where system dynamics should bring in concepts of feedback loops that would create better understanding and appreciation of the work that is involved. One powerful methodology that has been promoted in recent studies, for its ability to address difficult situations, is the SSM (Checkland and Poulter 2010: 191).

It is clear that, despite the broad spectrum of research that has been performed on supply chains and construction projects, much remains to be understood linking the complexities of supply chains together with specific projects in the construction industry of South Africa, to determine the nature of the particular environments, and the soft issues that have been affecting the efficiencies of the supply chain performances. Furthermore, to the researcher's knowledge, no studies using SSM have, until now, been performed on the construction industry supply chain in South Africa. This was confirmed where a systematic literature review performed on Google Scholar, analysing the broad spectrum of published literature for the years 1950-2019, realised no studies using SSM on the construction industry supply chain in South Africa. This provided support to the notion that no previous attempts were ever made to understand and model solutions for the soft problems that arise in the supply chains of South African construction projects. This provided the impetus to perform this current study, as outlined in the following sections.

1.4. AIM, OBJECTIVES AND RESEARCH QUESTIONS OF THE STUDY

1.4.1 Aim of the study

The aim of this study is to apply critically a SSM in relation to the supply chain processes of a construction site in the Gauteng province of South Africa, in order to determine how to improve

the efficiency and performance of the supply chain processes of other construction projects in Gauteng.

1.4.2 Study objectives

In order to achieve the aim of the study, it accomplished the following research objectives:

- to investigate the supply chain processes on a construction site in Gauteng;
- to identify the aspects in the supply chain processes that have been best enhancing the successful project performance of a construction site in Gauteng;
- to identify the dynamic challenges facing the supply chain that have been limiting the successful performance of a construction site in Gauteng;
- to determine the role of the project leadership in failing to overcome any challenges facing the supply chain on a construction site in Gauteng; and
- to develop a suitable leadership perspective through a SSM to resolve any impasses that have been found in the supply chain processes of construction sites in Gauteng.

1.4.3 Research questions

In line with the above research objectives, the following research questions were posed:

- What were the supply chain processes on a construction site in Gauteng?
- Which aspects in the supply chain processes were best enhancing the successful project performance of a construction site in Gauteng?
- Which dynamic challenges facing the supply chain were limiting the successful performance of a construction site in Gauteng?
- What was the role of the project leadership in failing to overcome any challenges facing the supply chain on a construction site in Gauteng; and
- What suitable leadership perspective based on a SSM could be proposed to resolve any impasses found in the supply chain processes of construction sites in Gauteng?

1.5. RATIONALE FOR THE STUDY

The purpose of this study was to understand the relationships and processes that affected the supply chain of a construction project, which had led to increased costs and reduced efficiencies and performances. The intention was to formulate a model, based on a SSM that would be appropriate to maximise the effectiveness of the supply chain. This was based on the rapidly

changing terrain of developments of project management, and the need to look at the complexity of projects using a systems thinking lens. Systems thinking is an all-inclusive attitude towards analysis that centres on how systems work within the context of larger systems and over time, and how the constituent parts of a system interrelate (Williams, Kennedy, Philipp and Whiteman, 2017:866). This contrasts traditional approaches of analysis that attempt to study systems by isolating them into individual distinct components (Arnold and Wade, 2015:669). Systems thinking also realises that diverse opinions exist, while appreciating the complexity and value of responsiveness and feedback.

One of the reasons for conducting research in the construction industry was that it was considered peculiar because of the nature of its work being temporary, and yet very dynamic. There was therefore a need to understand the industry properly, and to distinguish the facts from some of the myths that had arisen (Segerstedt and Olofsson 2010: 348). This was based on the logic that many of the problematic situations that had arisen in the supply chain of the construction project could be categorised as 'soft' issues, which required a qualitative soft systems approach to be able to understand and resolve.

This research has generated a model to enable better results in construction projects for all stakeholders, by addressing all of the soft issues that related to the project's supply chain, such as trust, communication, and reliability; and this is expected to have an immense impact on the successes of future projects. It is anticipated that the results of this study could have far-reaching benefits; such that the models for improvement in the supply chain could drastically aid other Gauteng-based construction companies in the execution of their supply chain tasks. This could result in considerable operational improvements, with reductions in costs, and improved stakeholder satisfactions. It is also anticipated that this study will provide a much-needed addition to the void of research that currently exists on the topic of CPSC management — both in South Africa, and internationally.

1.5.1 Personal motivations for performing the study

The author's interest in project management research arose out of a background in projects, where the researcher observed that projects that often began with energy and vitality were suddenly left incomplete. As supported by authors such as Yoon, Tamer and Hastak (2014: 04014090), the construction industry is one that typically has extremely large amounts of money invested; and yet, many projects still ultimately fail. The author read some articles to

understand the reasons why many such construction projects fail; and through this, the author found numerous journal articles that argued that it was very difficult to understand or pinpoint the root causes of failure in most projects.

The researcher was interested in understanding the different components of management, namely: administration, purchasing, production and financing. The researcher's major focus on this particular research was special because he wanted to understand how soft skills impacted on the success of projects. This was spurred on by the notion that while PMs generally have a good comprehension of the reality around them on construction sites, it was evident that numerous soft skills were also incumbent upon the PMs' abilities to manage their construction projects. This is because, as emphasised by Zhang, Zuo and Zillante (2013: 750), it takes more than just the competent areas of a project to retain the same workers, and to get the best performance out of these workers. In addition, the outsourcing and subcontracting of skills and work-related tasks are built on soft skills (Gewanlal and Bekker 2015: 33); hence, this prompted an interest in studying project management in construction. The researcher's interest in project management has also helped him to understand and appreciate the complexities that arise in construction projects, prior to undertaking this research.

In the researcher's experience of being a PM, and having taken on various construction projects, the author has seen that there are numerous loopholes in most of the supply chains that he has had to deal with, and that most construction supply chains have problems that are people-centred, and not caused by the work they are involved in. In addition, the researcher has observed that communication must flow smoothly across all the actors of the supply chain, for the project to function efficiently. However, because of a lack of communication, there are various types of problems that are caused between individuals, which have the potential to disrupt the work that is being done (Fisher 2011: 998). The researcher undertook to perform this research in order to broaden his knowledge on the subject of construction supply chain management, and to help to validate his suspicions and expectations on the soft issues surrounding construction supply chain management.

The next section presents a brief overview of the methodology that was employed for this study.

1.6. METHODOLOGICAL CONSIDERATIONS

1.6.1 Overview of the research philosophy and introduction to the Soft Systems Methodology

The methodology of this research was designed to identify the issues and potential improvements to the supply chain of a new office park construction project in Oxford Road, Rosebank, Johannesburg. In research, two primary research philosophies are generally followed, which form the roots of the qualitative and quantitative research strategies (Brannen 2017: 101). Qualitative research is founded on the phenomenological perspective that the universe is not one single reality, but multiple realities that are subject to the interpretations of the observers that live in that universe (Creswell and Poth 2017: 156). Qualitative researchers try to understand a topic from the perspective of the participant, meaning that in such studies, there exists a level of contextualism (Collis and Hussey 2013). That is, the macro- and micro-contexts in which people dynamically interact with their environments are thought to be unique, and fundamentally associated with their individual experiences (Atwood and Stolorow 2014). Three main categories have been described to define each of the circumstances in which qualitative research occurs: Action research, phenomenography and holistic ethnography (Struwig and Stead 2013; Whyte 1991; Åkerlind 2017: 1; Moore 2011: 654).

This study was designed as a qualitative study in line with the research philosophy of action research, as expressed through the ideologies of the SSM. It was believed that the supply chain is ultimately subject to numerous complexities that are constantly arising from the decisions of management in the construction industry (see Simone Guercini and Guercini 2014: 662), and it was upheld that employing SSM would be the most effective means of approaching and understanding the soft problems in the supply chain of the construction industry in South Africa. Based on the literature reviewed (Luckett and Grossenbacher 2003: 147), and through personal experience with the construction industry, the researcher also upheld that the issues within the supply chain of the construction industry could not be attributed to one single agreed cause or solution; and that the complexities found in the construction industry supply chain would be best understood by unlocking information through verbal interactions with those who had interacted with that environment.

1.6.1.1 Soft Systems Methodology

As opposed to the 'hard' systems methodologies described above, the SSM is a process of an action-oriented inquiry into situations that are problematic in nature, in which users are able to learn and understand potential solutions by "finding out about the situation, to taking action to improve it" (Checkland and Poulter 2010: 191). Consequently, the *soft systems* style utilises the concept of a 'system' as a mechanism for probing the situation, while facilitating discussion and debate among those involved, in order to understand the procedures, objects, relationships and resources that have been causing, or adding to the problematic situation (Sewchurran and Barron 2008: S56). As explained in the literature review of Chapter Two, a key function of SSM is to help with the analysis of complex circumstances, where a variety of opinions exist about a problem, and where there is no single answer for what the root cause has been, or what actions should be taken to resolve that situation (Checkland and Scholes 1999: 330; Wilson 1990; 2001). SSM is therefore directed at assisting people to improve complex organisational difficulties, which are considered complicated due to the unknown variables involved at the foundations of those situations (Proches and Bodhanya 2015: 1-15).

Consequently, SSM is a form of action research that is especially suited to qualitative enquiry (Wilson and Van Haperen 2015: 15). However, it is important to note that SSM does not attempt to define ways for implementing solutions to problems, but only to offer frameworks to comprehend the problematic situations, and to implement changes for improving them (Checkland and Poulter 2006).

1.6.2 Research design

The research design of a study is the plan or framework that is created to allow the research questions of the study to be answered, in line with the research philosophy upon which the study has been founded (Kowalczyk 2014: 1). In research, there are three primary categories of research designs: descriptive, exploratory, and explanatory research designs, with differing degrees of observation and causality being concluded by each, across the spectrum of qualitative and quantitative research (Richters and Melis 2017: 146). A descriptive research framework was used, here, with procedures being followed to align with the SSM, as this was considered the most appropriate design for the qualitative research being performed.

1.6.2.1 Target population

The population of a study is the entire universe of elements with the necessary properties to be able to answer the research questions that have been posed (Levy and Lemeshow 2013: 125). The population of this study included the broad spectrum of all construction projects in the Gauteng province of South Africa; where this population was pursued because construction projects in Gauteng were known to have encountered and interacted with the full range of practices and complexities involved with the supply chain operations of their projects. The target population was broad in essence only stakeholders participating in Oxford road Office Park were identified. The specific target population of this study was principal contractors, subcontractors, PMs, foremen, and different levels of management in supply chain companies of any construction project across Gauteng.

1.6.2.2 Sampling method

In research, two primary types of sampling are performed, where probability sampling is most appropriate in quantitative studies, as some form of preference or bias is applied in an attempt to gather a sample with access to the most suitable data (Uprichard 2013: 1; Mathieson 2014: 1-2; Vehovar, Toepoel and Steinmetz 2016: 329). Non-probability sampling was therefore the sampling strategy employed in this study, to optimise the quality of the qualitative data that was gathered.

Of the five main non-probability sampling techniques available (Bryman 2015: 418), purposive sampling was used to recruit 17 participants for this research, as it was assumed that a specific sample of participants that had been intentionally chosen by the researcher would possess characteristics that were most favourable for answering the research questions of the study. The purposive sample of participants included members of the construction industry that were known to have interacted with the project's supply chain; such as workers, supervisors, foremen, site clerks, senior managers, and the CEO.

The construction site of a new office park in Oxford Road, Rosebank, Johannesburg, Gauteng, which was being constructed by the Giuricich Bros. construction company, was used as the location from which to purposely select the participants for this study. The Giuricich Bros. construction company was chosen as it was easily accessible to the researcher; while on this construction site, no more than ten logistics companies were specifically selected by the

researcher as they were expected to possess the necessary rich knowledge on the project's supply chain processes, which would allow the research questions of the study to be answered fully.

1.6.2.3 Research instrument

There is a wide variety of data collection instruments used in research (Adams, Khan, Raeside and White 2007; Six and Bellamy 2012: 245). Interviews with open-ended questions, audio recording devices, and PCs with Microsoft Word provided the best tools for the researcher to gather sufficient data that would allow the SSM of this study to be correctly implemented. The researcher attempted to gather information to assess the effectiveness of the leadership, by trying to understand how the leaders were viewed and experienced by fellow employees or colleagues on the construction site; while at the same time, identifying the aspects in the supply chain processes that had been best enhancing or limiting the successful performance of the construction project. To do so, questions relating to soft issues, such as trust, reliability, and care, were also asked.

1.6.2.4 Data collection procedure

In order to gather the necessary data, open-ended questions were presented through face-to-face interviews with the sample of managers, sub-contractors and workers involved with supply chain tasks at the chosen construction site in Gauteng. All the respondents were asked open-ended which allowed and enabled them to share as much detail as possible on various topics. A voice-recording equipment was used during the interviews to gather all the information and allowing the researcher to pay attention to exercising accurate interviewing techniques. The audio recordings were then transcribed into written text in Microsoft Word format, for data analysis.

1.6.2.5 Data analysis

In order to analyse the data for this study, and thereby present models for improvement, the data analysis was separated into two stages. The first stage involved the qualitative thematic analysis of the interview transcripts, and the second phase involved performing a SSM on the first-phase data.

- Phase One — Qualitative Thematic Analysis: Once the audio recordings of the interviews were transcribed into written text in Microsoft Word format, the data was analysed using standard methods of qualitative thematic analysis, as per the directions of Braun and Clarke (2006: 77), Vaismoradi, Turunen and Bondas (2013: 398), and Vaismoradi, Jones, Turunen and Snelgrove (2016: 100). As explained by Bryman (2015: 580), "A theme is a category identified by the analyst through his/her data".
- Phase Two — SSM: In order to unpack the data from the interviewees, which had been prepared in Phase One, in the form of written themes and codes from the interview transcripts, the second phase of the data analysis employed a SSM according to the guidance of SSM experts such as Burge (2015: 2-18), and Williams (2005: 2).

Full descriptions of the methodological considerations of this study, along with a full breakdown of the Phase One and Phase Two procedures, are presented in the methodology of Chapter Three, as explained at the end of this chapter.

It should be noted that SSM is an action-based methodology, which is inherently based on iterative reciprocity. For instance, to determine whether the tasks are 'effective', it requires an overarching degree of monitoring and control, with feedback adjustment to attune the tasks as they are being actioned. However, this dissertation was not intent on actually implementing the recommended changes, but only on generating potential models for change. The recommended tasks of improvement that were ultimately produced in this study, therefore, were only those that were expected to be the most effective, in the event that these models were, indeed, implemented.

1.6.3 Delimitations/scope

This research only studied one construction site on Oxford road in Rosebank of Gauteng Province, South Africa. This meant that all opinions on the challenges of the supply chain in the construction project were confined to the experiences of the participants at this particular site. This study also only focused on the processes and challenges of the supply chain, and nothing further related to the copious other tasks involved with the execution of the construction project. This study considered the supply chain from a qualitative perspective, and no attempt was made to obtain quantitative data, such as financial records, numerical facts, or project-related quantities to support the results with statistical reliability. Finally, this study

was only intent on developing a suggested model for change, to improve the supply chain of the construction project; but it neither considered the actual implementation of this model nor the efficiency of the recommended model would be in improving any problematic issues within the supply chain of the chosen construction project.

1.6.4 Reliability, validity and the elimination of bias

1.6.4.1 Reliability

Reliability is typically regarded as the extent that the outcomes of a research project would provide comparable outcomes if the study were to be independently repeated (Howell, Miller, Park, Sattler, Schack, Spery, Widhalm and Palmquist 2012; Golafshani 2003: 597). In this study, the interrater reliability and internal consistency were maximised during the codification of the data from the interviews; whereby, professional data analysts were engaged for the purposes of increasing the consistency of the outcomes between raters, and helping to minimise any potential biases that may have arisen by the researcher. Similarly, internal consistency was also optimised by basing the questions of the interviews on the principles of SSM, thereby using principles that have been repeatedly shown in the literature to effectively understand the soft issues involved with supply chains, such as in other industries of South Africa and around the world.

1.6.4.2 Validity

Next, a study's validity provides an indication of how well the study's findings reflect the results they were meant to symbolise (Howell et al. 2012). The construct validity of this study was maximised firstly during the planning of the questions for the interviews; and thereafter, through the procedures used for the data collection. To maximise the content validity, the study was structured on the framework of SSM, which allowed the soft issues of management in the supply chain of the construction industry to be measured completely and in suitable detail to answer the research questions that had been posed. Finally, the results of this study were triangulated with the literature to compare the results to other studies that had been performed, thereby maximising the criterion validity, as per the recommendations of Yeasmin and Rahman (2012: 154).

1.6.4.3 The elimination of bias

In attempting to maximise the quality, reliability and validity of a study, a final approach typically involves the acknowledgement of any bias that may act to negatively influence the final results, and thereby negate the findings (Simundic 2013: 12). Careful attention was taken to design this study within the framework of SSM, meaning that researcher bias was minimised in the initial stages of the study. To overcome unreliability, poor sharing of information and inconsistency among participants, interviews were held in private and anonymously, and with the understanding that knowledge from the study would ultimately lead to improvements in the supply chain process, to encourage participants to be as open and truthful as possible. In addition, as per the recommendations of Saunders and Lewis (2012), assistant data capturers and professional data analysists were recruited to minimise any potential data analysis biases that may have occurred.

1.6.5 Ethical considerations

In qualitative research, a number of challenges or issues could occur (Greenfield and Greener 2016); however, this study was performed within the standard requirements of the Durban University of Technology. I also had to get ethical clearance from ERIC which guarantees that all necessary steps to protect all people participating in this study. It was ensured that the researcher's relationship with the participants was cordial, while the researcher also maintained a standard of trust and truthfulness with the participants, by disclosing the full nature of the study before commencing the interviews. The participants were also given the choice to stop the interviews and address any issues or concerns they might have had, and to withdraw from the study if they wished. If the acts of the study proved to be too stressful for any of the participants, they would also have been referred for professional help, as per the guidelines of Orb, Eisenhauer and Wynaden (2001: 93-96). However, during the study, the need for such measures did not transpire; though it should be noted that efforts were made to minimise any such stresses, by ensuring standards of anonymity and confidentiality.

1.7. STRUCTURE OF THE DISSERTATION

The structure of this dissertation is as follows:

- Chapter 1 — Introduction of the research topic and its sub-topics: This has covered the introduction of the study, including the dynamic challenges in the supply chain facing

the construction industry in Gauteng. It has also highlighted why this study is important at the moment, and the lessons that will be learnt in order to improve the efficiency and performance of projects in the construction industry in Gauteng.

- Chapter 2 — Literature Review: This chapter will unpack the dynamic challenges in the supply chain, which have already been discussed in the literature. There will be background information in this chapter across all facets of this research, including leadership, project management and the role of different participants on the site of construction projects.
- Chapter 3 — Methodology: This chapter will present the overview of the qualitative methodology that was performed in lines with the SSM, in order to answer the research questions of the study.
- Chapter 4 — Results: The results of the data analysis, which were generated from the methodology in Chapter 3, are presented here.
- Chapter 5 — Discussion and model development: This chapter will deliberate the results from the previous chapter, through triangulation with the literature in Chapter 2.
- Chapter 6 — Conclusion of the study: The final chapter will highlight each of the lessons that were learned from the study; outlining the conclusions of the research, and the proposed mode for improving the supply chain of other similar construction projects in Gauteng and around the country. It will also outline future research that can be done to bridge the current gap, and advance the volume of knowledge on the topic.

1.8. CONCLUSION

The interconnectedness of the supply chain, project management and leadership are the keys to an operational model being developed in the supply chain of the construction industry. This study attempted to outline the aspects of leadership that were necessary for the successful implementation of the supply chains within a construction project in Gauteng, which may not otherwise have been seen clearly or correctly implemented from the onset. This required bringing in models from SSM, which permitted the researcher to develop a better system of addressing the complexities of the supply chain.

A descriptive research framework was performed to identify the issues and potential improvements to the supply chain of a new office park construction project in Oxford Road, Rosebank, Johannesburg, where purposive sampling was used to recruit the 17 participants of

this research. In order to gather the necessary data, open-ended questions were presented through face-to-face interviews with the sample of managers, sub-contractors and workers involved with supply chain tasks on the chosen construction site. In order to analyse the data for this study, and thereby present models for improvement, the data analysis was separated into two stages: Phase One involved the qualitative thematic analysis of the interview transcripts, and Phase Two involved the SSM on the data from Phase One.

This research has consequently generated a model to enable better results in construction projects for all stakeholders, by addressing all of the soft issues that relate to the project's supply chain, such as trust, communication, and reliability. This should have an immense impact on the successes of future projects, and it is anticipated that the results of this study could have far-reaching benefits; such that the models for improvement in the supply chain could drastically aid construction companies locally and nationwide in the execution of their supply chain tasks. This could result in considerable operational improvements being achieved, with reductions in costs, and improved stakeholder satisfaction being generated. It is also anticipated that this study will provide a much-needed addition to the void of research that currently exists on the topic of CPSC management — both in South Africa, and internationally.

The literature review chapter follows, next, to unpack the dynamic challenges in the supply chain that have already been discussed in the literature; thereby presenting the theoretical basis upon which this study was launched.

CHAPTER TWO
LITERATURE REVIEW

2.1. INTRODUCTION

Supply chain theory and practice have evolved over time combined with the dynamic and complex nature of the construction industry. These complexities arise in the supply chain because projects have to be executed through project procedures and principles, which are now deeply imbued in leadership. Research in the supply chain of the construction industry is based on projects, so to unpack what is in the literature, this study is going to be analysing it from three perspectives: The supply chain itself, project management, and leadership. The three perspectives are interconnected, and the impact of the PMs, project teams, and leadership all impact heavily on the success or failure of a project. This chapter presents the literature review of the dissertation, beginning with a definition of key terms, particularly relating to the project team, outsourcing, and how success is measured in construction projects. Next, the chapter presents a detailed overview of the concepts of project management in construction projects, with a focus on the skills that PMs should possess, the importance of emotional intelligence among PMs, and one important style of leadership recommended in the literature, termed Servant Leadership.

Next, the chapter turns to review supply chain management, focusing on supply chains in the construction industry. In particular, the external and internal challenges affecting construction supply chains are reviewed, commencing with a PESTLE (political, economic, social, technological, legal and environmental) analysis of the macro-environmental factors that are known to affect construction supply chains. This is followed by a review of the internal factors that have been found to affect construction supply chains on a project-by-project basis. In line with the nature of this study, the methods of identifying and resolving issues in construction projects are reviewed, with a detailed explanation and overview of the SSM that has been chosen for this study. The chapter then concludes with a discussion on the gaps that currently exist within the literature which essentially prompted this study.

2.2. DEFINITION OF TERMS

Construction is defined as the erection, restoration or demolition of structures that are permanent in a particular place; or the complete transformation of an area of land that has either

been laying fallow, or used for faming (Segerstedt and Olofsson 2010: 347). According to Walker (2015: 23), construction project management is defined as:

> *"The planning, co-ordination and control of a project from conception to completion (including commissioning) on behalf of a client, requiring the identification of the client's objectives in terms of utility, function, quality, time and cost; the establishment of relationships between resources; integrating, monitoring and controlling the contributors to the project and their output; and evaluating and selecting alternatives in pursuit of the client's satisfaction with the project outcome."*

One may already elucidate at this point that there are many issues covered within the definition of project management, which aligns with the definition of a project. This, of course, requires complex teams to be in place to ensure that all of the client's requirements are met, and within the timeframe that has been provided for within the project's charter (Kerzner and Kerzner 2017).

2.2.1 The project team

In construction, one has to be very clear as to who makes up the project team. On a construction site, several different groups of people, from several different companies, are involved that vary in size, and areas of expertise (Cheng, Law, Bjornsson, Jones and Sriram 2010: 246). **Error! Reference source not found.** below presents an overview of the human capital that is involved in a typical construction project.

Construction responsibility	**Description of the responsibility, and personnel involved to achieve these responsibilities**
Construction management	This ensures the execution of the works, in accordance with the plans and specifications of the project. It involves the co-ordination of the daily activities, compiling the construction programme for the works to be carried out, and the planning of future works. Personnel involved with construction management, such as foremen and supervisors, must instruct, co-ordinate and work with all the relevant consultants, architects, engineers and quantity surveyors, and ensure that any sub-contractors carry out what is required of them. They should also solve any challenges that may be met during the execution of the works, and

	ensure that the required standards are met (Joslin and Müller 2015: 1377).
Engineering	There are normally various engineering disciplines on a construction site. For example, civil engineering involves the design of roads, and storm water management systems; structural engineering ensures the structural integrity of buildings, and that they comply with all the relevant regulations; electrical engineering deals with the design and installation of all the electrical systems; and mechanical engineering deals with the installation and design of mechanical systems, such as the air conditioning. Quantity surveying is also required, which deals with the cost elements of the project; whereby, a bill of quantities is drawn up after the building is designed, and expected costs and monthly budgets are drafted and monitored. It must be noted that all of these activities should be co-ordinated by the architect, who usually leads this team (Simpeh, Ndihokubwayo, Love and Thwala 2015: 109).
Procurement	This is usually done by a purchasing department, where the procurement of materials for the execution of the works is done in close liaison between the builder's quantity surveyor, and the construction management team of site agents and foremen. This is where the bill of quantities and drawings are extensively analysed to determine how much material is needed for the works, and its expected costs (Ibem and Laryea 2015: 364).
Transportation	Here, there are various options available to achieve the many tasks that are needed, depending on the scale of the project and sizes of the companies involved. Trucks deliver materials, such as bricks, sand and cement; specialised trucks deliver ready-mixed concrete to sites; tipper trucks move materials around sites; bakkies carry small amounts of materials and equipment that may be needed during the course of the working day; and buses are used to transport people to work (Titov, Nikulchev and Bubnov 2015: 68).
Construction equipment	This varies from site to site, though typically, one would find dumpers, skid steers, and mobile cranes to assist with working at heights. Tower Cranes are also usually used for multi-storey buildings, while back-end

	loaders are used to dig trenches for foundations, or to lay pipes and services underground (Fill, Forsyth, Kritzinger-Klopper, Le Maitre and van Wilgen 2017: 1).
Labour and additional resources	This deals mainly with the human side of works, and includes lower-level foremen, artisans, and labourers. Groups of human labour are usually created in teams, which comprise of different elements; whereby, a foreman would have a team around him or her, consisting of skilled staff, such as carpenters, bricklayers, and their helpers (Windapo 2016: 1). Another aspect, which is often overlooked, is the security resources, which are vital to reducing pilferage that takes place on sites; and this includes guards and gatemen to control the traffic in and out of construction sites (Hannan and Sutherland 2015: 205). Subcontractors also have teams to carry out their specific tasks, while they would usually only be on-site for much shorter periods of time — for the duration of their specific work (Deacon and Van der Lingen 2015: 73). Other resources on sites could include non-mechanised equipment, such as offices and storage containers; diesel tanks for fuel; ablution facilities with toilets and showers; and canteen facilities. Technological facilities, such as computers, cell phones, two-way radios, and office equipment would also be necessary to ensure that the site operates efficiently (Ofori 2015: 115).

In summary, the human resources on construction sites include the principal contractor, sub-contractors, architects, engineers, labourers and developers; with some supplying materials and components, and others providing construction services (Simpeh et al. 2015: 109). It has been argued, though, that the four primary categories of professions on a construction site are the PM, technician, engineer and labourer; where these four can be seen as the baseline of who typically comprises a project team tasked with running a successful project (Joslin and Müller 2015: 1377). However, it should be ementioned that there is also the project sponsor, or the representative of the top management of the principal contractor or the construction firm, who

forms an important part of the project cycle (Chinyio and Olomolaiye 2009). A summary of these core professions is as follows:

- A PM is the person who is responsible for overseeing the development of the project by managing and controlling the cost, time and quality of the project; while seeing to the implementation of the project's objectives (Baloyi and Bekker 2011: 51). The PM would also be the key link to any subcontractors.
- An engineer is a person with extensive mathematical and physical science knowledge, who understands how to use the quantified resources for accomplishing the goals of the project effectively (Herbst 2016: 1).
- A technician has the role of using technical knowledge in planning, designing, production and maintenance of building projects, under the supervision of the construction engineer.
- Finally, a labourer is a person with the role of assisting on a construction site with the general construction tasks that are required, such as general hand worker, machine operator, brick layer, or driver (Shahhosseini and Sebt 2011: 165). Labourers differ in a number of ways, in the sense that some jobs require a certain degree of training (for example, driving a front loader, brick laying, and so on), while some of the work does not require any form of training as it does not require any technical skills (Clarke, Gleeson and Winch 2017: 78).

2.2.1.1 Outsourcing on projects

Outsourcing is a component of almost every construction project, because construction projects are typically substantial, and their delivery timelines are generally very tight (Yong Seng, Mehdi Riazi, Mohd Nawi and Ismail 2018: 155). In construction, generally, the main contractor would outsource a number tasks in which they are not specialists in order to focus on improving the performances of their key speciality areas, while simultaneously reducing costs (Emuze and Julian Smallwood 2014: 294; Vrijhoef and Koskela 2000: 171). There is a lot of work that is done by subcontractors on behalf of the principal contractor, such as electricians, carpenters, builders, and more; and these subcontractors would also have foremen and managers on-site, depending on the size of the project (Thwala and Phaladi 2009: 533). Errasti, Beach, Oyarbide and Santos (2007: 251-252), believe that outsourcing is beneficial to all participants; although their interests may not always align individually, when combined collaboratively, their interests are often mutually beneficial. It was, therefore, an aim of this research to commence

by analysing the different outsourced components of the supply chain in the construction industry of this study, to determine the dynamics that have been involved.

2.2.2 Measuring project success

Everyone in business typically has one common goal: To make money and increase the profitability of his or her current and future ventures (Gandy 2015: 1). The construction industry is no different, and project investors also wish to realise their dividends over time, with the overall expansion of their business (Yoon, Tamer and Hastak 2014: 04014090). As far as projects are concerned, the standard ways of considering project success have been in relation to time, cost and quality (Nixon, Harrington and Parker 2012: 205; Lloyd-Walker and Walker 2011: 384). However, in the current age, while it is important to focus on ROI, there are now more measures for reflecting on the success of projects, including the style of the leadership, the relationship management, customer needs, and similar considerations (Lloyd-Walker and Walker 2011: 384). Any construction project comprises a whole combination of events, objectives and activities. In this setup, every participant has the capacity to contribute to the success of the project. This indicates that there has been a recent shift from the traditional measures of ROI, for measuring project success, to far broader perspectives that include elements of the project's leadership (Kerzner 2017).

While projects might initially seem to have everything under control, major setbacks that ultimately result in delays in the projects often arise. Such setbacks include but are not limited to not having sufficient workers, not having the required skills on the construction site, a lack of experience in handling projects by contractors, poor planning, delayed or non-payment by owners, and unrealistic schedules that cannot be achieved (Islam Mohammad Saiful 2015: 82). Some of these factors must be taken into account in measuring successful outcomes; but having a comprehensive reflection on a project requires a number of issues to be clarified first. Three major concerns arise from the traditional method of project reflection: the scope of work, the costs, and the project timelines (Larsen, Shen, Lindhard and Brunoe 2015: 04015032; Joslin and Müller 2015: 1377). Therefore, the concepts of time, cost, and quality are still important measures that are used to determine project success (Lock 2004: 14), and need to be clearly defined, as highlighted next.

2.2.2.1 Time

All stakeholders would want to know how much time a construction project is expected to take, from start to handover. It is entirely the PMs' responsibility to ensure that time lines are set and met, as agreed upon with the stakeholders (Kerzner and Kerzner 2017). The expected timelines must not only be made clear to the project investors, but also to any end users and stakeholders of the project, so that they are informed of what can be anticipated from the developments within their communities (Kerzner 2017). The success of a project, therefore, is determined by how well a project is completed within the specified time at the beginning of the project.

2.2.2.2 Cost

There is more likely to be momentum in ventures if the costs of the projects are far lower than the expected proceeds that are to be gained soon after completion of the project (Larsen et al. 2015: 04015032). However, budget constraints are always central determining factors, which determine how project teams are composed and funded. This needs to be balanced by a fundamental expectation that the project management team should be fair in their dealings with the different suppliers and artisans on-site, since they are also trying to make a living, and improve their living standards (Titov et al. 2015: 68). The success of a project, though, is determined by how closely a project is completed within the expected costs.

2.2.2.3 Quality

Quality can be understood from a number of angles on a construction site, which are primarily: The type of materials being used; the calibre of the workmanship being implemented; and the overall grade of the end product that is produced (Singh 2017: 1). Ultimately, the measure of the success of a project is determined where the quality of the materials, workmanship, and end product are at a similar or better standard than was agreed upon at the start of the project (Joslin and Müller 2015: 1377).

2.3. PROJECT MANAGEMENT

As alluded to previously, PMs play very important roles in any construction project, as their leadership determines the success or failure of their projects. It may at first, seem difficult to comprehend why a single person are emphasised so explicitly. However, from the eyes of the principal contractor, it is evident that there is always a need for a single accountable person to

deal with the decisions of an entire project; to achieve all the needs of a project; and to consider all the dynamics that are at play (Gewanlal and Bekker 2015: 33). The PM is, therefore, the 'play-maker' that facilitates this entire process; and as such, they must possess a wide range of competencies to allow them to guide their project team to success (Zhang and Fan 2013: 199).

2.3.1 Skills of project managers for dealing with project-specific issues

Table 2.*1* presents a list of the potential hard issues that may be observed on a construction project, in relation to the standard methods of measuring project success that were discussed previously, and the soft skills that a good PM would require to be able to lead all the participants of a project. These skills would have to be embodied in the PM, to manage the hard issues experienced by the project team (Gewanlal and Bekker 2015: 33). It is important to note that due to the temporary nature of construction projects, this may often be very tricky, since there is a continuous movement of project management teams as projects progress towards their delivery points (Dansoh, Frimpong and Oteng 2017: 1).

Table 2.1 List of the potential hard issues and soft skills required by PMs on a construction project

Hard skills/issues	**Soft skills/issues**
Cost	Trust
Time	Communication
Quality	Information sharing
Profit	Reliability
	Consistency
	Commitment
	Collaboration

Source: Windapo (2016:1)

As noted above, a PM, who is the key link to all contractors and subcontractors, must embody a detailed list of hard and soft skills. In terms of the skills that PMs are expected to have, skills like problem solving, decision making capabilities, the ability to see opportunities, and the ability to manage change are important skills to ensure that the project plan is well established, and correctly adhered to (Hwang and Ng 2013: 272). Specific issues may also arise in projects,

which require particular management skills to be exercised. In the following sections, some of these issues are discussed.

2.3.1.1 Environmental issues

Change will always be an issue of concern to every PM because countries are becoming more and more concerned about the environment, which makes it important that the PM is aware and informed about the legislations covering that region (Hwang and Ng 2013: 273). While PMs are not necessarily required to be advocates of 'green construction' projects, there is a need for PMs to consider, and have an understanding of, sustainability in every construction project they undertake (Martens and Carvalho 2017: 1084; Windapo 2014: 6088; Banihashemi, Hosseini, Golizadeh and Sankaran 2017: 1103).

2.3.1.2 Conflict issues

Whenever people congregate, conflict is bound to happen for different reasons; hence, problem solving or crisis handling is a very important part of the job of the PM because it requires using skills such as trust building, reliability and coordination (Mok, Shen, Yang 2015: 446-457). The work of the PM is, therefore, relatively complex, as the response of the PM has to be enacted in real time, so that things happen and evolve fluidly, as the project progresses.

2.3.1.3 Communication issues

The heart of everything a PM does is dependent on the quality of his or her communication skills, because people generally respect people they believe are listening to them, or who are paying attention to what they are saying (Fisher 2011: 998). Communication is, therefore, one of the soft skills that is key to maximising the outcomes that are achieved from the project's team (Gewanlal and Bekker 2015: 33; Windapo 2016: 1-8).

2.3.1.4 Worker commitment issues

PMs are now expected to be worker-oriented, rather than being 'work' oriented, meaning that the manifestation of the softer skills of leadership, negotiation, effective communication and professionalism, are just a few among many that the PM would be expected to have (Zhang, Zuo and Zillante 2013: 750). When a PM is worker-oriented, they would tend to position themselves to align with the needs of the workers, without jeopardising the progress of the

work that needs to be completed. Commitment from the workers would, of course, be one of the attributes that a PM would generate more easily on a site if they were worker-oriented, since workers would naturally be more committed to a manager that was caring for their personal needs (Hiyassat, Hiyari, and Sweis 2016: 138).

It should be highlighted that because projects are often required to deal with soft skills, hard skills can at times be forgotten (Zhang et al. 2013: 750). However, successful execution as a PM requires combining hard skills, by implementing them with various soft skills (Azim, Gale, Lawlor-Wright, Kirkham, Khan and Alam 2010: 388). A PM, therefore, has many issues of concern; such as the objects of the project, the stakeholders' needs, the goals that need to be achieved; and the required delivery date of the project (Joslin and Müller 2015: 1377). Maintaining clarity about their feelings would help in observing the feelings of others, thereby being in a position to reduce any negative energy that could affect the project (Gewanlal and Bekker 2015: 33). Consequently, a topic pertaining to project management that is often discussed in the literature is that of of emotional intelligence, which is outlined next.

2.3.2 Emotional intelligence among project managers

Emotional intelligence is people's capacity to recognise their feelings, and the power to control those feelings (Sunindijo 2012: 182). Table 2.*2* below, gives an overview of the emotional intelligence competencies required of PMs.

Table 2.2 Emotional intelligence competencies required of PMs in construction projects

Emotional intelligence skill	**Description**
Self-awareness Emotional self-awareness Self-confidence	To recognise people's feelings, and how they affect work performances. To believe in, and understand people's abilities.
Self-management Adaptability Emotional self-control Positivity	To handle changes. To keep people from following impulses and negative emotions. To persist in pursuing goals, even when faced with troubles.
Social awareness Empathy	To read others' feelings, perspectives, and demands. To recognise emotional and political atmospheres.

Organisational awareness Cultural understanding	To understand and recognise different cultures.
Team management Communication Conflict management Inspirational leadership Teamwork	To conduct effective communications. To resolve conflicts. To inspire and guide individuals and teams. To cooperate in teams.

Source: Adapted from Zhang and Fan (2013: 199)

In considering the list of emotional intelligence skills set out in Table 2.*2* above, it is clear that the importance of the different components should not be underestimated. This is so because the PM, as the leader of a project, holds more than simply the title of his or her job post. Self-awareness, for instance, is an important attribute that helps the PM to be in control of his/her emotions, and to relate to how others are feeling. Sunindijo (2012:187) emphasises that there is a need for the PM to have self-awareness, as it aids his/her relationships with the different people in the project team, even though short schedules on projects make relationship building difficult to accomplish. The PM has the task of carrying his/her team along through motivation, and this arises from the PM having concern for each participant, while being able to listen to everything their subordinates say (Gewanlal and Bekker 2015: 33).

Figure 2.*1* highlights the impact of a PM's emotional intelligence on project performance. Emotional intelligence among PMs in the South African construction industry, though, has taken a long time to develop; and this is mainly attributed to the environment in the construction industry having primarily been very masculine, with the emphasise being on toughness, decisiveness and control (Lindebaum and Cassell 2012: 65-66). Detrimentally, the emphasis on toughness inherently requires a PM to take an interest in his own developments, irrespective of the best leadership styles to be used (Liphadzi, Aigbavboa and Thwala 2015: 284). Yet, in projects, everything is connected, so it is always important for those acting in leadership positions to enable each of the participants to engage with the top management, through the act of empowerment or mentorship in the workplace (English and Hay 2015: 144-164). PMs should also know the cultures and beliefs of the people on their project teams, in order to behave accordingly (Fisher 2011: 995).

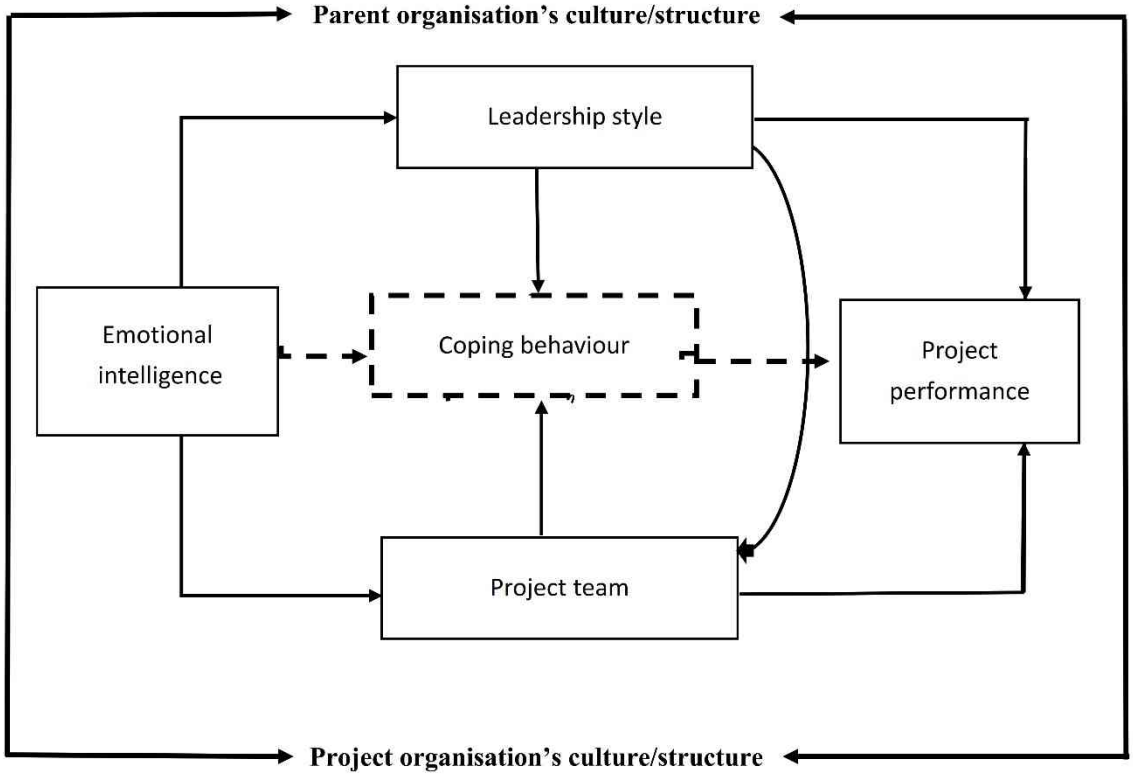


Figure 2.1 The impact of emotional intelligence of a PM on project performance

Source: Adopted from Love, Edwards and Wood (2011: 57)

On a construction site, team management has many different facets since many interesting developments can occur within a short period (Dansoh et al. 2017: 1). PMs should therefore always strive to be positive, while still ensuring that the team understands the project needs; the rationale for decisions; and the importance of their work as a crucial contribution to the success of the project. Aligning the goals of any efforts to the objectives of a project therefore means more to the team members, as they feel more inclusively part of the project, as well as having an important purpose in the outcome of the project (Ojiako, Chipulu, Marshall, Ashleigh and Williams 2015: 47). Furthermore, since many projects are extensive undertakings, it is not always easy to know how each of the project teams are faring; so the PM should employ an open-door policy to allow each of the aspects of the project to be followed up on, and to ensure that no conflicts arise (Mok et al. 2015: 457). The PM must therefore effectively communicate the objectives and goals of the project at all times; while tapping into the ideals of servant leadership, as outlined, next.

2.3.3 Servant Leadership theory

Greenleaf (1977:1-6) developed the Servant Leadership theory in the late sixties and seventies, while attempting to explore techniques that would be good for society; wherein, his reflections on a journey to the East helped him come up with new outlooks on leadership. His main assertion was that a servant leader must aspire to serve, before being a leader (Greenleaf 1977: 5); and this has helped to change the picture of leadership among scholars in the field considerably. In his reflections, Greenleaf portrayed the fascinating picture that a servant leader should be concerned with listening, searching, and above all, wanting to be a follower. Because of this shift in the focus of the leadership away from the strategies, goals or end product, to the servant, it influences the followers to buy into the process far more whole-heartedly (Prieto, Phipps and Mathur-Helm 2018).

Some authors believe, with reference to the Bible, that there is even more to the theory of Servant Leadership than is initially apparent, as it is connected with the concept of love (Boers 2015). There is an understanding that agape love resonates well with Servant Leadership, which is philanthropic in its nature (Manala 2014: 254). This approach to leadership makes one think of the most important sections of life; whereby, one serves simply because it is the right thing to do, and for the common good. It is worth noting that being ethical, and having integrity, makes serving from the top very difficult; but focusing on the servants becomes more achievable as the focus is rather on growth of the bottom, and building a greater community (Winston and Fields 2015: 413).

2.3.3.1 Qualities or characteristics of a servant leader

One has to understand that the qualities or characteristics of a servant leader are follower-centred. The primary characteristics of Servant Leadership include: active listening, empathy, healing, awareness, persuasion, conceptualisation, foresight, stewardship, commitment to growth, and community building; and these characteristic shed light into how trust is built between the followers and the leaders (Parris and Peachey 2013: 380). The understanding of a servant leader is that of stewardship, where the follower is the priority, with the ultimate outcome typically being to increase buy-in from the follower, as a result of the efforts of that leader to centre others' needs at the core of their relationship (Parris and Peachey 2013: 378). This also applies to the concept of emotional intelligence, as noted earlier in the chapter. Therefore, servant leaders are often seen as empowering their followers (Pekerti and Sendjaya

2010: 755); and there is a strong belief that servant leaders are of service to others, as they manifest true commitment from their followers (Mahembe and Engelbrecht 2013: 1).

2.3.3.2 Servant Leadership in construction projects

There are a number of leadership styles that can be applied to construction project management such as Situational Leadership, Transformational Leadership, Transactional Leadership and Participative Leadership (Gwaya, Masu and Oyawa 2014: 39). Sunindijo (2012: 187-188) argues that connections exist between Transformational Leadership and emotional intelligence, as noted earlier in the chapter. These are all leadership styles that are value-based; and they work to some extent, but Servant Leadership is argued to work much better because of its orientation on the servant (Mahembe and Engelbrecht 2013: 2). Authors that have written about the topic of stewardship, and the consideration of everyone involved around a construction site, argue that Servant Leadership is an appropriate perspective form of leadership; and state the significance of emotional intelligence as a necessity for any leader — not only a PM.

It is also valuable to note that there is another proposal for leadership, called Complexity Leadership Theory (CLT), which seems to look at organisations from the perspective of complex adaptive systems. This complements the Soft Systems Modelling approach, as used in this study, as it is a constant reminder of the dynamic nature of change (Uhl-Bien, Marion and McKelvey 2007: 299). The complexities in this development are also related to leadership in the way that decisions are made, especially at the planning level (Sterman 2001: 8). Leadership is an underlining factor in a project; hence, there are proposals from Goleman (1995; 1998), and others, that emotional intelligence is a necessity for all leaders — not only the PMs. Thus, all leaders involved in a project, not only the PM, should be self-aware, such that he or she should be aware of the emotions of those that they are working with (Li, Gupta, Loon and Casimir 2016: 110-112); complementing the principles of the emotional intelligence of PMs.

As noted earlier in the chapter, in projects, there are jobs for many general workers that do not require particular skills, but only an idea of what work a construction site entails, and what they can do. This requires a more worker-centred style of management, to be able draw the most from such unskilled workers (Windapo 2016: 1-8). Soft skills and Servant Leadership qualities should be at play all the time; and are paramount for anyone wishing to be a PM, foreman or

team leader in such environments (Prieto et al. 2018). The PM and any other leaders involved in a project should, therefore, be emotionally aware to such an extent that they are aware of the emotions of those working around them too (Li et al. 2016:110-112). This is mainly because one needs to put the importance of those who wish to serve at heart, and to gain their trust and commitment to perform. Consequently, in the interviews of this study, this research has paid attention to issues pertaining to the different categories of emotional intelligence.

While this section has discussed the numerous soft elements of project management, it is also important to outline the various technologies that PMs use to improve project performance, next.

2.3.4 Technologies used by project managers to improve project performance

Complementing the many soft skills required by PMs, there are also a variety of technologies available, which are commonly applied to assist PMs with handling the challenges and requirements of their projects, and to improve their projects' performances. Common technologies that are used by PMs to improve project performance include Gantt charts, project evaluation and review technique (PERT) charts, work break down structure (WBS) diagrams, mind maps, status tables, timelines, calendars and quality function deployment (QFD) systems (Musa, Abanda, Oti, Tah and Boton 2016). These are summarised, next.

2.3.4.1 Gantt charts

Gantt charts, named after their creator, Henry Gant, aid in managing and planning projects by separating the many tasks of a large project into a sequence of smaller tasks, in an organised manner. It lists each task with a specified and corresponding duration and completion deadline that is depicted graphically on a horizontal bar, with the left-most end of the bar signalling the task's start date, and the righter-most end signalling the task's completion date (Rolfsen and Merschbrock 2016: 558). Used widely in projects in the construction industry, numerous tasks can be executed sequentially, and overlapping tasks are depicted in a visual format vertically to provide a total project overview (Marengo, Dallasega, Montali and Nutt 2016). Important events or 'milestones' are also marked on the chart, usually by way of small diamond demarcations. Although Gantt charts allow the PMs and stakeholders to visually observe any primary and secondary tasks, as well as the dates on which the various tasks should begin and

end in a sequential format, they do not allow any relationships between tasks to be displayed; and as such, are often used in combination with other PM tools (Mubarak 2015).

2.3.4.2 Project evaluation and review technique (PERT) charts

This tool is an important PM mechanism for the scheduling and planning of entire projects, while also allowing the implementation phases of projects to be logged, and the time allocation, start date, end date, and divisions between tasks to be shown (Cooray, Somathilake, Wickramasinghe, Dissanayke and Dissanayake 2018: 909). PERT charts use boxes and arrows between boxes to represent the tasks and respective dependencies between tasks, in a network model (Agyei 2015: 222). Consequently, the layout of PERT charts allows the relationships between tasks to be clearer; although a disadvantage with PERT charts is in the depicting of long or complex projects, where many intertwining tasks and dependencies are often difficult to observe and follow (Parlak 2016).

2.3.4.3 Work break down structure (WBS) charts

Work break down structure (WBS) charts are common PM tools for visualising the scope of work that is to be performed, by separating the project into its individual parts, where each of these components can be efficiently scheduled (Li and Lu 2016: 04016086). The WBS chart follows a tree-type of format, where overarching tasks are placed at the top, and distinct project sections and individual tasks are placed sequentially lower down (Hidayah, Latief and Riantini 2018: 012003). Consequently, WBS charts are generally likened to flowcharts that logically link their various components, and these components can be illustrated or elucidated in text boxes (Sutrisna, Ramanayaka and Goulding 2018: 381). As a result, WBS charts are often employed as a PM tool of choice in construction projects (Liu, Al-Hussein and Lu 2015: 29).

2.3.4.4 Quality function deployment

QFD refers to a category of project management tools for ensuring project quality, by defining the relationship between the desires of the client, and the capabilities of the products, materials, and executors (Dikmen, Birgonul and Kiziltas 2005: 245). One such QFD tool is House of Quality, which was developed at Mitsubishi's Kobe shipyard site in the 1970s, to offer a system for functional communications and planning. HOQ is often executed using software such as Edraw, which uses analytical structures such as legend boxes, markers, matrices, and the project roof to elucidate the respective components of the project. It also assists with group

decision-making, satisfying the needs of the client, developing designs for translating the clients' demands into design targets, and quality assurance checks throughout the project (Raut and Mahajan 2015: 260). A shortcoming of HOQ, though, is that it can be complex to construct manually, and requires specialised software to be able to develop the intricacies of the tool (Dikmen et al. 2005: 245).

2.3.4.5 Status tables

Status tables effectively track the progress of projects, though they contain limited detail of the relations or durations of the tasks of the project. They rather focus more on the complete status and progress of projects; while indicating who should take charge of the various tasks (Milosevic and Martinelli 2016). Consequently, project leaders are informed of who to contact regarding the various tasks, and are able to evaluate the respective employees on their performance (Kim, Oh, Cho and Seo 2008: 163). This makes status tables useful for construction projects, and for planning the construction supply chain (Gong and Azambuja 2013: 671; Kim et al. 2008: 163).

2.3.4.6 Mind map

Mind maps are powerful PM tools, and unlike most PM tools, they are more flexible and less formalised (Chen and Lin 2012). They are, however, effective at analysing problems, managing to-do lists, and breaking complex projects into concise tasks. Mind maps allow PMs to zoom down and focus on specific portions of projects, link files, and insert pictures, which most other tools are unable to do (Suresh and Egbu 2008: 48).

While the subjects are generally discussed in different quarters, it is important to understand that there is a clear link between supply chain management, project management and leadership. Therefore, there is a need for efficiency and better performance in projects, which brings together the topics of leadership theories and supply chain management (Khalfan and Maqsood 2012: 300). This is emphasised in the next section, which depicts the connection between the supply chain, leadership styles and project performance levels.

2.4. SUPPLY CHAIN MANAGEMENT

There have been a number of developments over the years as people attempt to understand the most effective way of defining and elucidating the construction industry supply chain.

(Agapiou, Flanagan, Norman and Notman 1998: 351; Akintoye, McIntosh and Fitzgerald 2000: 159; Croxton, Garcia-Dastugue, Lambert and Rogers 2001: 13; Segerstedt and Olofsson 2010: 347; Chan and Lam 2011: 1332; Tejpal, Garg and Sachdeva 2013: 51) There is a clear understanding that when dealing with the complex supply chain of construction projects, one has to develop a model that can accommodate all of the inputs from each of the people involved (Thunberg, Rudberg and Karrbom Gustavsson 2017: 90). There are four focus points that have traditionally characterised the supply chain industry namely: [1] in every project, there is an interest by the stakeholders to reduce the cost and time spent on a construction site; [2] the transporting of materials can be very costly, but there is need to focus on reducing costs for the timely delivery of inventory; [3] considerations must be made for the moving of any other activities, which can happen away from the construction site, to the initial stage; and [4] there always is a need to improve the efficiency and performance of the construction site (Titov et al. 2015: 68; Vrijhoef and Koskela 2000: 171).

The supply chain has therefore been defined as an interaction of different activities, which leads to the generation of a product that consumers would be expecting as products, services or information (Croxton et al. 2001: 13). Reflecting on the supply chain, one might think that it is a straightforward step of the process management of activities pertaining to the final output; but it is rather a complex affair. The supply chain has many players; and currently, the literature does not seem to elaborate much on the relationships of management with subcontractors, especially in the planning phases of projects (Venselaar, Gruis and Verhoeven 2015: 1-8). The term procurement seems to dominate the supply chain, but it is only one of the components of the supply chain (Croxton et al. 2001: 13). The current supply chain management systems have also been focusing solely on the contractor, while ignoring other important players (Zlatanovic 2015: 15).

The uniqueness of the construction industry is that most of the time, projects are not repeated, meaning that designers must continuously come up with something different, which makes it difficult for the same suppliers to be involved in the supply chain. There is, however, an understanding that supply chain management is generally guided by three major ideals: trust, commitment and collaboration (Khalfan and Maqsood 2012: 300), and this is where system dynamics should bring in concepts of feedback loops that would create better understanding and appreciation of the work that is involved. There are numerous challenges that are known to inhibit the smooth operation of supply chains in construction projects, which can be

categorised as either external challenges, which occur on a macro-scale, or internal challenges, which occur on a smaller, site-specific scale (Yüksel 2012: 53; Vrijhoef and Koskela 2000: 171). Systems thinking has also been applied in numerous instances to elucidate the principals of sustainability in supply chain management (Rebs, Brandenburg and Seuring 2018; Mello, Gosling, Naim, Strandhagen and Brett 2017:89).

The next section addresses the external challenges experienced in the supply chains of South African construction projects.

2.4.1 External challenges experienced in the supply chains of South African construction projects

In order to identify the dynamic challenges facing the supply chain, which are known to limit the successful performance of construction sites in South Africa, it is valuable to firstly perform a PESTLE analysis of the construction supply chain in the country (Yüksel 2012: 53). A PESTLE analysis is the best tool to use, as it is detailed, while also being compatible with qualitative research methods. Generally, PESTLE analyses are considered to generate a very good picture of the market environment, particularly in terms of the macro-environmental factors that are at play (Lamas Leite, de Brito Mello, Longo and Cruz 2017: 708).

2.4.1.1 Political factors

Political stability is required for smooth industrial operation, and politicians are expected to help in creating an environment that stimulates growth in the economy (Yüksel 2012: 53). Infrastructure development is generally encouraged by the public and private sector, but changes in government often mean that there are changes in policies that can significantly affect whole sectors of industry as the primary focus of the national drive might also be changed (Srinivasan, Stank, Dornier and Petersen 2014). Government investments also make it easier to deal with some of the needs of industries, which cause outcomes such as improving the flow of construction projects (Osei-Kyei and Chan 2017: 92).

2.4.1.2 Economic factors

Since investment in almost any venture is geared towards profit gains, macro-economic factors in a country are important, as they affect how people spend their money; what reserve banks determine to be the interest rates; and exchange, import and export tariffs (Yüksel 2012: 53). It is a general economic principle that people are happier to spend when they feel that they are receiving value for their money. Conversely, while if there is a large amount of money being spent on purchasing materials from outside a country, it could make it too expensive for construction companies to employ sufficient quantities of workers, while still keeping within the competitive budget constraints of projects — leading to unemployment trends (Grant 2017: 245). The interest rates also impact the construction industry, in general, because many construction projects must borrow large sums of money in order to complete the projects; and this has large effects on the availability of funds for project budgets (Martens and Carvalho 2017: 1084; Windapo 2014: 6088).

2.4.1.3 Social factors

People's attitudes, as well as the composition of communities, and social lifestyles stimulate projects (Yüksel 2012: 53). South Africa is not an easy country for many types of construction projects, in the sense that there is a scarcity of many important types of project skills (Windapo 2016: 1-8). In South Africa, there is also a social need to contribute to an improvement in the wellbeing of the people across the country; meaning that there is a social pressure to employ more people from disadvantaged communities (Aigbavboa, Oke and Mokasha 2016: 53).

2.4.1.4 Technological factors

Technological factors pertaining to the technological and mechanical developments that have been made in the market, such as the availabilities of machinery, products changes, and the varieties of technologies that are available (Yüksel 2012: 53). At the same time, the increase in technologies means that there is progressively more work being done with machines, so there is a general trend towards labour replacement by machines (Galeon 2017). This can generate difficult situations because one machine could function more efficiently, and with lower costs than numerous people, which could lead to considerable job losses, along with unrest through strikes (Williams and Booysen 2013).

2.4.1.5 Legal factors

Legal factors are closely linked to political factors, since politicians are the ones who enact the laws, having significant effects on the different industries (Yüksel 2012: 53). In South Africa, various legal factors are known to affect the construction industry, such as legal requirements for minimum wages, legal stipulations for trade union affiliations, and Broad-Based Black-Economic Empowerment (BBBEE) compliancy requirements (Lindsay 2016: 1). The topic of minimum wages is a critical issue for the construction industry supply chain, as increasing wages reduces the amount of profit generated in the projects; however, there is a motive in legal statute to attempt to alleviate the current state of poverty in the country (Arya and Bassi 2011: 674; Tangri and Southall 2008: 699). Some of the requirements of minimum wages are, however, making it undesirable to remain in the industry, with many workers feeling that wages are still too low; while project investors and contractors are feeling that reduced profit margins are making the project efforts too futile (Finn, 2015).

Trade unions are notoriously difficult associations to cooperate with, despite claims that they collaborate well (Buhlungu 2006). This can be attributed to their desire to keep as many people as possible at work, and maintaining their contributions to the unions — even though this is often highly obstructive to the employers. While it is, sometimes beneficial, particularly for ensuring the rights of the employees, this can often hamper the progress of projects (Tangri and Southall 2008: 699). BBBEE compliance also means that procurers are forced to acquire materials from companies that are registered with a minimum staff complement and shareholders from previously disadvantaged population demographics. This can be difficult because many of these companies do not have the capacity to supply all the necessary materials; and many logistics companies also lack the capacity and experience to handle large construction projects (Kleynhans and Kruger 2014: 1).

2.4.1.6 Environmental factors

Climate change awareness is important in construction projects, along with a knowledge on the laws around dumping and pollution (Yüksel 2012: 53). While construction projects are life injectors into communities, making it possible to change people's lives, some projects do affect the natural ecosystems surrounding the projects, such as requiring birds and wildlife to be moved. There are always concerns arising from political circles, civil societies and the communities about biodiversity, and the effects of new permanent structures and so forth (Fill

et al. 2017: 1). Most construction projects seem to attack negative reactions from different lobby groups in the society; and it is generally known that construction projects change the outlook of societies, which can sometimes be destructive if they are not well managed (Lizarralde and Massyn 2008: 1; Ugwu and Haupt 2007: 665).

Generally, with the growth of urbanisation in most countries, there has been a massive impact on the environment, with large areas of land being turned into built-up metropolises; and yet, most construction companies do find themselves unprepared to handle the environmental challenges facing them. In South Africa, this is covered under Ecosystems Services, which has a broad outlook on the macro environment, focusing on a number of issues such as clean water, raw materials, production processes and climate stability (King, Damon, Forsyth and Trends 2005: 2). The construction industry, and its supply chain, must therefore deal continuously with environmental compliancy issues, because of the nature of its business, which uses a lot of resource materials and water, while producing many highly polluting materials (Horvath 2004: 182).

2.4.2 Internal challenges experienced in the supply chains of South African construction projects

There are a number of challenges experienced in the supply chains of construction sites that could be contributed to internal factors. For instance, an active industry will always be seeking growth, and the people involved in the industry would want emancipation for a better living (Grant 2017: 245). As a result, there are numerous internal challenges experienced in CPSCs, which are listed here.

2.4.2.1 Outsourcing

Many of the challenges experienced in the construction industry in Gauteng are complex because they deal with complexities that are generated by outsourcing within the supply chain. Outsourcing parts of projects to subcontractors brings with it a reduction in the control of those elements of the project; while outsourcing also brings with it the need for networking among the subcontractors, which might impact the way things are done (Lizarralde and Massyn 2008: 1; Mbachu 2008: 471). For instance, new dynamics are often introduced because of concerns that may develop over trust between the PM and the outsourced logistics organisations (Ke, Cui, Govindan and Zavadskas 2015: 349; Mbachu and Nkado 2007: 39).

2.4.2.2 Communication

There is always a need to rely on information between project participants, in order to achieve the goals of a project, requiring that the mode of communication and the channels to be followed should be very clear to the project team (Gómez-Ferrer 2017: 2). There are two major forms of communication: formal and informal communication. In addition, there are also directions of flow of communication within a project; where the communication may flow in the following general directions (Zulch 2016: 3-4):

- a downward direction, where information starts at the top management, which communicates the objectives, strategies, and so forth, to the lower tiers of the project;
- an upward direction, where communication occurs from the lower tiers of the project to the upper tiers, providing feedback on what is happening;
- a horizontal direction, where communications from project teams flow to other teams and sections at the same tier level; and
- a diagonal direction, where communication occurs among people from different tiers, and across different departments of the project.

While both formal and informal communication can follow these directions of flow, informal communications that flow through the project process, such as hearsay or rumours, can result in major problems, such as project participants concluding their own views, or making decisions that could affect the delivery and performance of various aspects of the project (Hoezen, Reymen and Dewulf 2006: 1).

2.4.2.3 Poor planning

When it comes to supply chain management, one of the problems that is frequently noted on construction sites is poor planning and scheduling, which occurs as a result of the insufficient involvement of all participants, from the onset of a project (Bankvall, Bygballe, Dubois and Jahre 2010: 389). Planning becomes a central constraint if it is not adhered to, because its main purpose is to ensure that each of the tasks of the project happen according to a pre-set schedule. Failing to plan means that projects could devolve over time, leading to significant dissatisfaction and a scrambling for resources as the primary contractors and subcontractors compete with each other to complete their work on time (Kerzner and Kerzner 2017). Failing to plan is therefore a primary cause for increased costs and penalties, which may be incumbent

upon those that have failed to plan and execute their projects correctly (Subramani, Sruthi and Kavitha 2014: 1).

Planning is especially important in construction supply chains, since there are typically lengthy lead times for the different materials, and materials must be supplied in the correct quantities and at the correct time, to complete the various stages of work (Mahamid 2016: 27). Therefore, the sequences in which these different kinds of work must be done, and by whom, necessitates a comprehensive plan to be drafted in order to avoid extensive delays. In projects, a general trend is that subcontractors, such as logistics companies, are not involved in the design phase, but there are suggestions that if they were to be part of the design team, this would improve the relationships of all the participants (Errasti et al. 2007: 251-252).

In addition, looking at the supply chain process of construction projects, there is a challenge because everything seems to focus only at the end stage of the supply chain (Behera, Mohanty and Prakash 2015: 1332). A construction project is complex from the onset, but a lot of detail of the supply network is left out, which does not bring all parties' participation and contribution to the fore — only that of the main contractor (Vidalakis et al. 2011: 66). Waugh and Luke (2011) are of the belief that planning needs to involve all participants from the start, which increases the emphasis on trust, because communication lines must be opened, and everyone must know what their responsibilities are, and what they are expected to do for the project to be on-time, on-quality and on-budget. It was considered in this study, therefore, how planning has affected the supply chain operations of the construction site.

2.4.2.4 Poor knowledge management

The challenge among many construction projects in South Africa is that there is little documentation taking place to detail the informal innovation that is continually occurring in the industry (Ramazani and Jergeas 2015: 41). One can clearly realise, though, how much learning is needed in the construction industry, and how important it is to understand and document the factors generating success or failure on construction sites (Walker and Walker 2016: 115). Learning from three of the major international clusters of construction innovation — The UK, Australia and Sweden — there is definitely a significant amount of good to be generated from the collaboration of academics with various practitioners on construction sites. This could result in the development and documentation of more knowledge (Serpella, Ferrada,

Howard and Rubio 2014: 653; Ojiako et al. 2015: 47). There is always a disparity, though, for people in the developing world, such as in South Africa, because often, a large amount of construction is done without proper knowledge management, or any documentation and understanding on the factors that have led to the success or failure of the project (Joslin and Müller 2015: 1377).

2.4.2.5 Conflicts of interest

Sometimes, there can be conflicts between the different service providers on a construction project because of sharing of resources and costs (Lee, Han, Jang and Jung 2017: 1). There could, for instance, be issues of concern because some subcontractors would want to keep their suppliers and resources to themselves (Jelodar, Yiu and Wilkinson 2015; 89; Bowen, Akintoye, Pearl and Edwards 2007: 134). This conflict over resources, and the supply of these resources, therefore presents a potential factor driving the success or failure of supply chains in South African construction projects (Mok et al. 2015: 446).

2.4.2.6 Collusion

Collusion is one inherent aspect of projects in South Africa, which is known to affect the performance of CPSCs; whereby, there is a tendency for some members of projects to be involved with other suppliers, resulting in a lack of fairness in the decision-making process (Bowen et al. 2007: 134). One would therefore need to be very frank about the project team, such that freedom and communication should exist without fear of negative outcomes resulting on any of the participants of the project for voicing any such concerns about collusion (Oke, Aigbavboa and Zacharia 2017: 342). It is clear, though, that since collusion is occurring in many construction projects, the ability to address collusion is certainly not being provided.

2.4.2.7 Corruption

Another one of the major challenges to the supply chain is corruption, which in South Africa, is considered to be experienced at every level of construction projects, in different forms (Le, Shan, Chan and Hu 2014: 02514001). Fraud and bribery, for instance, is considered relatively normal in construction projects; even though it is not always evident to all participants. And, while this is not an issue that is widely discussed as being a concern to the supply chains of the construction industry, it would likely be a prominent issue among exceptionally large construction projects (Bowen et al. 2007: 135). Bowen, Edwards and Cattell (2012: 886) have

used the United Nations Development Programme's (UNDP – UNIFEM 2015: 3) definition of corruption to quantify the problem as "the misuse of entrusted power for private gain". While it is impossible to evaluate precisely what this is doing to the supply chains of the construction industry, one of the major challenges is that corruption occurs across-the-board, and it has been estimated that approximately $1.5 trillion is transacted through corruption, globally, each year (Bowen et al. 2012: 886). As a result, a general understanding is that up to 25% of a project's budget is spend on corruption activities, just trying to ensure that the process runs smoothly (Bowen et al. 2007: 631). However, there is much to be understood in attempting to define the reasons that corruption exists in the supply chain, specifically; and what steps should be taken to overcome these issues (Aigbavboa, Oke and Tyali 2016; Le et al. 2014: 02514001).

2.4.2.8 Nepotism

In the case of nepotism one is never clear of what can be possible in private sector cannot be so in public sector. This simply means that it is an area of concern as alluded to in chapter one that nepotism does filter through most construction projects. Some of the soft skills (trust, reliability etc.) are the main reason why people would choose their own people.

2.5. METHODS OF IDENTIFYING AND RESOLVING ISSUES IN CONSTRUCTION PROJECT SUPPLY CHAINS

As noted in the previous section, the range of external and internal issues affecting construction supply chains is broad; and at times, it is difficult to clearly quantify and address. One important methodology that has been promoted for its ability to address difficult situations is the SSM (Checkland and Poulter 2010: 191). This section provides a detailed explanation and overview of SSM, along with the important considerations when using the principle in this study to determine how to improve the efficiency and performance of the supply chain processes of construction projects in the Gauteng province of South Africa.

2.5.1 The Soft Systems Methodology

A system of research that has been developed over the past four decades for solving management problems is the SSM. Originally developed by research at the Lancaster University by Checkland and Scholes (1999: 330) and Wilson (1990; 2001), through a systematic process of action research, the researchers produced a set of tools to identify and

attempt to improve the "soft", or poorly-defined problems that exist in society (Ivanov 1991: 39). As explained by Checkland and Poulter (2010: 191), SSM is "an approach for tackling problematic, messy situations of all kinds. It is an action-oriented process of inquiry into problematic situations in which users learn their way from finding out about the situation, to taking action to improve it". SSM is, however, particularly useful in the analysis of complex problematic situations where there may be conflicting opinions on the definition of the problem, and how it should be addressed. These issues are termed "soft problems", that have no single, clearly defined root problem, or solvable outcome; with examples of soft problems including: how to solve a disease outbreak, how to solve drug problems among the youth, and how to improve education in government schools. Thus, in such situations, even the root of the issue and recommendations for solutions may be debated; and to create a possible resolution, a soft systems approach has been recommended as one successful system of doing so (Sewchurran and Barron 2008: S56; Proches and Bodhanya 2015: 1-15).

Checkland and Scholes (1999: 330) proposed that SSM is a not specifically a system for resolving problems, since by nature, problems imply that there is a solution. However, through the framework of SSM, it has been proposed that many circumstances in private and professional life are characterised by complex, "messy" situations that do not have one single solution; but which can, at best, only be improved through an action-oriented system of tackling the perceived problem (Bailey 2008). This includes, for instance, the supply chains of construction projects. Checkland and Scholes (1999: 330) explain that the complexity of a problematic situation is based on the notion that any situation is subject to multiple interacting perceptions of the people who are involved with the issue. And, while one person may perceive a situation within one frame of mind, another person may perceive it with a totally different worldview (Mobach, Van der Werf and Tromp 2000: 1). Further to this, Checkland and Scholes argued that problematic situations also contain people acting purposefully and wilfully within that situation — both adding to, and attempting to resolve that problematic situation. The process of tackling problematic situations is therefore founded on the notion that there are always people involved in a problematic situation with conflicting world-views; and those acting with would-be purposeful intentions.

In the development of SSM, Checkland and Poulter (2006) made a clear change from the traditional notions of functionalism and positivism, which they argued were "hard" strategies for solving problems, to interpretive sociology and phenomenology, or "soft" approaches. It is

worth highlighting that the word "soft" in SSM is sometimes considered problematic in qualitative inquiry; but it does not imply that the study is at all less significant than "hard" studies; it only provides a mechanism to deal with complications that can be challenging to comprehend because of the interpersonal and political dynamics involved (Kayaga 2008: 273). These problems are often evolving, socially complicated, and difficult to define, since they contain many interdependent factors that can lead to unintended consequences; while at the same time, having no obvious solutions (Australian Public Service Commission 2012). This is contrary to "hard" problems, which can often have more easily formulated solutions (Brenton 2007: 12).

It is therefore important to use robust solutions that allow investigations of such problems. The interpretive paradigm in which SSM is situated, acknowledges how such systems are better understood through getting a subjective perspective of the perceptions and understanding of those involved (Jackson 2010: 133). This necessitates considering how cultural the truth is constructed and reconstructed through actions and discussions, rather than having a static outlook on social interactions, which disregards people's worldviews (Checkland and Scholes 2001: 91; Checkland and Poulter 2006). SSM can therefore be applied in any real-world situation where people act purposefully, such as in the supply chain of the construction industry (Checkland and Poulter 2006).

2.5.1.1 Stages of the SSM

Within the principles of SSM, a possible solution is achieved by using a seven-step system that facilitates debate among the parties concerned; but which ultimately involves an in-depth comprehension of the issue, after which numerous systems of human activities are modelled that could be beneficial to overcoming the problem (Couprie 2004: 10; Jackson 2010: 133). Through deliberations among the decision makers, a consensus or compromise is drafted over the changes that can be systematically and feasibly made. The seven-step process of SSM involves entering the situation; expressing the problem; formulating root definitions; building conceptual models; comparing the models with the real world; defining the changes; and taking action (Luckett and Grossenbacher 2003: 147). This has, however, generally been compressed into four main stages (Kayaga 2008: 273; Khisty 1995: 91).

The first stage involves exploring the problematic situation by identifying the problems, and determining any power and cultural relations (Checkland and Poulter 2006: 39). Rich pictures may be used to express the problem by depicting the stakeholders and the issues that they experience regarding workings between stakeholders, and also interconnections and relationships between the actors (Kayaga 2008: 273; Khisty 1995: 91). The next stage of SSM includes constructing a sequence of potential purposeful activities that correspond to the actors' worldviews, which outline what is being done, how it should be done, and why (Checkland and Poulter 2006: 39). A formula termed PQR is developed as the model of purposeful activity for transformation, where the P is the 'what', Q is the 'how', and the R is the 'why' — or as Checkland and Poulter (2006: 39) explain, "do P, by Q, in order to help accomplish R".

A general style of purposeful activity, referred to as CATWOE is ultimately created as a means of improving the problematic situation, which involves the following players (Checkland and Poulter, 2006):

- C – clients who are beneficiaries or victims.
- A – actors who are accountable for the activities.
- T – transformation.
- W – worldview.
- O – owners who can prevent or modify the activity.
- E – environmentally-friendly constraints.

The final stage in the SSM process therefore consists of defining and implementing the proposed model of actions, with the purpose of making the desired culturally- and practically-feasible adjustments (Checkland and Poulter 2006).

2.5.1.2 Applications of SSM in supply chain management and construction projects

As noted by Checkland and Poulter (2006), since this approach to tackling problematic situations is so all encompassing, its applications are extremely broad. It is therefore possible to use it in understanding and improving problematic situations arising in the construction industry; and in particular, in relation to supply chain problems that have been inhibiting the construction industry from performing more efficiently and effectively. To the researcher's knowledge, only one study has been completed using SSM to analyse the problems with the supply chain in the construction industry, wherein a study by Elliman and Orange (2000: 345)

was performed nearly two decades ago on a supply chain in the United Kingdom. However, this is deemed both outdated, and unreflective of the environment in South Africa. In addition, as confirmed by a systematic literature review on Google Scholar, analysing the broad spectrum of published literature for the years 1950-2019, no studies using SSM have ever been performed on the construction industry supply chain in South Africa, rendering this study as the first of its kind in the country. Indeed, studies on the construction industry supply chain remain limited, with few known recent studies having been performed but that of Ojo, Mbowa and Akinlabi (2014: 1974) on the factors preventing green sustainable supply chain management in the Nigerian construction industry; and Ibem and Laryea (2015: 364), which considered electronic procurement and e-commerce in the supply chain of the construction industry in South Africa. The findings of their studies were noted in the previous section of the chapter.

A more recent study by Mello et al. (2017: 89) also used a soft systems approach to consider the implications of improving coordination in an engineer-to-order supply chain; though their study was not specifically focused on the construction industry; nor was it based on the South African dispersion. In addition, a study by Panova and Hilletofth (2018) considered how to manage the delays and risks in the supply chain of a construction project, and while this study employed systems thinking, it did not specifically attempt to use a SSM.

2.5.1.3 Applications of SSM in South African industry

Some studies have been performed using SSM in other industries in South Africa, such as Wing, Andrew and Petkov (2015), who used SSM to understand soft client requirements in information system development projects; and Gilson, Elloker, Olckers and Lehmann (2014: 30), who used SSM as a methodology for improving primary health care in Cape Town. Earlier work by Barry and Fourie (2002: 23) also used SSM to develop a conceptual framework for improving land management systems in South Africa, while Sewchurran and colleagues performed various research around a decade ago that used SSM for understanding and improving business situations (Sewchurran and Barron 2008: S56; Sewchurran and Petkov 2007: 46). A study by Proches and Bodhanya (2015: 1-15) on the sugar cane industry in South Africa found that SSM was a highly-effective methodology in generating improvements in a sugar cane mill environment. Proches and Bodhanya found that SSM proved to be an effective methodology since the industry was characterised by multiple diverse stakeholders, with often

diverging objectives. Thus, by following a qualitative methodology using the principles of SSM, the authors were able to identify various problematic aspects of the sugar industry that were modelled and presented to the stakeholders in order to initiate action towards improving the encountered problematic situations.

Various other research has also been performed, in attempting to use systems thinking to improve project performance; where, for instance, Zhu and Mostafavi (2017:4) developed a novel approach for understanding construction project performance using an investigation of the ability of a construction project to handle complexity. Zhu and Mostafavi used theoretical underpinnings of organisational theory and systems science to argue that a framework, based on the congruence of complexity and emergent properties (CEPC), was able to increase the chance of a project achieving its performance goals. To this end, three dimensions of project emergent properties (restorative, adaptive, and absorptive capacities), and two dimensions of project complexity (dynamic complexity and detail) were said to be necessary to determine the CEPC of construction projects.

Concepts such as this have been considered during this study as well; however, the proposed research topic of this study is about improving the efficiency and performance of the supply chain in the construction industry, which means understanding that human capital must be related to the work at hand and not just numbers. A SSM helped unpack some of the complexity found in the supply chain of the targeted construction project in Gauteng.

2.5.2 Recommendations for improving the supply chains of construction projects

There are advances in the way contemporary people think, and how they wish to express themselves as being part of a project. The theories of leadership seem to be debating the whole understanding of leadership, where DeRue (2011: 127) proposed that leadership in projects in the past was addressed only from the perspective of the leader who should give instructions that others should follow. However, DeRue thought that this particular type of leadership seemed not to take into account the necessary feedback loops from followers. An authentic leadership style is now being proposed in the modern literatures to fit in with the success of projects, because it encompasses the qualities or characteristics of both the transformative and ethical leadership styles of PMs (Lloyd-Walker and Walker 2011: 385).

While one would anticipate acceptable norms of conduct in organisations, which permeate the fabric of each person who works in that organisation, the reality is that not all people are fond of educating or empowering themselves of the acceptable norms of organisations; especially the code of ethics that seems to help everyone in the organisation (Garegnani, Merlotti and Russo 2015: 541). In leadership, the same appears to be the case; therefore, unless there has been an empowerment from the main leadership of an organisation, many PMs find themselves in a situation of dealing with people who are not adhering to the acceptable norms of the organisation.

In South Africa, there is The King Code (I-IV), which enumerates a number of basic principles about how one should exercise their leadership in corporate South Africa (Institute of Directors in Southern Africa 2010; 2016). In the code, there is an emphasis on the 'triple bottom line', which maintains that directors of organisations should attempt to maximise the benefit of the corporation towards the profit, people and the planet (Ackers and Eccles 2015: 515). This has also brought about a shift in how certain operations are being realised; and it is within this context that the different leadership styles or theories in the management of construction projects are discussed.

2.6. GAPS IN THE RESEARCH

While this chapter has presented a concise review of the literature, it is clear that there are numerous gaps in the research that need to be highlighted, as follows:

- There is a clear lack of appreciation for the dynamic complexity of the supply chain from the perspective of the decision makers on construction sites;
- The main focus of most of the literature is still very much on the main principal contractor, which is likely due to the position of impact held by the PM;
- There is a clear need to have a model that embraces all of the above gaps in the supply chain of a construction site, and such models have not been clearly developed; and
- According to a systematic literature review performed on Google Scholar, analysing the broad spectrum of published literature for the years 1950-2019, no studies using SSM have ever been performed on the construction industry supply chain in South Africa, meaning that no attempts have ever been made to understand and model solutions to the soft problems that arise in such an important part of South African industry.

2.7. CONCLUSION

This concludes the literature review on the challenges surrounding the supply chain of the construction industry in South Africa. The interconnectedness of the supply chain, project management and leadership are the keys to an operational model being developed in the supply chain of the construction industry. The hope from this study was that the researcher was in a position to outline the aspects of leadership that are necessary for the successful implementation of supply chains within a construction company in Gauteng, which may not otherwise have been seen clearly from the onset. This has required bringing in models from the SSM, which have permitted the researcher to develop a better system of addressing the complexities of the supply chain. For instance, during the interviews, the researcher paid attention to issues pertaining to the different types of emotional intelligence of the supply chain's leadership. The methodology that was used to understand the complexities in the supply chain on a construction site, and the development of a model to enable more effective performance in the project's management, is outlined next.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1. INTRODUCTION

This research was conducted on the construction industry in the Gauteng province of South Africa. This chapter outlines the research methodology that was performed for this study. It begins with a discussion on the considerations that were made in line with the research philosophy, and why a qualitative research methodology was ultimately chosen for this study. Next, the chapter presents a detailed overview of the research design of the study, beginning with an overview of the different types of research designs available in research, and why a descriptive research framework was employed here. In line with this descriptive research framework, the target population is discussed, along with the methodologies that were used to create the purposive sample of this study, the interview research instrument that was used with open-ended questions, and the qualitative thematic analysis and SSM that was performed to analyse the data. Finally, the delimitations and scope of the study are presented, along with the steps that were taken to ensure validity and reliability, eliminate bias, and to ensure that the study was conducted within the ethical requirements of the Durban University of Technology. The chapter begins, first with the research philosophy.

3.2. RESEARCH PHILOSOPHY

Before making any considerations on the methodology of a research project, it is important to consider firstly the philosophical paradigms of the research, as it helps to establish the expectations of the study, which in turn helps to clarify the reasons to choose a particular research design to conduct the study. In research, two primary research philosophies are generally followed, which form the roots of the qualitative and quantitative research strategies (Brannen 2017: 101). Qualitative research is founded on the phenomenological perspective that the universe is not one single reality, but multiple realities that are subject to the interpretations of the observers that live in that universe (Creswell and Poth 2017: 156). Conversely, positivists maintain that there is only one single reality, which can be precisely measured and observed with quantitative accuracy and consistency (McNabb 2015: 240).

3.2.1 Qualitative methodologies

Qualitative researchers try to understand a topic from the perspective of the participant, meaning that in such studies, there exists a level of contextualism (Collis and Hussey 2013).

That is, the macro- and micro-contexts in which people dynamically interact with their environments are thought to be unique, and fundamentally associated with their individual experiences (Atwood and Stolorow 2014). Typically, qualitatively-structured methodologies rely on ethnographic or discourse analyses, which generate conclusions from verbal or visible communications (Gee 2010). Three main categories have, however, been described by Struwig and Stead (2013) to define each of the circumstances in which qualitative research occurs. First, in research where patterns are being extracted to confer importance, the following are typically used:

- action research: In such studies, actionable results are generated that are primarily meant for the purposes of the research workers, or the study's contributors (Whyte 1991);
- phenomenography: In such studies, the ways in which people comprehend the world are analysed (Åkerlind 2017: 1); or
- holistic ethnography: In such studies, hypothetical effects on socio-cultural systems are created from empirical observations (Moore 2011: 654).

The second category of qualitative strategies occurs in studies where understandings are being gathered on the meaning of actions, where the following can be used:

- case studies: Where singular cases or texts are analysed to obtain explanations (Yin 2013); or
- phenomenology: In which prevalent themes are deciphered to comprehend hidden meanings (Smith 2015).

Finally, where the researcher is seeking to obtain associations among identified or known factors, the following qualitative strategies can be performed:

- event structure analysis: In which research workers obtain underpinning logical components that have arisen in previous occurrences (Heise 1991: 136);
- grounded theory: Where research workers develop hypotheses that are grounded in the data that is collected for the study (Glaser 2017); and
- ethnographic content analysis: In which grounded theory is applied to documented facts (Altheide 1987: 65).

3.2.2 Quantitative methodologies

Quantitative strategies vary substantially to qualitative research; whereby, the emphasis is instead on deriving generalisable results that may be expanded past the bounds of the research sample (Bryman 2015). Quantitative methodologies try to establish cause-and-effect type associations among constructs, as well as to generate results that can be repeated. These characteristics are typically hard to accomplish in qualitative studies (Bryman 2015).

3.2.3 Systems thinking and the Soft Systems Methodology

A philosophy that is applied to various types or research, and which applies to this study, is systems thinking. Systems thinking is defined as a sequence of related events that add up to a whole entity (Wilson and Van Haperen 2015: 9). One cannot simply add up what seems to be the parts of an entity to analyse the whole; but must rather see how each element compliments the formulation of the whole. Systems thinking suggests that the world is systemic through the lens of the social sciences (Flood 2010: 270). A number of authors have described systems thinking as the only philosophy that addresses the complexities of how dynamic things are in the real world (Ivanov 1991: 39). Authors such as Forrester (2009) and Ulrich (2003: 325) developed lines of systems thinking; while Senge (1987) advocated for the use of systems thinking in everyday life, in order to gather a good grasp of reality. Systems thinking has been widely used in the construction industry, having been applied to understand applications as diverse as the safety mechanisms of construction projects (Saurin 2016: 240), risk management of construction supply chains (Arthur 2016; Panova and Hilletofth 2018: 1413), and accident investigations on construction projects (Woolley, Goode, Read and Salmon 2018: 297).

It is important to clarify that systems thinking approaches are not specifically associated with either quantitative or qualitative methodologies; however, certain approaches, such as Systems Dynamics, appreciates the complexity of relationships in any organisation, and tries to show structural flows of information and clear feedbacks through diagrammatical and mathematical models (Dangerfield, Green and Austin 2010: 411; Flood 2010: 273). Systems Dynamics is, therefore, most appropriate in quantitative studies.

3.2.3.1 Soft Systems Methodology

Contrary to the ‘hard’ systems methodologies described above, The SSM is an action-oriented process of inquiry into problematic situations in which users learn their way from “finding out

about the situation, to taking action to improve it" (Checkland and Poulter 2010: 191). As a result, the *soft systems* style employs the concept of a 'system' as a probing mechanism that will facilitate debate among the individuals involved, so as to understand the procedures, objects, relationships and resources that are adding to the problematic situation (Sewchurran and Barron 2008: S56). As explained in the literature review of Chapter Two, the main use of SSM is in analysing complex circumstances where varying views about a problem exist, and where there is no single answer for what the root cause is, or what course of action should be taken to resolve the situation (Checkland and Scholes 1999: 330; Wilson 1990; 2001). Thus, SSM is focused on helping people improve complicated organisational difficulties, which are considered complex because of the unknown variables of the situation (Proches and Bodhanya 2015: 1-15).

By default, therefore, SSM is a form of action research, which is particularly suited to qualitative enquiry (Wilson and Van Haperen 2015: 15). It is important to note, though, that SSM does not attempt to describe methods for implementing solutions to problems, but simply to provide frameworks to understand the problematic situations, and to make changes to improve them (Checkland and Poulter 2006).

3.2.4 Considerations in choosing the methodology for this study

This study was formulated as a qualitative study based on the research philosophy of action research, as expressed through the principles of the SSM. It was upheld that the supply chain is ultimately open to complexities that are continuously emerging from management decisions in the construction industry of South Africa (see Simone Guercini and Guercini 2014: 662), and it was considered that using SSM would be the most appropriate means of approaching the soft problems in the construction industry supply chain. Based on the literature reviewed (Luckett and Grossenbacher 2003: 147), and through personal experience with the construction industry, the researcher also upheld that there was not one single agreed cause or solution to the issues within the supply chain of the construction industry. Furthermore, that the complexities found in the supply chain of construction projects would be best understood by attempting to unlock information through social interactions with the participants.

3.3. RESEARCH DESIGN

The research design of a study is the plan or framework that is created to allow the research questions of the study to be answered in line with the research philosophy that the study has been founded (Kowalczyk 2014: 1). In this research, I have chosen a qualitative approach that allowed me to select the particular people needed. I have selected the Office Park being constructed on Oxford Road in Rosebank in Gauteng province. In research, there are three primary categories of research designs: descriptive, exploratory, and explanatory research designs, with differing degrees of observation and causality being concluded by each, across the spectrum of qualitative and quantitative research (Richters and Melis 2017: 146). Descriptive research designs attempt to provide a basic level of observation of a phenomenon; while exploratory research designs provide a moderate amount of understanding into the reasons behind a phenomenon; and explanatory research designs attempt to generate detailed cause-and-effect type associations that explain a phenomenon. A descriptive research framework was therefore used, here, with procedures being followed to align with the SSM, as this was the most appropriate design for the qualitative research being performed. The target population, sampling strategy, research instruments, data collection and data analysis techniques that were employed to align with this SSM-based descriptive research design are each outlined in turn, next.

3.3.1 Target population

The population of a study is the entire universe of elements with the necessary properties to be able to answer the research questions of the study (Levy and Lemeshow 2013: 125). The population of this study included the broad spectrum of all construction projects in the Gauteng province of South Africa. This population was pursued because construction projects in Gauteng were known to have encountered and interacted with the full range of practices necessary for the supply chain operations of their projects. The specific target population of this study was individuals from the different sections of management within supply chain companies in any construction projects, as well as foremen and ordinary workers that had been involved in the construction supply chain process. Stated simply, the target population included principal contractors, subcontractors, PMs, foremen, and different levels of management in supply chain companies of any construction projects in Gauteng.

In research, though, it is neither cost effective nor practical to approach every member of the target population (Uprichard 2013: 1). Sampling strategies are therefore employed to gather a smaller, representative sample of the target population, which still possess suitable information to answer the research questions of the study (Levy and Lemeshow 2013: 125), as outlined next.

3.3.2 Sampling method

In research, two primary types of sampling are performed, where probability sampling is most appropriate in quantitative studies; and non-probability sampling is the strategy of choice in qualitative studies. This is because probability sampling strategies afford every member of the target population an equal chance of inclusion in the sample, which is an important requirement for inferring statistical reliability and generalisability to the entire population (Uprichard 2013: 1). Within the category of probability sampling, five main sampling techniques exist (Mathieson 2014: 1-2): Simple random sampling; stratified random sampling; quasi-random or systematic sampling; multi-stage sampling; and cluster sampling. Due to the qualitative nature of this study, though, these techniques were not applicable, and are therefore not discussed in further detail here.

Conversely, in non-probability sampling, some form of preference or bias is applied in an attempt to gather a sample with access to the most suitable data; and this is the preferred technique in qualitative studies, where generalisability and statistical reliability are deemed to be less important (Vehovar, Toepoel and Steinmetz 2016: 329). Non-probability sampling was therefore the sampling strategy that was employed in this study, to optimise the quality of the qualitative data that was gathered. Within the category of non-probability sampling, five main sampling techniques exist, as follows (Bryman 2015: 418):

- judgment, or purposive sampling, where a specific sample of participants is intentionally chosen by the researcher, which possesses a set of characteristics that the researcher deems most favourable to the study in question;
- quota sampling, in which a sample is intentionally created that is a smaller, proportionally representative share of the larger population;
- convenience sampling, in which the participants of the study have been included because they are the most easily accessible to the researcher;

- self-selection sampling, where the sample of participants is included by volunteering into, or selecting themselves as participants of the study; and
- snowball sampling, in which participants are included into the study through a process of networking or word-of mouth, thereby reaching participants that would otherwise have been unreachable by the researcher.

Purposive sampling was used to recruit the participants of this research, as it was assumed that a specific sample of participants that had been intentionally chosen by the researcher would possess characteristics that were most favourable for answering the research questions of the study. The purposive sample of participants included members of the construction industry that were known to have interacted with the project's supply chain.

The construction site of a new office park in Oxford Road in Rosebank, Johannesburg, Gauteng, which was being constructed by the Giuricich Bros. construction company, was used as the location from which to purposely select the participants for this study. The Giuricich Bros Construction company was chosen as it was easily accessible to the researcher; while on this construction site, no more than ten logistics companies were approached. It should be clarified that while the construction project was chosen by convenience, the actual sample of participants was selected through judgment sampling from the selected construction site. In particular, the following types of individuals from companies at the target construction site were approached, and purposely included in the study:

- the CEO of the principal contractor;
- PMs of both the principal contractor and subcontractor organisations;
- project foremen of both the principal contractor and subcontractor organisations; and
- worker employees of both the principal contractor and subcontractor organisations.

Participants fitting these job descriptions were chosen because it was expected that they would be suitable to provide detailed, yet broad overviews of the perceptions of individuals involved with the leadership and outcomes of the supply chain management in the selected construction project. A small sample (17 participants) was ultimately gathered, as it was upheld that qualitative studies only require smaller quantities of well-informed individuals to gather rich, high-quality insights, as opposed to larger quantities of individuals with moderate to low levels

of insight (Vehovar et al. 2016: 329). The actual sample of 17 participants that was included in this study is depicted in the Results of Chapter Four.

3.3.3 Research instrument

The collection of data for the purposes of analysing, evaluating, and inferring answers to the research questions of the study forms a core activity of conducting research (Six and Bellamy 2012: 245). There is a wide variety of data collection instruments used in research, though Adams, Khan, Raeside and White (2007) categorise the instruments into one of six categories namely: case studies, diary methods, surveys, interviews, experiments, and observations. While this list includes the broad scope of all possible methods in academic research, Saunders, Lewis and Thornhill (2009: 267) instead suggest that only three main types of research instruments are useful for conducting social research on human participants (such as in the case of researching organisations): observations, interviews, and questionnaires; whereby, interviews were chosen as the best instrument to gather the necessary information from this study's participants.

The questions used for an interview or questionnaire may be formulated with either structured questions, which are presented with a set structure of possible answers in the form of ranked-data or multiple-choice type answers; or with open-ended questions, where the participants are expected to present varied answers that are open to their own interpretations of the questions (O'Cathain and Thomas 2004: 1-7; O'Cathain 2010: 124). While structured questions are typically more useful in quantitative social science studies, where large volumes of data must be compared in a consistent format, in qualitative studies, open-ended questions are more valuable (Phellas, Bloch and Seale 2011: 181). Interviews with open-ended questions provided the best tool for the researcher to gather sufficient data that would allow the SSM of this study to be correctly implemented, as explained in the data analysis section later in the chapter. In the interviews, the researcher attempted to gather information to assess the effectiveness of the leadership, by trying to understand how fellow employees or colleagues on the construction site viewed and experienced the leaders. To do so, it was necessary to ask questions relating to trust, reliability, and care, which were each soft issues. Appendix I presents the interview schedule that was used for the study.

3.3.4 Data collection

In order to gather the necessary data, open-ended questions were presented through face-to-face interviews with the sample of 17 managers, sub-contractors and workers involved with supply chain tasks at the selected construction site in Gauteng. Open-ended questions were posed to allow the respondents full scope to discuss the various topics, in as much detail as they were able. When performing the interviews, voice-recording equipment was used to capture the answers from the interviewees; to ensure that all of the pertinent information was gathered; and to allow the researcher to pay attention to exercising accurate interviewing techniques. The audio recordings were then transcribed into written text in Microsoft Word format, for data analysis, as described next.

3.3.5 Data analysis

It was hoped that this study would allow a model to be proposed that would allow for improvement in the supply chain of the construction project — which was an otherwise 'messy' situation with no clear hard solutions. In order to analyse the data for this study, and thereby present models for improvement, the data analysis was separated into two stages. The first stage involved the qualitative thematic analysis of the interview transcripts, and the second phase required performing a SSM on the data.

3.3.5.1 Phase One: Qualitative Thematic Analysis

Once the audio recordings of the interviews were transcribed into written text in Microsoft Word format, the data was firstly analysed using standard methods of qualitative thematic analysis, as per the directions of Braun and Clarke (2006: 77), Vaismoradi, Turunen and Bondas (2013: 398), and Vaismoradi, Jones, Turunen and Snelgrove (2016: 100). As explained by Bryman (2015: 580), "A theme is a category identified by the analyst through his/her data". During the initial phase of data analysis, the following steps were performed:

- firstly, becoming familiar with the data;
- next, observing patterns that existed within the data;
- generating and writing down the detailed sequences of codes that described the patterns across the data;
- probing for, and writing down the themes that occurred among the patterns of codes; and

- writing a report on the themes and codes within the data, which offered another opportunity for the data to be re-analysed.

It was anticipated that the themes that would be extracted from the data would be related to soft issues such as relationships, trust and reliability, project management principles of vision, risk taking, and emotional intelligence; leadership principles of self-awareness, supportiveness and motivation to the subcontractors and workers; and challenges experienced in the supply chain of the construction project. The actual themes that were generated from the thematic content analysis were, however, ascertained through the above steps of content analysis. Next, the data was processed through a second phase of analysis, in the SSM phase of the data analysis, to generate actionable recommendations for the construction supply chain.

3.3.5.2 Phase Two: Soft Systems Methodology

In order to unpack the data from the interviewees, which had been prepared in the form of written themes and codes from the interview transcripts, the second phase of the data analysis employed a SSM according to the guidance of SSM experts such as Burge (2015: 2-18), and Williams (2005: 2). There are seven steps in the SSM process, which were each factored into this study:

Step 1: To enter into the problematic situation, and in so doing, gather as much information on the situation as possible, while accepting all prevailing viewpoints. This was done during the interview phase of the study — during data gathering, with the interviews, and through the qualitative thematic analysis in the first phase of the data analysis.

Step 2: To express the situation of the problem with the use of **rich pictures** that explain the problem and all its interconnected relationships. This step expressed what the goal had been so far, what had been done to achieve this goal, and what had been most- and least-effective in achieving the goal, and why. This step of SSM relies on the use of rich pictures, as it recognises that the real world is 'messy', and that rich pictures offer a highly efficient system of capturing large volumes of information in a small space. The rich pictures also primarily help the researcher to identify the **relevant systems** that can be taken into the systems world, for the purposes of improving the current situation.

Step 3: To formulate **root definitions** of the various systems of purposeful behaviour (the emergent properties, communication, hierarchy, and control) being applied within the problematic situation. This is a critical step in SSM, which stated simply, is a statement of purpose that defines the general, broadly encompassing systems that need to be done in order to achieve the definition. A root definition is a concise sentence depicting an idea to resolve or improve a particular theme of issues as determined in Step 2 (Checkland and Scholes 2001: 91). Stated differently, root definitions are concise sentences or ideas that consider what the real world *is* currently like, and is defined as a theme of issues in the Step 2 (an input); what an unproblematic (good) situation would consist of, if that issue did not exist (an output); and what transformation processes (changes) in human activity could be made to achieve that good situation (Brenton 2007: 12). In this step, the **CATWOE** technique is used to help define the transformation process, together with the potential players that could be involved (Checkland and Poulter, 2006):

- The **C**ustomers included the beneficiaries or victims inside or outside the construction supply chain that would receive the output of any transformations that were made.
- The **A**ctors were the people within the construction supply chain that executed or caused the main activities of the transformation to be executed (the actors were the ones doing the transformation).
- The **T**ransformation processes were the actual purposeful activities that were necessary to transform the current existing inputs into intended potential outputs. As explained by Burge (2015: 2-18), it was important to correctly determine the transformation, and to make sure that the transformation was accurate, particularly identifying what constituted the inputs and the outputs, so that the necessary conceptual models could be clearly identified (in the next step) for transforming the inputs into the outputs.
- The **W**orldviews (Weltanschauung) were the perspectives from which the relevant systems were observed, and which formed the belief systems that made sense of each root definition. In this study, for instance, it defined whether the root definition was expressed from the perspective of the manager, foreman, worker, or otherwise.
- The **O**wners were the stakeholders with the ultimate power to end or shut down the proposed transformation, and who were ultimately concerned with the transformation's performance.
- Finally, the **E**nvironmental constraints were difficult to influence or change, but ultimately had an influence on the project's supply chain. They formed the key

constrains that existed externally to the construction supply chain, but which were still significant to the transformation ideas.

In this study, this step expressed root definitions, whereby system 'X' was needed to achieve 'Y' for stakeholder 'Z, while CATWOE elements were defined for each of the root definitions.

Step 4: To construct **conceptual models.** In this step of SSM, conceptual models are constructed from each of the root definitions; whereby, these models offer feasible changes and actions to be made to address (and achieve) the root definitions. Stated simply, the conceptual models are defensible roadmaps of sequential and related actions to take, resources to use, or tasks to perform to systematically address (improve) each root definition that has been devised; and thereby, transform the input (the current situation of each problematic theme) into an output (an improved version of its input). Based on the work of Miller (1970), Checkland (1981) recommended devising between five and nine activities in each conceptual model of SSM, which are approximately the same in magnitude, where activity 2 is dependent on dependent on activity 1, activity 3 is dependent on activity 2; and so forth. As per the recommendations of Burge (2015: 2-18), notes were made on each task to express the rationale behind each particular activity, and why they were important, thereby satisfying SSM's need for 'defensible logic'. Tasks were also chosen that were deemed to be the most **effective**; to have the highest **efficacy**; and to be the most **efficient**, as per the three E's requirement of the tasks.

Step 5: To measure the conceptual models against real world situations, where differing alternative models are assessed and compared to reality. Aspects of this were initially included in the question structure of the interviews, where during the interviews; discussion was initiated between the participants to express whether they thought the changes they could recommend would be accepted. And, if not, why these changes would not be accepted; and what would need to be done to overcome these barriers to change (See the interview schedule in Appendix I).

Step 6: To identify both possible and feasible potential changes that can be made to improve the situation. Through a cyclical, iterative process that considers the individual tasks of the conceptual models and compares them to real-world barriers and possibilities, the sets of recommended activities of the transformation processes are refined and honed until the most

feasible and potentially implemented changes are presented, in final models for change. In summary, this step considers changes to be made to bring the real-world situation closer to the conceptual model, and to make the conceptual model more feasibly achievable. Ultimately, this step considers the difficulties that are preventing various ideal changes from being made, and what could or should be done to overcome these difficulties. One means of defining this, as suggested by Burge (2015: 2-18), is to place the individual tasks of the conceptual models on an Ease-Benefit matrix, with the ease of the tasks being considered in relation to the amount of resources that would be required, and the potential ultimate benefit to the problematic situation being ranked as a means of organising and promoting thinking on solutions that will allow the decisions to be made. This step was performed by, firstly, iteratively gathering data with the participants (see Step 5); and thereafter, by the researcher iteratively refining the conceptual models to identify the most possible and feasible models for change. Final models were then expressed on an Ease-Benefit matrix, as shown in Chapter Four, identifying the overall ease and benefit for executing the different conceptual models.

Step 7: The final step of the SSM is to take action to improve the problematic situation, although for the purposes of this study, this step was not ultimately performed. This is because the intention of the methodology was to identify the existing challenges of the supply chain of this new office park construction project in Oxford Road, Rosebank; and to develop suitable operational models for change within the supply chain of the project, rather than to make or observe these recommended changes.

Considerations of each of these seven steps were integrally incorporated into the methodology of this study, by ensuring that the questions of the interviews were correctly structured and analysed to achieve all of the above steps. It is important to note, though, that unlike hard systems methodologies that follow stringent methodological protocols, SSM is a looser framework of tools that the analyst can customise and use at his or her discretion. The SSM in this study was therefore customised to most effectively achieve the goals and intended outcomes of the study. The methodology was therefore carried out as a structured interview process with individuals, followed by a cyclical and iterative analysis of the data; instead of a group debate with multiple iterations of discussion, as proposed in the initial SSM format. The format chosen for this study proved to be far more feasible than performing a single group debate (focus group) among the entire sample of 17 participants, because the variety of companies and job titles that were approached, would have made combining multiple ranks of

employees from different organisations unfeasible. It was also impractical to perform multiple follow-up interviews with the participants because of the dynamic nature of construction projects, which meant that new employees were continuously entering onto the site, completing their work, and moving onto other project sites, making repeat follow-ups with the same individuals virtually impossible.

In the literature, the seven stages of the original SSM have been changed and condensed over time to incorporate fewer steps, and to be customised to specific industrial applications (Couprie 2004: 10; Jackson 2010: 133; Luckett and Grossenbacher 2003: 147; Kayaga 2008: 273; Khisty 1995: 91). For instance, the following four-step process has been proposed: (a) what is seen to be the problems; (b) what could be the best way to respond to the problems through models; (c) can the models provide possible solutions to problems through engagement; and (d) will results from (a) and (c) be considered (Checkland and Poulter 2010: 191; Hildbrand and Bodhanya 2014: 2048). This condensed approach, though, did not provide a sufficiently detailed methodology to capture the benefits of the complete seven-step SSM procedure. There was also no justifiable advantage to exclude or condense any of the initial seven steps, since the full methodology was well suited to analysing the supply chain of this study's construction project. Thus, all of the six-steps (excluding the Step 7 'to take action') were performed for this study.

Finally, it should be noted that SSM is an action-based methodology, which is inherently based on iterative reciprocity. For instance, to determine whether the tasks are 'effective', it requires an overarching degree of monitoring and control, with feedback adjustment to attune the tasks as they are being actioned. However, this dissertation was not intent on actually implementing the recommended changes, but only on generating potential models for change. The tasks that were ultimately produced in this study, therefore, were only those that were expected to be the most effective, in the event that these models were, indeed, implemented.

3.4. DELIMITATIONS/SCOPE

This research only studied one construction site on the East Rand of Gauteng province. This meant that the opinions on the challenges of the supply chain in construction projects were confined to the experiences of the participants at this particular site. This study also only focused on the supply chain processes and the challenges of the supply chain, and nothing

further. This study considered the supply chain from a qualitative perspective, and no attempt was made to obtain quantitative data, such as financial records, numerical facts, or project-related quantities to support the results with statistical reliability. Finally, this study was only intent on developing a potential model for change to improve the supply chain of the construction project, and it did not consider the actual implementation of this model, or the efficiency of the model in improving any problematic issues within the supply chain of the chosen construction project.

3.5. RELIABILITY, VALIDITY AND THE ELIMINATION OF BIAS

3.5.1 Reliability

Reliability and validity are observed to have different standards between qualitative and quantitative studies, though authors such as Heale and Twycross (2015: 66), and Golafshani (2003: 597) suggest that both concepts are equally important in both types of research. Reliability is typically regarded as the extent that the outcomes of a research project would provide comparable outcomes if the study were to be independently repeated (Howell, Miller, Park, Sattler, Schack, Spery, Widhalm and Palmquist 2012); and while reliability is considered a corner stone of quantitative studies, the reliability of qualitative studies should also be maximised (Golafshani 2003: 597). Howell et al. (2012) argue that there are four main types of reliability: stability reliability, equivalence reliability, interrater reliability, and internal consistency, which pertain to the following:

- stability reliability (which is also referred to as test, re-test reliability) is the amount of agreement and consistency that is achieved between measurements taken at different time-points;
- equivalency reliability (which is also referred to as parallel forms reliability) is a reference of how different types of measurement are able to create similar findings on the same construct;
- interrater reliability describes the degree that multiple evaluators (raters) concur with the results generated, thereby indicating the level of consensus following critical appraisal; and
- internal consistency is the amount that the different procedures or tests that are used precisely and accurately measure the same constructs.

In this qualitative study, the interrater reliability and internal consistency were maximised during the codification of the data from the interviews; whereby, professional data analysts were engaged for the purposes of increasing the consistency of the outcomes between raters, and helping to minimise any potential biases that may have arisen by the researcher. Similarly, internal consistency was also optimised by basing the questions of the interviews on the principles of SSM, thereby using principles that have been repeatedly shown in the literature to effectively understand the soft issues involved with the supply chain, such as in the construction industry of South Africa.

3.5.2 Validity

Next, a study's validity provides an indication of how well the study's findings reflect the results they were meant to symbolise (Howell et al. 2012). While numerous sub-categories of validity have been defined in the literature, three core types of validity are typically considered important: construct validity, content validity, and criterion validity (Heale and Twycross 2015: 66):

- construct validity indicates how precisely and accurately the research instruments measure the constructs of the study;
- content validity measures how completely the research instruments have covered the topic; and
- criterion validity measures the variety of tools being used to measure the constructs of the study, thereby providing a system of additional support for the results.

The construct validity of this study was maximised firstly during the planning of the questions for the interviews; and thereafter, through the procedures used for the data collection. To maximise the content validity, the study was structured on the framework of SSM, which allowed the soft issues of management in the supply chain of the construction industry to be measured completely and in suitable detail to answer the research questions that had been posed. Finally, the results of this study were triangulated with the literature to compare the results to other studies that had been performed, thereby maximising the criterion validity. As noted by Yeasmin and Rahman (2012: 154), triangulation describes activities that mix empirical strategies, theories and materials from numerous observers to increase the validity of a study. This usually involves including both qualitative and quantitative findings to observe the same phenomenon (Olsen 2004: 103); and while one system of triangulation involves the

use of mixed qualitative-quantitative methods, it fails to combine the results of multiple researchers (Olsen 2004: 103). Therefore, a more suitable technique — particularly in the event of qualitative studies — involves comparing the findings with quantitative and qualitative results of other studies (Yeasmin and Rahman 2012: 154). Triangulation with the literature was therefore performed in this study as well, to maximise the criterion validity of the results.

3.5.3 The elimination of bias

In attempting to maximise the quality, reliability and validity of a study, a final approach typically involves the elimination of any bias that may act to negatively influence the final results, and thereby negate the findings. Simundic (2013: 12) describes bias as any unintentional or intentional variation or deviation in the collection, analysis, interpretation, or reporting of an academic report, resulting in false conclusions and claims being made. In academic research, numerous factors related to bias may affect the objectivity of the findings, which Smith and Noble (2014: 34) group into the following five categories:

- Design bias, where a mistake in the study's design, for instance due to influence by the researcher on the questions or methodology, can affect the ultimate findings of the study.
- Selection bias, where the nature of the participants is affected, and the procedures that are used to gather the participants in the study are prejudiced so much that the findings are not a true reflection of the results.
- Data gathering or data measurement bias, where the data collection techniques or efforts are influenced by the expectations of the researcher.
- Data analysis bias, where a study is directed to generate findings that confirm or refute a previous notion or hypothesis by the researcher, while disregarding results that do not align with the expectations of the study.
- Publication bias, where the nature of the material that is published is prejudiced towards statistically significant or socially interesting findings, while ignoring inconclusive or 'unfashionable' topics.

To minimise biases, Smith and Noble (2014: 34) recommend firstly identifying the likely sources of bias, to allow each of these sources to be curtailed. Of the above forms of bias, it was possible for design bias, selection bias, data gathering, and data analysis bias to have occurred; although publication bias was not ostensibly a factor, as this academic dissertation

was not under the biases imposed by academic publications. Particular attention was paid to design this study within the framework of SSM, meaning that researcher bias was minimised in the initial stages of the study. Ultimately, therefore, three sources of bias may have existed within this study, which related to participant selection bias, data gathering bias, and the data analysis bias. For instance, this study used non-probability sampling techniques to gather the sample of informants; and as noted by Uprichard (2013: 2), this meant that a type of bias or partiality was involved in the selection process. Since this was a qualitative study, though, non-probability sampling techniques were considered more appropriate than probability sampling techniques, since statistical reliability was not the ultimate aim; and obtaining rich information was considered more important. This aspect of selection bias, therefore, was considered to be a strength, as it allowed the researcher to specifically target individuals with experience on the supply chain of the selected construction project; whereas, in the event of a probability sampling strategy, a broad spectrum of individuals would have been included with many having had no interaction with the supply chain. Care was taken, though, to ensure that all perspectives of the supply chain were sampled, to ensure that no particular positive or negative perspective was inflated.

Next, it was possible that through the face-to-face interviews with voice recording instruments, the researcher or data capturers may have inadvertently swayed the participants' responses as they may have been self-conscious or wary of criticising aspects of the project that may have affected their own professional positions (Simmons and Bobo 2015: 357). Furthermore, due to the nature of construction sites, participants may have been primarily only interested in the completion of their sections of work; which could have caused the loss of communication, unreliability, poor sharing of information and inconsistency among participants. To overcome this, interviews were held in private and anonymously, and with the understanding that knowledge from the study would ultimately lead to improvements in the supply chain process, to encourage participants to be as open and truthful as possible. In addition, as per the recommendations of Saunders and Lewis (2012), assistant data capturers and professional data analysists were recruited to minimise any potential data analysis biases that may have occurred, by the researcher attempting to inadvertently search for answers to prove or disprove any prior notions or hypotheses. This was done instead of simply reporting on the results that emanated from the data analysis. Consequently, the results and conclusions generated from this study were considered to have been minimally affected by any problems arising from bias.

3.6. ETHICAL CONSIDERATIONS

Any research, particularly involving human participants, should be performed within a universal standard of ethics (Greenfield and Greener 2016). This study was performed within the standard requirements of the Durban University of Technology, which are governed by the ethical requirements of the National Health Act of 2003 (Republic of South Africa 2003). In qualitative research particularly, a number of challenges or issues might occur. However, it was ensured that the researcher's relationship with the participants was cordial, while the researcher also maintained a standard of trust and truthfulness with the participants, by disclosing the full nature of the study before commencing the interviews. In this regard, the participants received an explanation on the purpose of the study, including an information page, as outlined in Appendix II, and how their participation was expected to enhance the research. The participants were also given the choice to stop the interviews and address any issues or concerns they might have had, and to withdraw from the study if they wished. If the acts of the study proved to be too stressful for any of the participants, they would also have been referred for professional help, as per the guidelines of Orb, Eisenhauer and Wynaden (2001: 93-96). Nonetheless, during the study, the need for such measures did not transpire; though it should be noted that efforts were made to minimise any such stresses, by ensuring standards of anonymity and confidentiality, as outlined next.

3.6.1 Anonymity and confidentiality

None of the people taking part in the interviews was requested to reveal their names, and only information relating to the participants' supply chain experience and job titles was gathered. In addition, the managements of the principal contractor, subcontractors and logistics companies were presented with signed commitments of confidentiality from both the Durban University of Technology and the researcher. It was not anticipated that there would be any information that might be required for any legal reporting purposes; but if, following the conclusion of this study, this did indeed become the case, the participants would be informed of such eventualities before their names were released.

3.7. CONCLUSION

This chapter outlined the research methodology that was performed for this study. This research was performed to identify the issues and potential improvements to the supply chain of a new office park construction project in Oxford Road, Rosebank, in Johannesburg. It was

conducted as a qualitative study based on the research philosophy of action research, as expressed through the principles of the SSM. It was upheld that the supply chain is ultimately open to complexities that are continuously emerging from management decisions in the construction industry of South Africa, and using SSM was considered the most appropriate means of approaching the soft problems in the construction project's supply chain.

Of the different types of research designs available, a descriptive research framework was employed here, while the target population of this study included principal contractors, subcontractors, PMs, foremen, and different levels of workers in supply chain companies of construction projects in the Gauteng province of South Africa. Purposive sampling was used to recruit the 17 participants of this research, as it was deemed that a specific sample of participants that had been intentionally chosen by the researcher would possess characteristics that were most favourable for answering the research questions of the study. The purposive sample of participants included fewer than 20 PMs, subcontractors, foremen and workers employed at fewer than ten of the organisations involved with the supply chain of the new Giuricich Bros. office park construction project in Oxford Road, Rosebank, Johannesburg.

In order to gather the necessary data, open-ended questions were presented through face-to-face interviews with the sample of 17 managers, sub-contractors and workers involved with supply chain tasks on the chosen construction site in Gauteng. Interviews with open-ended questions provided the best tool for gathering sufficient information to assess the effectiveness of the leadership, and trying to understand how fellow employees or colleagues viewed and experienced the leaders on the construction site. Open-ended questions also allowed the respondents full scope to discuss the various topics in as much detail as they were able. A voice-recording equipment was used to collect information during interviews while allowing the researcher to exercise accurate interview techniques. This allowed the SSM of this study to be correctly implemented. The audio recordings were then transcribed into written text in Microsoft Word format, for data analysis.

In order to analyse the data for this study, and thereby present models for improvement, the data analysis was separated into two stages: Phase One involved the qualitative thematic analysis of the interview transcripts, and Phase Two involved the SSM on the data. There are seven steps in the SSM process where the first six steps were included in this study. This involved entering into the problematic situation during the interview phase of the study;

expressing the situation with the use of rich pictures; formulating root definitions using the CATWOE technique; constructing conceptual models**;** measuring the conceptual models against real world situations; and identifying both possible and feasible potential changes. The seventh step of taking action to improve the problematic situation, though, was not performed in this study, because the intention of the methodology was to identify the existing challenges of the supply chain of this new office park construction project in Oxford Road, Rosebank; and to develop suitable models for change, without actually making or observing these recommended changes.

The interrater reliability and internal consistency was maximised during the codification of the data from the interviews; whereby, professional data analysts were engaged for the purposes of increasing the consistency of the outcomes between raters, and helping to minimise any potential biases that may have arisen by the researcher. By basing the questions of the interviews on the principles of SSM, thereby using principles that have been repeatedly shown in the literature to effectively understand the soft issues involved with the supply chain, such as in the construction industry of South Africa, optimised internal consistency. The construct validity was maximised here firstly during the planning of the questions for the interviews; and thereafter, through the procedures used for the data collection. To maximise the content validity, the study was structured on the framework of SSM, which allowed the soft issues of management in the supply chain of the construction industry to be measured completely and in suitable detail to answer the research questions that were posed. Finally, the results of this study were triangulated with the literature to compare the results to other studies that had been performed, thereby maximising the criterion validity. Steps were also taken to minimise biases during sample selection, data gathering, and data analysis.

This study was performed within the standard requirements of the Durban University of Technology, where it was ensured that the researcher's relationship with the participants was cordial, while the researcher also maintained a standard of trust and truthfulness with the participants, by disclosing the full nature of the study before commencing the interviews. The participants were also given the choice to stop the interviews and address any issues or concerns they might have had, or to withdraw from the study if they wished. None of the people taking part in the interviews was requested to reveal their names, and only information relating to the participants' management portfolios was gathered. In addition, the managements of the principal contractor, subcontractors and logistics companies were presented with signed

commitments of confidentiality from both the Durban University of Technology and the researcher.

The outcome of this research methodology, and the thematic analysis and SSM of the data that was collected, is presented in Chapter Four, next.

CHAPTER FOUR
RESULTS

4.1. INTRODUCTION

The methodology of this research was designed to identify the issues and potential improvements to the supply chain of a new office park construction project in Oxford Road, Rosebank, in Johannesburg. As noted in Chapter Three, a descriptive research framework was performed to identify the issues and potential improvements to the supply chain of the new office park project, where 17 participants were recruited for this research through purposive sampling, and open-ended questions were presented through face-to-face interviews with this sample. Analysing the data for this study was separated into two stages: a qualitative thematic analysis of the interview transcripts, and a SSM on the thematic data. The outcome of this research methodology, and the thematic analysis and SSM of the data that was collected, is presented now.

The purpose of this chapter is to present a detailed descriptive analysis of the results that were generated from the methodology, though it does not attempt to provide any discussion on the results, or any triangulation of the results with the literature, as this is the entire purpose of the Chapter Five: Discussion, later in this dissertation. This chapter begins with the descriptive statistics of the data, providing statistical profiles of the sample of 17 participants that were interviewed. It also presents the results of the thematic content analysis of the data and the SSM that were performed, where the chapter is structured according to each of the seven steps of SSM. The chapter begins, first, with the descriptive statistics of the study.

4.2. DESCRIPTIVE STATIS TICS

There was a broad spectrum of participants in this study, which consisted mostly of employees of the principal contractor, the Giuricich Bros. Construction Company (10 of the 17 participants), and the remaining seven (of the 17 participants) were subcontractors on the new office park construction project in Oxford Road, Rosebank (hereafter referred to as the project). This is presented visually in Figure 4.*1*, which figure also shows that the official titles of the participants on the project were distributed across the full authoritative hierarchy of the project, with workers (n=4), supervisors (n=3), foremen (n=4), a site clerk (n=1), PMs (n=2), a senior manager (n=1), and the CEO (n=1) all being interviewed to provide data for this study.

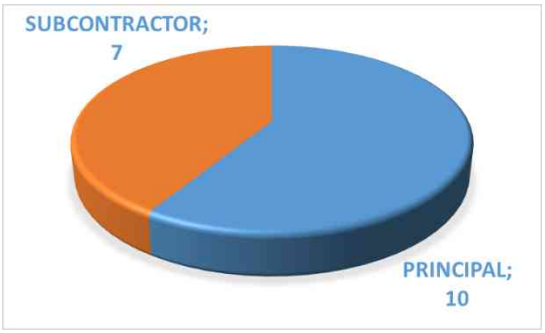


Figure 4.1 Number of participants working for the principal contractor, or as a subcontractor (left), and the official titles of the participants on the construction site (right)

There was also a full spectrum of experience among the participants, with two of the participants having been involved with supply chain matters for more than 50 years on construction projects over the course of their careers; though three of the participants had fewer than five years' worth of experience in construction supply chains. There were also eight participants with between 10 and 20 years' construction supply chain experience, and four participants with between 20 and 50 years' experience in construction supply chains, as shown in Figure 4.*2* below.

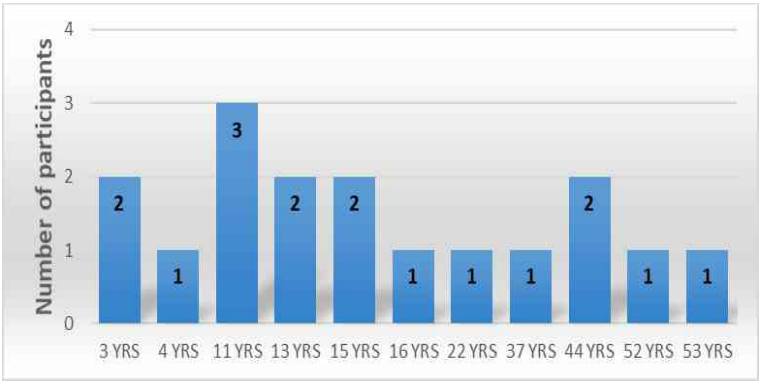


Figure 4.2 Number of years' experience of the participants

The participants were involved with all of the various aspects of the supply chain on the study's chosen construction project, with six of the participants handling tasks on 'all' aspects of the project's supply chain, as shown in Figure 4.*3*, and only one participant admitted that they were not actually involved with supply chain tasks on this particular project. As noted in the previous figure, however, since the participant described having had previous supply chain experience on construction projects, this participant was deemed fit for inclusion in this study. The largest number of participants (n=6) was those that were involved with supply chain tasks related to equipment or materials handling, while two participants (n=2) were each involved with supply chain tasks related to procurement, storing, and security (total n=6). Individual participants were also involved with each of the supply chain tasks of scheduling (n=1), and safety (n=1), respectively.

Figure 4.3 Roles of the participants on the construction site

Based on this detailed spectrum of participants for this study, it was therefore considered that the data that had been collected indeed covered a suitably broad and comprehensive spectrum of the project's supply chain to provide the researcher with all possible information on the nature of the problems that were being experienced on site. It was also considered that this spectrum of participants was suitably qualified, and experienced with the dealings of the project to provide information that allowed the thematic content analysis and SSM of the study to be correctly performed. It was also considered that due to the considerably large sample (for qualitative research), the potential for selection bias — where the nature of the participants may have prejudiced the data submitted in the study — would have been minimised; thereby improving the reliability of the data. Not rehash a full explanation of the efforts that were taken to minimise bias, and to maximise reliability and validity, have been covered in the Methodology of Chapter Three, and will therefore here.

The next section of the results focuses on the thematic content analysis and SSM of this study, and the findings that were produced from each of these two combined techniques.

4.3. RESULTS OF THE THEMATIC CONTENT ANALYSIS AND SOFT SYSTEMS METHODOLOGY

As explained in Chapter Three, the transcribed recordings of the interviews were firstly analysed using standard methods of qualitative thematic analysis, which allowed the researcher to observe patterns that existed within the data; generate and write down the detailed sequences of codes that described the patterns across the data, and probe for themes that occurred among the patterns of codes. Therefore, while the thematic content analysis and SSM were conducted as two distinct phases while performing the methodology, their overall purpose and end goal was the same — attempting to identify the 'soft' aspects in the supply chain processes that had been enhancing and limiting the successful project performance. In striving towards this goal, and because the SSM is a well-established and precisely articulated methodology (see Chapter Three), the results of this study are outlined according to the findings of each step of the seven-step SSM methodology, and discussions on how the thematic content analysis was used in each SSM step, is outlined next.

4.3.1 Step 1: Entering into the problematic situation

The first step of the SSM is to enter into the problematic situation, and in so doing, gather as much information on the situation as possible, while accepting all prevailing viewpoints. This was done during the interview phase of the study, during data gathering with the interviews, and through the qualitative thematic analysis of the interview transcripts. The thematic content analysis determined that the aspects of the supply chain that had been working well were predominantly the scheduling of the materials and equipment, as coded by the term 'SCHEDULING' in Figure 4.*4*. There was also a fair amount of consensus among the different participants that the project's scheduling was working well, as it was noted a total of five separate times by the participants. It is worth noting that while qualitative research does not strive to infer importance by quantitative summation of qualitative ideas (Vaismoradi, Jones, Turunen and Snelgrove 2016:100; Vaismoradi, Turunen and Bondas 2013:398), it was interesting to note where there was a high degree of unanimity among the participants, as it showed where there was a prevailing consensus on the project site. In this case, for example, it

provided an indication that scheduling was agreed to be working well among numerous employees on the site. Comments by the participants such as "[d]eliveries have had to be clearly communicated […] in order to schedule the use of the tower crane accordingly to prevent delays to the other work which is dependent on the use of the tower crane"; and "Everything [is] good, [the] schedule from [the] consultant [is…] very clear [and] easy to understand" confirmed this.

Figure 4.4 Aspects of the supply chain that have been working well

Scheduling was, however, not an isolated aspect that was said to be working well, with equipment and materials handling (HANDLING), supply delivery matters (SUPPLY DELIVRY), and safety on site (SAFETY) also being noted on three distinct occasions each, respectively. Procurement (PROCUREMENT) and storing within the supply chain (STORING) were also noted by more than one participant, each, indicating a slight degree of consensus; while one participant noted that the labour force (LABOUR) was working well, and another claimed that "all" aspects of the supply chain (ALL) were working well. In the case of the latter two claims, while it could not be said that the low degree of consensus among the participants was any reason to suspect that these factors were any less important than the other more commonly-noted factors, the fact that labour and all supply chain processes were only deciphered in isolation during the content analysis, by two separate participants, among a sample of 17 site employees, showed that these were clearly not strongly-held opinions across the majority of people that worked on the site.

In order to delve deeper into the soft elements of the supply chain's management and understand how soft elements had affected the supply chain of the project, the respondents were asked to describe how the vision, risk-taking, emotional intelligence and trust of the project management had enhanced the effectiveness of the supply chain on this project. As

shown in Figure 4.5, six themes were deciphered during the thematic content analysis of the respondents' interview transcripts: More teamwork; more worker responsibility; improved project efficiency; manager-specific improvements; improved worker skills; and an improved working environment. Described differently, the respondents claimed that the vision, risk-taking, emotional intelligence and trust of the project management had resulted in more teamwork, more worker responsibility, improved project efficiency, manager-specific improvements, improved worker skills, and an improved working environment. Two of the respondents did not answer the question.

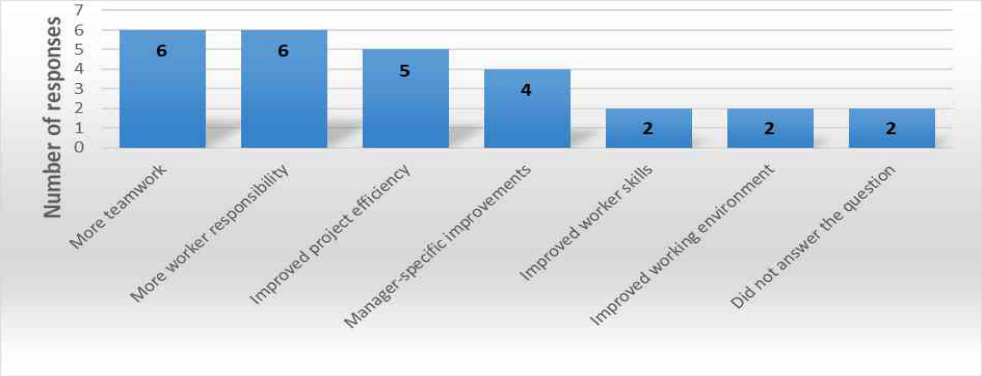


Figure 4.5 Effect of the project management's vision, risk-taking, emotional intelligence and trust on the effectiveness of the supply chain

The participants were also asked to determine how they thought the project management's self-awareness, supportiveness, communication and motivation to the subcontractors and workers had enhanced the effectiveness of the supply chain on the project. An amalgamation of 34 subthemes was deciphered during the thematic content analysis, which could be grouped into five overarching themes of improved information flow; improved project efficiency; improved working environment; manager-specific improvements, and improved teamwork, as shown in Figure 4.6. The most commonly recurring theme among the respondents was that there had been improved information flow, with respondents noting subthemes that were coded as daily and weekly meetings, increased discussions on site, increased knowledge of the PMs, who were increasing the number of work reminders, explaining challenges better, supplying the necessary information, and improving subcontractor-manager meetings, and the managers were also perceived as explaining tasks better. A full list of the subthemes that were deciphered during the thematic content analysis of the interview transcripts for this question is provided in Appendix I. Only one of the participants did not provide any information or answer for this question.

Figure 4.6 Effect of project management's self-awareness, supportiveness, communication and motivation to the workers on supply chain effectiveness

Aside from the improvements due to the aforementioned soft characteristics, the PMs were noted to have numerous other characteristics that were enhancing the effectiveness of the project's supply chain, such as operations control; management skills; emotional intelligence; motivation; communication skills; supportiveness; trust and vision, as shown in Figure 4.*7*. Interestingly, many of these soft skills were skills that had been discussed in the previous questions of the interviews, but were reiterated by the respondents.

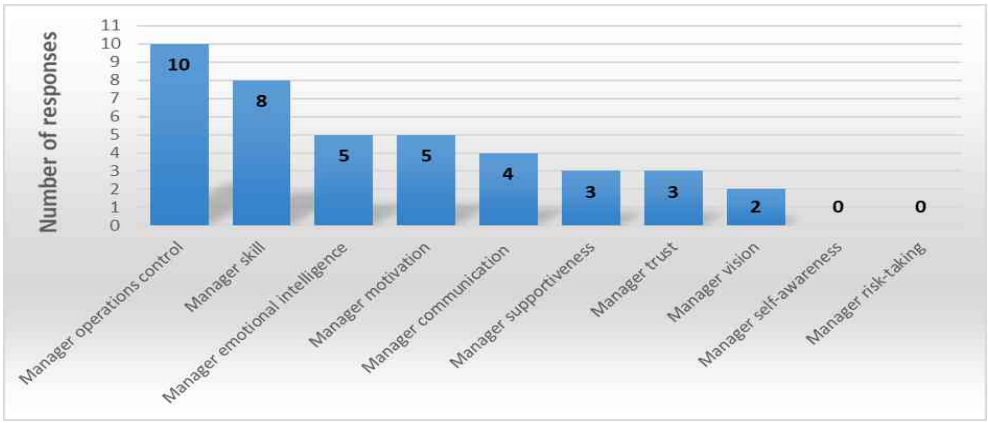


Figure 4.7 Effect of project management's other characteristics on supply chain effectiveness

When asked how the strengths in the supply chain of this project were different to other construction projects, respondents argued that more responsibility was given to the workers compared to other projects the participants had worked on. The respondents further described various working environment factors such as fewer accidents, smaller teams and more safety checks on this project, as shown in Figure 4.*8*. Some manager-specific factors were also

different on this project compared to others, such as being more approachable, more vigilant, and having different permissions processes and project control; while better project efficiency and improved information flow were also listed. Two of the respondents argued that there were no differences between this project and other sites, and two respondents declined to answer the question. Discussions on these results and how they relate to the literature are presented in Chapter Five, later in the dissertation.

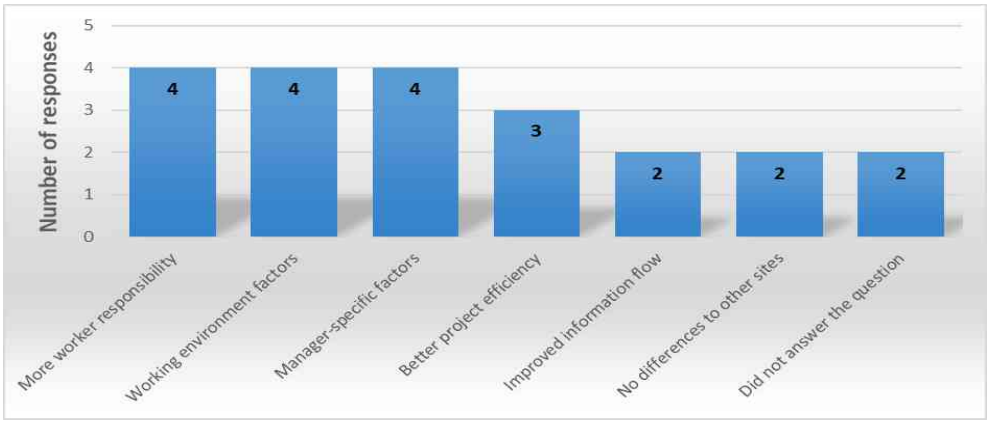


Figure 4.8 How this project's strengths differed to other projects

This step of the SSM had therefore been helpful in deciphering the overall nature of the supply chain of the project, while the next step was valuable in attempting to express the situation of any problematic circumstances that existed in the supply chain, in order to move towards actionable changes that could improve these problems in the supply chain.

4.3.2 Step 2: Expressing the situation of the problem

The second step of the SSM was to express the situation of the problem, with the ultimate goal of developing a rich picture that, as described in Chapter Three, explained the problem and all its relationships. The ultimate purpose of expressing the problematic situation with the use of a rich picture was because SSM recognises that the real world is 'messy', and that a rich picture offers a highly efficient system of capturing large volumes of information in a small space (Kayaga 2008: 273). To begin with, before drawing the rich picture, the respondents were asked to describe the nature of the problem, and their answers were analysed through thematic content analysis. The results of this thematic content analysis are expressed here, in graphical form, and ultimately, in the form of a rich picture.

To begin with, the respondents were asked to describe which aspects of the supply chain on the project had been working badly, and limiting their successful work performance. As shown in Figure 4.*9*, a wide spectrum of 11 different themes were deciphered on the current weaknesses of the supply chain; and interestingly, in line with the principals of SSM, many of the weaknesses were in direct contrast to the aforementioned strengths of the supply chain. Indeed, the purpose of SSM, as developed by Checkland and Scholes (1999: 330) and Wilson (1990; 2001), is to address problematic and disorganised situations of all kinds. In such a situation, the definition of a problematic situation or what needs to be done is often not clearly defined; and indeed, there is often not even consensus on whether a problem exists to begin with, or what is causing that problem (Proches and Bodhanya 2015: 1-15).

A key example of the 'messiness' of the supply chain of this project was therefore observed in the case of aspects such as handling, scheduling, procurement, storing and safety, where despite the numerous comments describing their strengths in the previous step, were noted by numerous individuals here to contain weaknesses as well. This was confirmed with comments by the participants such as "Scheduling: project duration [has been] reduced, [which has had] more impact on time and project delivery", and "The only problem you can get in prospects of the nature on the supply methods that is time or crane if its only one everything has to rely on it [sic]".

Indeed, in every single area that was noted to have been working well by respondents previously, other respondents noted aspects that had also been working poorly. Furthermore, other additional problem areas were also described, such as a lack of security on the site that was resulting in theft (SECURITY), problems with designs and plans on the site that were causing supply chain problems (PLANS), and transport problems (TRANSPORT), as shown in Figure 4.*9*. It should be noted, though, that it was quite likely that in many cases, such as handling, certain aspects were working well, while other aspects were working poorly. It was therefore useful, while carrying out this study, to use SSM to attempt to delineate these issues clearly.

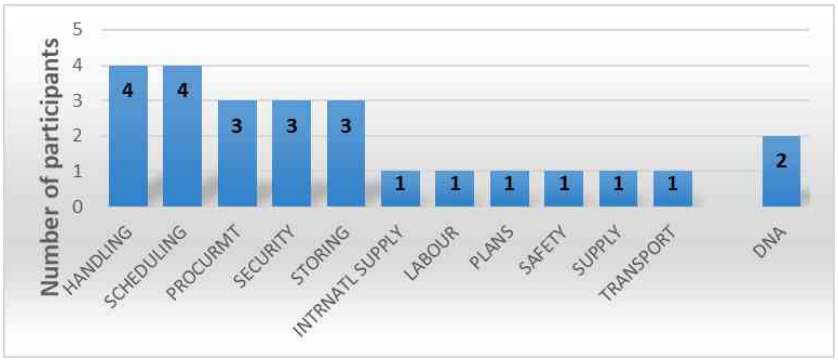


Figure 4.9 Aspects of the supply chain that have been working badly

In order to ascertain how many of the soft characteristics of the PMs, such as the vision, risk-taking, emotional intelligence and trust had limited the effectiveness of the supply chain on the project, this was specifically explored in the interviews. The thematic content analysis of the interview transcripts delineated ten subthemes of answers that could be grouped into three overarching themes. These overarching themes were **worker-related problems** causing issues such as new-worker challenges, depression, emotional problems, poor attitude, and some weak relations; **manager-specific problems** that involved dangerous risk-taking, having an unrealistic deadline, requiring contingency plans, and requiring subcontractors to continuously seek permission for works on site; and problems that related to **reduced project efficiency** (see Figure 4.*10*). Two of the respondents answered in line with the first step of the SSM, and said that there were no problems experienced; while seven respondents declined to answer the question, further confirming the variability of opinions on the management's supply chain performance.

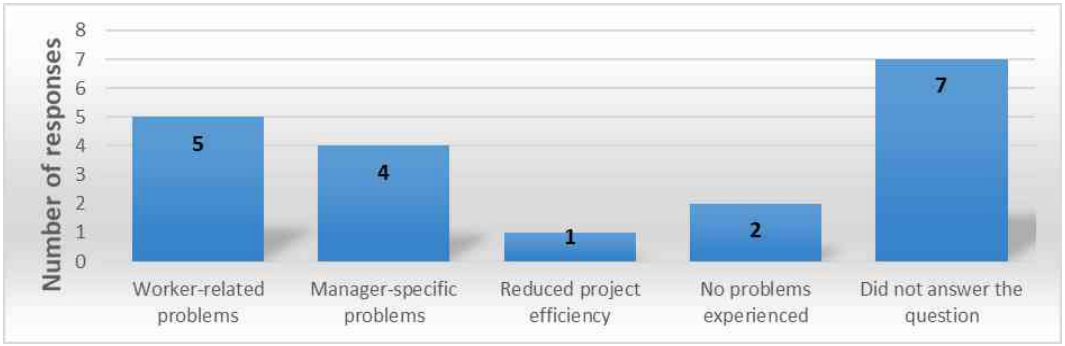


Figure 4.10 Effect of project management's vision, risk-taking, emotional intelligence and trust on limiting supply chain effectiveness

In defining how soft topics such as the PM's self-awareness, supportiveness, communication and motivation to the subcontractors and workers had limited the effectiveness of the supply chain on the project, the respondents were forthcoming with twelve coded subthemes across three overarching themes. These overarching themes are **worker-related problems** such as human errors, worker frustration, making workers tense, lowering subcontractor meeting attendance, and causing meetings to be missed; **manager-specific problems** such as having complex communications systems, poor communications between the designers and the managers, and having a poor project programme; and **reduced project efficiency** that were increasing work delays, causing the project to run behind schedule, having late subcontractor requests, and insufficient materials quantities. One respondent claimed that there were no issues experienced, and three respondents declined to answer the question, as shown in Figure 4.*11* below.

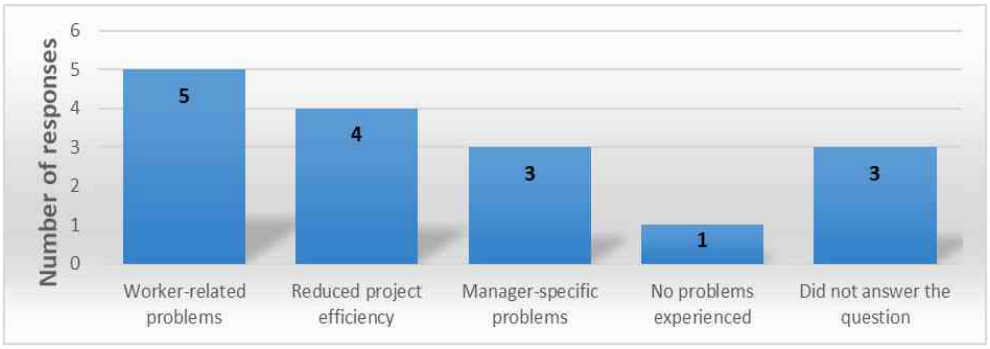


Figure 4.11 Effect of project management's self-awareness, supportiveness, communication and motivation to the workers on limiting supply chain effectiveness

In determining how these weaknesses in the supply chain were different to other construction projects, the respondents listed with 18 subthemes of topics across nine overarching themes, namely that this site was being affected by more client and time-related problems, space problems, site location problems, materials supply problems, site information problems, project efficiency problems, worker problems, security problems and site management problems than other sites they had worked on, as shown in Figure 4.*12* below. Two of the participants stated that there were no differences to other sites, or that these problems were universal problems to construction projects, and three participants did not provide any answers or information to this question.

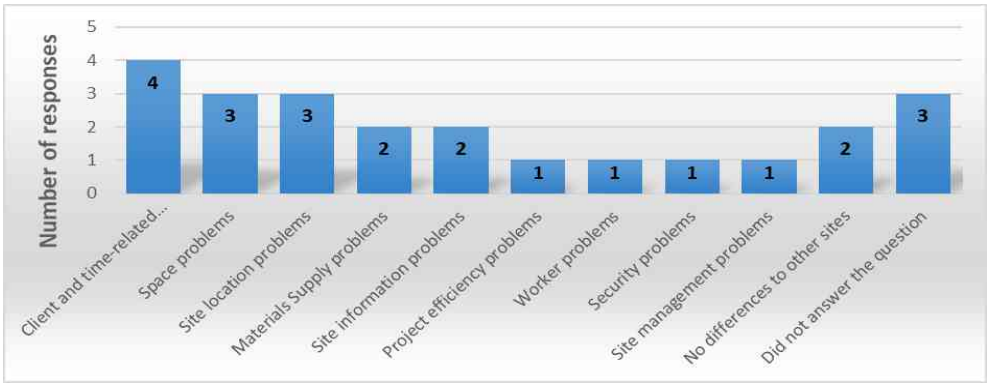


Figure 4.12 How this supply chain's weaknesses differed to other projects

While these answers helped to quantify the basis of the problematic situation, the ultimate purpose of this step of SSM was to express the problematic situation with the use of a rich picture, since a rich picture offers a highly efficient system of capturing large volumes of information in a small space. A rich picture was therefore drawn to help the researcher depict the relevant systems that could be taken into the systems world, for the purposes of improving the supply chain situation of the project under study. This rich picture is shown in .

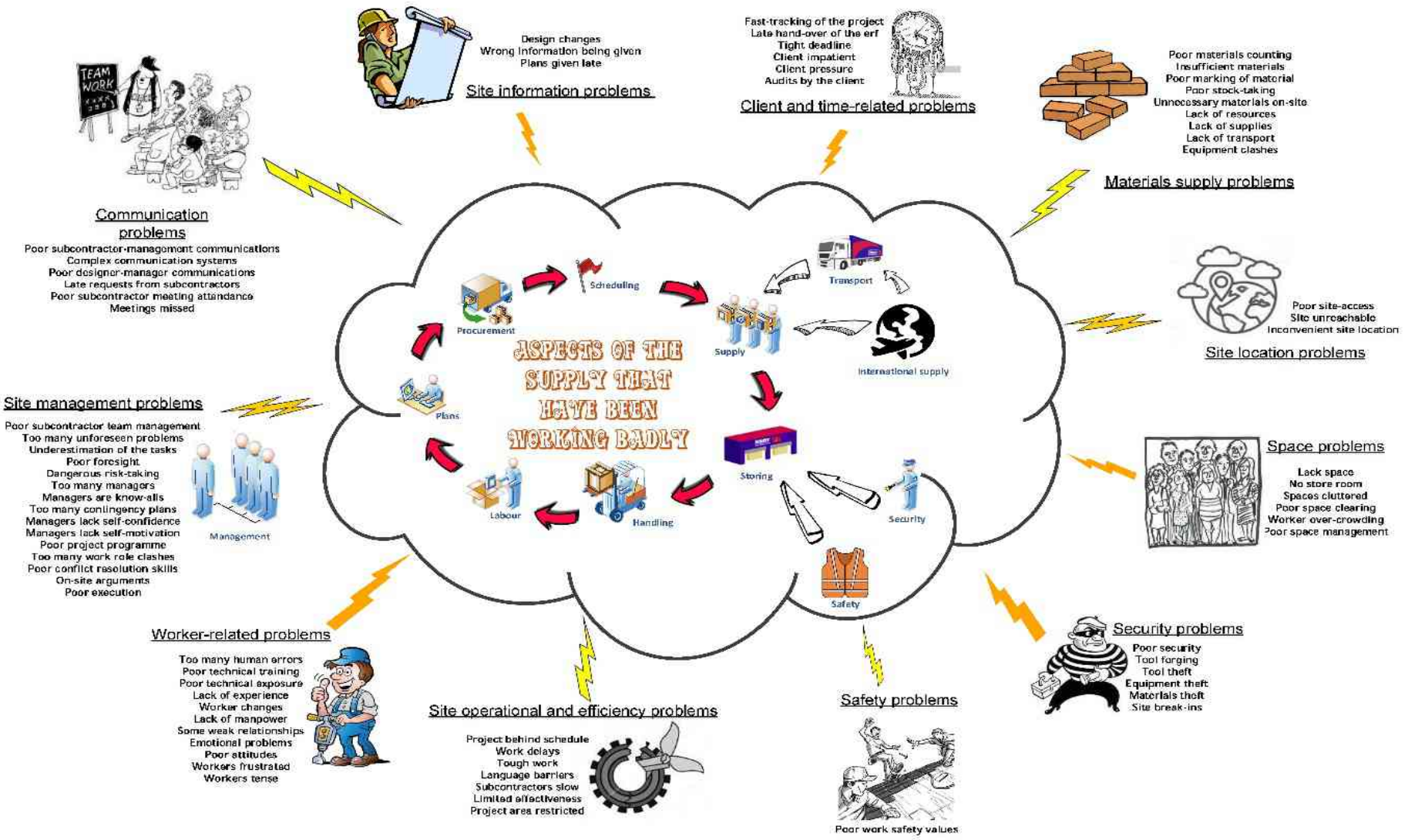


Figure 4.13 Rich picture depicting the supply chain problem and all its relationships

As alluded to above, the information for the rich picture was gathered via thematic content analysis of the interview transcripts, where the 'problem areas' noted in the interviews were depicted in the centre cloud of the rich picture as the 'aspects of the project's supply chain that have been working badly'. Surrounding this cloud, the rich picture depicted eleven themes of 'problems' that were noted by the respondents to have been inhibiting, or otherwise limiting the smooth functioning of the supply chain on the project. The themes, as shown in the rich picture, related to communication, site information, client and time-related issues, materials supply, the site's location, space, security, safety, site operation and efficiency, worker-related issues, and the site's management.

The point of a rich picture in SSM is to visually represent the problematic situation based on the English idiom that 'a picture is worth a thousand words'. As an example, to depict the nature in which the rich picture was drafted, one of the themes that was noted by numerous respondents to be negatively affecting the project's supply chain was the theme of 'security problems'. This theme was ascertained where the respondents noted six subthemes of issues, coded as 'poor security'; problems that had occurred as a result of 'tool forging'; 'tool theft'; 'equipment theft'; 'materials theft'; and the fact that security problems had been caused by 'site break-ins'. These were shown on the rich picture under the section 'security problems'. A similar set of coded subthemes for each of the problem areas was deciphered from the transcribed interviews, and compiled into the rich picture. These problematic issues were then adopted, and factored into the remainder of the SSM analysis, as noted in the third and remaining steps of the SSM analysis that follows.

4.3.3 Step 3: Formulating root definitions

The third step of SSM requires the researcher to formulate root definitions of the various systems of purposeful behaviour (the emergent properties, communication, hierarchy, and control) being applied within the problematic situation, as explained in the Methodology of Chapter Three. Root definitions can be defined, simply, as concise sentences depicting an idea to resolve or improve a particular theme of issues, as determined in the second step of SSM, where system 'X' is needed to achieve 'Y' for stakeholder 'Z (Checkland and Scholes 2001: 91). In order to ensure that the root definitions have been prepared accurately and thoroughly, a 'CATWOE' technique has been proposed to help define the transformation process, together with the potential players that could be involved (Checkland and Poulter, 2006). In this study,

five root definitions were devised, while CATWOE analyses were performed for each of these root definitions. It is worth mentioning that although eleven problematic themes were noted in the rich picture of Step 2, only five root definitions were devised to resolve or improve issues of the project's supply chain, since some of the actions for improvement that were noted from the interview transcripts could be grouped to target multiple problem categories simultaneously.

For instance, Root Definition 1 was devised to target communication problems, and site information problems simultaneously. It should also be noted that root definitions were prepared for almost all of the issues that were described in the rich picture; however, the problems related to the location of the project did not have any solutions offered up by any of the participants. Of course, this was to be expected since the location of the site itself was an unchangeable constant of the entire construction project; and indeed, was noted as an unchangeable external factor later in Step 5 of the SSM. However, it was interesting to note that none of the respondents offered any potential efforts that could be taken to help alleviate this barrier, such as efforts to help work around this immovable limitation, like changing delivery times or enlisting the help of the Traffic Department to handle the traffic-related problems caused by the site location. Aside from this issue with the site location, though, all of the other ten problematic circumstances noted in the rich picture were tackled in the following five root definitions.

4.3.3.1 Root Definition 1: To target communication, and site information problems

Root Definition 1 was developed to target communication, and site information problems on the project, so that the clients, or owners of the new office park could receive a more effectively-completed project. The concise definition, in the conventional 'X', 'Y', 'Z' format is as follows:

Root definition 1: *To introduce various systems of communication and site information changes (X) by the designers, project managers, subcontractors and workers (Y), to overcome the communication and site information problems that have been experienced in the project (Z).*

In order to define this root definition clearly, the CATWOE analysis presented in Table 4.*1* was performed. Based on this analysis, the clients, or owners of the new office park were the beneficiaries or customers inside or outside the construction supply chain that would receive the output of any transformations that were made; and incidentally, these 'customers' were the beneficiaries that would stand to benefit the most from all the transformations proposed by the root definitions. Conversely, the designers, PMs, workers and subcontractors appointed by the Giuricich Bros. Construction Company managing the project were the 'actors' within the construction supply chain that would execute or cause the main activities of the transformation to be performed. Introducing various systems of communication and site information changes around the new office park project were the actual purposeful transformation activities that were necessary to transform the current existing inputs into intended potential outputs. While worldviews such as smooth communications were essential aspects of an efficient, effective and profitable construction project according to the perspectives of a foreman, senior manager, supervisor, worker, and PM; which formed the belief systems that made sense of the root definition.

Table 4.1 CATWOE analysis for Root Definition 1

CATWOE Categories	**Considerations of each CATWOE category**
Customers	The clients, or owners of the new office park in Oxford Road in Rosebank, Johannesburg.
Actors	The designers, PMs, workers, and subcontractors appointed by the Giuricich Bros. Construction Company managing the project.
Transformation processes	Introducing various systems of communication and site information changes around the new office park in Oxford Road.
Worldviews (Weltanschauung)	Prepared from the perspectives of a foreman, senior manager, supervisor, worker, and PM.
Owners	The directors and senior managers of the Giuricich Bros. Construction Company managing the project.
Environmental constraints	Time and financial constraints.

Finally, the stakeholders with the ultimate power to end or shut down the proposed transformation were the directors and senior managers of the Giuricich Bros. Construction Company managing the project; while time and financial constraints were environmental constraints that were difficult to influence or change, but which ultimately had an influence on the outcome of the root definition. These two environmental factors also formed the key constrains that existed externally to the construction supply chain, but which were significant to the efficacy of the transformation ideas.

It is important to note that the transformation processes of the root definitions, as deciphered from the CATWOE analysis, are the focus of the conceptual models in Step Four of the SSM; and as such, are not discussed in great detail during this step of SSM. For instance, the fourth step of SSM requires the construction of feasible changes and actions to be made (transformation processes) to address and achieve the root definitions (Checkland and Scholes 2001). As such, the transformation processes are discussed in more detail in the next subsection of this chapter, as they describe the actions and feasible changes to be made to address and achieve these root definitions. Indeed, the purpose of the root definitions is to clarify, in a short concise format, the main actors and processes of changes to be made, rather than to elucidate the intricate workings of these actors and processes. Rather, this is the purpose of the fourth, fifth, sixth, and seventh steps of the SSM. Consequently, the root definitions are only outlined here in a concise format, together with the summarised findings of the CATWOE analysis; and the players, actors and actionable processes are outlined, in turn, during the subsequent steps of the SSM, later in the chapter.

It would have been possible, for instance, to explain here that in order to address Root Definition 1, and introduce various systems of communication and site information changes to overcome the communication and site information problems that had been experienced, a conceptual model of six concise transformation processes of communication and site information changes around the new office park in Oxford Road was devised. These commenced with daily meetings between workers and supervisors, which a foreman involved in the study suggested as “daily toolbox talk”. Concurrently, the respondents in their interviews also advocated programme meetings and regular directors’ meetings as first measures for making the proposed communication and site information changes. For the sake of diligence, though, and in-keeping with the spirit of systems thinking that confers importance on the

interrelatedness of each step of SSM — while also avoiding repetition — these discussions will only be outlined in detail during their appropriate steps of the SSM.

4.3.3.2 Root Definition 2: To target space, site operational and efficiency problems

Root Definition 2 was developed to target space, site operational and efficiency problems. The concise definition, in the conventional 'X', 'Y', 'Z' format was as follows:

> *Root definition 2:* *To implement some new systems of space, operational and efficiency changes (X) by the project managers, subcontractors and workers (Y), to overcome the space, operational and efficiency problems that have been experienced in the project (Z).*

In order to define this root definition clearly, the CATWOE analysis presented in Table 4.*2* was performed. As in the case of Root Definition 1, the clients, or owners of the new office park were the customers that would receive the output of any transformations that were made, while the actors here were the PMs, workers and subcontractors appointed by the Giuricich Bros. Construction Company managing the project. The transformational process required introducing various systems of space, operational and efficiency changes in the new office park project; while making space rearrangements and improving operations efficiency were essential worldviews according to the perspectives of a supervisor, foreman, senior manager, worker, and CEO. The clients, directors and senior managers of the Giuricich Bros. Construction Company managing the project were the stakeholders with the ultimate power to end or shut down the proposed transformation; and aside from time and financial constraints, community constraints were also key environmental constraints that were difficult to influence or change, and which ultimately hampered any intended transformations.

Table 4.2 CATWOE analysis for Root Definition 2

CATWOE Categories	**Considerations of each CATWOE category**
Customers	The clients, or owners of the new office park in Oxford Road in Rosebank, Johannesburg.
Actors	The PMs, workers and subcontractors appointed by the Giuricich Bros. Construction Company managing the project.
Transformation processes	Introducing various systems of space, operational and efficiency changes in the new office park in Oxford Road.
Worldviews (Weltanschauung)	Prepared from the perspectives of a supervisor, foreman, senior manager, worker, and CEO.
Owners	The clients, directors and senior managers of the Giuricich Bros. Construction Company managing the project.
Environmental constraints	Time, financial, and community constraints.

4.3.3.3 Root Definition 3: To target site management, client and time-related problems

Root Definition 3 was developed to target site management, client and time-related problems. The concise definition, in the conventional 'X', 'Y', 'Z' format was as follows:

Root definition 3: *To make some site management, client and time-related changes (X) by the project managers, foremen and team leaders (Y), to overcome the site management and space problems that have been experienced in the project (Z).*

In order to define this root definition clearly, the CATWOE analysis presented in Table 4.*3* was performed. In contrast to Root Definitions 1 and 2, the actors in this root definition were to be the PMs, foremen and team leaders appointed by the Giuricich Bros. Construction Company managing the project. The transformational process was said to require introducing various systems of site management and client and time-related changes around the new office park project; while efficient site management and space usage were essential for achieving the root definition according to the worldviews of a supervisor, worker, and foreman. Once again, the directors and senior managers of the Giuricich Bros. Construction Company managing the project were the stakeholders with the ultimate power to end or shut down the proposed

transformation. In this regard, time and financial constraints were the key environmental constraints that were difficult to change, but which would ultimately have an effect on whether the root definition could be feasibly implemented.

Table 4.3 CATWOE analysis for Root Definition 3

CATWOE Categories	**Considerations of each CATWOE category**
Customers	The clients, or owners of the new office park in Oxford Road in Rosebank, Johannesburg.
Actors	The PMs, foremen and team leaders appointed by the Giuricich Bros. Construction Company managing the project.
Transformation processes	Introducing various systems of site management and client and time-related changes around the new office park in Oxford Road as well as with the client directly, for better time-management in relation to the schedule of the project.
Worldviews (Weltanschauung)	Prepared according to the perspectives of a supervisor, worker, and foreman.
Owners	The directors and senior managers of the Giuricich Bros. Construction Company managing the project.
Environmental constraints	Time, and financial constraints.

Once again, it is important to reiterate that the transformation processes of the root definitions, as deciphered from the CATWOE analysis, are the focus of the conceptual models in Step Four of the SSM, and as such, are not discussed in great detail now. To this end, the transformation processes are discussed in more detail in the next subsection of this chapter, as they describe the actions and feasible changes to be made to address and achieve this root definition.

4.3.3.4 Root Definition 4: To target project planning and materials supply problems

Root Definition 4 was developed to target project planning and materials supply problems. The concise definition, in the conventional 'X', 'Y', 'Z' format was as follows:

Root definition 4: *To make some project planning and materials supply changes (X) by the project managers (Y), to overcome the planning and*

materials supply problems that have been experienced in the project (Z).

In order to define this root definition clearly, the CATWOE analysis presented in Table 4.*4* was performed. The actors in this root definition were the PMs appointed by the Giuricich Bros. Construction Company managing the project, while the transformational process required various systems of project planning and materials supply changes around the new office park project to be introduced, and project planning and materials supply to be improved which were essential worldviews according to the perspectives of a PM, CEO, supervisor, and worker. The directors and senior managers of the Giuricich Bros. Construction Company managing the project were the stakeholders with the ultimate power to end or shut down the proposed transformation; and time and financial constraints were the key environmental factors that were difficult to influence or change, which would hamper any intended transformations.

Table 4.4 CATWOE analysis for Root Definition 4

CATWOE Categories	**Considerations of each CATWOE category**
Customers	The clients, or owners of the new office park in Oxford Road in Rosebank, Johannesburg.
Actors	The PMs appointed by the Giuricich Bros. Construction Company managing the project.
Transformation processes	Introducing various systems of project planning and materials supply changes around the new office park in Oxford Road.
Worldviews (Weltanschauung)	Prepared according to the perspectives of a PM, CEO, supervisor, and worker.
Owners	The directors and senior managers of the Giuricich Bros. Construction Company managing the project.
Environmental constraints	Time, and financial constraints.

4.3.3.5 Root Definition 5: To target safety, security, and worker-related problems

Root Definition 5 was developed to target safety, security, and worker-related problems. The concise definition, in the conventional ‘X’, ‘Y’, ‘Z’ format was as follows:

Root definition 5: *To make some safety, security, skill and training changes (X) by the project managers, subcontractors and workers (Y), to overcome the safety, security and worker-related problems that have been experienced in the project (Z).*

The CATWOE analysis of this final root definition is presented in Table 4.5. As in the case of all the previous four root definitions, the key beneficiaries of this transformation were the clients, or owners of the new office park; though the actors of this specific root definition were the PMs, subcontractors, and workers appointed by the Giuricich Bros. Construction Company managing the project. The transformational process would require introducing various systems of safety and security changes, and skill and training for workers around the new office park site; while improving safety and security, and improving the skills and circumstances were worldviews of a worker, site clerk, foreman and supervisor. The directors and senior managers of the Giuricich Bros. Construction Company managing the project were the stakeholders with the ultimate power to end or shut down the proposed transformation; and aside from time and financial constraints, site-related limitations were other key environmental constraints that were difficult to influence or change, which would hamper any intended transformation.

Table 4.5 CATWOE analysis for Root Definition 5

CATWOE Categories	**Considerations of each CATWOE category**
Customers	The clients, or owners of the new office park in Oxford Road in Rosebank, Johannesburg.
Actors	The PMs, subcontractors, and workers appointed by the Giuricich Bros. Construction Company managing the project.
Transformation processes	Introducing various systems of safety and security changes, and skills training for workers around the new office park in Oxford Road.
Worldviews (Weltanschauung)	Prepared according to the perspectives of a worker, site clerk, foreman and supervisor.
Owners	The directors and senior managers of the Giuricich Bros. Construction Company managing the project.
Environmental constraints	Time, financial and site-related limitations constraints.

The next section discusses the conceptual models that were constructed in Step 4 of the SSM, in order to model the execution of each of these five root definitions. The transformation processes of the root definitions, as deciphered from the CATWOE analyses, are also one of the core focuses of the conceptual models in Step Four of the SSM; and as such, are not discussed in great detail now. Rather, the transformation processes are discussed in more detail, next.

4.3.4 Step 4: Constructing conceptual models

The fourth step of SSM requires the construction of conceptual models, which offer feasible changes and actions to be made to address (and achieve) the root definitions (Checkland and Scholes 2001). In the fourth step of the SSM of this study, therefore, tasks were chosen following the thematic content analysis of the respondents' interview transcripts, which were deemed to be the most effective; to have the highest efficacy; and to be the most efficient, as per the three E's task requirement of SSM. In addition, as per the guidelines of SSM analysis, each conceptual model was devised with between five and nine tasks, as shown in Table 4.*6*. Flow charts of each of the conceptual models were also drawn to depict the sequential flow of

tasks of each conceptual model, and these flow charts are presented in Figure 4.*14* to Figure 4.*16*.

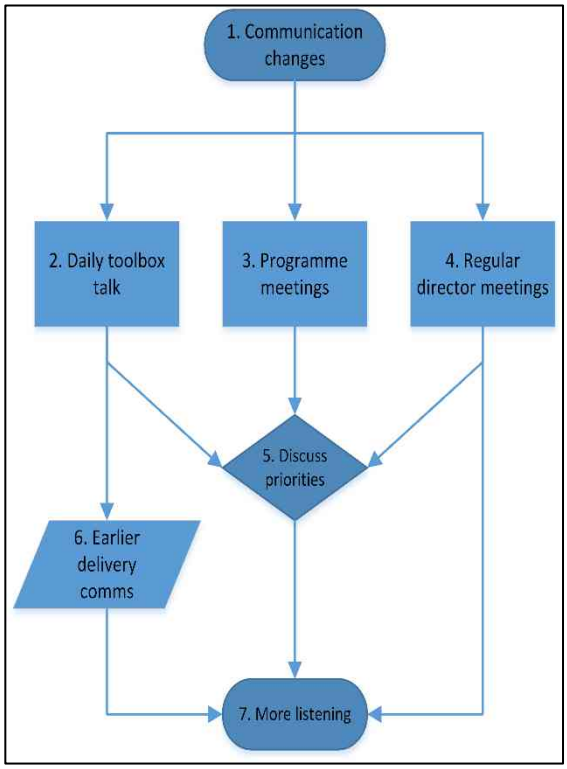
Table 4.6 Conceptual models of each of the five root definitions

Conceptual model #	**Root definition being addressed**	**Codes of sequential and related actions to take, which were deciphered during the thematic content analysis of the interview transcripts**	**Frequency noted by respondents**
1	Communication changes and Site information changes	DAILY TOOLBOX TALK	1 Foreman
		REGULR DIRECTR MEETS	1 Senior Manager
		PROGRM MEETGS	1 Supervisor
		DISCUSS PRIORITIES	1 Worker
		EARLIER DELIVRY COMMS	1 Proj Mgr
		MORE LISTEN	1 Proj Mgr
2	Operational and efficiency changes	DIFF EAT AREA	1 Supervisor
		IMPROV WRKR TRANSPRT	1 Supervisor
		MORE WRKERS	1 Foreman
		WRK BONUSES	1 Senior Manager
		WITHOLD SUB PAYMTS	1 Foreman
		MORE COOPERATN	1 Foreman
		MORE EQUIPT	1 Worker
	Space changes	MORE SPACE	1 Worker
		USE ADJOING PROPRTY SPACE	1 CEO
3	Site management changes And Client and time-related changes	CHANGE TEAM LEADRS	1 Worker
		SUBCONTR SUPPLIER INDPENDC	1 Supervisor
		MANAGE INEFFECTIVE SUBS	1 Worker
		CHECK WRK QLTY	1 Foreman
		ENSURE WRK ADHERNCE	1 Worker
4	Project planning changes	MORE FWRD PLANNG	2 Proj Mgr; CEO
		RISK ASSESSMTS	2 Superv; Worker
		EXPECT UNEXPECTD	1 Proj Mgr

	Materials supply changes	REARRANG DELIVRY TIMES	1 Proj Mgr
5	Safety and security changes	NEW-WRKR SAFTY EFFRTS	1 Worker
		REPORT UNSAFE ACTS	1 Worker
		INCR SECURTY	1 Site clerk
	Skill and training changes	ENSURE WRK UNDRSTANDG	1 Worker
		INCR COMPTNC	1 Foreman
		MORE LEARNG	1 Foreman
		MORE TRAING	1 Supervisor

4.3.4.1 Conceptual Model 1: Steps for resolving communication problems, and site information problems

In order to address Root Definition 1, and introduce various systems of communication and site information changes to overcome the communication and site information problems that had been experienced, a conceptual model of six concise tasks was devised, beginning with daily meetings between workers and supervisors, which a foreman involved in the study suggested as "daily toolbox talk". The respondents, during their interviews, also advocated programme meetings and regular directors' meetings as first measures for making the proposed communication and site information changes. As shown in Figure 4.*14*, the daily toolbox talk, programme meetings and regular director meetings would all provide opportunities to achieve a fifth task, which was to discuss the priorities of the project. In addition, the daily toolbox talk would provide an opportunity for task six to be achieved, which was to have earlier communications on the arrival of deliveries. Combined, these six tasks were expected to result in more listening, which would ultimately act to greatly reduce the communication and site information problems that had been experienced.



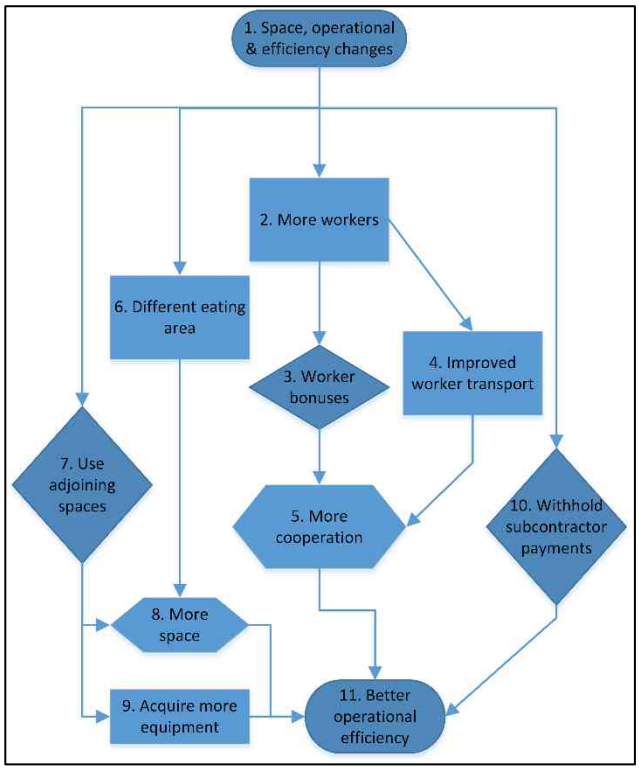


Figure 4.14 Conceptual Model 1 (left) for making communication and site information changes, and Conceptual Model 2 (right) for making space, operational and efficiency changes

4.3.4.2 Conceptual Model 2: Steps for resolving space problems, and site operational and efficiency problems

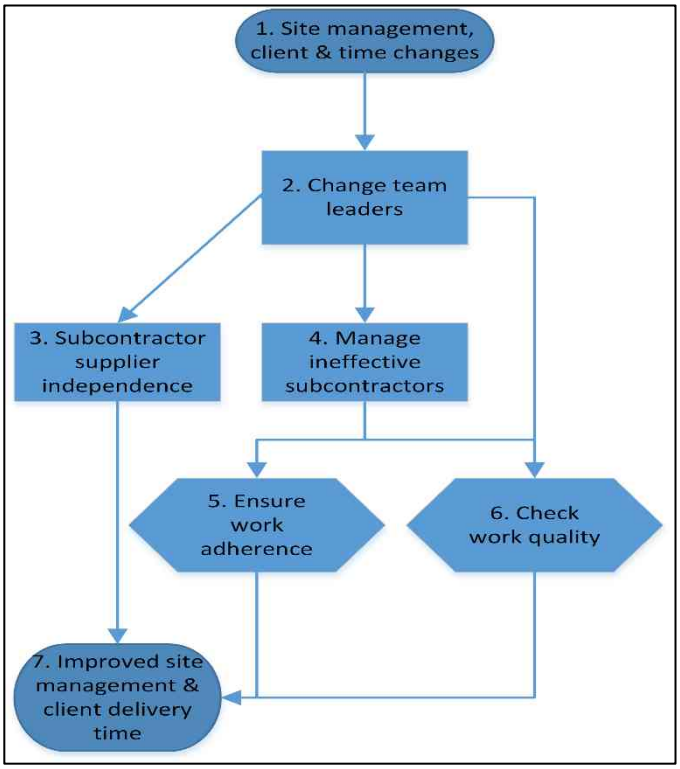
A similar flow of sequentially executed tasks was proposed for Root Definition 2, to target space, operational and efficiency problems; though four separate lines of tasks were proposed to move towards a final outcome of improved operational efficiency. To begin with, the first task of the conceptual model — as deciphered following the thematic content analysis of the respondents' interview transcripts — was for more workers to be hired on the project, as shown in Figure 4.*14*. Following on from this, a senior manager proposed that worker bonuses should be paid as incentives for improving work performance; while a concurrent task that was recommended together with worker bonuses was that workers should have improved worker transport. This improved worker transport, together with worker bonuses was expected to result in an improvement in cooperation, as a fifth step of the conceptual model.

Running concurrently to this primary line of tasks was for subcontractor payments to be withheld until their works were completed; which was proposed by one of the foremen that participated in the project. Three individual tasks were separately proposed by the respondents to address the problems with space on the project, which were for different eating areas to be provided for the workers, and for space from adjoining properties next to the Rosebank project to be used for the needs of the project. With this additional space availability from the adjoining spaces, it was also suggested that the management of the project should acquire more equipment; although such additional equipment would only be practical if additional space had been sourced; since the availability of space was already too limited to efficiently allow more equipment, if additional space was not acquired. Together, these space-related efforts were argued to result in more space on the site; and combined with the other tasks in this conceptual model, the participants foresaw that there would be overall improved operational efficiency across the supply chain of the project.

4.3.4.3 Conceptual Model 3: Steps for resolving site management problems, client and time-related problems

An elaborate flow of tasks was proposed in the respondents' interviews for making site management, client and time-related changes towards Conceptual Model 3, as shown in Figure 4.*15*, where the first step proposed was for the management to change the team leaders in the project. It was also proposed that the subcontractors should be given more independence to use

their own suppliers, rather than suppliers that were mandated by the principal. It was proposed that, upon changing the team leaders, the project's management would need to manage and deal with any ineffective subcontractors, while ensuring that all subcontractors had adhered to their work requirements and provided suitable work quality. Overall, it was advocated that these steps would result in improved management of the site, and a minimising of any site management problems. In addition, it was argued that these changes would result in less chance of the principal missing the deadline set by the client, and ensuring that the project was handed over on time.



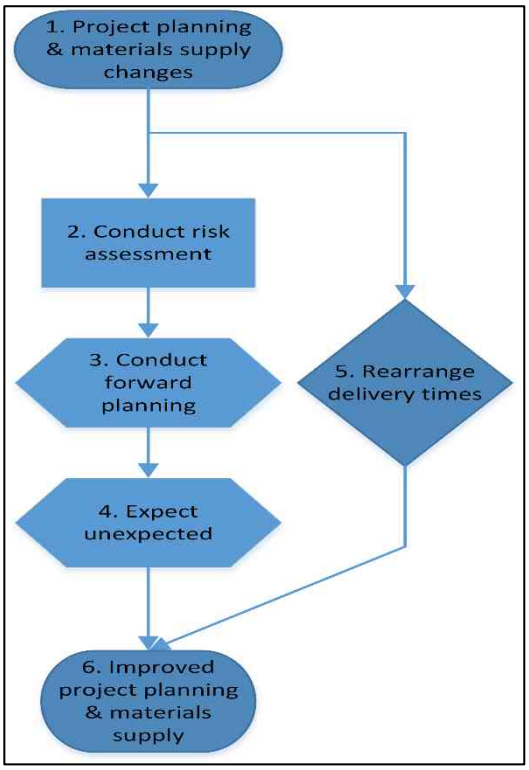


Figure 4.15 Conceptual Model 3 (left) for making site management and client and time-related changes, and Conceptual Model 4 (right) for making project planning and materials supply changes

4.3.4.4 Conceptual Model 4: Steps for resolving project planning and materials supply problems

For Conceptual Model 4, as shown in Figure 4.*15* above, six steps were recommended to resolve the project planning and materials supply problems that had been described. The first task was for the 'actors' — the PMs appointed by the Giuricich Bros. Construction Company (see CATWOE analysis earlier in the chapter) — to conduct a risk assessment of the project; after which it was proposed that the management should conduct more forward planning and expect the unexpected. The suggestions to conduct a risk assessment and to conduct forward planning were each noted by two separate respondents each, respectively, while risk assessments were proposed by a supervisor and a worker; and more forward planning was proposed by a PM and the CEO, respectively. In a separate, fifth line of tasks for this conceptual model, it was proposed that a materials supply change should be made in the form of rearranging the delivery times; and together with the planning changes, it was advocated that these tasks would act to improve the overall project planning and materials supply on the site.

4.3.4.5 Conceptual Model 5: Steps for resolving safety, security, skill and training problems

In the final conceptual model, steps were proposed for resolving safety, security, skill and training problems that had been noted earlier; whereby, a worker, site clerk, foreman and supervisor proposed five individual tasks, as shown in Figure 4.*16*, to improve the safety, security, and worker skill within the project's supply chain. The first task that was proposed was for the PMs to increase the security systems on site, which would help to target the security issues that had been observed. In a second line of changes, it was proposed that worker training should be conducted, and that safety training efforts should be made, particularly in the case of new workers to the site. Both the worker training and new-worker safety efforts were suggested to be followed up with ensuring worker understanding of their tasks and roles on the project, and on safety matters that would, in turn, increase worker competence. When executed together, these seven tasks were argued to result in numerous safety, security, skill and training improvements on the site.

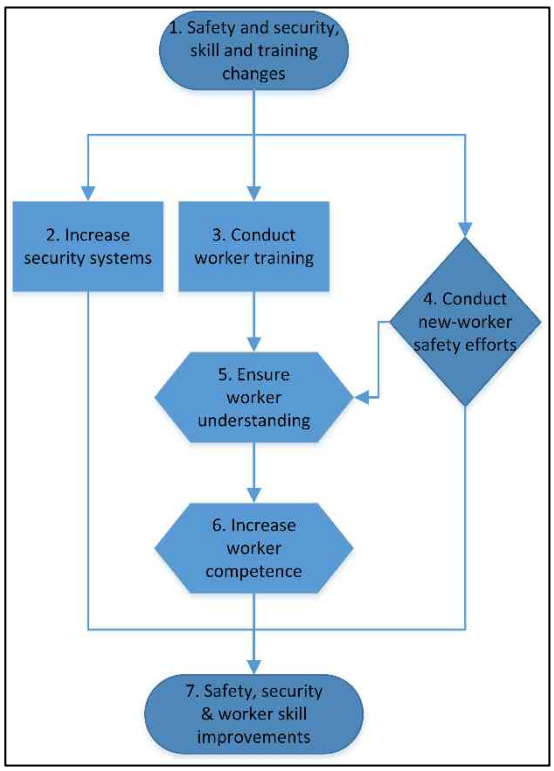


Figure 4.16 Conceptual model 5 for making safety, security, skill and training changes

4.3.5 Step 5: Measuring the conceptual models against real world situations

The fifth step of SSM required the conceptual models to be measured against real world situations, where differing alternative models were assessed and compared to reality. Aspects of this real-world assessment were initially included in the question structure of the interviews. During the interviews, discussions were initiated between the participants to express whether they thought the changes they had recommended would be accepted by the management; and if not, why these changes would not be accepted, and what else would need to be done to overcome these barriers to change.

4.3.5.1 Measuring internal likelihoods that the conceptual models would be implemented

The answers of the respondents, as deciphered from the thematic content analysis of the respondents' interview transcripts (see Figure 4.*17*), indicated a relatively dispersed sequence of answers: only six respondents indicated a positive likelihood that the suggestions they proposed would be considered by the management; and seven of the respondents noted a general pessimism that the suggestions they proposed would not likely be considered by the management. Two of the respondents noted that there was some likelihood that the proposed conceptual models would be considered only if some form of concession was made. For

instance, one of the respondents noted that it was “Likely although with compromises”, while another noted that it was “Likely for the next project”; and a third respondent noted that the management “might” consider the proposed conceptual models.

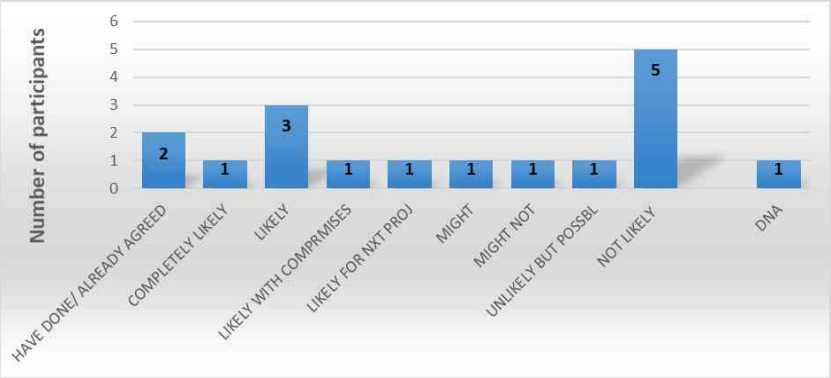


Figure 4.17 Likelihood that the suggestions proposed would be considered by the management

4.3.5.2 Measuring uncontrollable external factors on the conceptual models’ feasibility

Numerous uncontrollable external factors in the environment or outside the construction project were noted to have been incumbent upon the management’s ability to consider the proposed conceptual models, as shown in Table 4.7, where uncontrollable external factors preventing the suggestions from being made were broadly categorised into five themes during the thematic content analysis. The most frequently occurring theme was that of traffic limitations, which was noted a total of four times by different respondents. In particular, issues with road conditions, traffic, the site being along public roads, and the fact that deliveries opposed traffic, were the four subthemes that were noted by the participants pertaining to this theme of uncontrollable traffic limitations.

The participants also observed three financial limitations namely, that there was a lack of funds on the project; and this subtheme was described in recurrence by three separate participants in the interview transcripts. Community limitations was another theme with three overall responses, where subthemes of intimidation by the community, complaints by the community, and the fact that the “neighbours were grumpy” were external limitations that were preventing the conceptual models from being implemented. Two issues with time limitations related to the lack of time, and that the project deadline was immovable were also described; while natural

limitations in the form of rain delays were noted by one of the respondents in isolation, as an uncontrollable external factor that was preventing the conceptual models from being executed.

Table 4.7 Overarching themes and subthemes of the uncontrollable external factors preventing the suggestions from being made

Themes deciphered	**Subtheme codes deciphered from the respondents**	**Number of times noted**
Traffic limitations	ROAD CONDITS	1
	TRAFFIC	1
	PUBLC ROADS	1
	DELIVRY OPPOSE TRAFFIC	1
Financial limitations	LACK FUNDS	3
Community limitations	COMMNTY INTIMIDATN	1
	COMMUNITY CMPLAINTS	1
	NEIGHBRS GRUMPY	1
Time limitations	PROJ DEADLINE	1
	LACK TIME	1
Natural limitations	RAIN DELAYS	1

4.3.5.3 Measuring uncontrollable internal factors on the conceptual models' feasibility

The thematic content analysis of the respondents' interview transcripts identified four key themes to explain why they thought the management would not ultimately consider making the changes that they had proposed; as shown in Table 4.*8*. These themes were primarily akin to the uncontrollable external factors (noted previously), which were said to be preventing management from making the proposed changes. These four themes were financial limitations, time-related limitations, and site-related limitations, although two subthemes related to management limitations were also noted; namely that poor early planning, and poor management were the core reasons why the management would not consider making the proposed changes.

The subthemes related to financial limitations were a lack of funds, and that there would be penalties for any delays, which factors were limiting the management from considering any

proposed changes. This, in turn, was closely related to the time limitations, which stated that there was a lack of time for completion of the project, since the schedule was already finalised; and this in turn was limiting the number of new changes that the management could now make on the supply chain to improve the project. Finally, the site-related limitations reiterated the problems with the location of the site, while a somewhat isolated problem that was noted was that the subcontractors on the site were independent of the primary contractor, and this was limiting the amount of control that the management was able to make on the site. Interestingly, these themes and subthemes were the ideas of only nine of the 17 participants, as eight of the participants declined to provide any input into this question during the interviews, as coded with the subtheme 'DNA', or 'did not answer'.

Table 4.8 Overarching themes and subthemes of why the management would not consider making this proposed change

Themes deciphered	**Subtheme codes deciphered from the respondents**	**Number of times noted**
Financial limitations	LACK FUNDS	4
	DELAY PENALTIES	1
Time limitations	LACK TIME	2
	SCHEDULE FINALIZD	1
	ORDERS NEARLY CMPLET	1
Management limitations	POOR EARLY PLANNG	1
	POOR MGT	1
Site-related limitations	SITE LOCATN	1
	SUBS INDPENDT	1
Did not answer	DNA	8

4.3.6 Step 6: Identifying possible and feasible changes

The sixth step in this study's SSM was to identify both possible and feasible changes that could be made, through a cyclical, iterative process that considered the individual tasks of the conceptual models and compared them to real-world barriers and possibilities. This step was performed by firstly, iteratively gathering data with the participants; and thereafter refining the conceptual models to identify the most possible and feasible models for change. In order to refine the conceptual models from Step 4, and in attempting to truly reiteratively determine the

possible changes that could be made on the project, the respondents were again asked what other changes could be made, which would be more likely to be accepted by the management (considering the above challenges). Only seven of the respondents had any further information to input into the iterative process, and 12 of the respondents did not answer (DNA) this question, as shown in Table 4.*9*.

There were five themes of changes that the eight remaining respondents thought would be the most likely to be accepted, which each aligned with themes that had been noted during the conceptual model stage of the SSM, in Step 4. The five overarching themes were communication changes, client and time-related changes, site operations and efficiency changes, site management changes, and space changes. For instance, two subthemes of codes were deciphered from the respondents' transcripts pertaining to communication changes; namely, having more frequent mutual discussions, and in turn, having more communications on the site. Subthemes in relation to the client and time-related changes were for the management to negotiate a later hand-over time for the project; and in addition, to have the workers work over-time to strive to complete the project in the shortest time possible. It was also argued that increasing equipment efficiency was the most likely option to be considered and accepted by management, in terms of site operation and efficiency changes for overcoming site operation and efficiency issues. Finally, it was suggested that the most likely site management change would be for the management to become less autonomous; while the most likely space change to be accepted was for the space on the site to be recycled.

Table 4.9 Overarching themes and subthemes of what other changes would be more likely to be accepted

Themes deciphered	**Subtheme codes deciphered from the respondents**	**Number of times noted**
Communication changes	FREQ MUTUAL DISCUSSN	1
	MORE COMMS	1
Client and time-related changes	LATER HAND-OVER	1
	WRK OVER-TIME	1
Site operation and efficiency changes	INCR EQUIPT EFFICNCY	1
Site management changes	MGT LESS AUTNMOUS	1
Space changes	RECYCLE SPACE	1
Did not answer the question	DNA	12

These final changes were entered into an ease-benefit matrix to identify the overall ease and benefit for executing the different conceptual models, as noted in the seventh and final step of the SSM, next.

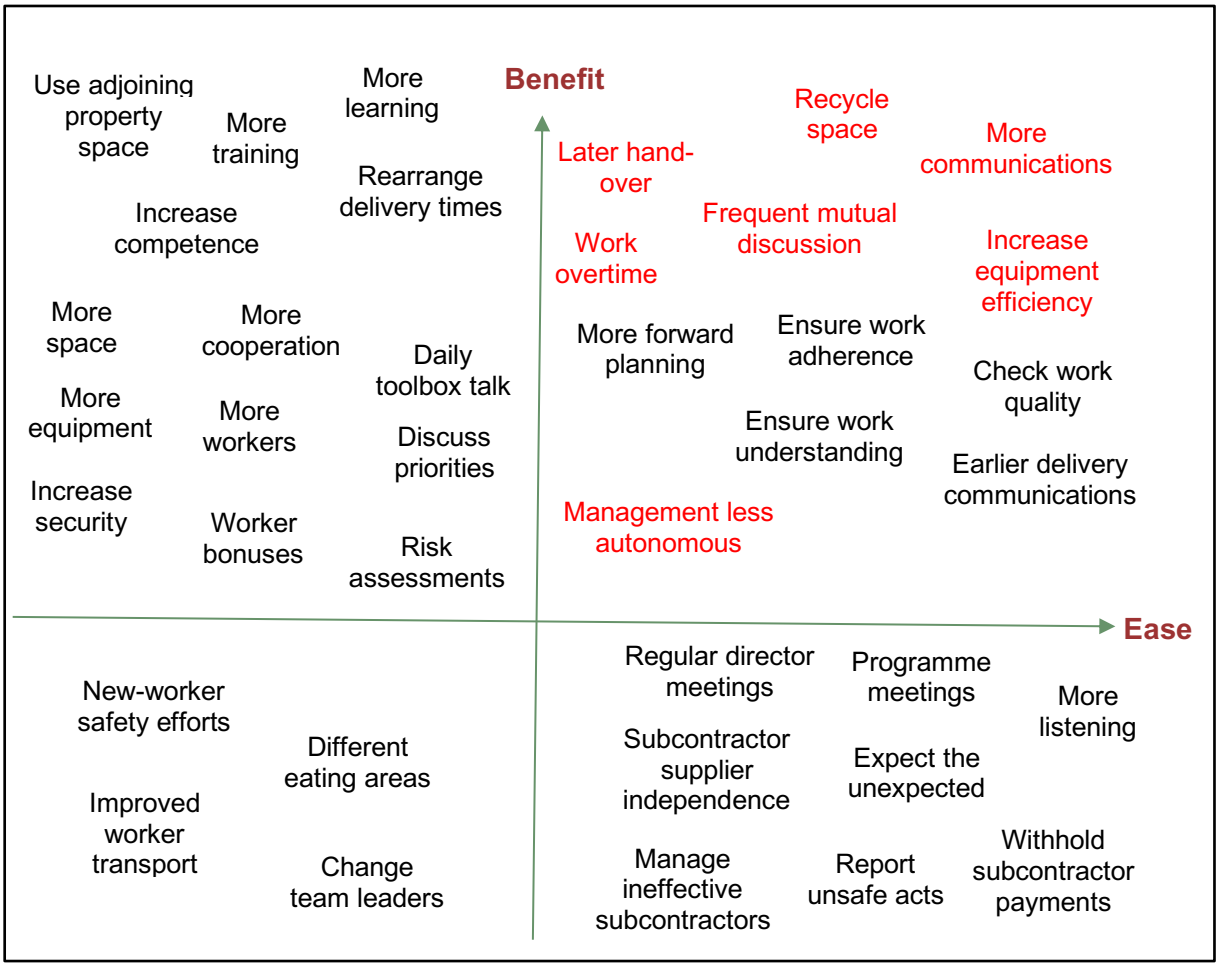
4.3.7 Step 7: Taking action to improve the problematic situation

The seventh and final step of the SSM is typically to take action to improve the problematic situation (Jackson 2010: 133). However, for the purposes of this study, this step was not ultimately performed, because the intention of the methodology was to identify the existing challenges of the supply chain of the new office park construction project in Oxford Road, Rosebank. Its aim was further to develop suitable operational models for change within the supply chain of the project, rather than to make or observe these recommended changes.

There was, however, a final set of recommendations that were forthcoming from the study, which could be offered up in the final step of the SSM of this study. These recommendations were entered into an ease-benefit matrix, to identify the overall ease and benefit of executing the different changes, where the seven subthemes of codes from the five themes of likely actions in the Step 6, were noted in red in the ease-benefit matrix (see Figure 4.*18*). These

changes were noted in red, as they depicted changes with the highest ease, and greatest benefit, according to the respondents; while the remaining suggestions that had been noted previously during the SSM (see Table 4.*6*), but which were noted to have barriers inhibiting their smooth implementation, were noted with lower ease or benefit in the matrix.

Figure 4.18 Ease-benefit matrix of changes to improve the supply chain of the Rosebank construction project



It is important to note that despite the guideline by the respondents in Step 6 of the SSM that seven 'most likely' subthemes should be entered into the ease-benefit matrix in red, there was no clear guideline as to which changes would be more or less difficult to implement; or which would have more or less benefit to the project. These changes were therefore placed in the ease-benefit matrix according to the intuition and initiative of the researcher, considering the amount of effort, resources and time that would be required to complete the changes, and the amount of benefit that the researcher perceived the respective changes would have on the overall functioning of the project's supply chain. Explanations and discussions as to why the different

changes were placed at each of the different places in the ease-benefit matrix, in relation to the literature, are given in the discussion of Chapter Five, later in the dissertation.

Meanwhile, in elucidating the findings of the ease-benefit matrix, the changes that were recommended by the participants, but which were expected by the researcher to be the most difficult to execute, based on the effort, resources, and time that would be required to achieve them, while having the least benefit — as noted in the lower-left quadrant of the ease-benefit matrix — were to change the team leaders; for the project to use different eating areas; to improve worker transport; and to make greater efforts towards improving the safety of new workers. These tasks were recommended by the participants, but were ultimately expected to require high effort, time and resources, with the least amount of resultant benefit to the supply chain of the project.

Changes that were recommended by the participants that were perceived by the researcher to exhibit larger benefit to the project, but which would still require a large amount of effort, resources, and time — therefore ranking them low on the 'ease' end, and high on the 'benefit' end of the spectrum, in the upper-left quadrant of the matrix — were for the principal to arrange to use the adjoining property space for the purposes of the project, to produce more space, to invest in more training, to generate more learning opportunities, and to increase competence among the workers. Other changes that were recommended in this quadrant were for the work teams to hold daily toolbox talk meetings, to generate more cooperation on site, for the PMs and participants to discuss the project's priorities, to increase the amount of security and equipment on site, to arrange for more workers, to pay worker bonuses, and for the principal to conduct risk assessments of the project.

Contrary to the above, in the lower-right quadrant were changes that were recommended by the participants that the researcher perceived to require lower amounts of effort, resources and time to execute, but which ultimately were not anticipated to render as high benefits to the supply chain of the project as other tasks that had been proposed. Such tasks were for the principal to withhold payments to the subcontractors, for the managers to listen more to the needs of the workers, for the project to report unsafe acts, and for the subcontractors to have more independence in their suppliers. Other changes that were recommended in this quadrant were for directors to hold regular meetings, for managers to hold programme meetings, for the PMs to manage ineffective subcontractors, and for the PMs to expect the unexpected. Once

again, explanations and discussions as to why the different changes were placed at each of the different places in the ease-benefit matrix are given in the discussion of Chapter Five.

Finally, changes that were considered the easiest to implement, requiring the least effort, time and resources, while generating the most benefit, were tasks in the upper-right quadrant of the matrix. Many of these changes were those that had been recommended in Step six of the SSM, and were therefore noted in red in Figure 4.*18*. Some of the recommendations from earlier in the SSM analysis in Table 4.*6*, though, were also deemed by the researcher to be relatively effortless changes, but which could render high benefits to the project's supply chain. Changes that had been recommended in Step 6 of the SSM were for the management to negotiate a later hand-over time for the project, and having the workers work over-time to strive to complete the project faster. Increasing equipment efficiency was also the most likely option to be considered and accepted by management, and in terms of effort and benefit, it ranked very highly in the matrix; while it was also suggested for space to be recycled, which again, due to the relative ease of effort and high overall benefit, ranked it very highly in the matrix. It had also been recommended in Step 6 of the SSM for the management to become less autonomous, and since it was a final iterative recommendation of the respondents, it was placed in red in the upper-right quadrant. However, removing the autonomy of the management would likely have numerous difficulties, and arguably have had limited benefit, therefore placing it close to the centre of the matrix, as opposed to clearly in the top-right corner of the matrix. Further discussions on this are presented in Chapter Five.

There were five recommendations from earlier in the SSM (Table 4.*6*), which as alluded to here, were deemed by the researcher to be worthy of classification in the upper-right quadrant of the matrix, due to their relative ease and benefit to the project. These were for the management to check work quality, and to ensure work adherence, to provide earlier communications on delivery, and for the management to ensure work understanding across the site. Finally, it was also recommended for the management to perform more forward planning; which it was deemed by the researcher to be an important task for the management to perform, and which should ultimately be relatively easy to achieve, especially as it constitutes a standard function of project management. This chapter, however, has been dedicated to descriptive analysis of the results that were generated from the methodology, and not a detailed deliberation on the results, or any triangulation with the literature, as this is the entire purpose

of Chapter Five, next. This chapter therefore ends, now, with a summative conclusion, before delving into this discussion in the next chapter.

4.4. CONCLUSION

This chapter has presented a detailed descriptive analysis of the results that were generated from the thematic content analysis and SSM of the interviews' transcript data. There was a broad spectrum of participants in this study, which consisted mostly of employees of the principal contractor, and some subcontractors; with two of the participants having been involved with supply chain matters for more than 50 years on construction projects over the course of their careers. The participants were also involved in all of the various aspects of the supply chain on the study's chosen project. The thematic content analysis determined that the aspects of the supply chain that had been working well were predominantly the scheduling of the materials and equipment, equipment and materials handling, supply delivery matters, safety on site, procurement, storing, and labour.

The respondents claimed that the vision, risk-taking, emotional intelligence and trust of the project management had resulted in more teamwork, more worker responsibility, improved project efficiency, manager-specific improvements, improved worker skills, and an improved working environment. So too, had the project management's self-awareness, supportiveness, communication and motivation to the subcontractors and workers improved information flow, project efficiency, working environment, teamwork, and caused manager-specific improvements. Aside from this, the PMs were also noted to possess numerous other characteristics that were enhancing the effectiveness of the project's supply chain, such as operations control, management skills, emotional intelligence, motivation, communication skills, supportiveness, trust and vision. Respondents argued that there was more responsibility given to the workers on this site compared to other projects they had worked on; and that there were fewer accidents, smaller teams and more safety checks on this project. Some manager-specific factors were also different on this project compared to others, such as being more approachable, more vigilant, having different permissions processes and project control, better project efficiency, and improved information flow.

A key example of the 'messiness' of the supply chain was observed in this study where, despite the numerous comments describing the project's strengths, every single area that was noted to

have been working well by respondents was noted by other respondents to have aspects that were working poorly. The thematic content analysis of the interview transcripts determined that soft characteristics of the PMs, such as the vision, risk-taking, emotional intelligence and trust had likewise caused worker-related problems, manager-specific problems, and reduced project efficiency. So, too, had the project management's self-awareness, supportiveness, communication and motivation to the subcontractors and workers resulted in limited effectiveness of the supply chain, in the same three areas of worker-related problems, manager-specific problems, and reduced project efficiency. A rich picture was drawn to express the situation of the problem. The respondents noted eleven themes of 'problems' inhibiting, or otherwise limiting the smooth functioning of the supply chain, namely: communication, site information, client and time-related issues, materials supply, the site's location, space, security, safety, site operation and efficiency, worker-related issues, and the site's management.

Although eleven problematic themes were noted in this rich picture, only five root definitions were devised via CATWOE analyses to resolve or improve the issues of the project's supply chain, since some of the actions for improvement could be grouped to target multiple problem categories. In the fourth step of the SSM, tasks were chosen following the thematic content analysis of the respondents' interview transcripts, which were deemed to be the most effective; to have the highest efficacy; and to be the most efficient, as per the three E's task requirement of SSM. Each conceptual model was devised with between five and nine tasks, and flow charts of each of the conceptual models were drawn to depict the sequential flow of tasks that needed to be performed.

In measuring the conceptual models against real world situations, the answers of the respondents indicated that there was a considerable amount of doubt over whether the conceptual models would be accepted by the management. Only six respondents indicated a positive likelihood that the suggestions would be considered; and seven of the respondents noting a general pessimism, stating that the recommendations would not be considered. The respondents identified four key themes to explain why they thought the management would not ultimately consider making the changes that they had proposed: financial limitations, time-related limitations, site-related limitations, and poor management. Iteratively gathering data with the participants and refining the conceptual models to identify the most possible and feasible models for change to accommodate these reasons, five themes of changes were

ultimately recommended, focusing on communication changes, client and time-related changes, site operations and efficiency changes, site management changes, and space changes.

In a final step, changes that were considered to be the easiest to implement, requiring the least effort, time and resources, while generating the most benefit, were placed on an ease-benefit matrix. These changes were for the management to negotiate a later hand-over time for the project, and to have the workers work over-time to strive to complete the project faster. Increasing equipment efficiency was also the most likely option to be considered and accepted by management, while it was also suggested for space to be recycled, and for the management to become less autonomous. Five recommendations from earlier in the SSM were also deemed by the researcher to be feasibly considered, due to their relative ease and benefit to the project. These were for the management to check work quality and to ensure work adherence, to provide earlier communications on delivery, for the management to ensure work understanding across the site, and for the management to perform more forward planning.

A detailed discussion of these results, while triangulating with the literature, is presented in the Chapter Five, next.

CHAPTER FIVE
DISCUSSION

5.1. INTRODUCTION

This chapter covers the discussion of this dissertation. The purpose of this chapter is to present a detailed deliberative analysis of the results that were generated from the study, including a discussion on the understanding of what the results mean, and a triangulation of the results with the current literature. This chapter is structured to discuss the findings of this study in line with the five research objectives that were developed in Chapter One. As such, it begins by investigating the supply chain processes on the chosen construction site, as well as the aspects in the supply chain processes that have been best enhancing or otherwise limiting the successful project performance of the construction site. The chapter then discusses the role that the project leadership has performed in failing to overcome any challenges facing the supply chain on the project; before discussing the eventual operational model that was developed through the SSM methodology, to resolve the impasses that were found in the supply chain of the construction site. The chapter begins, first, with the discussion on the first objective of the study.

5.2. OBJECTIVE ONE: INVESTIGATING THE SUPPLY CHAIN PROCESSES OF THE NEW OFFICE PARK CONSTRUCTION PROJECT IN OXFORD ROAD, ROSEBANK

In order to investigate the supply chain processes of the new office park construction project in Oxford Road, Rosebank, it was important to begin, first, by discussing the nature of the individuals who participated in this study. This is necessary because, as alluded to in the literature review in Chapter Two, one has to be very clear in construction as to who makes up the project team (Cheng, Law, Bjornsson, Jones and Sriram 2010: 246). There was a broad spectrum of participants in this study, which consisted mostly of employees of the principal contractor, the Giuricich Bros. Construction Company, and the remaining participants were subcontractors on the project. Outsourcing appeared, therefore, to be a significant component of this study, which tended to support the literature where it has been argued that outsourcing is a component of almost every construction project, as construction projects are typically very large, and their delivery timelines are generally very tight (Yong Seng, Mehdi Riazi, Mohd Nawi and Ismail 2018: 155). In construction, therefore, the main contractor would outsource a number of issues in which they were not specialists so they could focus on improving the performances of their key speciality areas, while also reducing costs (Emuze and Julian

Smallwood 2014: 294; Vrijhoef and Koskela 2000: 171); and as observed in this study, this project was no different.

In most construction projects, subcontractors such as electricians, carpenters, builders, and others individuals do a considerable amount of work (Thwala and Phaladi 2009: 533). This aligned with this project as well, since the participants were involved with all of the various aspects of the supply chain; with some of the participants even handling tasks on 'all' aspects of the project's supply chain, and only one person not being currently involved with supply chain tasks on this particular project. This spectrum of participants was not at all unexpected, since the human resources on a construction site includes the principal contractor, sub-contractors, architects, engineers, labourers and developers; with some supplying materials and components, and others providing construction services (Simpeh, Ndihokubwayo, Love and Thwala 2015: 109). However, it should be established that there is also the project sponsor, or the representative of the top management of the principal contractor or the construction firm, who is also an important part of the project cycle (Chinyio and Olomolaiye 2009); and in this study, each of these groups of professionals was targeted and included.

There was also a full spectrum of experience among the participants in this study, with some having been involved with supply chain matters for more than 50 years over the course of their careers; though three of the participants had fewer than five years' worth of experience in construction supply chain work. This spectrum of participants was therefore deemed exceptionally well qualified and experienced to allow the researcher to investigate the supply chain processes throughout the project. The investigation was conducted scrupulously; and ultimately, allowed the next three objectives of the study to be targeted fully.

5.3. OBJECTIVE TWO: IDENTIFYING THE ASPECTS IN THE SUPPLY CHAIN PROCESSES THAT HAVE BEEN BEST ENHANCING THE PERFORMANCE OF THE CONSTRUCTION PROJECT

The study determined that the aspects of the supply chain that had been working well were predominantly the scheduling of the materials and equipment; while there was also a fair amount of consensus that the project's scheduling was working well. This was not wholly unforeseen, because scheduling, timing, and work scheduling are key elements of a supply chain; particularly in the construction industry (Harrison and Lock 2017). As such, due to the

broad spectrum of people interviewed for this study, there would undoubtedly have been aspects of the scheduling of the project, and the materials and equipment that were working well; lest the project would have ground to a standstill. Scheduling was, however, not an isolated aspect, with equipment and materials handling, supply delivery matters, safety on site, and procurement and storing within the supply chain also being noted; while one participant noted that "all" aspects of the supply chain were working well.

This tended to concur with recent literature that argues that that there has been a recent shift from the traditional measures of ROI, for measuring project success, to far broader perspectives including elements of the project's leadership (Kerzner 2017). When looking at projects, the standard ways of considering project success have been in relation to time, cost and quality (Nixon, Harrington and Parker 2012: 205; Lloyd-Walker and Walker 2011: 384). However, as noted during this study, numerous microsystems supported the pathway to reaching this success; while many of these microsystems - in the case of this project, appeared to be working well. In addition, the successes of these various systems were also clearly accolades of the success of the project's management as well.

In order to delve deeper into the supply chain's management, though, and understand how the soft elements related to the project management had affected the project supply chain, the effects of the vision, risk-taking, emotional intelligence and trust of the PMs on the project supply chain's effectiveness were ascertained. As explained in the literature review of Chapter Two, emotional intelligence, for instance, is a soft skill that people have to be able to recognise their feelings, and the power to control these feelings (Sunindijo 2012: 182). There is a list of important soft skills that the PM, as the leader of a project, should hold, since as alluded to in Chapter Two, the PM must hold more skills than simply the title of his or her job post (Sunindijo 2012: 187). The literature details a list of hard- and soft skills that must be embodied in a PM as the key link to all contractors and subcontractors. In this regard, PMs should have skills of problem solving, decision making capabilities, the ability to see opportunities, and the ability to manage change, in order to ensure that a project is well planned, and that it is correctly adhered to (Hwang and Ng 2013: 272).

It was determined, during this study, that the management's skills of vision, risk-taking, emotional intelligence, and trust, were producing more teamwork, more worker responsibility, improved project efficiency, improved worker skills, an improved working environment, and

also manager-specific improvements. This tended to verify the arguments of Hwang and Ng (2013: 272) who stated that exhibiting a broad array of skills outside of their immediate project management tasks, would be exceptionally beneficial to the efficiency of the project.

Further expanding on these soft skills, when asked to express how the participants thought the project management's self-awareness, supportiveness, communication and motivation to the subcontractors and workers had enhanced the effectiveness of the supply chain on the project, there was also a full list of positive comments noted. Self-awareness, for instance, is an important attribute that helps PMs to be in control of their emotions, and to relate to how others are feeling. This is important, for instance, since building sites are often highly charged atmospheres, where a considerable amount of emotional content is distributed among a large spectrum of individuals, with an enormous array of personal considerations, issues, and concerns.

When considering some of the complex personal issues of subcontractors and workers, for instance, many of the people involved in projects are dealing with personal problems at home, or in their private life, such as marital or relationship problems; health and wellbeing issues in their households; and/or the loss or death of family members and loved ones (Lingard, Francis and Turner 2012: 282). In addition, many contractors or workers have financial or other difficulties that may be acting negatively on their emotional states (Salehi Sichani, Lee and Robinson Fayek 2011: 849). This has been supported by authors such as Sunindijo (2012: 187), who emphasised that there is a need for the PM to have self-awareness, as it aids his or her relationships with the different people in the project team, even though short schedules on projects make relationship-building difficult to accomplish.

It was largely believed that the management’s skills of self-awareness, supportiveness, communication and motivation to the subcontractors and workers had improved information flow; improved project efficiency; improved the working environment; improved teamwork; and also caused manager-specific improvements. This included outcomes such managers explaining tasks well; they were holding daily and weekly meetings on frequent occasions; the PMs were supplying the necessary information with improved subcontractor-manager meetings; there were increased discussions on site; and there was a good degree of knowledge among the PMs, who were explaining challenges well, and providing a suitable number of work reminders. While the participants in this study verified the sizeable benefits of the project

management's communications skills, this has also been asserted in the literature that the heart of everything a PM does is dependent on the quality of his or her communication skills. This is the case because people generally respect people they believe are listening to them, or who are paying attention to what they are saying (Fisher 2011: 998). Communication is, therefore, one of the soft skills that is key to maximising the outcomes that are achieved from the project's team (Gewanlal and Bekker 2015: 33; Windapo 2016: 1-8).

When asked how the strengths in the supply chain of this project were different to other construction projects, respondents argued that there was more responsibility given to the workers on this site compared to other projects the participants had worked on. The respondents described various working environmental factors such as fewer accidents, smaller teams, and more safety checks on this project compared to others. This was an unpredicted finding, since the PMs on this project were not entirely new or different to other projects being performed around Gauteng. There is, for instance, a considerable amount of overlap between project contractors, especially within a primary contractor firm such as Giuricich Bros. Construction; while such a primary contractor also often uses recurring contractors, workers and PMs on different project sites (Lee 2016: 04016064).

It was possible, though, that when combining the skills of different individual managers together, this may have acted to compliment certain skills or ensure that certain aspects of the project were enhanced compared to other projects around the province. In addition, it was argued that the management on this project was more approachable, vigilant, had different permissions processes and project control, and had better project efficiency and information flow compared to PMs on other projects. It was possible, therefore, that growth and managerial evolution of the managers may have been taking place on this site, which would align well with the current feelings in the literature that in modern times, PMs must continuously grow and develop to meet the needs of their projects (Zhang, Zuo and Zillante 2013: 750). It is quite possible, therefore, that experience, personal development, and efforts to develop the managers in this project continuously, was resulting in improvements in the overall working environment of the site.

5.4. OBJECTIVE THREE: IDENTIFYING THE DYNAMIC CHALLENGES FACING THE SUPPLY CHAIN THAT HAVE BEEN LIMITING THE PERFORMANCE OF THE CONSTRUCTION PROJECT

Delving deeper into the project's supply chain was important in order to identify the dynamic challenges that had been facing the supply chain, and limiting the performance of the construction project. This was important because inherently, the purpose of a SSM is to delve into a situation in which the problematic circumstances are not likely to have been clearly defined. The literature, for instance, notes that there are numerous challenges that inhibit the smooth operation of supply chains in construction projects, which can be categorised as either external challenges, which occur on a macro-scale, or internal challenges, which occur on a smaller, site-specific scale (Yüksel 2012: 53; Vrijhoef and Koskela 2000: 171).

A wide spectrum of problematic issues was deciphered from the interviews with the study participants, identifying the weaknesses that had been limiting the performance of the project's supply chain; and interestingly, in line with the principals of SSM, many of the weaknesses were in direct contrast to the aforementioned strengths of the supply chain. This appeared to confirm the notions in the literature that the definition of a problematic situation, through the eyes of SSM, is often not clearly defined; and indeed, there is often not even consensus on whether a problem even exists to begin with (Proches and Bodhanya 2015: 1-15).

A key example of the 'messiness' of the supply chain of this project was observed in the case of aspects such as handling, scheduling, procurement, storing and safety, where despite the numerous comments describing their strengths in the previous step, it was noted by numerous individuals that they contained weaknesses as well. Indeed, in every single area that was noted to have been working well by respondents previously, other respondents noted aspects that had also been working poorly. Other problem areas were described, for instance, to include a lack of security on the site that was resulting in theft; problems with designs and plans on the site that were causing supply chain problems; and transport problems. It should be noted, though, that it was quite likely that in many cases, such as with handling, certain of the aspects may have been working well while other aspects may have been working poorly; and when classifying these issues with codes during the thematic content analysis, they would have appeared contradictory. It was useful, therefore, while carrying out this study, to use SSM to attempt to delineate these issues clearly.

While projects might initially have everything possible under control, there are often major setbacks that result in delays in the projects. These setbacks can include not having enough workers, not having the required skills on the construction site, having a lack of experience for handling projects by contractors, poor planning, delayed or non-payment by owners, and unrealistically-achievable schedules (Islam Mohammad Saiful 2015: 82). These are some of the factors that need to be taken into account in measuring successful outcomes. Indeed, this appeared to be echoed, in its overall nature, by the respondents in this study. A significant problem that was observed here, for instance, was that the project had a poor project programme; and reduced project efficiencies that were increasing work delays, causing the project to run behind schedule, having late subcontractor requests, and insufficient materials quantities.

This was not a problem unique to this project and, where supply chain management is concerned, one of the problems that is frequently noted in the literature pertaining to construction sites, is poor planning and scheduling which occurs as a result of the insufficient involvement of all participants from the onset of a project (Bankvall, Bygballe, Dubois and Jahre 2010: 389). Planning will be a big challenge if one does not do it because work is done according or per schedule. Failing with planning means those projects could devolve over time, leading to significant dissatisfaction, and a scrambling for resources as the primary contractors and subcontractors compete with each other to complete their work on time (Kerzner and Kerzner 2017). Failing in planning, therefore, is a primary cause for increased costs and penalties, which may be incumbent upon those that have failed to plan and execute their projects correctly (Subramani, Sruthi and Kavitha 2014: 1).

Planning is also especially important in construction supply chains since there are typically lengthy lead times for different materials, and materials must be supplied in the correct quantities, and at the correct time, to complete the various stages of work (Mahamid 2016: 27). Therefore, the sequences in which these different kinds of work must be done, and by whom, necessitates a comprehensive plan to be drafted to avoid extensive delays. In a few instances during this study, it appeared to be consistent with the grievances that aspects of the scheduling of the materials and equipment, and the project's scheduling, were not on par. It is important to note that there were numerous issues that had been described in the literature as potential issues on construction projects, such as collusion (Bowen, Akintoye, Pearl and Edwards 2007:

134), corruption (Aigbavboa, Oke and Tyali 2016; Le, Shan, Chan and Hu 2014: 02514001), and nepotism (Aigbavboa et al. 2016), which were not specifically described as causing any problems by the respondents in this study. It is possible, though, that these issues may have indeed been present, though at levels that were concealed to the participants of this project, or at a level that was too covert to have caused any grievances among the workers.

In determining how these weaknesses in the supply chain were different to other construction projects, the respondents stated that client and time-related problems, space problems, site location problems, materials supply problems, site information problems, project efficiency problems, worker problems, security problems, and site management problems affected this site more than other sites they had worked on. The fact that client and time-related problems were listed as a problem was a somewhat concerning finding, since it is entirely the PMs' responsibility to ensure that the project's timelines are met, as agreed upon with the stakeholders (Kerzner and Kerzner 2017). The expected timelines must not only be made clear to the project investors, but to any end users and stakeholders of the project as well, so that they are informed of what can be anticipated from the developments within their communities (Kerzner 2017).

In addition, everyone in business typically has one common mission: To make money and increase the profitability of his or her current and future ventures (Gandy 2015: 1). The construction industry is no different, and project investors also wish to realise their dividends over time, with often strict financial implications for the time required for their developments to be completed (Yoon, Tamer and Hastak 2014: 04014090). Thus, the success of a project is determined by how well a project is completed within the specified time. The fact that some of the participants were noting this as a problem was a confirmation that these inherent principles of the nature of the construction project were not being universally communicated to those involved with the supply chain operation; and worse, that they were not being managed effectively. This, in turn, fed into the fourth objective of the study, which was to determine the role of the project leadership in failing to overcome any challenges facing the supply chain on the construction project; as outlined next.

5.5. OBJECTIVE FOUR: DETERMINING THE ROLE OF THE PROJECT LEADERSHIP IN FAILING TO OVERCOME ANY CHALLENGES FACING THE SUPPLY CHAIN ON THE CONSTRUCTION PROJECT

While it was observed, as noted in Section 5.3, that the project's management was responsible for many of the successes on the project's supply chain, it was also observed that many of the problems that were caused within the project's supply chain could be attributed to the failure of the project's leadership to appropriately dealing with the challenges. In attempting to decipher exactly why the project's management was failing to overcome the challenges on the project supply chain, this research attempted to ascertain how the soft characteristics of the PMs had limited the effectiveness of the supply chain on the project. Specifically, it considered how limitations in soft skills such as the vision, risk-taking, emotional intelligence, trust, self-awareness, supportiveness, communication and motivation had limited the effectiveness of the supply chain on the project. This study confirmed a range of subthemes of issues that could be grouped into three overarching themes, namely worker-related problems; manager-specific problems; and reduced project efficiency.

5.5.1 Worker-related problems

Firstly, it was observed that worker-related problems were causing issues such as depression, emotional problems, poor attitude, and some weak relationships. It was also noted that there had been worker frustration, and onsite conflicts that had caused workers to be tense. This appeared to suggest that there was a failure among the PMs to communicate effectively with many of the teams of workers on the site regarding issues outside of their immediate work requirements, and to target the personal wellbeing of the workers. As noted in the Literature Review in Chapter Two, many projects are extensive undertakings, and while it is not always easy to know how each of the project teams are faring, the PM should employ an open-door policy to allow each of the aspects of the project to be followed up on; and to make sure that there are no conflicts (Mok, Shen and Yang 2015: 457).

The results of this study therefore concurred with the literature that there was a need for the PMs on the site to employ a more worker-centred style of management, to be able draw the most from the workers, while ensuring a positive working environment (Windapo 2016: 1-8). A topic that has been noted in the literature is the need for Servant Leadership qualities among PMs (Prieto, Phipps and Mathur-Helm 2018); where there is a need for a shift in the focus of

the leadership away from the strategies, goals or end product, to the follower (or worker) (Prieto et al. 2018). In such environments, the follower is the priority, with the ultimate outcome typically being to increase buy-in from the follower, as a result of the efforts of the leader centring others' needs at the core of their relationship (Parris and Peachey 2013: 378).

The researcher argues that this is not a practical attitude in projects, in its totalitarian form. If the entire focus of the project were to be on the needs of the workers, the priorities of the client or project sponsor would be relegated; which in turn would have consequences for the client-PM relationship, and result in a potential collapse of the entire project. Indeed, such an attitude could have far more negative effects on the workers through cancellation of the project, than on the need to be project focused. Instead, the arguments noted in the literature that the focus of a servant should be follower-centred are clearly unrealistic if adhered to in its extreme form. However, there is merit to the argument that certain characteristics of Servant Leadership should have been *more* incorporated into the management style of the PMs on this project; for instance, by including more active listening, empathy, healing, awareness, persuasion, conceptualisation, foresight, stewardship, commitment to growth, and community building — as per the guidelines of Parris and Peachey (2013: 380). The priority for this project, therefore, should have been more towards striking a balance between the current principles of client focus, and servant leadership.

This, in effect meant that the PMs should have employed more skills of emotional intelligence; and that as noted by Li, Gupta, Loon and Casimir (2016: 110-112), the PM and any other leaders involved in the project should have been more emotionally-aware; such that they were aware of the emotions of those working around them. This tended to concur with previous findings in the literature that have argued that emotional intelligence among PMs in the South African construction industry has taken a long time to develop. This is mainly attributed to the environment in the construction industry having primarily been very masculine, with the emphasis being on toughness, decisiveness and control (Lindebaum and Cassell 2012: 65-66). Detrimentally, the emphasis on toughness inherently requires a PM to take an interest in his own developments, irrespective of the best leadership styles to be used (Liphadzi, Aigbavboa and Thwala 2015: 284). Yet, in projects, everything is connected, so it is always important for those acting in leadership positions to enable each of the participants to engage with the top management, through the act of empowerment or mentorship in the workplace (English and

Hay 2015: 144-164). PMs should also know the cultures and beliefs of the people on their project teams, in order to behave accordingly (Fisher 2011: 995).

The findings of this study also fell into the realms of other leadership styles that have been discussed in the literature, which could also be applied to construction project management: Situational Leadership, Transformational Leadership, Transactional Leadership and Participative Leadership (Gwaya, Masu and Oyawa 2014: 39). Sunindijo (2012: 187-188) argued that connections exist between Transformational Leadership and emotional intelligence, as noted earlier in the chapter. These are all leadership styles that are value-based (Mahembe and Engelbrecht 2013: 2); and they work to some extent, perhaps better than the notions of Servant Leadership due to the potential problems with directing the entire orientation of a project on the servant, as noted previously.

It is also valuable to note that another proposal for leadership exist, namely CLT, which seems to look at organisations from the perspective of complex adaptive systems. This complements the Soft Systems Modelling approach, as used in this study, as it is a constant reminder of the dynamic nature of change (Uhl-Bien, Marion and McKelvey 2007: 299). The complexities in this development are also related to leadership in the way that decisions are made, especially at the planning level (Sterman 2001: 8). Leadership is an underlining factor in a project; hence, there are proposals from Goleman (1995; 1998), and others, that emotional intelligence is a necessity for all leaders — not only the PMs. Thus, all leaders involved in a project, not only the PM, should be self-aware, such that he or she should be aware of the emotions of those that they are working with (Li et al. 2016: 110-112); complementing the principles of the emotional intelligence of PMs.

5.5.2 Manager-specific problems; and reduced project efficiency

Manager-specific problems were also noted in this study, which were said to involve dangerous risk-taking, having an unrealistic deadline, requiring contingency plans, and requiring subcontractors to continuously seek permission for works on site; while problems related to reduced project efficiency were also noted by the participants. This was quite a contradictory finding, since some of the respondents had noted quite emphatically in Section 5.3 how the management's skills of risk-taking had been positively influencing the project. It is worth clarifying, though, that two of the respondents said that there were no problems experienced,

and seven respondents declined to answer the question, further confirming the variability of opinions on the management's supply chain performance.

Specifically, when referring to manager-specific and reduced project efficiency problems, it was argued that there had been issues with having complex communications systems, low subcontractor meeting attendance and frequent missing of meetings, and poor communications between the designers and the managers. This echoed sentiments that were indicated in the literature, such as the notion that there is always a need to rely on information between project participants, in order to achieve the goals of a project, requiring that the mode of communication and the channels to be followed should be very clear to the project team (Gómez-Ferrer 2017: 2).

Clearly these skills needed to be improved on to enhance the efficiency of the project, or to ensure the efficient and effective functioning of future undertakings. It also confirmed the arguments of Lloyd-Walker and Walker (2011: 384) that while it is important to focus on skills directly targeting project completion and ROI, there are now more measures necessary to ensure the success of projects. These include the style of the leadership, the relationship management, customer needs, and other similar considerations that need to be developed as well; and these are aspects that have been taken into consideration in the final section, next.

5.6. OBJECTIVE FIVE: DEVELOPING A SUITABLE OPERATIONAL MODEL THROUGH A SOFT SYSTEMS METHODOLOGY (SSM) TO RESOLVE ANY IMPASSES IN THE PROJECT'S SUPPLY CHAIN.

The final section of the discussion focuses on the outcomes that were derived from the thematic content analysis and SSM of this study, and the outcomes towards developing a suitable operational model to resolve any impasses in the project's supply chain. This was achieved by deliberating the various conceptual models and how they fared against real world situations; identifying possible and feasible changes to these conceptual models; and finally making recommendations for actions to improve the problematic situation, as per the guidelines of SSM researchers such as Williams (2005: 2).

5.6.1 Measuring the conceptual models against real world situations

At the outset, it is worthwhile to note that there have been a number of developments over the years as people have tried to understand the most effective way of improving the construction industry supply chain (Agapiou, Flanagan, Norman and Notman 1998: 351; Akintoye, McIntosh and Fitzgerald 2000: 159; Croxton, Garcia-Dastugue, Lambert and Rogers 2001:13; Segerstedt and Olofsson 2010: 347; Chan and Lam 2011: 1332; Tejpal, Garg and Sachdeva 2013: 51). There is a clear understanding that when dealing with the complex supply chain of construction projects, one has to develop a model that can accommodate all of the inputs from each of the people involved (Thunberg, Rudberg and Karrbom Gustavsson 2017: 90). In measuring the conceptual models of this study against real world situations, differing alternative models were assessed by comparing the likelihood that the conceptual models would be implemented by internal controlling factors; and the effect of uncontrollable factors on the conceptual models' feasibility.

5.6.1.1 Measuring internal likelihoods that the conceptual models would be implemented

It was apparent from this study that there was a broadly dispersed likelihood of any of the conceptual models being considered by the project's management, with some positive likelihood, and some pessimism that the suggestions would not likely be considered by the management. This was not ultimately an unexpected finding, since a large proportion of the participants in this study were at lower tiers of the project; who would have seen the management at a superior, untouchable controlling level. It did, however, confirm that many of the respondents saw the PMs as not being open or approachable for such matters. Thus, while the PMs may, as noted earlier in the chapter, have been open to being approached by the workers for day-to-day operational matters, they were not open to general qualms, or grievances, or to having their management styles questioned. Indeed, this is a situation that any organisation can be subject to, and more so perhaps in the construction industry where managers are operating with clearly defined manager-subordinate rankings. This is also noted by Brunelle (2013), and Adkins and Russell (1997: 205). This was also supported in this study where the respondents who argued that there was some likelihood that the proposed conceptual models would be considered, were managers or upper-tiered employees themselves, and clearly biased towards the flexibility of the project management being open to making changes on the project.

5.6.1.2 Measuring uncontrollable factors on the conceptual models' feasibility

Numerous uncontrollable external factors in the environment or outside the construction project were noted to have been incumbent upon the project's likelihood of being able to implement the proposed conceptual models. It was ascertained that traffic limitations such as the road conditions, traffic, the site being along public roads and opposed to traffic; and financial limitations such as a lack of funds on the project were likely to inevitably prevent the models from being implemented. This concept of financial limitation has been corroborated in the literature, since investment in almost any venture is geared towards profit gains, and finances are only available when it is profitable the finances to be so (Yüksel 2012: 53). Aspects such as interest rates, for instance, also impact on projects in the construction industry, because many construction projects must borrow large sums of money from financial institutions in order to complete the projects; and rate hikes have large effects on the availability of funds for project budgets (Martens and Carvalho 2017: 1084; Windapo 2014: 6088). Recent hikes in interest rates in the country would help to explain the lack of finances in the current project environment (BusinessTech, 2018; Business Report, 2018).

Community limitations was another uncontrollable external factor that was affecting whether any changes could be accepted, since it was observed that there was intimidation by the community, complaints by the community, and that the "neighbours were grumpy", which was hampering any potential changes to the project. These were not problems that were specific to this project, though, as this was supported in the literature where projects are known to be stimulated by people's attitudes, as well as by the composition of communities, and social lifestyles (Yüksel 2012: 53). South Africa is not an easy country for many types of construction projects, in the sense that in South Africa, there is a social pressure to employ more people from disadvantaged communities and to contribute to an improvement in the wellbeing of the people in the immediate community (Aigbavboa, Oke and Mokasha 2016: 53). Changes at a macroeconomic level would therefore be required for such changes in community attitude to take place; failing which, it would take a significant amount of effort (and likely capital) to be able to interact and collaborate with the community in a manner that would alleviate such community-related issues.

While construction projects are life injectors into communities, making it possible to change people's lives, some projects do negatively affect the natural ecosystems surrounding the

projects; and it is generally known that construction projects change the outlook of societies, which can sometimes be destructive if they are not well managed (Lizarralde and Massyn 2008: 1; Ugwu and Haupt 2007: 665). Environmental awareness is also important in construction projects, along with a knowledge on the laws around dumping and pollution (Yüksel 2012: 53). Interestingly, though, there was no mention of such elements within this project — either inhibiting the project, or being handled correctly within the project. Only one mention of natural limitations was noted, namely in the form of rain delays that were preventing the conceptual models from being executed. It was therefore likely that any natural environmental aspects surrounding the project were an insignificant element to any of the respondents, making it a topic that should receive more attention in future construction projects.

Issues with time limitations were also noted, which related to the lack of time and the immovable nature of the project deadline. However, this was ultimately not unexpected since it aligned with a central definition of what construction project management involves, which is the coordination of complex teams to ensure that all of the client's requirements are met, and within the timeframe that has been provided for within the project's charter (Kerzner and Kerzner 2017).

Despite these various uncontrollable external factors that were described, here, there were also various other external factors, as noted in the PESTLE analysis in Chapter Two, that were *not* noted to have been inhibiting this project; for instance, political factors, technological factors, and legal factors (Yüksel 2012: 53). As one example, it was not apparent in this study that trade unions had been hampering the operations on the project at all, though it has been argued in the literature that trade unions are notoriously difficult associations to cooperate with (Buhlungu 2006). The fact that they were not inherently inhibiting this project appeared to support the argument of Buhlungu (2006) that trade union difficulties are likely to be felt in more sporadic instances as opposed to on any universal basis.

5.6.2 Identifying possible and feasible changes

The sixth step in this study's SSM was to identify both possible and feasible changes that could be made, through a cyclical, iterative process that considered the individual tasks of the conceptual models and compared them to real-world barriers and possibilities. This step was targeted at identifying the most possible and feasible models for change; whereby, in order to

iteratively refine the notions surrounding the conceptual models of the study, the respondents had again been asked what other changes could be made that were more likely to be accepted by the management — considering the above uncontrollable external challenges.

Most of the respondents did not answer this iterative question of the interview; and it is worth noting that this was a possible likelihood of any SSM-style study; since these final stages of iterative interrogation may have appeared repetitive to many of the participants. Such iteration is also meant to be performed in a focus group or discussion-type of environment, where brainstorming and freethinking are more easily achieved (Salner 1999:1). Due to the complex and multi-organisational environment of this project, though, this was not possible, and in the one-on-one interview environment of this study, where group free thought was not a factor, new ideas would likely not have been as forthcoming.

Based on the answers of those who did answer this iterative question, though, it was apparent that communication changes, client and time-related changes, site operations and efficiency changes, site management changes, and space changes were changes that could be made that would have been more likely to be accepted by the management. For instance, having more frequent mutual discussions, and in turn, having more communications on the site, were argued to be the most likely options to be considered and accepted by management. Management should further be recommended and encouraged to negotiate a later hand-over time for the project; to have the workers work over-time to strive to complete the project in the shortest time possible; to increase equipment efficiency in terms of site operation and efficiency changes for overcoming site operation and efficiency issues; for the management to become less autonomous; and for the space on the site to be ‘recycled”. These final changes were entered into an ease-benefit matrix to identify the overall ease and benefit for executing the different conceptual models, producing the final recommended actions for improvement, as noted next.

5.6.3 Taking action to improve the problematic situation

The entire purpose of the SSM analysis of this study was to generate an actionable model to improve the problematic situation within the supply chain of the research project, as per the guidelines of authors such as Jackson (2010: 133). While, as clarified in the earlier chapters of this dissertation this step was not finally performed, it did allow for a model to be developed

with a strong set of recommendations or measures to resolve any impasses that had been found in the supply chain processes of this — and potentially other — construction sites around Gauteng. It is important to clarify that in developing the model for change, a wide spectrum of solutions was considered from throughout the study; though as noted in the previous sections, many of the changes were likely not as feasible as others to make. In addition, some of the changes would likely produce far more effect on the project than others, so placing the changes into an ease-benefit matrix allowed the model to be devised with changes that would be both the easiest, logistically, to perform and the most overall beneficial to the project.

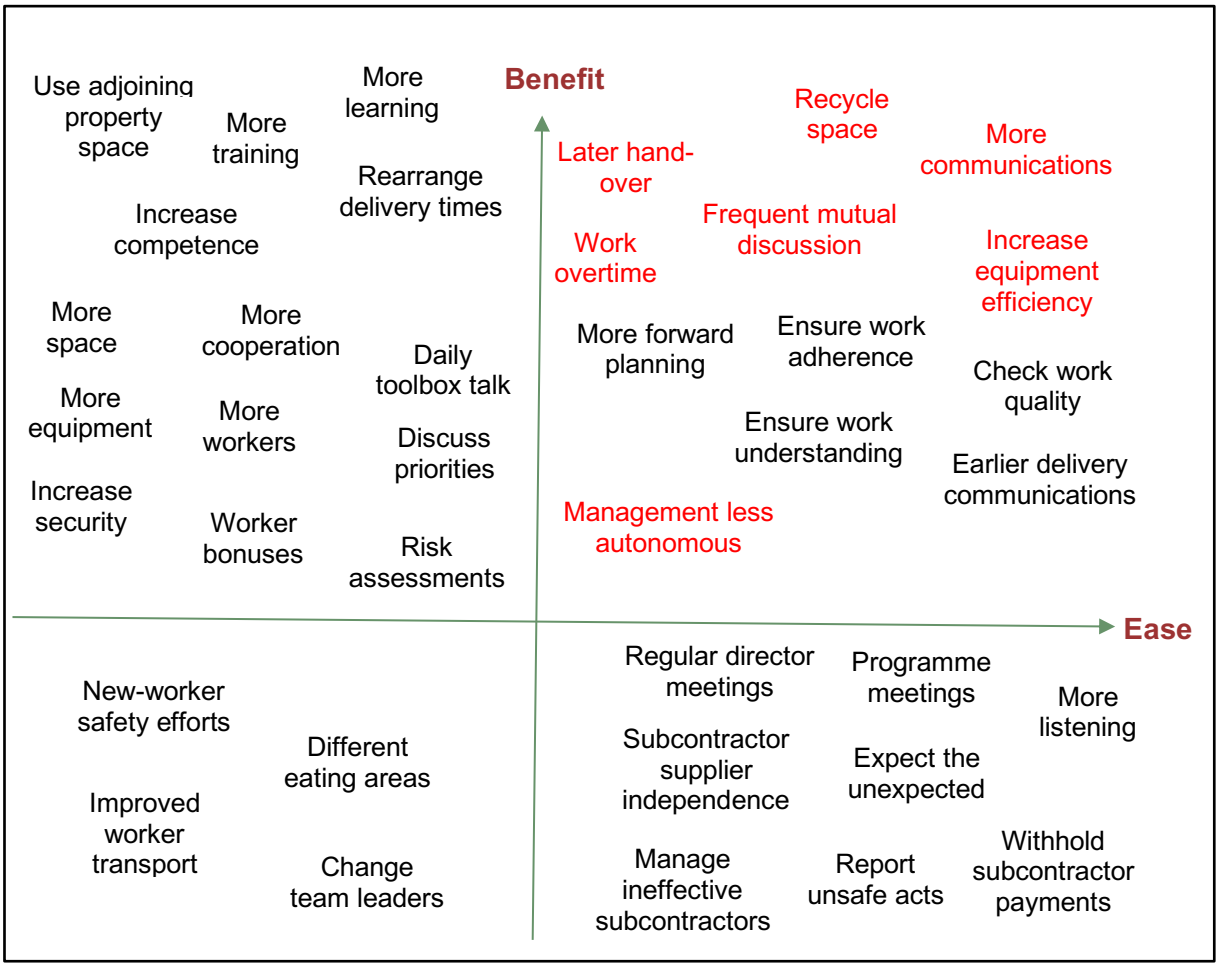
Changes that were noted as the most feasible changes in the previous section, by default, were placed highly within the ease-benefit matrix; while certain other recommendations were also ranked highly according to the intuition and initiative of the researcher, by considering the amount of effort, resources and time that would be required to complete the changes, relative to the amount of benefit that the changes would likely have on the overall functioning of the project's supply chain. High ease-and-benefit changes that have been recommended are for the management to negotiate a later hand-over time for the project, and to have workers work over-time to strive to complete the project faster. Increasing equipment efficiency is also the most likely option to be considered and accepted by management, and in terms of effort and benefit, it has ranked very highly; while it is also suggested for space to be recycled, which again, due to the relative ease of effort and high overall benefit, has ranked it very highly in the matrix. It had also been recommended for the management to become less autonomous; though removing the autonomy of the management will likely have numerous difficulties, and arguably have a limited benefit, therefore placing it close to the centre of the ease-benefit matrix, as opposed to clearly in the top-right corner of the matrix. The model devised in the ease-benefit matrix was presented in the Results of Chapter 4, but is provided again here for ease of reference in Figure 4.*18*.

Many of these recommendations appear to be specific to this construction project, having been excluded from many general texts in the literature on the possible actions that may be taken to improve construction supply chains. There are, however, five additional recommendations from throughout the SSM that are deemed by the researcher to rank highly in the ease-benefit matrix, and these are for the management to check work quality, and to ensure work adherence; to provide earlier communications on delivery; and for the management to ensure work understanding across the site. It is also recommended for the management to perform more

forward planning; which is deemed by the researcher to be an important task for the management to perform, and which should ultimately be relatively easy to achieve, especially as it constitutes a standard function of project management. Indeed, such changes should, theoretically, be immediate changes that could be made on this, or any construction project, and would tentatively draw immediate tangible results that could be felt without requiring considerable financial outlay, stakeholder buy-in, or managerial approval.

Changes that are recommended that are perceived by the researcher to exhibit larger benefit to the project, but which should still require a large amount of effort, resources and time — therefore ranking them low on the 'ease' end, and high on the 'benefit' end of the spectrum, are for the principal contractor to arrange to use the adjoining property space for the purposes of the project, to produce more space, to hold more training, to generate more learning, and to increase competence among the workers. While one would anticipate that there should be acceptable norms of conduct in organisations, which permeate the fabric of each person who works in that organisation, the reality is that not all people are fond of educating or empowering themselves of the acceptable norms of organisations; especially the code of ethics that seems to help everyone in the organisation (Garegnani, Merlotti and Russo 2015: 541). In leadership, the same appears to be the case; therefore, unless there has been an empowerment from the main leadership of an organisation, many PMs would find themselves in a situation of dealing with people who are not adhering to the acceptable norms of the organisation.

Figure 5.1 Ease-benefit matrix of changes to improve the supply chain of the Rosebank construction project



Other changes that are expected to produce considerable benefit, at the cost of high difficulty, are for the work teams to hold daily toolbox talk meetings; to generate more cooperation on site; for the PMs and participants to discuss the project's priorities; to increase the amount of security and equipment on site; to arrange for more workers to pay worker bonuses; and for the principal contractor to conduct risk assessments of the project. It is worth mentioning that in South Africa, there is The King Code (I-IV), which enumerates a number of basic principles about how managers should exercise their leadership in corporate South Africa (Institute of Directors in Southern Africa 2010; 2016). In the code, there is an emphasis on the 'triple bottom line', which maintains that directors of organisations should attempt to maximise the benefit of the corporation towards the profit, people and the planet (Ackers and Eccles 2015: 515). Achieving many of these tasks would require a close adherence to these principles in the King Code, while the proportional benefits of these efforts should, in turn, be clearly apparent.

Contrary to the above recommendations are changes that are expected to require lower amounts of effort, resources and time to execute, but which ultimately should not render as high benefits to the supply chain of the project as other tasks. Such tasks are for the principal to withhold payments to the subcontractors; for the managers to listen more to the needs of the workers; for the project to report unsafe acts; and for the subcontractors to have more independence in their suppliers. Other changes that are recommended in this quadrant are for directors to hold regular meetings; for managers to hold programme meetings; for the PMs to manage ineffective subcontractors; and for the PMs to expect the unexpected.

Finally, the changes that are recommended but which will likely be the most difficult to execute, based on the effort, resources and time that would be required to achieve them, while having the least benefit, are to change the team leaders; for the project to use different eating areas; to improve worker transport; and to make efforts towards improving the safety of new workers. It is important to note that while the easiest and most beneficial changes should be implemented first, as more of these other changes from the other quadrants are implemented on this, or other future projects, so the overall improvements to the construction's supply chain, and therefore the overall operation, should be clearly discernible.

5.7. CONCLUSION

This chapter has presented a detailed discussion of the results that were generated from this study. The SSM methodology proved to be a strong system for defining the 'messiness' surrounding the project's supply chain; and indeed, it allowed the supply chain processes on the project to be deliberated in detail so that both the soft and hard issues surrounding the project could be defined. A wide spectrum of themes was deciphered from the study, which confirmed that the definition of the problematic situation is often not clearly defined; and indeed, there is often not even consensus on whether a problem exists to begin with, or what is causing that problem. A key example of the 'messiness' of the supply chain of this project was observed in the case of aspects such as handling, scheduling, procurement, storing and safety, where despite the numerous comments describing their strengths in the project's supply chain, it was also noted by numerous individuals to be problematic in the supply chain as well.

In deciphering exactly why the project's management was failing to overcome the challenges on the project supply chain, this research ascertained how the soft characteristics of the PMs

had limited the effectiveness of the supply chain on the project. Specifically, it was found that issues with the vision, risk-taking, emotional intelligence, trust, self-awareness, supportiveness, communication and motivation to the subcontractors and workers had limited the effectiveness of the supply chain on the project by causing worker-related problems; manager-specific problems; and reduced project efficiency. The results of this study therefore concurred with the literature that there was a need for the PMs on the site to employ a more worker-centred style of management, to be able draw the most from the workers. It was argued here, though, that while suggestions in the literature call for the manager to be a 'servant' of the worker, the priority for this project should instead have been more towards striking a balance between the current principles of client focus, and Servant Leadership. It was also argued here that communication skills clearly needed to be improved by the PMs to enhance the efficiency of the project, or to make future undertakings more efficient and smooth running.

Finally, at the culmination of the SSM, a model for change was developed to cope with the numerous internal and external inhibitory factors surrounding the project site. In terms hereof, changes that were noted that were the most feasible changes, requiring the least effort and producing the most benefit, were for the management to negotiate a later hand-over time for the project; to have the workers work over-time to strive to complete the project faster; to increase equipment efficiency; to recycle the space on the site; for aspects of the site management to become less autonomous; for the management to check work quality and ensure work adherence; to provide earlier communications on delivery; for the management to ensure work understanding across the site; and for the management to perform more forward planning. Indeed, such changes should, theoretically, be immediate changes that could be made on this, or any construction project, and would tentatively draw instant tangible results without requiring considerable financial outlay, stakeholder buy-in, or managerial approval.

The final conclusions of these results and recommendations for future research are presented in the final chapter, Chapter Six, next.

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1. INTRODUCTION

The aim of this study was to apply a SSM critically in relation to the supply chain processes of a construction site in the Gauteng province of South Africa, in order to determine how to improve the efficiency and performance of the supply chain processes of other construction projects in Gauteng. In order to achieve the aim of the study, it set out to find answers to the following questions:

- what comprised the supply chain processes on the construction site;
- which aspects in the supply chain processes were most successful in enhancing the successful project performance of the construction site;
- which dynamic challenges facing the supply chain were limiting the successful performance of the construction site;
- what role did project leadership play in failing to overcome any challenges faced by the supply chain on the construction site; and
- what suitable operational model based on SSM could be proposed to resolve any impasses found in the supply chain processes of the construction site.

This final chapter of the dissertation presents the final conclusive answers to these questions and offers a set of recommendations for future research that would assist in addressing those delimitations that were intentionally excluded from this study; or to otherwise fill gaps that have not been encompassed within the scope of this dissertation.

This chapter therefore commences with the conclusions from the study.

6.2. CONCLUSIONS FROM THE STUDY

In order to achieve the aim of the study, the study answered five research questions; and the answers to these five questions are concluded here.

6.2.1 Research question one: What were the supply chain processes on a construction site in Gauteng?

Before concluding on this first research question, it is important to clarify that the first four research questions of this study were in effect, all related; and were not individually isolated questions. The results that pertained to the second, third and fourth research questions, therefore, also applied to the first research question. So much so that the answers to which aspects in the supply chain were best enhancing or otherwise limiting the successful project performance, and what the role of the project leadership was in failing to overcome any challenges facing the supply chain, were also helpful in elucidating the supply chain processes of the project. However, to begin with, this study was clear in pointing out numerous characteristics of the new office park construction project in Rosebank to provide a concise answer to this research question. The study identified that the supply chain comprised of a broad spectrum of players, as confirmed by the multifaceted array of players that were involved in this study, which consisted mostly of employees of the principal contractor — the Giuricich Bros. Construction Company — with numerous participants also being subcontractors to the main contractor on site. This appeared to align with the notion in the literature that outsourcing is a component of almost every construction project (Yong Seng, Mehdi Riazi, Mohd Nawi and Ismail 2018: 155). Furthermore, in most construction projects, specialists such as electricians, carpenters, builders, and others do a considerable amount of the work (Thwala and Phaladi 2009: 533), and this was also confirmed by this project, since the participants were involved with all of the various aspects of the supply chain.

The supply chain was also characterised by professionals with a full spectrum of experience, with some participants in this study having been involved in supply chain matters for more than 50 years over the course of their careers. The supply chain was also characterised by a full array of activities dealing with all aspects of construction supply chain, such as the materials procurement, supply, handling, scheduling, shipping, storing, security, and other parts of the materials and equipment supply. Based on this broad spectrum of characteristics, it was deemed that this conclusively answered this first research question on the supply chain processes; particularly when considering that the answers generated to the following three research questions were also cumulative in further clarifying the supply chain processes of the chosen construction project. Based on the findings of this study, it could therefore be concluded that this research question was answered, and that the first research objective was satisfied.

6.2.2 Research question two: Which aspects in the supply chain processes were best enhancing the successful project performance of a construction site in Gauteng?

As alluded to in the previous section, while concurrently elaborating on the answer to the first research question of this study, the study was also conclusive in determining which aspects in the supply chain processes were best enhancing the successful project performance of the Rosebank construction site, and thereby answering the second research question of this study. It was concluded that the aspects of the supply chain that had been working well were predominantly the scheduling of the materials and equipment, as well as the project's scheduling. This was not wholly unforeseen since scheduling, timing, and work scheduling are key elements of any successful supply chain; particularly in the construction industry (Harrison and Lock 2017). Other aspects that were working well, however, included the equipment and materials handling, supply delivery matters, safety on site, and procurement and storing within the supply chain.

In order to understand the role that project management played in driving the successes in the project's performance, and to understand in particular how soft elements relating to the vision, risk-taking, emotional intelligence, trust, self-awareness, supportiveness, communication, and motivation to the subcontractors and workers enhanced the effectiveness of the supply chain on the project, it was ascertained that management's soft skills facilitated increased teamwork, worker and responsibility combined with improved project efficiency, worker skills, working environment, and other manager-specific improvements that applied to individual instances of excellence. It was also argued that these project management soft skills had improved information flow, project efficiency, the working environment, teamwork, and also caused manager-specific improvements, such increased instances of explaining tasks better, holding daily and weekly meetings, supplying the necessary information with improved subcontractor-manager meetings, holding sufficient discussions on site, having a good degree of knowledge on the project, explaining challenges well, and providing a suitable number of work reminders to the workers. This verified the arguments of Hwang and Ng (2013: 272) that a broad array of soft skills outside of immediate hard project management skills tasks is exceptionally beneficial to improving the efficiency of a project.

Many of these skills appeared to be better exhibited on this site than other sites the participants had worked on; however, it was possible that — in line with the notion that PMs must continuously grow and develop to meet the needs of their projects (Zhang, Zuo and Zillante 2013: 750) — there may have been attempts at personal development, and efforts to continuously develop the managers in this project which resulted in improvements in the soft skills of the PMs on this site. It was also possible to conclude, based on the findings of this study, that a convincing answer to this research question had been put forth and thus, the second research objective of the study had been meticulously achieved.

6.2.3 Research question three: Which dynamic challenges facing the supply chain were limiting the successful performance of a construction site in Gauteng?

While further elaborating on the answer to the first research question of this study, while simultaneously answering the third research question, the study was conclusive in ascertaining that, in line with the expected 'messiness' of the supply chain of this project, aspects such as handling, scheduling, procurement, storing and safety raised problematic issues that had been limiting the performance of the project's supply chain. Interestingly, this appeared to confirm the notions in the literature that considered through the lens of SSM, the definition of a problematic situation is often not clearly defined; and indeed, there is often no consensus over whether a problem even exists to begin with (Proches and Bodhanya 2015: 1-15). This is because many of the weakness areas observed in this study were in direct contrast to the strengths of the supply chain; while other problem areas were also described to exist. The latter, for instance, include a lack of security on the site that was resulting in theft; problems with designs and plans on the site were causing supply chain problems; and that transport problems were limiting the successful performance of the construction site.

In line with assertions in the literature that poor planning, delayed or non-payment by owners, and unrealistic schedules are often problems on construction projects (Islam Mohammad Saiful 2015: 82), a significant problem that was observed in this study was that the project had a poor project programme. This reduced project efficiencies and increased work delays, causing the project to run behind schedule; that there were late subcontractors requests; and there were insufficient materials quantities.

In determining how these weaknesses in the supply chain were different to other construction projects, it was evident that this site was being affected by more client- and time-related problems, space problems, site location problems, materials supply problems, site information problems, project efficiency problems, worker problems, security problems, and site management problems than other sites the participants had worked on. Moreover, the fact that client- and time-related issues were listed as a problem was a somewhat concerning finding, since it is entirely the PMs' responsibility to ensure that the project's timelines are met, as agreed upon with the stakeholders (Kerzner and Kerzner 2017). The fact that some of the participants were noting this as a problem was a confirmation that these inherent principles of the construction project were not being universally communicated to those involved with the supply chain operation; and worse, that they were not being managed effectively.

This, in turn, fed into the fourth objective of the study, which was to determine the project leadership's role in failing to overcome the challenges facing the supply chain on the construction project. Thus, based on the answers of this research question, and in combination with the answer to the next research question, it could be concluded that this research objective was fully satisfied.

6.2.4 Research question four: What was the role of the project leadership in failing to overcome any challenges facing the supply chain on a construction site in Gauteng; and

The fourth research question of the study was useful in feeding final confirmatory information towards answering the first research question of the study; while simultaneously concluding the arguments of the third research question by answering what the role of the project leadership was in failing to overcome the challenges in the Rosebank construction site. Proving to be an extremely informative research objective, with multiple networking outcomes, it was observed that many of the problems that were caused within the project's supply chain could be attributed to limitations in the soft skills of the project's leadership. It was found that limitations in the vision, risk-taking, emotional intelligence, trust, self-awareness, supportiveness, communication and motivation of the PMs had limited the effectiveness of the supply chain on the project by causing worker-related problems; manager-specific problems; and reduced project efficiency.

The results of this study concurred with the literature that there was a need for the PMs on the site to employ a more worker-centred style of management to be able draw the most from the workers, while ensuring a positive working environment (Windapo 2016: 1-8). This is because it was observed that failures among the PMs were causing issues such as depression, emotional problems, poor attitude, some weak relationships, worker frustration, and onsite conflicts that had caused some workers to be tense. While a topic that has been noted in the literature is the need for Servant Leadership qualities among PMs (Prieto, Phipps and Mathur-Helm 2018), this study argued that this was not a practical attitude in projects such as this, in its totalitarian form. This is because if the entire focus of the project were to be on the needs of the workers, the priorities of the client or project sponsors would be relegated; and this, in turn, would have consequences for the client-PM relationship that could result in a complete collapse of the project with potentially far more negative outcomes on the workers, such as the cancellation of the project. It was therefore argued that the priority for this project should have been more towards striking a *balance* between the current principles of client focus, and Servant Leadership.

Manager-specific problems that were noted in this study were said to involve dangerous risk-taking, having an unrealistic deadline, requiring contingency plans, and requiring subcontractors to continuously seek permission for works on site; while problems related to reduced project efficiency were also noted. This tended to contradict the respondents who had noted quite emphatically in previous sections that the PMs' skills of risk-taking had been positively impacting the project. In addition, when referring to manager-specific and reduced project efficiency problems, it was argued that there had been issues with complex communications systems, low subcontractor meeting attendance, frequent missing of meetings, and poor communications between the designers and the managers. This echoed a sentiment in the literature that there is always a need to rely on information between project participants to achieve the goals of a project, requiring that the mode of communication and the channels to be followed should be clearly optimised among the project team (Gómez-Ferrer 2017: 2).

These were clearly skills that needed to be improved to enhance the efficiency of the project, or to make future undertakings more efficient and smooth running. These aspects were also taken into consideration when answering the final research question of the study, next. In conclusion of this research question, and based on the findings of this study, therefore, it could

be concluded that this research objective was systematically and comprehensively accomplished.

6.2.5 Research question five: What suitable operational model based on a Soft Systems Methodology can be proposed to resolve any impasses found in the supply chain processes of construction sites in Gauteng?

The final objective of this study attempted to tie the entire efforts of the SSM research methodology together, and define what suitable operational model could be proposed to resolve to problematic issues that had been found in the Rosebank project supply chain. In beginning to develop this model, it was necessary, firstly, to identify the likelihood that the conceptual models would be internally implemented, which in effect, considered what the likelihood was that the project's management would consider the conceptual models. It was apparent from this study that there was a broadly dispersed opinion on the likelihood that any of the conceptual models would be considered, internally, by the PMs, with some positive likelihood, and some pessimism that the suggestions would not likely be considered. It also appeared that the respondents who argued that there was a likelihood that the proposed conceptual models would be considered were managers or upper-tiered employees themselves, who would clearly have been biased towards the flexibility of the project management to making changes on the project.

Numerous uncontrollable external factors in the environment or outside the construction project were also noted to potentially be incumbent upon the likelihood of the project being able to implement the proposed conceptual models; wherein, it was ascertained that traffic limitations such as the road conditions, traffic, the site being along public roads and opposed to traffic, and financial limitations such as a lack of funds on the project being likely to inevitably prevent the models from being implemented. Community difficulties were other uncontrollable external factors affecting whether any changes could be made; while issues with time limitations were also apparent, which related to the lack of time, and that the project deadline was immovable.

Ultimately, following an exhaustive, iterative process with the participants of this study, a model was developed with a strong set of recommendations for improvement. As clarified in the earlier chapters of this dissertation, this step was not finally performed, but it allowed for recommendations to be developed with a resilient set of steps to resolve any impasses that had

been found in the supply chain processes of this — and potentially other — construction sites around Gauteng. These changes were grouped according to their ease of implementation, and their potential benefit to the project, on an ease-benefit matrix.

Changes that have been noted in this model as being the most feasible changes, ranking highly within the ease-benefit matrix — when considering the amount of effort, resources and time that would be required relative to the amount of benefit they would have on the project — are for the management to negotiate a later hand-over time for the project, and to have workers work over-time to strive to complete the project faster. Increasing equipment efficiency is also the most likely option to be considered and accepted by the management; while it is also suggested for space to be recycled; and for the management to become less autonomous; though removing the autonomy of the management will likely have numerous difficulties, and arguably have a limited benefit, therefore placing it close to the centre of the ease-benefit matrix.

Five additional recommendations from throughout the SSM have also been deemed by the researcher to rank highly in the ease-benefit matrix; and as such, have been included in the change model. These recommendations are for the management to check work quality, and to ensure work adherence; to provide earlier communications on delivery; and for the management to ensure work understanding across the site. It is also recommended for the management to perform more forward planning; which is deemed by the researcher to be an important task for the management to perform, and which should ultimately be relatively easy to achieve, especially as it constitutes a standard function of project management. Indeed, such changes should theoretically be immediate changes that could be made on this, or any construction project, and would tentatively draw immediate tangible results that could be felt without requiring considerable financial outlay, stakeholder buy-in, or managerial approval.

Other recommendations, with different degrees of ease and benefit on the ease-benefit matrix have, however, also been made. It is important to note, though. that the easiest and most beneficial changes should be implemented first; yet as more of the changes from the other quadrants of the ease-benefit matrix are implemented on this, or other future projects, so the overall improvements to the construction's supply chain, and therefore the overall operation, should be clearly discernible. It is possible to conclude, therefore, that based on the findings of

this comprehensive SSM analysis, this final research question has been answered, and the fifth and final research objective has been scrupulously completed.

6.3. RECOMMENDATIONS FOR FUTURE RESEARCH

Having completed this study, and upon answering the research questions that were posed at the onset of this research, it is valuable to consider what could be studied, next, for future researchers or academics wishing to further the knowledge base on the topic of construction supply chain management. The following topics are some possible avenues that could be researched that would help to cover delimitations that were intentionally excluded from this study; or to otherwise fill gaps that have not been encompassed within this dissertation:

- Research could be performed on other construction sites across the East Rand of Gauteng province, and across South Africa, to broaden the knowledge on the challenges of the supply chain in construction projects to other construction sites as well;
- Future research could focus on the supply chain processes and challenges of the supply chain from the perspective of the logistics and supply chain firms that are operating externally to, but in collaboration with the construction companies (off-site), to ascertain their opinions on the challenges of working with construction projects.
- Research could consider the construction supply chain from a quantitative perspective, by attempting to obtain data such as financial records, numerical facts, or project-related quantities to support the qualitative results of this study with statistically reliability.
- Finally, a study could be performed that goes further than only developing a potential model for change to improve the supply chain of the construction project, and considers the actual implementation of that model to determine the efficiency of the model in improving any problematic issues within the supply chain of that chosen construction project.

6.4. CONCLUSION

This concludes the final chapter of this study. The SSM has proven to be a powerful means of measuring the supply chain processes of a new office construction project in Rosebank, Johannesburg; and determine how to improve the efficiency and performance of the supply chain processes of the project. For instance, the SSM methodology proved to be a strong system for defining the ‘messiness’ surrounding the project’s supply chain; and indeed, it allowed the supply chain processes on the project to be investigated in detail so that both the soft and hard

issues surrounding the project could be defined. In the process, it allowed the aspects in the supply chain that had been best enhancing the successful project performance to be identified; and for the dynamic challenges that had been facing the supply chain and limiting the successful performance of the project to be identified.

In burrowing to the core of the issues of the project, SSM allowed the role of the project leadership in failing to overcome any challenges of the project's supply chain to be identified, particularly pertaining to the soft skills of the managers, and how their soft skills — or lack thereof — were causing failures in the project. In order to make recommendations for improvement, a suitable operational model has been developed through the SSM methodology, and presented as a means of resolving any impasses in the supply chain processes of this, and potentially other, construction projects around South Africa.

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APPENDIX

8.1. APPENDIX I: INTERVIEW SCHEDULE

8.1.1 Section 1: Demographic information

1. Are you working for the principal contractor, or as a subcontractor on *this* new office park construction project in Oxford Road, Rosebank?
2. Are you currently a senior manager, project manager (PM), foreman, or worker for this project?
3. Are you involved with the materials procurement, supply, handling, scheduling, shipping, storing, security, or other parts of the supply chain on *this* construction project?
4. How long (months or years) have you been involved with supply chain matters on *any* construction project, over the course of your career?

8.1.2 Section 2: Entering into, and expressing the problem situation

STRENGTHS

5. Which aspects of the supply chain (materials procurement, supply, handling, scheduling, shipping, storing, security, or other parts of the supply chain), on *this* construction project have been working well, and **enhancing** your successful work performance?
6. How do you think the **vision, risk-taking, emotional intelligence and trust** of the project management have **enhanced** the effectiveness of the supply chain on *this* construction project?
7. How do you think the **self-awareness, supportiveness, communication and motivation** to the subcontractors and workers by the project leadership have **enhanced** the effectiveness of the supply chain on *this* construction project?
8. What **other characteristics** of the project management have **enhanced** the effectiveness of the supply chain on *this* construction project?
9. How are these **strengths** in *this* supply chain **different to other construction projects** you typically work on?

WEAKNESSES

10. Which aspects of the supply chain (materials procurement, supply, handling, scheduling, shipping, storing, security, or other parts of the supply chain), on *this* construction project have been working badly, and **limiting** your successful work performance?

11. What is **causing** these **problems** in the supply chain on *this* construction project?
12. How do you think the **vision, risk-taking, emotional intelligence and trust** of the project management have **limited** the effectiveness of the supply chain on *this* construction project?
13. How do you think the **self-awareness, supportiveness, communication and motivation** to the subcontractors and workers by the project leadership have **limited** the effectiveness of the supply chain on *this* construction project?
14. What **other characteristics** of the project management have **limited** the effectiveness of the supply chain on *this* construction project?
15. How are these **weaknesses** in the supply chain **different to other construction projects** you typically work on?

8.1.3 Section 3: Building feasible and possible conceptual models of human activities to respond to each of the core themes of issues in the supply chain

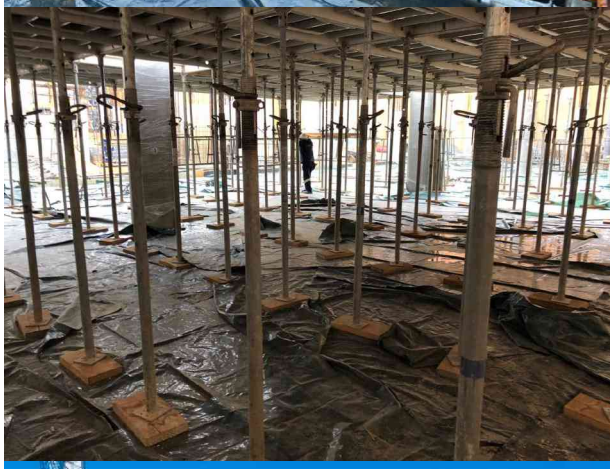
16. What **changes** would you recommend to **improve** the supply chain (materials procurement, supply, handling, scheduling, shipping, storing, security, or other parts of the supply chain) on *this* construction project?
17. How **likely** is it that this suggestion that you have proposed would be considered by the management?
18. If the management would **not consider** making this proposed change, **why** do you think this is the case?
19. Are there any uncontrollable **external factors** (in the environment or outside the construction project) that would prevent your suggestion from being made?
20. If your proposed change would not be possible (because of the management or any external factors), what **other changes** can you recommend that may be more likely to be accepted by the management and/or overcome the external barriers, to improve the supply chain of *this* construction project?

8.2. APPENDIX II: RESULTS NOT IN TEXT

Table 8.1 Overarching themes and subthemes of how the project management's self-awareness, supportiveness, communication and motivation to the subcontractors and workers have enhanced the effectiveness of the supply chain on the project

Themes deciphered	Subtheme codes deciphered from the respondents	Number of times noted
Manager-specific improvements	FULFIL REQUESTS	1
	INCR CONFLCT RESOLN	1
	INCR STAFF CNTROL	1
	INCR STAFF POSITNING	1
Improved working environment	GOOD WRKR-MGR RELATNS	1
	INCR STABILTY	1
	INCR WORK BALANCE	1
	INCR WRK EASE	1
	INCR WRK WILLNGNESS	1
	SAFETY ADDRESSD	1
	WRKRS HAPPY	1
Improved information flow	DAY/WEEK MEETS	2
	IMPRVD SUB-MGR MEETS	1
	INCR DISCUSSN	2
	INCR KNWLDG	1
	EXPLAIN CHALLNGES	1
	INCR WRK REMINDRS	1
	PROGRESS REPRTS	1
	SUPPLY NEEDED INFO	1
	BETTER EXPLAIN TASKS	1
More teamwork	IMPROVD TEAMWK	2
	INCR TEAM SUPPRT	1
	INCR TEAM TIME	1
Improved project efficiency	IMPROVD SCHEDULNG	2
	INCR RESRC AVAILBTY	1
	INCR WRK EFFICNCY	1
	INCR STAFF OUTCOMS	1
	IMPROVD DELIVRIES	1
	TIMELY EQUIP RETRN	1
	GIVE EQUIP WELL	1
Did not answer the question	DNA	1

8.3. APPENDIX III: VISUAL OVERVIEW OF THE NEW OFFICE PARK CONSTRUCTION PROJECT IN OXFORD ROAD, ROSEBANK, JOHANNESBURG




BEWARE
DEEP
EXCAVATIO