SUPPLY CHAIN COORDINATION AND FIRM PERFORMANCE IN THE CONSTRUCTION INDUSTRY IN GAUTENG PROVINCE

By

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DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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This dissertation is the result of my independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A list of references is appended.

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ABSTRACT

The construction industry is an important contributor to the economy of South Africa. In this industry, buyers and suppliers work in collaboration with each other to achieve superior supply chain performance. To achieve this, they have to find ways and methods to improve it. The purpose of this study was to investigate supply chain coordination and firm performance in the construction industry in the Gauteng Province. This study considers three drivers: supplier coordination, customer coordination and coordination effectiveness to achieve the performance of the construction industry.

In most previous research studies, researchers have overlooked the important considerations and variables of supply chain coordination and firm performances as environmentally-friendly exercises in the construction industry. As a result, there was an abundant necessity to examine how the construction industry should implement a supply chain coordination programme and firm performance as environmentally-friendly practices in the organisational activities to ensure the sustainability of the construction industry. The effective application of SCC and firm performance in the construction industry will benefit all stakeholders.

A quantitative approach was adopted in which a survey questionnaire was used to collect data from 414 construction supply chain managers and professional employees in the Gauteng Province. The study used a non-probability convenience sampling technique to select respondents. Data were analysed with the aid of two software packages: the Statistical Package for the Social Sciences (SPSS version 27.0) and the Analysis of Moment Structures (AMOS version 27.0). A confirmatory factor analysis was applied in examining and testing the relationships between observed constructs and their causal latent constructs while structural equation modelling was used to test the hypothesised relationships between constructs.

The results revealed that supplier coordination, customer coordination and coordination effectiveness positively and significantly influence firm performance in the construction industry. Further, the study determines that to improve firm performance, the construction industry should advance the stages of trust, guarantee and sustainable relationships with their stakeholders. The results provide useful insights into how the construction industry could benefit from cultivating trust, assurance and sustainable relationships between supply chain partners as well as on how to improve firm performance.

Therefore, this study is not only important for construction companies but also for manufacturers, suppliers and customers since most of them will collectively achieve the goal of performing purposeful activities to boost construction performance and sustainability.

Keywords: supplier coordination; customer coordination; coordination effectiveness; firm performance.

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ABBREVIATION	FULL ANNOTATION
AMOS	Analysis of Moment structures
AGFI	Augmented Goodness of Fit Index
AVE	Average Variance Extracted
BIM	Building Information Modeling
CFI	Comparative Fit Index
CMB	Common Methods Bias
CMV	Common Methods Variance
CR	Composite Reliability
CFA	Confirmatory Factor Analysis
C&DW	Construction and Demolition Waste
CIDB	Construction Industry Development Board
CST	Construction Sector Transparency
CSCM	Construction Supply Chain Management

CE	Coordination Effectiveness
CC	Customer Coordination
ERP	Enterprise Resource Planning
FP	Financial Performance
GFI	Goodness of Fit Index
GDP	Gross Domestic Product
IFI	Increment Fit Index
JIT	Just-in-Time
MHBP	Mass Housing Building Production
NPD	New Product Development
NFI	Normed Fit Index
OP	Operational Performance
RDP	Reconstruction and Development Programme
ROA	Return on Assets
ROI	Return on Investments
RMSEA	Root Mean Square of Error Approximation
SP	Social Performance
SPSS	Statistical Package for Social Scientists
SEM	Structural Equation Modelling
SC	Supplier Coordination
SCC	Supply Chain Coordination
SCM	Supply Chain Management

TQM	Total Quality Management
TRAMCON	Training for Manufactured Construction
TLI	Tucker-Lewis Index

CHAPTER 1

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION

The construction industry has seen momentous improvements. However, there had always been hazardous issues such as skill shortage, health and safety and communication, to mention a few that had affected the performance of the construction industry. These issues are discussed in detail in the next chapter of this study. This study is basically about the firm performance in the construction industry in the Gauteng province. An understanding of performance from the viewpoint of previous studies is part of the foundation of the overall study. Then, this calls for more analysis on how the construction industry implemented supply chain coordination to improve firm performance in the construction industry in the Gauteng province.

The construction industry has advanced the development process by providing many employment opportunities and with this rapid development of urbanisation, many construction projects are needed to fulfil people's growing needs and to substitute progressively aging structures (Xu & Xu 2021:1). According to Bawane (2017:1208), the construction industry is one of the largest economic activities globally, with an annual productivity of USD3 000 billion. Also, it accounts for 10 percent of the world's gross domestic product (GDP). The Construction Industry Development Board (2020:17) views the construction industry as a source that offers employment to a large amount of skilled and unskilled labour, which forms the fundamental labour element for the physical completion of the construction process. Furthermore, the Construction Industry Development Board (2016:6) indicates that the construction industry in South Africa makes up to 50 percent of the entire capital investment in the country and four percent of the GDP. According to Windapo (2016:1), there have been serious increases in infrastructural development and construction activities within South Africa in current years. These increases in infrastructure improvement came as a result of the government's R372 billion investment programme, resulting from the accelerated and shared growth initiative for South Africa projects as well as the infrastructural improvements that complemented hosting the 2010 Soccer World Cup (Prinsloo 2010:1).

Since the construction industry differs from most other businesses and firms in other sectors of the economy, it is greatly influenced by how the industry performs its functions as a project-based industry (Othman, Rahman, Sundram & Bhatti 2015:644). The construction industry entails different supply chains that need to be managed and organised differently depending on their situations and conditions. For example, Wu, Nisar, Kapletia and Prabhakar (2017:852) propose that these supply chains will vary depending on whether or not they are controlled by suppliers, contractors or architects. However, Segerstedt and Olofsson (2010:348) suggest that it is not unusual to hear that the construction industry totally differs from other industries and must find other purposes and ideas for refining performance and efficiency. However, the industry has recently not performed satisfactorily due to a long period of unutilised time during the Covid-19 pandemic, which inflicted destruction on an industry that likely became vulnerable to economic cycles (Ribeirinho, Mischke, Strube, Sjödin, Blanco, Palter, Biörck, Rockhill & Andersson 2020:1). Similarly, Golini, Kalchschmidt and Landoni (2015:651) indicate that the achievement of construction projects can be reliant on the entrepreneur with characteristics such as their experience, knowledge, capability and initiative being essential to project success. From this concept, it is clear what needs to be done, how it should be done and with what results to accomplish the determined goals.

The success of the construction industry is measured by performance, therefore, the healthier the performance, the more prosperous and developing the construction industry will be (Nugroho, Setiawan, Sutopo & Wibowo 2021:1). Stenmark (2021:1) suggests that effective supply chain coordination is required in the construction industry to manage all activities and relationships amongst stakeholders to achieve the optimum level of success and productive performance. A supply chain is observed as a network of firms involved in various activities such as planning, design, distribution, selling, support, usage and recycling of products both upstream and downstream to enhance value in the form of products and services delivered to end customers (Pagell & Shevchenko 2014:45). Since firms pursue different goals, research suggests that supply chain performance depends on how well supply chain partners work together and not on how well each partner firm performs individually (Jayaram, Xu & Nicolae 2011:59). As such, in this common-goal view, the interdependent activities between supply chain bodies have to be coordinated to achieve an important fit among supply chain partners. Given the nature of interdependence between supply chain members, Soosay and Hyland (2015:613) advocate that collaboration involves multiple firms or autonomous business entities engaging in a relationship that aims to share improved outcomes and benefits. The complex networks of supply chains are composed of several players that strive towards different purposes and have multiple performance measures at different levels. Therefore, Aslam (2013:1) suggests that these networks become in conflict with each other and have to be considered in their operations. In addition, coordination mechanisms, which are tools for managing these interdependencies, are instrumental in eradicating supply chain sub-optimisation and achieving anticipated performance outcomes (Susha, Janssen & Verhulst 2017:161). This being the case, construction supply chain coordination is a systemic construction corporate strategy that involves all the stakeholders in the construction process and requires them to establish common business goals (Schmidt & Redler 2018:186). Thus, managers need to select suitable coordination mechanisms that can stimulate effective coordination in Construction Supply Chain (CSC).

The key fundamental issue in supply chain processes is that normally clients depend on capability outside the client's organisation, that is, products and services are usually not in-house and are obtained from the industry. The supply chain process coordination becomes complex and significant to determine the efficiency of the firms in the construction industry (Huo, Zhang & Zhao 2015:728). Therefore, initiatives should be taken to apply best practices. One such practice would be the concept of coordination in the supply chain process to the construction industry. Furthermore, this study will address how coordination effectiveness affects the operational, financial and social performance of the firms in the construction industry.

1.2 PROBLEM STATEMENT

Although there has been an outstanding development of the construction industry, there are numerous challenges facing the industry, mostly because of the construction costs, on-time project achievement, tendering procedures and technical expertise (Mahmood, Zahari, Yaacob & Zin 2017:51). Further, it has been highlighted by some authors (Alaghbari, Salim, Dola & Abang Ali 2012:42; Silvana, Valentina, Vahida & Aida 2017:1431) that construction costs are normally very high and comparative to a rise in the costs of basic materials such as cement, bricks, steel and timber, labour, land and infrastructure such as roads, facilities and landscaping. According to Mpofu, Ochieng, Moobela and Pretorius (2017:348), the elements causing interruptions and delays in project schedules include financial constraints, client requirements for alterations in the design, less knowledgeable contractors, poor planning and weather conditions. In addition, Zhou, Gao and Zhao (2017:376) suggest that this is important because the success of an industry will be affected by the effectiveness of management, economy and market rivalry. The main problem that this study will investigate is how poor performance affects the construction industry. Furthermore, this study will propose a research plan for construction supply chain management (CSCM) for refining construction performance (Manu & Dinakar 2018:665). By so doing, the study will examine the factors that could influence the performance of the construction industry and propose pertinent actions to improve its performance. Previous studies have shown that the process of construction, depending on the complexity of the completed structure, requires a high level of coordination among all the specialists from design until the project is completed (Liu, Van Nederveen & Hertogh 2017:693). However, efforts of designing a coordination scheme that will align the incentives of marketing and production with the firm's general objectives need to be executed (Pekgün, Griffin & Keskinocak 2008:13). Therefore, according to Pozin and Nawi (2017:4), since construction is one of the most information-dependent industries amongst others, with its mixture of forms of information, supply chain coordination will be the crucial factor leading to the success of the construction industry.

Although numerous studies have been done to address the problem of performance in the construction industry, the application or execution of supply chain coordination has not been given much consideration to examine how it will advance performance in the industry. Therefore, there is a need to investigate the impact of supply chain coordination and firm performance in the construction industry in the Gauteng province.

Thus, this study will present an overall framework for the construction supply chain coordination as there is a lot of substantial work such as how to measure the firm performance and how to effectively implement this framework to be in practice. Furthermore, this study aims to address the limitations and gaps in the past studies.

1.3. PURPOSE OF THE STUDY

This study tests the relationship between supply chain coordination, coordination effectiveness and firm performance in the construction industry in the Gauteng Province.

1.4 RESEARCH OBJECTIVE

The following objectives of the study are stated:

1.4.1 Primary objective

To investigate the relationship between supply chain coordination and firm performance in the construction industry in the Gauteng province.

1.4.2 Theoretical objectives

Theoretical objectives are based on the literature review and these objectives have been formulated for the study as follows:

- to conduct an extensive review of literature focusing on the construction industry
- to conduct a review of literature focusing on supplier coordination
- to conduct a review of literature focusing on customer coordination
- to conduct an extensive review of literature focusing on coordination effectiveness
- to conduct a review of literature focusing on operational performance
- to conduct a review of literature focusing on financial performance and
- to conduct a review of literature focusing on social performance.

1.4.3 Empirical objectives

Empirical objectives are based on the relationships between research variables that this study seeks to measure. The following empirical objectives are set for the study:

- to determine the relationship between supplier coordination and coordination effectiveness in the construction industry in the Gauteng Province
- to determine the relationship between customer coordination and coordination effectiveness in the construction industry in the Gauteng Province
- to determine the relationship between coordination effectiveness and operational performance in the construction industry in the Gauteng Province
- to determine the relationship between coordination effectiveness and financial performance in the construction industry in the Gauteng province and
- to determine the relationship between coordination effectiveness and social performance in the construction industry in the Gauteng Province.

1.5 Hypothesised framework

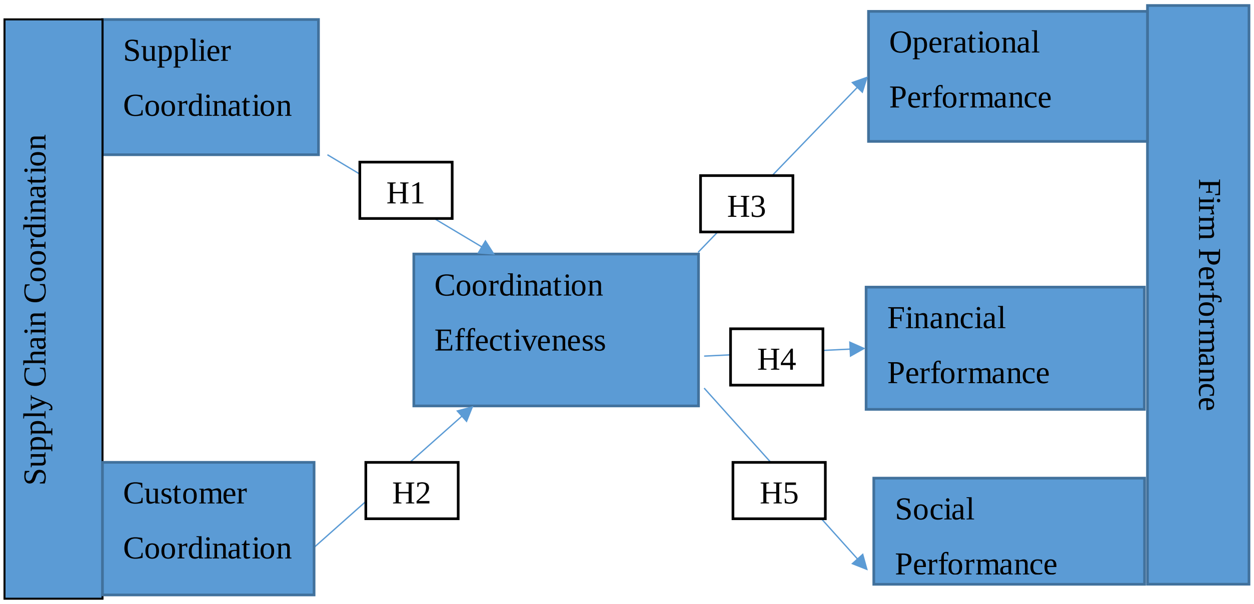


Figure 1.1 Hypothesised framework (own source)

The research framework above is composed of five constructs. There are two predictor variables under supply chain coordination known as supplier coordination and customer coordination. In addition, there is one mediator construct named coordination effectiveness. The outcome variable is firm performance, which is divided into three components namely operational, financial and social performance. Figure 1.1 indicates five hypotheses from H1 to H5.

1.6 HYPOTHESIS STATEMENT

H1: There is a positive relationship between supplier coordination and coordination effectiveness.

H2: There is a positive relationship between customer coordination and coordination effectiveness.

H3: There is a positive relationship between coordination effectiveness and operational performance.

H4: There is a positive relationship between coordination effectiveness and financial performance.

H5: There is a positive relationship between coordination effectiveness and social performanc**e.**

1.7. LITERATURE REVIEW

To achieve the aim of the study and explore the literature on firm performance, the study investigate whether the relationship between supply chain coordination and firm performance in the construction industry was undertaken. A wide range of materials, which included articles, conference papers, textbooks, journals, newspapers and the internet as the sources of data were utilised. This facilitated the critical analysis of the literature through comparing and constructing the perspectives, viewpoints and arguments by other researchers in similar studies.

1.7.1 A game-theory approach to supply chain coordination

To obtain a suitable contextual and organisational understanding of this study, the game theory suggested by Von Neumann and Morgenstern (1944:1) was used to observe the influence of supply chain coordination on supply chain performance. The theory suggested that both supplier and customer coordination can improve worldwide performance and decrease risks (Hennet & Arda 2008:399). As stated by Chopra and Meindl (2010:7), supply chain coordination progresses if the total supply chain profits grow through the actions in which all stages of the supply chain collectively participate. Hennet *et al*. (2008:401) suggest that cooperative game theory can be of great help in designing a supply chain or an essential enterprise by selecting an optimal coalition of partners.

Game theory is seen by Cachon and Serguei (2004:13) as an essential tool when dealing with supply chain management problems with multiple agents such as manufacturers, retailers, buyers and government, especially when there are conflicting objectives to support decision makers' abilities to enhance the cooperative efficiency of the partners involved. Furthermore, the application of game theory to the supply chain, especially coordination, economic stability and supply chain efficiency has been discussed by several researchers (Li, Huang, Zhu & Chau 2002:348; Yue, Austin, Wang & Huang 2006:66; Hennet & Arda 2008:401; Nagarajan & Sošić 2008:720; Leng & Zhu 2009:601; Esmaeili, Aryanezhad & Zeephongsekul 2009:442; Zhang & Huang 2010:121).

1.7.2 Supply chain coordination

Supply chain coordination (SCC) identifies reliant supply chain activities between supply chain members and creates strategies for managing those interdependencies, thus, helps advance the performance of all the participating members (Bandyopadhyay & Kim 2021:3). Coordination is a management function for bringing together the decisions of diverse parties to attain a mutual goal (Mello, Strandhagen & Alfnes 2015:1007). According to Zhang, Zhao and Qi (2014:147) and Xu, Huan and Xiaojun (2018:6), supply chain coordination refers to the interaction and cooperation with supply chain associates such as suppliers and customers, in forecasting activities and performance developments. This definition emphasises actors performing interdependent activities, which individually may have conflicting interests. However, Shukla, Garg and Agarwal (2012:69) state that coordination refers to the incorporation of trading partners in a supply chain to achieve a collective set of everyday jobs and mutual profits. The literature on supply chain shows that integration has offered several types of coordination such as customer/market coordination, information coordination, logistics and distribution coordination, supplier coordination and purchasing coordination but the focus in this study is on supplier and customer coordination (Zhang, Melcher & Li 2004:42; Das, Narasimhan & Talluri 2006:563; Li 2006:118; Beheshti, Hultman, Jungz, Opokuz & Salehi-Sangari 2007:256; Hou 2009:280).

1.7.3 Supplier coordination

Supplier coordination is viewed by Boyce, Mano and Kent (2016:4) as a state of synchronisation of supply chain cooperation that has the potential to reduce the natural conflict in supply chain relationships. However, Jayaram, *et al*. (2011:62) define supplier coordination as a key aspect for manufacturers to stay competitive in today's overall competition. Furthermore, Aljazzar, Jaber and Moussawi-Haidar (2016:9595) define supplier coordination as an intercessor between customer and manufacturing lead-times.

1.7.4 Customer coordination

According to Foss, Laursen and Pedersen (2011:980), customers and clients are a basis of knowledge or information in their innovative developments. Then, Chavez, Yu, Gimenez, Fynes and Wiengarten (2015:85) define customer coordination as that which involves improving performance in areas such as manufacturing and delivery lead-time and delivery consistency to achieve the primary goal of the business. Moreover, Jayaram *et al.* (2011:69) define customer coordination as a tool that allows the manufacturing firm to clearly realise customers' special needs and specifications and arrange its internal resources to serve such exceptions effectively.

1.7.5 Coordination effectiveness

Effective coordination is the concealed force multiplier in emergency response as it reduces repetition and competition and allows different agencies and organisations to complement each other and give additional value (Office for the Coordination of Humanitarian Affairs 2014:3). However, Hugos (2018:6) states that the effectiveness of an organisation's supply chain is how well the company can do and how it can compete in its markets successfully.

1.7.6 Operational performance

Operational performance is a set of principles or ethics and benchmarks that are applied and used by firms to achieve a competitive advantage, customer fulfilment and extreme levels of effectiveness (Saleh 2015:8). Even Chatfield and Pritchard (2013:159) note that operational performance involves lead times of manufacturing and distributions that are acknowledged among the processes that largely influence the effectiveness of operations in the supply chain.

1.7.7 Financial performance

According to Gu, Jitpaipoon and Yan (2017:226) financial performance is the extent to which an organisation attains its market and financial goals. However, Haa, Lo and Wang (2016:185) define financial performance as return on investment, return on capital employed, return on assets and return on equity.

1.7.8 Social performance

Social performance relates to how an organisation can create welfare for consumers (Ledgerwood, Earne & Nelson 2013:340). Suto and Takehara (2016:348) define social performance as a requirement for examining the effects of social responsibility activities on value creation and business sustainability and being significant for both shareholders and corporate managers.

1.8 RESEARCH METHODOLOGY

Research may be defined as an organised way to solve a problem, a discipline of studying how a scientific inquiry was carried out or the study of methods by which knowledge was gained (Rajaseka, Philominathan & Chinnathambi 2013:6). Research methodology helps in the understanding of the process of the research, thus giving it technical value (Sedgwick 2014:2277). Also, research methodology refers to a plan of action, which informs and links the methods used to collect and analyse data to answer the original research question (Flick 2015:15). In this study, research methodology relates to basics that include the research design, research approach, sampling design, method of data collection and measurement instruments, data analysis techniques, validity and reliability and research ethics.

1.8.1 Research design

According to Ledford and Gast (2018:6), research design is defined as the degree to which data collection procedures, data analyses and data reporting are observed as objective, reliable and valid. Similarly, Polit and Beck (2012:802) state that research design is the researcher’s overall plan for answering the question or testing the research hypothesis. For this study, a cross-sectional survey design was used. A cross-sectional survey design is one type of research design that involves the collection of data on more than one case and at a single point in time to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to identify patterns of association (Creswell 2017:216). As stated by Sedgwick (2014:2276), sometimes, cross-sectional studies are repeated at different times to assess trends over time. Therefore, this study adopted a cross-sectional survey design because it offers the following advantages:

- Studies were generally quick, easy and cheap to perform
- They were often based on a questionnaire survey. There was no loss to follow-up
- A cross-sectional design was used to develop hypotheses
- Data from a single study was useful to many researchers.

1.8.2 Research approach

Research approaches originate from research paradigms and the three main major approaches to research are the quantitative, qualitative and mixed method (Xiong, Skitmore & Xia 2015:62). In this study, the quantitative approach was adopted. A quantitative approach involves using measurements and numbers to help formulate and test ideas or hypotheses (McCusker & Gunaydin

2015:538). However, Baden and Major (2013:525) state that the quantitative approach may also be regarded as the systematic gathering and analysis of numerical data used to accept or reject a hypothesis. It is based on the evidence that something is meaningful only if it can be observed or counted (Bradford 2017:1). Therefore, the quantitative approach was selected because numeric data were collected from respondents to test the proposed hypotheses. Furthermore, the quantitative approach offered several advantages such as providing the estimates of large populations, providing results that were condensed to statistics, allowing for statistical comparisons between groups and providing answers to questions such as how many or how often (Brannen 2017:5).

1.8.3 Sampling design

Sampling design is viewed as a provision of a plan for the quantitative or numeric description of trends, attitudes or opinions of a population by studying a sample of that population (Lotterhos & Whitlock 2015:1035). Moreover, McCombes (2021:1) states that sampling design includes target population, sampling frame, sample size and sampling method.

1.8.3.1 Target population

The target population is defined by Etikan, Musa and Alkassim (2016:2) as a specific group of people or objects that are easily accessible to the researcher and are willing to participate in the study. The target population includes individuals, groups, organisations, documents and companies (Quinlan 2011:206). In this study, the target population consisted of 400 supply chain managers and operations management professionals in the construction industries in the Gauteng province.

1.8.3.2 Sample frame

A sample frame is a list that includes every member of the population from which a sample is to be taken or drawn and it is essential to all sampling processes (Barron, Davern, Montgomery, Tao, Wolter, Zeng, Dorell & Black, 2015:547). In other words, a sample frame is a major list of the entire population. Thus, this study did not use the sample frame as it was only focusing on the supply chain managers and professional employees of the construction industry in the Gauteng province.

1.8.3.3 Sample size

Sample size refers to how many respondents should be included in the study and is an important consideration for researchers as it affects the quality and generalisation of the data (Erdis 2011:117). In other words, the sample size is the number of respondents included in the study. In this study, the sample size was set at n=400 respondents. Previous researchers (Young 2017:135; Mba & Agumba 2017: 271; To, Lee & Lam 2018:11) made use of 400 respondents to obtain accurate and reliable results for their studies.

1.8.3.4 Sampling methods

Sampling method is the process of selecting participants from the population. As a group, sampling methods fall into two categories: probability and non-probability samples (McLeod 2014:1). However, the study used a non-probability purposive sampling technique to select respondents. Data were analysed with the aid of two software package namely the Statistical Package for the Social Sciences (SPSS version 27.0) and the Analysis of Moment Structures (AMOS version 27.0). A confirmatory factor analysis was applied in examining and testing the relationships between observed constructs and their causal latent constructs while structural equation modelling was used to test the hypothesised relationships between constructs.

1.8.4 Method of data collection and measurement instrument

In this study, data were collected using a survey questionnaire. The questionnaire used was divided into six sections. Section A was eliciting respondents' background information. Section B elicited information on supply chain coordination, which consisted of two predictor variables known as supplier coordination and customer coordination. In this section, questions were adapted from Jayaram *et al*. (2011:85). Section C focused on coordination effectiveness. The questions used in this section were adapted from Zhang, Zhao and Qi (2014:145). Section D focused on operational performance. In this section, questions were adapted from Gu *et al.* (2017:230). Section E focused on social performance, using questions adapted from a study conducted by Akhtar, Kaur and Punjaisri (2017:533). Section F focused on financial performance, using questions adapted from a study conducted by Yasar, Sezen and Karakadilar (2017:15). Response options in sections B to F were presented as a five-point Likert-type scale configuration presented as follows: 1=strongly disagree, 2=disagree, 3=moderately agree, 4=agree and 5=strongly agree.

1.8.5. Data analysis approach

After the data were collected, it was recorded on an Excel spreadsheet and then imported into the Statistical Package for Social Sciences (SPSS) and Analysis of Moment Structures (AMOS 27.0) statistical software. This software facilitates the systematic application of statistics or logical techniques to describe, illustrate, shorten, review and evaluate data (Jandagh & Matin 2010:67). Using this software made the research work more scientific and reliable as several different statistical tools such as confirmatory factor analysis (CFA) and structural equation modelling (SEM) applied to the study. The SPSS software was useful for descriptive statistics. The CFA procedure was used to check for the measurement scale accuracy while the SEM process was used to measure the proposed relationships between variables.

1.8.6 Reliability and validity of measurement scales

Reliability and validity are the key indicators of the quality of measuring instruments. For this reason, reliability and validity were applied in this study. Reliability is defined as the extent to which a measurement instrument is repeatable and consistent (Maree 2010:215). In other words, the applied measurement procedure will produce the same results on repeated trials if it is reliable. Reliability was measured using the Cronbach alpha coefficient and the Composite Reliability. The minimum cut off values are 0.7 for both measures as suggested by Tavakol and Dennick (2011:53).

Validity is defined as the degree to which an instrument measures what it intends to measure (Kubai 2019:5). Validity requires that an instrument is reliable but an instrument can be reliable without being valid (Kimberlin & Winterstein 2008:2278). Convergent validity was examined by item loadings, which included standardised regression weights as well as the average variance extracted (AVE). Discriminant validity was established through the interfactor-correlations between the research constructs and by comparing the AVE and shared variance.

1.8.7 Model fit analysis

Model fit analysis was ascertained using confirmatory factor analysis (CFA), which is a type of structural equation modelling that deals specifically with measurement models, that is, the relationships between observed measures or indicators (Brown & Moore 2013:2). The CFA provided evidence that all items are aligned properly with the correct latent variables within the general construct being measured (Holtzman 2014:1651). In this study, CFA was used to obtain a standard regression weight through which different fit statistics were applied to determine that the model is an adequate fit for the data. The indicators are chi-square/degrees of freedom, the goodness of fit index (GFI), augmented goodness of fit index (AGFI), normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis index (TLI), composite fit index (CFI) and the root mean square error of approximation (RMSEA) to assess the model fit.

1.9. ETHICAL CONSIDERATIONS

Ethics is a branch of philosophy that deals with moral or professional principles and differentiates between right and wrong conduct (Fieser & Pojman 2012:1). In other words, ethics are principles and guidelines that clarify the conditions under which the research was conducted (Oates, Kwiatkowski & Coulthard 2010:4). The following ethical issues that are important for this study were adhered to:

- Participation in the study was voluntary since respondents were not forced to participate.
- The privacy of the respondents was respected.
- The questionnaires did not contain the names of the respondents and the anonymity of the respondents was maintained throughout this study.
- Personal information from the respondents was not ascribed to any individual.

1.10 DEFINITIONS OF TERMS

Supply chain coordination: Supply chain coordination is the process that necessitates each stage of the supply chain to share information and take into consideration the effect its actions have on other stages (Wadhawan 2019:1).

Firm performance: The firm performance entails the organisational performance, including manufacturing of products and services, functioning of different units of the firm, the performance of employees and outcomes of their work in general (Urjavaha 2020:1).

Construction industry: The construction industry entails a wide variety of services ranging from planning and surveying to structural construction as well as completion of services such as the building of structures, painting and decorating (Australian Industry and Skill Committee 2021:1).

Supplier Coordination: Supplier coordination is a complex process involving supplier selection management as well as working with suppliers that can provide the products and services needed for a project in time (Raboin 2019:1).

Customer coordination: Customer coordination focuses on refining customers' experiences with a company and leading teams that handle customer experience-related activities such as optimising customer support, drafting strategies for management to implement and creating a company presence on social media (Porter 2020:1).

Coordination effectiveness: Coordination effectiveness is defined as the strategy used by firms to promote business performance, increase market shares and increase revenue by providing high-quality products and services at the lowest cost (Zhao, Xie, Chen & Liang 2021:1).

Operational performance: Operational performance is the capability of an organisation to accomplish its mission through governance, competency and devotion to achieving the aforementioned goals and objectives. (Kamau 2016:3).

Financial performance: Financial performance is an amount of how well an organisation can use assets productively and generate profits or returns (Kenton 2021:1).

Social performance: Social performance is an organisational concern that addresses management and business policies that are well-suited with the objectives and the values of the society (Battaglini 2019:1).

1.11. OUTLINE OF THE STUDY

The following section summarises how the study is structured or organised. This study comprises six chapters.

Chapter 1: Introduction and background of the study

This chapter outlines the background of the research and the research problem. Furthermore, the chapter highlights the problem statement, the purpose of the study, research objectives and scope of the study.

Chapter 2: Background of the construction industry in the Gauteng province

This chapter reviews the literature regarding the research context of the study by providing a background on the importance and the role played by the construction industries in the economy of South Africa.

Chapter 3: Literature review on the research variables

This chapter provides a theoretical and empirical review of the following variables: supply chain coordination comprising supplier coordination and customer coordination, coordination effectiveness, operational performance, social performance and financial performance. The research model of the study as well as developing the research hypotheses are discussed in this chapter.

Chapter 4: Research methodology and design

The chapter outlines the research philosophies, methods and design, sampling design, data collection as well as data analysis procedures employed in this study.

Chapter 5: Data analysis and interpretation of the results

This chapter addresses the analysis, interpretations and evaluations of the research results.

Chapter 6: Conclusion and recommendations

The chapter presents some concluding remarks on the research and offers a few recommendations as well as highlighting the most important results of the study.

1.12. CONCLUSION

This chapter consisted of twelve sections. The first section presented the introduction and background of the study. The second section presented the problem statement. The third section highlighted the purpose of this study. The fourth section explained the objectives of the study. The fifth section described the research model for this study. The sixth section provided the hypothesis statement of this study. The seventh section discussed the literature review as well as the research constructs. The eighth section presented the research methodology. The ninth section highlighted the ethical issues to be obeyed. The tenth section discussed the definition of terms for the study. The eleventh section highlighted the outline of the study while the twelfth section provided the conclusion of the study. The next chapter of this study will discuss in detail the background of the construction industry in the Gauteng province.

CHAPTER 2

BACKGROUND OF THE CONSTRUCTION INDUSTRY IN GAUTENG PROVINCE

2.1 INTRODUCTION

The previous chapter presented the study and delivered insight into the study. The recent chapter aims to present the background of the construction industry in the Gauteng province. To provide a distinct understanding of the industry, the chapter is divided into eight sections and each section discloses a detailed aspect relating to the construction industry in South Africa. The first section defines what the construction industry is. The second section outlines the historical background of the construction industry in South Africa. The third section discusses the composition of the construction industry in South Africa. The fourth section highlights the legislative framework in the construction industry in South Africa. The fifth section elaborates on the contribution of the construction industry in South Africa. The sixth section discusses the challenges and solutions facing the construction industry in South Africa. The seventh section discusses the previous supply chain management-related research in the construction industry in South Africa. The chapter closes with a conclusion.

2.2 THE DEFINITION OF CONSTRUCTION INDUSTRY

The construction industry is defined by Ball (2014:3) as the originator of the built environment in which economic activities such as profession, employment and business occur. However, according to Sindi (2018:277), construction industry is a process that is continuously conditioned by the relationship of both the core as well as the exterior atmosphere. As for Antunes and Gonzalez (2015:212), the construction industry is the realisation of a concept through design, taking into account practical requirements and technical conditions for a project product using expert labour to fulfil a strategic goal. The construction industry is also defined by Othman (2013:76) as an organisation that plays an important role in satisfying a wide variety of physical, financial and societal needs. Similarly, Haupt and Harinarain (2016:80) view the construction industry as an economically significant organisation that contributes to the country’s Gross Domestic Product (GDP), creates jobs and supplies infrastructure.

Besides, the construction industry is considered the vital sector of any nation that contributes immensely to economic growth and social development (Boadu, Wang & Sunindijo 2020:2).

Similarly, Yu and Yang (2018:783) regard the construction industry as one of the core industries that supports many countries' economic boom in the sense that it improves the organisational performance. As a result, Darko and Löwe (2016:1) note that in developing countries like Ghana where unemployment is high, the construction industry is an important source of jobs for the unemployed and unskilled.

Moreover, the construction industry is defined by Williams (2013:685) as a complex system of different parts of structures that deals with society, shelter, environment, economy and technology. Meshksar (2012:1), Saidu and Shakantu (2016:587) and Nnadi, Okeke and Alintah-Abel (2016:12) define the construction industry as the driving force behind the socio-economic development of any nation and the industry takes a huge amount of money, time and energy. As a result, Lopes, Oliveira and Abreu (2017:658) state that the success of the construction industry leads to the promotion and preservation of long-term economic growth and stability since the emerging countries are accountable for almost 6-9% of the GDP. Similarly, the construction industry, according to Chuai, Lu, Huang, Gao and Zhao (2021:1), is essential for countrywide economic and social improvement as it provides the needed infrastructure and buildings for human undertakings. Generally, construction is the creator of roads, airports, factories, hospitals, dams, power plants, urban spaces and the infrastructure that makes those spaces fit for human habitation (Ilhan & Yobas 2019:1). Therefore, Chuai, Lu, Huang, Gao and Zhao's (2021:1) definition is used as an operational definition for this study.

2.3 HISTORICAL BACKGROUND OF THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

The need for befitting and permanent structures led to the idea of construction, which started with simple tools and temporary shelters (Olarewaju & Ibrahim 2020:22508). As a result, construction involves environmental transformation through bridges, roads, housing, health, water and infrastructure for power generation (Kikwasi & Escalante 2018:1). Due to the loss of knowledgeable and expert project managers in the construction industry during the 1990s, the South African Government has acknowledged infrastructure expansion to stimulate the economy (South Africa, National Planning Commission, 2011:137). The construction industry started in 1974 to enable other developing countries to meet the enormous backlog of needs and demands and to improve their performance to help the customers, consumers and society (Ofori 2015:116).

However, Ahadzie and Amoah-Mensah (2010:65) mention that in Ghana, project management practices in the construction industry began around the late 1980s when first used in Mass Housing Building Production (MHBPs) by a quasi-government organisation, Social Security and National Insurance Trust (SSNIT) and throughout the country. However, the first idea of project management started in the United States of America (USA) in the early 1950s and later in Western Europe in the early 1960s and is now practised throughout the world (Kissi & Ansah 2016:29).

2.4. THE COMPOSITION OF THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

The construction industry of South Africa, like any other country, is divided into two main sectors namely formal and informal sectors (Krige 2019:1). The formal sector refers to the formal side of a country's economy, which includes all companies involved in legalised activities and all jobs have specific working hours, regular wages and the worker's job is assured (Heil 2018:1). Furthermore, Etor (2016:33) points out that the functioning of a formal organisation is grounded in a well-structured system of operations that are well managed and coordinated by specialists and practitioners in its different parts of the operation. The formal sector is one with income resources, thus, contributes to the gross domestic product (GDP) growth as well as the gross national product (GNP) of the country (Escandón-Barbosa, Urbano, Hurtado-Ayala, Salas-Paramo & Dominguez 2019: 458; Young, Hutchinson & Reeves 2021:1). In South Africa, the formal sector of the construction industry comprises companies such as Grinaker-LTA, Wilson Bayly Holmes Ovcon (WBHO), Group Five, Aveng Group, Motheo and Reubex (Fourie 2018:1).

Contrary to the formal sector, the informal sector refers to another part of the country's economy, which encompasses all informal companies that operate illegally under self-governing, small or unregistered enterprises (Pillay 2018:2). Similarly, Galea, Powell, Loosemore and Chappell (2020:1217) point out that informal sector rules are generally undocumented and enforced through understated, unknown and even unlawful channels. However, there is a twofold and deviating opinion when it comes to the informal sector's contribution to the development of the economy. The informal sector is perceived as a vigorous sector that accommodates a large part of the workforce with often very low incomes but is essential in keeping households above the poverty line (Rogan & Skinner 2019:3). However, Ahmed, Shaukat, Usman, Nawaz and Nazir (2018:241) mention that the informal sector is playing a vital role in the world economic system as it covers an enormous part of worldwide employment and opportunities for poor households. As a result, Veitch (2018:1) points out that the informal construction sector is predominant in rural provinces such as Limpopo, Mpumalanga and the Eastern Cape as well as urban provinces such as Gauteng and KwaZulu Natal whereby the demand to own houses is high. Generally, both formal and informal rules produce stable, valued, reoccurring patterns of behaviour that determine how things are done around organisations (Lowndes 2014:1).

In this study, the formal and informal sectors are considered to determine the importance of the construction industry in South Africa.

2.5. THE LEGISLATIVE FRAMEWORK IN THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

Corruption has spread widely in many countries including South Africa whereby public officials are involved in soliciting bribes and manipulating tenders (Bowen, Edwards & Cattell 2012:885). As a result, specialised codes of conduct and ethics that addressed client service delivery and standards of practice among construction professionals were introduced so that professionals must strictly adhere to the principles when executing their duties (Adeyinka, Jagboro, Ojo & Odediran 2014:865). In South Africa, Public Works and Infrastructure Minister, de Lille (2021:1) disclosed that South African construction industries had been left under attack with unfinished projects due to the sector being one of the most corrupt in the country. For such reasons, proper ethical practices to endorse consistency in construction procurement, efficient and effective infrastructure delivery and expansion of developing contractors as well as transformation and sustainability legislative frameworks were implemented (Oke, Aigbavboa, Mangena & Thwala 2017:2077). Those legal frameworks are discussed below.

2.5.1 Construction Industry Development Board

The Construction Industry Development Board (CIDB) is a national body established by an Act of Parliament (Act 38 of 2000) to administer the sustainability and development of construction enterprises through the country (Western Cape Government 2019:1). The CIDB plays an integral role in increased infrastructure delivery through improved coordination and partnerships across both the public and the private sector through its procurement improvement, industry performance, development and transformation mandate (Annual Performance Plan 2021:3).

2.5.2 Preferential Procurement Policy Framework Act

The Preferential Procurement Policy Act was implemented to amend the inequalities inherited from the aforementioned apartheid government by creating a qualifying environment for black South Africans to take part in the mainstream economy (Hlakudi 2015:56). The aim of the Preferential Procurement Policy Framework Act 5 of 2000 is to give effect to section 217(3) of the Constitution by providing the structure for the implementation of the procurement policy anticipated in section 217(2) of the Constitution and to provide for matters connected therewith (Finance Standing Committee 2000:2). As a result, Bowmanslaw (2016:7) mentions that fairness, equitability, transparency, competitiveness and cost-effectiveness are the regulatory ethics required by the Constitution about all public procurement in South Africa.

2.5.3 Council for the Built Environment

The Council for the Built Environment (CBE) is a legislative body established under the Council for the Built Environment Act no. 43 of 2000 to coordinate the six councils for the built environment professions namely architecture, engineering, landscape architecture, project and construction management, property valuation and quantity surveying to promote decent conduct within the professions, transform professionals and guide South African government on built environment-related matters (Staatskoerant 2018:271) The Built Environment Act specifically focused on the following aspects:

- upholding and defending the concerns of the community in the built environment
- stimulating and maintaining a sustainable built environment and natural environment
- promoting continuous human resources development in the built environment
- enabling participation by the built environment professionals in incorporated development in the setting of national goals
- endorsing suitable principles of health, safety and environmental protection within the built environment and
- stimulating sound governance of the built environment professions.

2.5.4 Construction Sector Transparency Initiative (CoST)

The Construction Sector Transparency Initiative (CoST) was founded in 2008 through support from the Institution of Civil Engineers to minimise corruption, maladministration and inefficiency in communal infrastructure by working with governments, industries and the public to acquire more information divulged at all stages of the project cycle (Hawkins & da Graça Ferraz de Almeida 2020:39).

2.5.5 Employment Equity Act

The legacy of apartheid contributed to poor working conditions and discrimination of Black women in the construction industry, which yielded lower earnings and less job security (Floro & Komatsu, 2011:34). Therefore, Madikizela and Haupt (2010:3) believe that legislation such as the Employment Equity Act generated a platform for addressing the little representation of women in the construction industry.

2.6. THE CONTRIBUTION OF THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

The South African construction sector contributes enormously to the socio-economic development and unemployment of the country (Research & Markets 2021:1). These contributions are discussed in detail below:

2.6.1 Infrastructure

The construction industry helps to shape the social lifestyle of the society through the formation of a wide range of buildings, manufacturing plants and infrastructures (Jiang & Wong 2016:850). However, Nel and Rogerson (2018:9) state that the construction industry in South Africa is more involved in projects such as the building of malls, the renewal of central business districts (CBD) and convention centre improvement. For example, when the African National Congress (ANC) took up office in 1994, the government was devoted to improving access to housing and in line with the ANC party's election manifesto, the Reconstruction and Development Programme (RDP) targeted at building one million dwellings within five years was agreed upon (Fieuw & Mitlin, 2018:218). Again, the construction industry satisfies the ever-increasing human demand by constructing and maintaining buildings and infrastructure facilities that are important to urban development (Cheng, Hsu, Li & Ma 2018:10). Generally, the construction industry provides the needed infrastructure for generating goods and services, which are important for growth and development in the country (Vergara & Serna 2018:54).

Although the South African construction sector in 2020 contributed with an added value of approximately 83 billion rands to the country's gross domestic product (Galal 2021:1), the Covid-

19 outbreak has severely disrupted the economy whereby there has been a financial recession in the construction industry and has created unemployment in South Africa and surrounding countries (Biswas, Ghosh, Kar, Mondal, Ghosh & Bardhan 2021:1). The construction industry in South Africa is viewed as a national asset that has to be supported, developed and transformed to meet both the local and global encounters caused by the competitive environment (Oyewobi, Windapo, Rotimi & Jimoh 2019:46). Generally, Baradan, Dikmen and Kale (2019:40) state that the construction industry is considered by economists as one pillar of social and economic improvement in which new housing sales and construction permits determine the growth of the economy.

2.6.2 Employment

The construction industry plays an important role in job creation as well as other sectors of the economy in South Africa (The Construction Industry Development Board 2020:1). For example, Stats SA (2012:11) states that the construction industry employed about 433,000 employees, which is 5.1% of the South African labour force in September 2012. However, Statistics SA (2017:2) shows that the construction industry shed 140 000 jobs between the first and third quarters of 2017. Furthermore, the United Republic of Tanzania (URT) (2015:13) through the Integrated Labour Force Survey (ILFS) Analytical Report, disclose that, in 2014, the construction industry employed 2.1% of the labour force in the formal sector and 6.2% in the informal sector. However, according to Neto and Correia (2019:176), the construction industry in Brazil plays a major role in employment as it is accountable for 8,808,155 individuals, which is 8.59% of the total labour force. Similarly, Sukumar and Kumar (2016:98) refer to the construction industry as a leading sector that consumes a major percentage of the nation's entire employment and also contributes to the income generation of any country.

2.6.3 Economy

From the economic point of view, Sospeter and Kikwasi (2017:1689) mention that the construction industry plays an important role by contributing to national growth through the gross domestic product (GDP), gross fixed capital creation, the establishment of employment opportunities and industrial productivity. English and Hay (2015:146) state that the construction industry in South Africa plays an important role in the South African economy in terms of the production of the country’s infrastructure and immovable capital possessions. McAleenan and McAleenan

(2017:2039) postulate that construction is more like agriculture in the sense that it is the greatest humanising activity that can fulfil or contribute to the satisfaction of the basics such as shelter and employment stated in Maslow's hierarchy of needs. As a result, Xiong, Lu, Skitmore, Chau and Ye (2016:223) mention that the construction industry's activities help improve the wellbeing, financial, social and traditional characteristics of the population. Moreover, Durdyev and Ismail (2017:195) regard the construction industry as a substantial contributor to the sustainable development of the overall economy by attaining basic objectives of growth, job creation and allocation of output and income. Furthermore, Mugwenhi, Mafini and Chinomona (2018:279) state that the CIDB of 2017 declares that the construction industry makes up to a minimum of 50% of the overall national capital investment in South Africa and accounts for at least 3.9% of the Gross-Domestic Product (GDP). Consequently, Crampton (2016:1) argues that the contribution of the construction industry towards the GDP in 2010 decreased from 8% to 3.9% in 2017. As a result, Pan (2018:234) noted that the construction industry significantly contributes to the gross domestic product (GDP) of several republics by increasing productivity, which is very important for the continued development and competitiveness of any country's economy.

2.6.4 Environment

The construction industry is a well-known key user of non-renewable resources and generous source of waste, a contaminator of water and air as well as the main supplier to the garbage dump (Aigbavboa, Ohiomah & Zwane 2017:3004). However, Darko, Chan, Gyamfi, Olanipekun, He and Yu (2017:206) mention that the construction industry uses an excessive amount of energy as well as additional natural resources, which have a substantial influence on the environment, economy and society. For example, in 2010, the construction industry was accountable for up to 32% of the entire global energy consumption, 19% of the whole world energy-related greenhouse gas (GHG) emissions, almost one-third of the complete global carbon discharges and an eighth to a third of fluorinated gas (F-gas) secretions (Zhang, Wang, Hu & Wang 2017:262). As a result, the construction industry activities have substituted the human environment effects such as forest and natural ecosystems with buildings and other infrastructural developments (Low, Gao & See 2014:31). However, Filho, Bezerra and De Oliveira (2017:73) state that construction is the sector accountable for important environmentally friendly effects because of its activities that begin with the removal of natural raw materials for construction and last until the end of their lifespan. Moreover, Xu, Wang and Tao (2019:1078) argue that green structures have attracted substantial consideration since the idea of sustainability was brought up in the construction industry. Furthermore, Mahat, Alwee, Adnan and Hassan (2019:1) mention that green technology (GT) is extremely helpful to the atmosphere as it can reduce greenhouses gases and protect the natural environment and resources that diminish the negative impact of human activities.

2.7 CHALLENGES AND CONTIBUTIONS OF THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

Although the construction industry is regarded (Meshksar, 2012:1; Saidu & Shakantu, 2016:587; Nnadi, Okeke & Alintah-Abel, 2016:12) as the driving force behind the socio-economic development of any nation, it is still faced with challenges that need to be addressed and resolved to ensure the sustainability of the industry. This section discusses the challenges the construction industry is faced with as well as solutions thereof.

2.7.1 Occupational health and safety

Even though the construction industry plays an important socio-economic role, there is a high occurrence of accidents in the industry that makes it an unsafe, dangerous and complex industry (Kheni, Dainty & Gibb 2008:1163; Sánchez, Peláez & Alís 2017:210). Furthermore, the construction industry, according to Aboagye-Nimo and Emuze (2017:2027), has numerous challenges and one of the main challenges is safety issues that differ much and are difficult to investigate. Generally, construction activities, according to Close and Loosemore (2014:816) and Jiang and Wong (2016:852), are labour intensive with high exposure to accidents, thereby making construction an unhealthy and unsafe enterprise for construction employees. However, Okolie and Okoye (2012:1), Diugwu, Baba and Egila (2012:141) and Idubor and Oisamoje, (2013:155) argue that the evident poor level of compliance with Health and Safety (H&S) regulations in Nigeria extremely contributes to the challenging state of safety in the construction industry. Furthermore, Van De Water (2016:45) reported that contact dermatitis is the most common occupational illness amongst employees in the building and South African construction industry and affects productivity.

The 4th industrial technologies (4IT) have the potential to improve the quality of buildings, develop health and safety, advance healthy working conditions, enhance sustainability as well as refine construction productivity and alleviate delays on projects (Keogh & Smallwood 2021:2). In this case, Greeff (2013:39) suggests that safety should be considered an ethical concern that directly opposes the reaching of estimated organisation's objectives or production outputs within the mining and construction industries of South Africa. However, Jaafar, Arifin, Aiyub, Razman, Ishak and Samsurijan (2018:493) remark that a well-organised safety management programme should be implemented to provide a safer working environment to reduce accidents and increase productivity at construction sites. Skin diseases such as dermatitis can be prevented by providing an enhanced working environment, protective clothes and health education as well as by improving professional skills (Bhuiyan, Sikder, Wadud, Ahmed & Faruq 2015:14). Furthermore, Niu, Lu, Xue, Liu, Chen, Fang and Anumba (2019:213) suggest that a coordinated and systematic approach be undertaken by the construction industry to protect the safety and health of all members through prevention of work-related injury, illness and disease. In general, Buniya, Othman, Sunindijo, Kineber, Mussi and Ahmad (2021:65) conclude that it is the responsibility of the construction team to implement safety programmes to guarantee that each project is completed without unnecessary injuries or documented accidents or adversities.

2.7.2 Lack of human and working capital

Regardless of the substantial role of employment and economic role the construction industry plays, the performance of informal and small construction firms is still minimal and this is because of a lack of human and working capital, poor technology, restricted access to distinguished markets and useful resources (Ishengoma & Lokina 2013:33). For this, Forcael, González, Orozco, Opazo, Vargas and Sandoval (2016:53) state that the construction sector offers employment to those with little education or skill and mostly to the poorest people. However, Haseeb, Lu, Bibi, Dyian and Rabbani (2011:41) note that interruptions and loss of construction productivity may also occur because of a contractor's incapability to successfully utilise construction human capital. Furthermore, Lin, Yu, Wu and Cheng (2018:233) report that there has not been an intellectual capital valuation model to tackle the issues of intellectual capital evaluation and business performance in the construction industry.

Fugar, Ashiboe-Mensah and Adinyira (2013:465) suggest that since the operational delivery of construction projects depends on the quality of personnel at all levels and stages of project inception to completion, the industry is labour-intensive and is closely tied to its human capital. Furthermore, Herciu and Ogrean (2015:557) and Ornek and Ayas (2015:1388) indicate that there should be an intellectual capital valuation model in the construction industry for managers to make applicable decisions and manage intellectual assets so that the long-term attractiveness could be maintained.

2.7.3 Poor communication

According to Alsamadani, Hallowell and Javernick-Will (2013:568) and Allison and Kaminsky (2017:2), poor communication about safety hazards can lead to safety measures not being identified thereby increasing risky behaviours and injuries in the industry. Although employers encourage workers to participate in safety communication efforts, desirable levels of communication are often unachieved in construction workplaces due to non-engagement of workers when safety hazards and injury prevention methods are identified (Albert & Hallowell 2017:1). For this, Saini, Arif and Kulonda (2019:17) posit that poor and unpredictable communication in a construction project is a dangerous issue as it increases poor planning and poor design. However, numerous studies globally indicate that poor management of communication is the primary reason for interruptions in construction projects (Ramanathan, Narayanan & Idrus 2012:38; Nasrun, Nawi, Baluch & Bahauddin 2014:8).

Communication is significant for the successful completion of a project and important to determine the skills and applications of effective and well-organised communication in the construction industry (Joubert 2020:1). Zulch (2016:3) suggests that the anticipated communication skills and governance model be used by construction project managers as a potential development tool for enhanced project communication as well as for refining their overall communication skills. Furthermore, Al Nahyan, Sohal, Hawas and Fildes (2019:4) indicate that for projects to be successful, there should be continuous, clear and effective communication practices between stakeholders, customers and the project management team. Finally, Pandit, Albert, Patil and Al-Bayati (2019:2) state that effective safety communication encourages the sharing of significant information, which improves safety behaviours such as hazard awareness and compliance in the construction industry.

2.7.4 Organisational culture

Organisational culture is regarded as the philosophy that enables communication and cooperation amongst employees and assists them in working more productively and make better decisions (Kuo & Tsai 2019:265). Since the construction industry involves numerous players at different stages as well as different ideas and behaviour due to different cultures, this may affect the completion of the project (Sinesilassie, Tabish & Jha 2018:108). For this, Harinarain, Bornman and Botha (2013:22) mention that organisational culture could cause conflict and misinterpretation among stakeholders that could lead to business decisions negatively affecting attractiveness and create a conflicting working atmosphere. Furthermore, Dada (2013:2) looks at conflict as the in-house battle that exists in the construction industry due to different backgrounds between project team members, which generally arise from misaligned desires, communication breakdown or not having the right players in key positions.

Consequently, Cameron and Quinn (2011:46) propose that regardless of culture, the construction industries need to practise teamwork, engage with employees in decision making, share information more often to enhance the smooth running of operations as well as treat their employees as family and clients as partners. However, Azmy (2012:6) argues that teamwork is predominant in the culture of every construction industry to ensure that all projects are successfully completed. Similarly, Ogunbayo (2013:140) mentions that since employees involved in the projects are from diverse backgrounds; it is suitable to resolve conflict within the limits of the project to have the anticipated outcome that will satisfy all stakeholders' needs.

2.7.5 Skill shortage and resource scarcity

South Africa faces challenges such as shortage of skills, financial instability, resource scarcities and failure to deal with main issues such as unemployment, hunger and poverty (Buys & Daluxolo 2012:75; Rust & Koen 2011:2). However, studies have revealed that construction projects are vulnerable to difficulties such as low productivity, poor safety, poor working conditions, inadequate quality, a lack of timely communication and coordination among stakeholders and increasing lawsuits (Olamilokun, Yusuf & Omopariola 2017:1780). The poor use of outdated techniques, the rise in entrepreneurship, harsh working conditions, insufficient training, low involvement of women and globalisation are contributing factors towards the shortage of skilled labour in the construction industry (Afolabi, Oyeyipo, Ojelabi & Amusan 2018:2885).

The construction industry and personnel training have continuously played an important role in improving the competence and throughput of the industry (Ahmadzade Razkenari, Fenner, Hakim & Kibert 2018:77). For this, Training for Manufactured Construction (TRAMCON) programme advanced the skills of the employees in the industry (Ahmadzade Razkenari, Fenner, Hakim & Kibert 2018:78). However, Ahmed, Islam, Hoque and Hossain (2018:1) state that, to maintain the sustainable development of the construction industry, the skillful employee is the major contributor. In general, for the construction industry to attain the role of its main resources namely materials humans and plants, it needs to improve its performance and capability to provide enhanced quality services and innovative products (Kissi & Ansah 2014:29).

2.7.6 Cost escalation

The construction industry clients' cash flow-related problems are perceived as the main reasons for delays while time and cost overruns were the main effects of delays in construction (Hove & Banjo 2018:2). However, Ping, Omran and Pakir (2009:258) along with Adewuyi and Otali, (2013:746) perceive that more construction materials are unnecessarily purchased during the construction process and this negatively affects the delivery of many projects. Therefore, the poor management of materials and waste leads to an increase in the entire cost of building projects (Ameh & Itodo, 2013:745). Poor cost performance has been reported to be a key problem in the industry because of regular increases in project materials (Zarina, Zawawi, Yusof & Aris 2014:62; Chen, Jin, Xia, Wu & Skitmore 2016:3; Suk, Chi, Mulva, Caldas & An 2016:605). Similarly, Seddeeq, Assaf, Abdallah and Hassanain (2019:2) note that design variations, poor labour productivity, inadequate planning and resource shortages are the main issues contributing to time overruns in the industry.

In South Africa, only 35% of the construction industries completes projects within the stipulated budget and realised that the problem can be reduced by applying Pre-Construction Planning (PCP) procedures (Akhund, Khoso, Khan, Imad & Memon 2019:2). Similarly, Khodeir and Ghandour (2019:2) propose that it is essential for the construction industries to develop an accurate cost management strategy as well as apply the Proactive Cost Management strategy. However, Maronati and Petrovic (2019:212) suggest that cost contingency be applied in the construction industry to offer compensation for expected accuracy based on quantities anticipated, unexpected market circumstances, a lack of bidding rivalry and interfacing errors amongst various work groups. Therefore, since construction requires direct decision during the planning and design phase, participation of numerous construction practitioners with a purpose to ensure that the project is completed within the time frame, budget and guaranteed quality is essential (Razi, Ali & Ramli 2019:1).

2.7.7 Technology

Information technology is not applied in the construction industry whereby data like drawings is still presented on papers, meetings held on site where everybody has to be present and modern dwellings are barely constructed due to inadequate information on how to enable the use of information technology (Amusan, Oloniju, Akomolafe, Makinde, Nkolika-Peter, Farayola & Faith 2018:739). Furthermore, Rust and Koen (2011:2) state that the technology used in construction is old and does not keep up with the developments in new sectors of the economy. However, Schweigkofler, Monizza, Domi, Popescu, Ratajczak, Marcher, Riedl and Matt (2018:47) report that the increasing digitisation of information management in the construction industry is viewed as an innovative prospect for new expertise to find valued employment as well as enhance construction developments. Furthermore, Owusu-Manu, Pärn, Antwi-Afari and Edwards (2017:1826) refer to technology transfer as a powerful source of innovation that can provide construction companies with new technologies, which can convert and complement existing technologies appropriately to comprehend and sustain enhanced performance. Generally, innovation is regarded by Ugwuoke and Abbott (2018:1) as a powerful tool for sustainable economic and social change as well as important for sustainable developments in the construction industry.

It has recently been stated by Lat, Mohd Noor, Rahman & Razali (2021:1) that the recent shocking Covid-19 outbreak has opened the eyes of the construction industry towards the industrial revolution (IR 4.0). The same authors, mention that the impact of Covid-19 forces all businesses including the construction industry to move towards IR 4.0. through the application of Building Information Modelling (BIM), the usage of drones or Unmanned Aerial Vehicles (UAE) to monitor construction sites, virtual meetings among stakeholders and the use of prefabrication works such as Industrial Building System (IBS). For this, Oladokun, Asuquo and Adelakun (2021:45) posit that the use of digital technologies in the construction industries will lead to improved construction project performance, thus, reducing cost and time overruns, providing greater viability and productivity that will lead to improved performance.

Therefore, tools such BIM have been implemented in the industry to modernise practices (Chalhoub & Ayer 2018:1). Radio Frequency Identification (RFID) and wireless networks such as ZigBee have been used to capture real-time construction site conditions while cyber-physical systems have been advanced to perfect the difficulties of construction safety (Wu, Gibb & Li 2010:845; Lu. Huang & Li 2011:101; Flanagan, Jewell, Lu & Pekericli 2014:12; Yuan, Anumba & Parfitt 2016:1). In general, Afolabi, Ibem, Aduwo, Tunji-Olayeni and Oluwunmi (2019:2) mention that the occurrence of information and communication technology (ICT) in the construction industry has assisted professionals in creating a reasonable position in their activities compared to their old-fashioned counterpart.

2.8 PREVIOUS SUPPLY CHAIN MANAGEMENT-RELATED RESEARCH IN THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

Supply chain management is defined by Ojo, Mbohwa and Akinlabi (2014:148) as the incorporation and management of supply chain organisations and undertakings through supportive organisational interactions, effective industry processes and productive stages of information sharing to produce high-performing value systems that afford members a sustainable competitive advantage. Similarly, Pillay and Mafini (2017:4) postulate that a construction supply chain is a linkage of organisations contracted to work together to make a distinction of objectives and goals qualified for construction projects. As a result, previous studies propose that change in culture and a move towards teamwork, collaboration and supply chain management of projects gave rise to the adoption of strategies that created an opportunity for collaboration and long-term relationships but these could not develop firm performance in the construction industry in the Gauteng province (Donohoe & Coggins, 2016:259; Kumar, Banerjee, Meena & Ganguly 2016:588; Wang, Wang, Jiang, Yang & Cui, 2016:5588; Chang, Tsai, Chen, Huang & Tseng 2015:868; Challender, Farrell & Sherratt 2014:257; Meng, 2013:423). In this regard, Du Toit and Vlok (2014:2) propose that to enhance performance and throughput in the construction sector, the latest studies have to emphasise the significance of embracing effective supply chain management within construction companies. The same authors further posit that since supply chain management incorporates the management of numerous activities and involves several role-players across divisional functions and organisations, the following supply chain management activities should be performed to improve the performance of the construction industry in the Gauteng province.

Collaboration and long-term relationships (CLR) are viewed by Ayegba, Kamudyariwa and Root (2018:2180) as some concerns for the construction industry that may be regarded to the industry's response to the faults of traditional contracting practices. However, the nature of supply chain management (SCM) is that of synchronised decisions and undertakings used to integrate suppliers, manufacturers, transporters, retailers and customers to ensure that the right product or service is distributed in the right quantities, to the right location, at the right time, to reduce costs while fulfilling the end-user's requirements (Singh, Singh, Mand & Singh 2013:85). As a result, Butković, Kauric and Mikulic (2016:798) mention that to enhance performance and throughput in the construction sector, the current studies should emphasise the significance of embracing effective supply chain management within construction companies.

The adoption and implementation of lean principles in the construction industry must eradicate waste, meet and exceed consumer requests, focus on the entire value stream and chase excellence inimplementating construction projects (Construction Industry Institute 2011:1). However, previous researchers have determined that the application of lean in the construction industry can minimise waste, enhancing quality and increasing value for money in the construction industry. Therefore, the adoption of lean concepts is very important in the industry (Sospeter & Kikwasi 2017:1689). Although lean is a way to create more value for customers using fewer resources by maximising customer value while minimising waste such as defects, over-processing, overproduction and handling is caused by a lack of skills by construction employees, thus should be avoided (Fourie & Umeh 2017:178).

Although, the previous studies focused on the recycling, reuse and disposal progressions for construction and demolition waste (CDW), studies focusing on the usage of transportation for CDW management did not evaluate the economic and environmental aspects of recycling and reusing CDW to manufacture new products but only considered decreasing costs and productions from construction companies (CDW) (Kucukvar, Egilmez & Tatari 2014:500; Bakshan Srour, Chehab & El-Fadel 2015:71; Nwachukwu, Ronald & Feng 2017:924; Hossain, Wu & Poon 2017:325) as well as to obey governmental regulations to escape penalties (Yuan, Huang & Xu 2016:856). Therefore, since the aim of this study is to improve firm performance in the construction industry in the Gauteng province, arguably, previous studies failed to realise how performance plays an important role in the construction industry.

2.9 CONCLUSION

The purpose of this chapter was to analyse the background of the construction industry in the Gauteng province. In South Africa, the construction industry remains vital for the socio-economic development of the country. In fact, the construction industry plays an important role in the economy of South Africa and the neighbouring countries by creating jobs, building private infrastructures such as environmental and affordable houses as well as public infrastructures like roads, schools and hospitals. Thus, the study illustrates how the construction industry contributes to a country's Gross Domestic Product (GDP) through the creation of jobs and supplying infrastructure. Although the construction industry plays in the economy of South Africa, there are challenges facing this industry such as corruption, safety issues, organisational culture, skills shortage and resource scarcity. Hence, there are legislations, policies and Acts in place to create a platform of how professionals should behave when executing their duties as well as creating a conducive work environment. There are also supply chain management processes that must be implemented to improve performance and ensure sustainability in the construction industry. According to the researchers knowledge there is a dearth in literature for the main indicators in this study. These include supplier coordination, customer coordination and coordination effectiveness explored in this study to enhance the performance of the construction industry. The next chapter of this study explores the literature on the research constructs. The relationship that might exist between the variables namely supplier coordination, customer coordination, coordination effectiveness, operational performance, financial performance and social performance is also explored.

CHAPTER 3

LITERATURE REVIEW ON THE RESEARCH VARIABLES

3.1 INTRODUCTION

In chapter two, the background of the construction industry was analysed. In this study, it is noticed that former studies have clarified numerous theories to demonstrate the performance of the construction industry. The current chapter is subject to three sectors. The first segment discusses the theoretical framework, which is the game theory. The second segment elaborates on the literature review of the research constructs, which are supplier coordination, customer coordination, coordination effectiveness, operational performance, financial performance and social performance. The last segment of this chapter examines in detail the conceptual framework and hypotheses development.

This chapter aims to analyse if there are positive and significant relationships between the constructs as illustrated by the conceptual framework of this study. The chapter used an extensive variety of sources from local and international literature as it reflects on the different issues of performance in the construction industry. Thus, the chapter is aimed at divulging an understanding of the developments regarding supply chain coordination and firm performance in the construction industry in the Gauteng province. The chapter concludes with a brief conclusion of the entire literature.

3.2 THEORETICAL FRAMEWORK

This section analyses literature on game theory in the construction industry. The study is focusing on how individuals interrelate in circumstances involving a change in which the objective is mutually beneficial. The discussion further focuses on the outcomes of the game theory, which are communication, coordination, joint decision-making and knowledge sharing.

3.2.1 Game Theory

This study is based on the game theory developed by Von Neumann and Morgenstern (1944:1), which focuses on how individuals interact and make strategic decisions. Game theory is a concept that examines conflict situations, collaboration amongst teams and choices they make (Webster 2009:1). The same author further states that game theory provides a common language to formulate, structure, analyse and realise diverse strategical situations. However, Kundu, Jain, Kumar and Chandra (2014:799) emphasis that game theory is the ideal method for collaborating activities such as information sharing decisions, revenue sharing problems and supplier buyer relation management in the construction industry. Furthermore, game theory is defined by San Cristóbal (2015:46) as the study of mathematical models to resolve conflict and boost cooperation among decision-makers as well as address certain difficulties facing the construction industry in a cooperative structure. For this, Barough, Shoubi and Skardi (2012:1588) mention that game theory is used in an accurate and compliant way to find the best choices that will lead to the anticipated result. Similarly, Dominici (2011:3524) postulates that the game theory aims to offer a proper language to describe mindful and goal-oriented decision processes that involve one or more players in achieving one goal. Moreover, Barough, *et al.* (2012:1586) further explain how game theory can identify the conducts of parties involved in the construction project and describe how collaborations of diverse parties such as stakeholders (client), main contractors or subcontractors can lead to project success.

Several authors have applied the game theory to solve difficulties in construction engineering and management (Kaplińsk & Tamošaitienė 2010:350). Given this, Zavadskas, Peldschus, Ustinovičius and Turskis (2004:195) state that the game theory solves construction complexities and management complications. However, Peldschus and Zavadskas (2005:109) investigate uncertainties in terms of unclearness of information and a lack of uniqueness in construction. Further, Homburg and Scherpereel (2008:294) examine the cost of combined risk capital to be assigned for performance measurement. Moreover, Meszek (2008:345) and Gu, Vestbro, Wennersten and Assefa (2009:323) analyse investment projects strategies for energy-efficient housing improvement from an architect's viewpoint.

Consequently, Blumentritt, Mathews and Marchisio (2012:52) state that the principal use of the game theory is to model decisions and predict outcomes in interactions among construction participants to ensure the successful implementation and completion of the project. Furthermore, Peckiene, Komarovska and Ustinovicius (2013:891) point out that game theory enables the construction industry to engage in cooperative decision-making methods to avoid uncertainties such as risk outcomes in terms of cost or time overruns as well as legal disputes. Similarly, Cohen, Pearlmutter and Schwartz (2017:123) state that game theory offers tools and techniques for resolving problems of conflict or cooperation between decision-makers such as suppliers, manufacturers and consumers as well as set up rules that will persuade construction participants to improve environment-related problems.

In general, Myerson (1991:1) states that the game theory in the construction industry is used to identify the activities that are accountable for the interruptions in a project and distribute the costs amongst such activities accordingly. Below, the outcomes of the game theory that impact the construction industry are discussed.

3.2.1.1 Communication

Effective communication is required to deliver a project on time and to avoid failure in attaining the objectives of a project, therefore, the project teams should work together and depend on each other to achieve the set goals for the construction industry (Malik, Taqi, Martins, Mata, Pereira & Abreu, 2021:2). As a result, Popoola, Atayero, Badejo, Odukoya and Omole (2017:76) and Lekan, Opeyemi and Olayinka (2013:239) mention that the construction industry is a multifaceted industry that requires a combined communication structure amongst numerous construction representatives to achieve a successful project. For this, Senescu, Aranda-Mena and Haymaker (2012:1) postulate that project characteristics such as quick information exchanges, transparency, uniformity of information among team members, joint decisions, collective process knowledge and planned coordination can be achieved through effective communication. Along these lines, Cohen, Pearlmutter and Schwartz (2019:2) suggest that the application of the game theory in the construction industry is significant and suitable as it offers tools for resolving difficulties of conflicting interests as well as collaboration among decision-makers.

Communication is defined by Nipa, Kermanshachi and Kamalirad (2019:2) as an interchange of opinions and information from one source to another. He, Jia, McCabe and Sun (2019:3) define communication as the process of sharing information, thoughts and feelings amongst leaders and team members to successfully provide expert knowledge and messages. Kamalirad and Kermanshachi (2018:1) posit that communication plays an important role in linking personnel, information, resources and duties to each other. Consequently, Korkmaz and Park (2019:1) state that it is important to communicate safety information through well-designed coordination to keep workers aware of potential dangers and to safeguard them from workplace hazards in the construction industry.

Generally, the game theory, according to Michael-Tsabari and Weiss (2015:31), is used as a collaboration between the initiator and the successor regarding the choices of moving forward or holding back the progression process in the construction industry. This means that by having the perfect communication between initiator and successor, the two parties can openly discuss the issue, thus achieving the main objective of the industry (Sawyer 2021:1). Moreover, Han, Nivato, Saad, Basar and Hiorungnes (2012:37) mention that the game theory was implemented in the construction industry to explore well-organised wireless network communications to avoid human mistakes that could lead to dangerous and crowded movement environments.

3.2.1.2 Coordination

Coordination is a carefully structured method of handling resources so that an outstanding standard of operational effectiveness might be attained in any given project (Siddique, Ahad & Ud Din 2019:356). However, Mehrbod, Staub-French, Mahyar and Tory (2019:196) define coordination as the management of building systems in which components of building methods are channelled to avoid complications and to conform to diverse design and operations standards. Thus, Kubicki, Guerriero, Schwartz, Daher and Idris (2019:164) posit that coordination and communication are considered a key to the successful completion of any project, hence project managers have to consider suitable ways to involve shareholders in joint decision-making. Furthermore, McAdams (2009:219) state that the game theory identifies why team members in the construction industry need mechanisms for coordination as well as cooperation to combine their actions in a way that they reach mutually desired outcomes. Even Soltani, Sadiq and Hewage (2016:392) propose an application of game theory in the construction industry as an effective method to be considered for stakeholders' collaboration and coordination of resources. For this, Govindan and Popiuc (2014:327) confirm that the application of the game theory improves coordination of supply chain players such as manufacturer and distributor situations, which enhances the performance of the construction industry.

3.2.1.3 Joint decision-making

Joint decision making is a knowledgeable process of choosing the best choice amongst various choices and results in an outcome that can be in form of an action that needs to be implemented (Verma 2014:171). Since the implementation of the building project entails the gathering and accumulation of activities at an enormous scale for it to become a success, the construction industry involves a lot of tasks, therefore, requires good use of information and communication technology tools for the project to become productive (Tanga, Aigbavboa, Akinradewo, Thwala & Onyia 2021:1) As a result, Marold (2015:3) mention that the outcome of the decision is also affected by situational factors such as time and pressure and intragroup factors like the active leading of the decision-making process and clear or understood communication of uncertainty. Thus, in the construction industry, specialists make joint decisions on demand and production capacities with suppliers that have a lower price and a shorter distance between the plants and construction sites to control the procurement and transportation costs (Xu, Zhu, Zhao & Xie 2019:501).

Given the position by Rapoport (2012:1) that the game theory encompasses a set of decision makers called players, strategies and outcomes, the game theory plays an important role in engaging all team players to make mutual decisions in the successful implementation and completion of the project in the construction industry. As a result, Petrosjan and Mazalov (2012:1) state that the game theory has been applied in the construction industry to understand, analyse and model the decision-making procedures. For this, McGinty, Milam and Gelves (2012:328) posit that the game theory offers resolutions for a reasonable allocation of costs and benefits among shareholders to control decisions made within the construction industry. Furthermore, Liang, Peng and Shen (2016:1305) state that the game theory is broadly used in studies associated with sustainable development and green building, especially about the relationship between the shareholders and their decision making.

3.2.1.4 Knowledge sharing

Knowledge sharing refers to effective and well-organised flows of information amongst an organisation and its members in a supply chain (Chang, Wong & Chiu 2019:3). For this, Pai and Tsai (2016:40) and Cigdem, Nowicki, Sauser and Randall (2018:169) mention that the purposes of knowledge sharing comprise sharing of mutual benefits between team members and reducing the bullwhip effect whilst improving the construction industry's performance. As mentioned by Mehrbod *et al*. (2019:196) the design and construction of buildings is an extremely complex process; it requires enormous amounts of knowledge that must be shared amongst numerous players and used in several ways to ensure successful completion of projects.

Generally, knowledge sharing is effective in project delivery, enhances organisational attractiveness, stimulates innovation and empowers teams (Saini, Arif & Kulonda 2019:16). As for Li and Jhang-Li (2010:1054), the game theory has been applied to the issues of knowledge sharing in several construction industries and this has proven to yield improved performance and advanced levels of innovation than organisations that do not practise knowledge sharing. Moreover, Ghobadi and D'Ambra (2011:310) state that the game theory application in the construction industry has had a fruitful influence on encouraging knowledge sharing that descriptive aspects such as conceptual framework may be active at modelling collaboration within the industry.

3.3 RESEARCH CONSTRUCTS

This section will analyse the literature concerning the elements observed in this study. It is imperative to analyse these constructs as this will allow the provision of empirical evidence and results linked to the respective variables given their relevance to the study. Identifying the antecedent elements influencing firm performance being the purpose of this study, the present study has established supplier coordination, customer coordination as well as coordination effectiveness as possible aspects impacting construction performance. These performance areas are operational, financial and social performance. This provides the foundation for discussing the respective variables in this section. Furthermore, supply chain coordination will be discussed as the main construct for supplier coordination and customer coordination in this study.

3.3.1 SUPPLY CHAIN COORDINATION

Supply chain coordination (SCC) is the process that reflects the collaboration extent between the manufacturer and its supply chain (SC) associates and among its internal activities (Li, Zhao & Huo 2018:47). However, Mathu (2019:2) views supply chain coordination as the synchronisation of activities within an organisation and external relationships with other supply chain partners. Furthermore, Bellamy, Ghosh and Hora (2014:358) define supply chain coordination as the process that improves design perceptions and speeds up the pace of product development. Similarly, supply chain coordination is linked to innovation, enhanced market orientation and improved knowledge integration (Mostaghel, Oghazi, Patel, Parida & Hultman 2019:1).

Based on the above definitions, Chen, Zhao, Tang, Price, Zhang and Zhu (2017:73) postulate that supply chain coordination is a system in which the construction industry through the supply chain share information, make tactical coalitions to advance performance and decrease total costs and inventories. However, Lavikka, Smeds and Jaatinen (2015:206) define supply chain coordination as the incorporation of an organisation’s diverse activities to accomplish a mutual goal when uncertainties occur. Moreover, Fulford and Standing (2014:315) regard coordination as lifeblood of competency developments within the construction industry as it allows integration and automation of processes that improve profits for all the construction participants. To support this study, the definition of Chen, Zhao, Tang, Price, Zhang and Zhu (2017:73) is used as an operational definition.

A well-organised relationship amongst supply chain activities is required to achieve the benefits of supply chain coordination and this linkage should be subject to the effective application of several practices to attain an integrated supply chain within the construction (Zailani, Iranmanesh, Foroughi, Kim & Hyun 2019:2). For this. Dietrich, Kujala and Artto (2013:7) view coordination as being able to manage dependencies amongst activities to emphasise information-processing actions such as communication. Furthermore, Berntzen and Wong (2019:974) view supply chain coordination as the use of tactics and conduct patterns designed to incorporate and align the knowledge, actions and purposes of interdependent team members towards a mutual goal. Hence, Nawi, Lee, Mydin, Osman and Rofie (2018:143) suggest that to avoid unnecessary delays and reworks of construction projects, effective coordination of data and information sharing is highly required.

Rahman (2013:69) state that the crucial viewpoint in the prefabricated construction supply chain management (PCSCM) is to coordinate independent contractors to avoid uncertainties that always occur in construction projects. Similarly, Zhai, Zhong and Huang (2018:193) add that the adoption of prefabrication helps in coordinating channel members to overcome challenges that impede the success of logistics and increase the benefits of completing projects successfully. Shi, Zhu and Li (2018:1) add that proficient application of prefabrication permits the major construction projects to reach greater productivity, enhanced quality and substantial time-cost savings.

Generally, Zhang, Zhao, and Qi (2014:146) and Xu, Li, Govindan and Yue (2018:3715) view supply chain coordination as the collaboration and teamwork with supply chain partners such as suppliers and customers in forecasting undertakings and performance developments. However, Chen, Lei, Wang, Teng and Liu (2018:6513) consider supply chain coordination as fundamental within the construction industry that saves time and costs to increase supply chain effectiveness. Similarly, Singh, Garg and Sachdeva (2018:150) postulate that supply chain coordination enables construction participants to focus on mutual objectives to improve supply chain performance in terms of enhanced revenue, reduced costs and increased flexibility to tackle demand uncertainty. Several researchers found that for the construction industry to achieve mutual goals, they need to acknowledge the significance of supply chain coordination to pursue greater capabilities in sourcing, planning, producing and distributing (Abdi & Aulakh 2017:773; Chen, Zhao, Tang, Price, Zhang & Zhu 2017:73 & Liao, Hu & Ding 2017:143).

For this, Huo, Zhang and Zhao (2015:729) state that supply chain coordination entails supplier and customer coordination, which are the core competencies of cooperation to achieve collaborative and synchronised processes within the industry. Therefore, the focus of this study is to analyse how supplier coordination, customer coordination and coordination effectiveness contribute towards the performance of the construction industry in the Gauteng province.

3.3.1.1 Activities of supply chain coordination

Lavikka, Smeds and Jaatinen (2015:206) define supply chain coordination as the integration of different tasks to accomplish one common goal. Those activities include planning, sourcing, execution, processing and reduction of delays. Hence, due to the complexity of the construction industry, such activities are important for the successful implementation and completion of projects whilst enhancing the overall performance of the construction industry (Popoola, Atayero, Badejo, Odukoya & Omole 2017:76; Lekan, Opeyemi & Olayinka 2013:239).

Planning

Planning is the first and most important task for every project manager to avoid uncertainties such as poor process coordination, hazardous working environments, unnecessary wastage and inconsistency in the construction process (Brady, Tzortzopoulos, Rooke, Formoso & Tezel 2018:1278). As such, Schwabe, Teizer and König (2018:205) posit that planning is usually performed just before the beginning of construction work to place temporary resources like containers, power sources and storage areas to most effective, efficient and safe use during operation. However, Hansen, Too and Le (2018:23) suggest that project planning is the second phase in a project life cycle that involves bringing together and preparing a set of plans to direct the project team through the execution and closure phases of a project.

The planning stage helps project managers in developing a cooperative state of management that tactically coordinates the predictable project objectives with other long-term project initiatives, thus attaining successful project performance (Patanakul & Shenhar 2012:7; Thamhain 2014:32 & Aldhaheri, Bakchan & Sandhu 2018:1227). Furthermore, Bansal (2011:66) posit that effective planning in the construction industry helps in reducing accidents and ill health of teams as well as decreasing unnecessary costs and interruptions. Thunberg, Rudberg and Gustavsson (2017:103) postulate that appropriate planning for supply chain management help establish communication and coordination amongst project teams and consequently enhances performance as well as decrease the project costs and other overruns.

Purchasing

Purchasing is one of the principal activities that has a direct influence on the performance of every industry (Schoenherr, Modi, Benton, Carter, Choi, Larson, Leenders, Mabert, Narasimhan & Wagner 2012:5). Tolstoy and Axelsson (2018:163) posit that purchasing is a strategic activity when compared to other organisation's functions, hence it opens up new opportunities for industries to become more cost-effective. Similarly, Rezaei and Lajimi (2019:419) state that purchasing is more involved in strategic activities and decisions such as supplier relationship management. Moreover, Chavan and Chaudhuri (2016:1473) report that previous researchers defined purchasing as an activity of information exchange that increases value in terms of important feedback to the whole supply chain. For this, Frösén, Jaakkola, Churakova and Tikkanen (2016:92) postulate that it is imperative for the construction industry to continually examine changes in customer preferences that help manage demand uncertainty throughout the project life-cycle as customer needs change over time.

Purchasing process, according to Janipha, Ahmad and Ismail (2015:31), help industries to obtain the best-evaluated cost for quality and services, minimise the risk and accountability as well as maximise the market share for the construction industry. Furthermore, purchasing helps in identifying the strategic nature of purchasing items, improving negotiation skills, decreasing the risk of failure in the supply markets as well as managing the relationships between buyer and supplier (Ghanbarizadeh, Heydari, Razmi and Bozorgi-Amiri 2019:1285). In general, Čuš-Babič, Rebolj, Nekrep-Perc and Podbreznik (2014:346) postulate that coordination and integration amongst supply chain partners are very important as they enable the construction sites to purchase and receive prefabricated building essentials from the same manufacturer. Finally, the key role of purchasing in the construction industry is to achieve perfect order fulfilment (POF), which is considered to meet customers' requirements in terms of order quantity and items, delivery date, time and place, documentation and condition as per specification, correct shape and with no damage when accepted by the customer (Mishra & Sharma 2014:102). Since the outbreak of Covid-19 has affected the construction industry's buying behaviour, new purchase patterns such as e-procurement need to be identified to help the procuring team in developing suitable strategies to respond to fundamental consumer changes (Valaskova, Durana & Adamko 2021:1).

Implementation and control

The customer is the one who has a greater influence on the specification of the final product and can determine how physical functions concerning manufacturing and assembly on the construction site should be carried out (Ferreira, Arantes & Kharlamov 2015:377). As such, Mulla and Waghmare (2015:48) suggest that effective and significant control must begin at the design stage and should be supported by appropriate and precise estimation and data analysis. However, Griffith, Stephenson and Watson (2014:3) suggest that for the construction industry to succeed and have a competitive advantage, it must have a high degree of sustainability and this can be achieved by implementing total quality management initiatives. Consequently, Babalola, Ibem and Ezema (2019:34) state that the lean production method and its applications is beneficial in designing and carrying out construction activities to reduce waste in materials, time and struggles to attain greater cost-effective value. Similarly, Tezel, Koskela and Aziz (2018:268) note that the application of the lean production approach enable the construction industry clients to experience thoughtful budget cuts and performance enhancement.

For the construction industry to achieve its project objective, waste and non-value-adding activities must be eliminated and efficient two-way communication among participants must also be effective (Adamu & Howell 2012:3). In general, Rajasekar (2014:171) posit that coordination of activities, streamlining of processes, aligning the organisational structure as well as keeping employees motivated and committed are main tasks towards achieving the successful completion of the project.

Materials management and reduction of delays

Material is the core component of any construction project and if it is not correctly managed, it can cause a huge project cost variance (Gulghane & Khandve 2015:60). As such, Phani, Mathew and Roy (2013:400) posit that the total cost of the project should be well controlled by taking remedial actions to avoid cost overruns. Furthermore, material management in the construction industry is a practice that concerns mainly managers and designers on how to control costs without any emphasis on material management measures (Wahab & Lawal 2011:249; Harris, McCaffer & Edum-Fotwe 2013:11; Kerzner 2013:707).

However, Safa, Shahi, Haas and Hipel (2014:64) define construction materials management as the planning and monitoring of all activities to confirm that accurate quantity and quality of materials and equipment are obtainable at a sensible cost and when required. The same authors emphasises that resourceful materials management system can ensure that the quantities of materials available are enough for construction needs and can decrease surpluses after the project, thus leading to great cost savings.

Similarly, Phu and Cho (2014:2134) define materials management practice as a process that synchronises planning, evaluates requirement, assists in sourcing, procuring, transporting, storing and handling of materials as well as reducing the waste to improve productivity by decreasing the cost of material within the construction industry. For this, the same authors emphasise that the organisation must be structured to provide suitable work performance with material personnel to stimulate the decision-making process as well as to utilise resources in the best way.

Just-in-time (JIT) was suggested by Lindblad, Bolmsvik, Pettersson and Wiberg (2018:253) to be applied in the construction to allow an efficient delivery plan that will create better materials handling at construction locations to reduce on-site storage and provide quicker amendments should mistakes occur during delivery. In general, Harrington, Voehl and Wiggin (2012:353) postulate that the application of total quality management (TQM) will help the construction industry to achieve customer satisfaction in aspects such as process improvement, cost-effectiveness, customer and supplier involvement as well as teamwork, training and education.

3.3.2 The importance of supply chain coordination

The construction industry uses coordination mechanisms to organise and control activities to accomplish supply chain performance goals such as information and technology sharing, joint creativities, risk management and combined decision-making (Alves, Schultz & De Barcellos 2018:4). Thus, Allaoui, Guo and Sarkis (2019:762) affirm that supply chain coordination enables improved usage of resources, reduced operating costs, increased profits, better customer satisfaction and improved effectiveness in product improvement. Liao (2019:547) supports that the supply chain coordination in the construction industry is used to resolve the difficulties in the project construction operation and to connect all the members of the project and handle project risks in time.

Using the supply chain coordination in the construction industry improves the quality, robustness and reliability of the concrete structures and decreases the total time of the construction and the cost (Suchithra & Malathy 2016:286). Liao, Hu and Ding (2017:144) state that supply chain coordination improves communication to reduce uncertainties and high inventory levels, shortens lead-time of high-quality goods and services at a reasonable cost as well as engages suitable business partners. Furthermore, Zhou, Dan, Ma and Zhang (2017:787) indicate that supply chain coordination plays a major role in examining mechanisms that can resolve the misuse of incentives by making the construction participants perform according to the set rules. In general, supply chain coordination models, according to Basiri and Heydari (2017:233), improve the channel members' decisions to enhance the total supply chain profit within the construction industry.

Modular coordination is defined by Singh, Sawhney and Borrmann (2018:16) as a dimensional coordination system used for sizing and placing building elements within a three-dimensional (3D) reference system in the construction industry. However, Azhar and Behringer (2013:2) define Building Information Modeling (BIM) as a collaborative device used by architectural, engineering and construction (AEC) industries to manage construction projects by improving planning processes as well as help in designing. For this, McGraw Hill Construction's (2014:20) usage of BIM process plays a significant role in coordinating activities throughout the design phase and improves the value of the built environment by permitting designers to make informed decisions at early phases of design. Furthermore, Building Information Modeling (BIM), according to Rezahoseini, Noori, Ghannadpour and Bodaghi (2019:6), maximises adaptation of design and construction processes whilst decreasing the costs and time of the project. Furthermore, Latiffi, Mohd, Kasim and Fathi (2013:2) report that BIM use in a construction project helps in the effective management of the project by encouraging collaboration among construction players and enabling the design process decision.

BIM implementation may influence all the processes within the project organisation from beginning to completion (Eadie, Browne, Odeyinka, McKeown & McNiff 2013:145). Manzoor, Othman, Kang and Geem (2021:1) postulate that execution of BIM is a feasible technique to advance high-rise building sustainability performance. As a result, Figure 3.1 represents how BIM implementation impacts all stages of the construction industry.

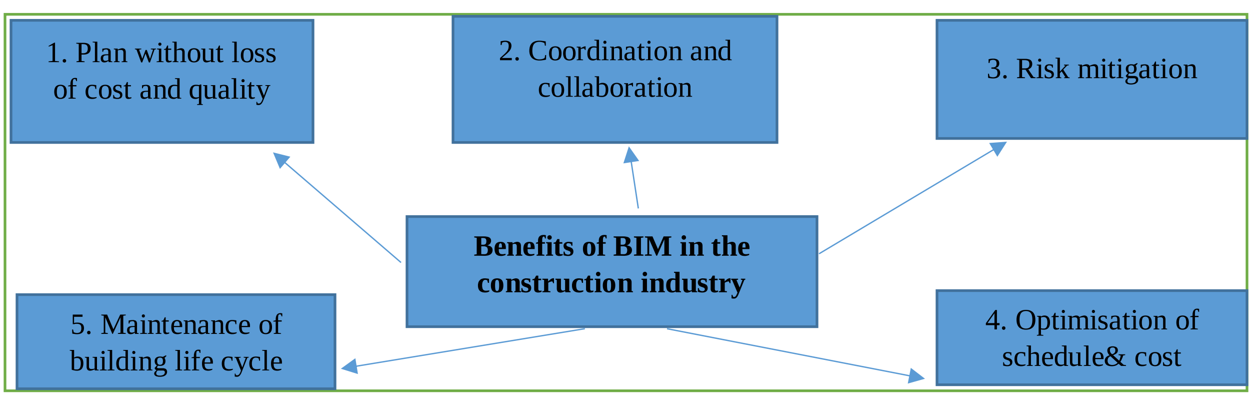


Figure 3.1: BIM Implementation

Source: McGraw Hill Construction (2014:20)

Figure 3.1 represents the role played by the BIM process to coordinate activities throughout the design phase and improves the value of the built environment by permitting designers to make informed decisions in the early phases of design. Based on the model above, the benefits are presented as follows: planning without loss of cost and quality, coordination and collaboration, risk mitigation, optimisation of cost schedule and cost as well as maintenance of building life cycle.

3.3.2.1 Planning without loss of cost and quality

BIM is used in the planning process to provide simple, more detailed and precise cost estimations of the project while reducing time and expenses (Plebankiewicz, Zima & Skibniewski 2015:537). Teo and Cho (2016:268) state that BIM improves route planning in the construction industry as it holds specific measures as well as information of building components, thus treated as a perfect source of longitudinal indoor information. For this, Peckienė and Ustinovičius (2017:851) report that BIM can be used for building spatial planning to allow designers to assess the planned building and how it can influence the environment as well as how the environment can influence the building. Gerges, Mayouf, Watson, John, Ahmed, Selim and Wenman (2019:54) point out that the planning stage of a project is critical to guarantee that all participants understand their roles and responsibilities as well as knowing that the project can run smoothly from the beginning to completion, thus avoiding delays, re-work and unhappy clients.

3.3.2.2 Coordination and collaboration

Accurate collaborative design and construction undertakings enable information sharing, knowledge creation, technological coordination as well as resource allocation to function effectively and eliminate unnecessary conflicts (Liu, Van Nederveen & Hertogh 2017:687). For this, Isikdag and Underwood (2010:544) state that the BIM support for coordination has become an unavoidable need due to the uneven nature of the design and construction environment as well as enormous information, which needs to be shared among the numerous members. Therefore, BIM plays an important role in collaborating members and coordinating resources to achieve one common goal of the construction industry.

3.3.2.3 Risk mitigation

Risks are actions that are likely to affect supply chain performance objectives such as network-wide service levels, awareness and competence (Tummala & Schoenherr 2011:6). For this, BIM can be connected with time to put on the construction process and identify risks in the procurement process and propose developments before the real construction process begins (Azhar, Khalfan & Maqsood 2015:19 & Kassem, Dawood & Chavada 2015:45). Zou, Kiviniemi and Jones (2017:89) state that to reduce the possibility of hazards occurring and achieve project goals successfully, utilisation of BIM and BIM-related tools is used to assist in early risk identification, accident prevention as well as risk communication. Then, it appears imperative for the construction industry to consider the implementation of BIM to avoid risks that may impact the successful completion of the projects.

3.3.2.4 Optimisation of schedule and cost

BIM optimises different qualitative, financial and graphical aspects to guarantee productivity and to give exact forecasts essential for useful coordination of numerous disciplines and formation of the optimal labour force (Ustinovičius, Puzinas, Starynina, Vaišnoras, Černiavskaja & Kontrimovičius 2018:17). Ismail, Drogemuller, Beazley and Owen (2016:65) mention that BIM contributes to the preparation of construction cost estimations, which is the most valued quantity surveying exercise to determine the project costs. Given this possibility, it is pertinent to consider how the utilisation of BIM in the construction industry can save costs and enhance productivity.

3.3.2.5 Maintenance of building life cycle

BIM uses building life cycle management to manage a building and its lifecycle including materials, construction process, quality of workmanship, analysis of results, test specifications, environmental component information and quality standards as well as manufacturing procedures (Rodrigues, Matos, Alves, Ribeirinho & Rodrigues 2018:84). Doumbouya, Gao and Guan (2016:75) claim that BIM maintains accuracy and reliability even when the changes take place within the coordination and construction process. Furthermore, Gundes (2016:917) posits that life cycle analysis is used as the decision-making support tool to assess the possible environmental impacts of a product or a process during the entire life cycle.

3.3.3 Challenges of supply chain coordination

In the view of Bashir, Suresh, Oloke, Proverbs and Gameson (2015:10), construction industry as any other industry faces different challenges such as a lack of trust, poor communication and a lack of collaboration. A clear understanding of these challenges is explained in the following section.

3.3.3.1 Lack of trust

According to Nofer, Gomber, Hinz and Schiereck (2017:183), trust plays an important role among supply chain members since there is no need to assess the honesty among participants in the industry and information is easily viewed and compared. Thus, Li, Wang and Yang (2019:3) affirm that a lack of trust amongst supply chain members leads to poor attractiveness and productivity in the construction industry. Lawani, Hare and Cameron (2019:5) mention that a lack of trust in the supply chain coordination leads to unwillingness and vulnerability of management as well as resources being utilised for non-productive issues. As a result, Saini, Arif and Kulonda (2019:18) state that a lack of trust leads to poor partnership, entrusted partnering and unproductive process integration in the construction industry. Generally, a lack of trust will lead to the following:

- Lack of support amongst workers
- Lack of learning abilities
- Lack of decision-making to enhance competitiveness
- Lack of confidence, dependability and honesty
- Short project life cycle for the construction industry.

3.3.3.2 Poor communication

Poor communication is one of the greatest common project risks in construction that contributes towards poo performance and a high turnover of team members (Senaratne & Ruwanpura 2016:3). Under these circumstances, Ogunde, Olaolu, Afolabi, Owolabi and Ojelabi (2017:3) indicated that poor communication is a core constraint that the construction project management is faced with.

- It will harm the performance of project team stakeholders
- Make it difficult for stakeholders to meet clients' requirements
- Project requirements in terms of time and budget will not be met
- Inaccuracies that can cause re-work, causing cost and schedule overruns may develop.

3.3.3.3 Lack of collaboration

Lack of collaboration in construction project teams leads to misunderstandings of data, poor communication and subsequently increased repetition of work (Hosseini, Zavadskas, Xia, Chileshe & Mills 2017:291). As a result, Oraee, Hosseini, Edwards, Li, Papadonikolaki and Cao (2019:843) mention that a lack of collaboration affects the compatibility, abilities and requirements to communicate and cooperate in projects implementations. Buvik and Rolfsen (2015:485) argue that a lack of collaboration may have an influence on trust development, which will subsequently affect work processes and the successful performance of operational teams. Generally, inaccurate collaborative design and construction activities will obstruct the information transfer, knowledge creation, technological coordination and resource distribution to operate successfully and minimise unnecessary conflicts (Liu, Van Nederveen & Hertogh 2017:687).

3.4 RESEARCH CONSTRUCTS

This section will review the literature regarding the aspects observed in this study. It is imperative to review these constructs as this will allow the provision of empirical evidence and results correlated to the respective variables given their significance to the study. Identifying the antecedent aspects influencing the construction performance being the purpose of this investigation, this study has established supplier coordination, customer coordination and coordination effectiveness as the possible factors impacting the performance of the construction industry. These performance areas are operational, financial and social performance. Therefore, this provides the basis for discussing the respective variables in this section.

3.4.1. SUPPLIER COORDINATION

As stated by Song, Cai and Feng (2017:4), supplier coordination in this study will provide the construction industry with core resources and technologies as well as information sharing to improve the performance of the industry. Therefore, this section defines supplier coordination, discusses the importance of supplier coordination, provides dimensions of supplier coordination as well as its antecedents and explains the outcomes of supplier coordination.

3.4.1.1 Definition of Supplier Coordination

Supplier coordination is the process whereby the suppliers provide manufacturers with high-quality supplies, knowledge, technology and design to support the industry’s new product development and produce new information for all parties (Yam & Tang 2013:368). Similarly, Patrucco, Luzzini and Ronchi (2017:1272) define supplier coordination as the process that involves information-sharing with key suppliers to gain better knowledge on developments, competencies and challenges, thus allowing more effective planning and forecasting as well as creation and process design for the industry. Furthermore, Gulati, Wohlgezogen and Zhelyazkov (2012:12) define supplier coordination as the careful and organised arrangement of the team's activities to attain mutually determined objectives of the industry. Supplier coordination is also defined by Lawson, Krause and Potter (2015:778) as the set of activities undertaken by the supplier in their efforts to improve the performance and quality of products and services they deliver. To support this study, the definition of Patrucco, Luzzini and Ronchi (2017:1272) is used as the operational one.

3.4.1.2 The Importance of Supplier Coordination

Supplier coordination enables awareness in meeting quick changes in demand whilst allowing the construction industry to offer competitive pricing and invention diversification (Odhiambo & Nassiuma 2017:100). He, Lai, Sun and Chen (2014:263) note that supplier coordination encourages the formation of internal information networks and supply chain visibility, which leads to greater trust between the manufacturer and customer as well as enhanced customer coordination. Furthermore, supplier coordination, according to Peng, Verghese, Shah and Schroeder (2013:10), Feng, Sun, Sohal and Wang (2014:730) and Knoppen, Johnston and Sáenz (2015:546), provides the manufacturer with external information such as relationship detailed knowledge, the supplier's professional skills as well as new construction development-related knowledge. Importantly, Ho and Lu (2015:1) postulate that supplier coordination enables the supplier to achieve a greater understanding of the strengths, challenges and improvement prospects of shared activities leading to stronger operational performance and successful completion of projects. Generally, supplier coordination, according to Sadigh, Mozafari and Karimi (2012:144), generates models that can yield the price of materials to be purchased and order quantity to avoid purchasing unnecessary materials that will lead to a greater loss for the construction industry.

3.4.1.3 Dimensions of supplier coordination

For the construction industry to commit to corporate sustainability, suppliers need to be developed with training, workshops and evaluation (Grimm, Hofstetter & Sarkis 2016:1972). Therefore, supplier coordination will easily focus on sustainability performance, collaboration practices to enable the incorporation of tacit knowledge and the joint development of sustainability resolutions to make the project a success. For this, Gupta and Choudhary (2016:258) suggest that for the construction industry to have a well-organised supplier coordination, an integrative framework that considers significant strategies such as purchasing strategies, supplier selection, supplier evaluation and development as well as continuous improvement should be developed.

3.4.1.4 Antecedents of Supplier Coordination

A well-organised coordination of suppliers results in an industry's supply chain being more efficient and flexible as well as being able to offer quality materials and on time deliveries to customers (Okoumba 2015:47). Therefore, since supplier coordination enables the construction industry in meeting quick changes in demand, this results in reduced costs, increased sales and improved forecast accuracy (Odhiambo & Nassiuma 2017:100; Scholten & Schilder 2015:471). These antecedents are discussed below.

Reduced costs

Effective coordination of suppliers enables the construction industry in decreasing the costs of information exchange and regulate performance dimensions and standards, thus achieving cost efficiency through resource-saving (Wong, Wong & Boon-itt 2018:379).

Increased sales

Supplier coordination obtains and uses internal information to develop an improved performance in creating and encouraging long-term internal and external relationships with profitable customers, thus increasing sales for the construction industry (Claro & Ramos 2018:173).

Improved forecast accuracy

To advance the supply chain performance in terms of the condition of demand uncertainty and to create a more collaborative environment, Ali, Mohamed, John and Syntetos (2017:984) propose that the construction industry shares information and regulates orders, which requires more realistic demand forecasting.

3.4.1.5 Outcomes of Supplier Coordination

The study shows that successful coordination is considered to yield significant benefits such as inventory reduction, better quality, improved delivery, reduced costs, compressed lead time, faster product-to-market cycle time, higher flexibility, increased customer service and market share increase for the construction industry (Banchuen, Sadler & Shee 2017:111). Lawson, Krause and Potter (2015:779) and Yan and Dooley (2014:59) state that several studies show that supplier coordination provides substantial benefits in the pioneering efforts of the buying department by gaining access to external resources such as new equipment and tools that the buying unit may require for the construction industry.

3.4.2 CUSTOMER COORDINATION

Customer coordination, according to Omoruyi (2015:63), is a process that enables the construction industry to achieve its goals and objectives, thus creating value and enhanced performance for the industry. Therefore, this section defines customer coordination, discusses the importance of customer coordination, provides dimensions of customer coordination as well as its antecedents and the outcomes of customer coordination.

3.4.2.1 Definition of Customer Coordination

Customer coordination is defined by Yam and Tang (2013:368) as a downstream integration that enables the construction industry to proactively seek information on customer preferences and needs and quickly respond to customers' needs before the competitors gain a competitive advantage. Dong and Sivakumar (2017:944), Dong, Sivakumar, Evans and Zou (2015:160), Mustak, Jaakkola and Halinen (2013:342) define customer coordination as the degree to which individual customers are involved in service production and delivery by contributing effort, knowledge, information and other resources. Furthermore, Alaloul, Liew and BWA Zawawi (2016:2) outline customer coordination as the process whereby customers bring about dependencies amongst undertakings and organise together various parts to achieve a combined set of tasks in the construction industry. Similarly, customer coordination, according to Prior, Keränen and Koskela (2019:2), deals with developing problems, coordinating difficult tasks and accomplishing task requirements within the construction industry.

Moreover, Edvardsson, Kristensson, Magnusson and Sundström (2012:421) refer to customer coordination as value creation considered in different activities and interactions of the construction industry during integration and operation of resources, with a specific purpose for creating value. Besides, customer coordination is defined by Droge, Vickery and Jacobs (2012:251) as the process that encompasses putting attention and resources towards understanding how products and processes interrelate and incorporate methods and strategies that increase coordination between the industry and the customer. To support this study, the definition of Prior, Keränen and Koskela (2019:2) is used as an operational one.

3.4.2.2 The Importance of Customer Coordination

Customer coordination enables relationships between the construction industry and the customer by persuading the industry to adapt to the needs of customers, provide better services and products whilst creating good financial returns for the construction industry (Yu, Jacobs, Salisbury & Enns 2013:347). Other researchers (Chan, Yim & Lam 2010:49; Hoyer, Chandy, Dorotic, Krafft &

Singh 2010;283; Stock 2014:536; Gruner, Homburg & Lukas 2014:34) mention that customer coordination increases the simplicity of new product development (NPD) management, granting customers more independence while decreasing the industries' control over NPD activities and limit the capability to influence technological knowledge.

3.4.2.3 Dimensions of customer coordination

The construction industry regards the customer as the focal point of its business functions by offering services that are in line with customer's expectations and needs to attain enhanced customer satisfaction (Abidemi, Halim & Alshuaibi 2018:4). Given the above statement, customer coordination plays an important role in leading to improving performance and profitability of the construction industry. Smirnova, Rebiazina and Frösén (2018:457) state that customer coordination enhances the industry's capability to serve its customers successfully, thus improving customer satisfaction and enabling the industry to distinguish their offering to customers meaningfully. Based on the above statement, it is illustrated that customer coordination is a multi-dimensional construct and the details are discussed below.

Enhanced customer satisfaction and performance

Customer coordination improves innovativeness, enhanced performance, the general formation of customer worth whilst environmental circumstances influence the overall effectiveness of the construction industry (Frambach, Fiss & Ingenbleek 2016:1431; Reed, Goolsby & Johnston 2016:3592). Consequently, Kotzab, Darkow, Bäumler and Georgi (2019:3) postulate that customer coordination is an important driver for supply chain strategy, which positively influences the operational and relational outcomes that positively affect the construction industry's performance.

3.4.2.4 Antecedents of Customer Coordination

The involvement of customer coordination in NPD actively contributes to awareness, selection of different characteristics of a new product offering and acts as the main designer of new products and services for the construction industry (Morgan, Obal & Anokhin 2018:499). For this, coordination allows customers to share their solutions related to contributions in the industries' NPD process, enhance NPD performance as well as assist in capability development in the construction industry (Chang & Taylor 2016:47; Coviello & Joseph 2012:87). Based on the importance suggested by many authors (Chan, Yim & Lam 2010:49; Hoyer, Chandy, Dorotic, Krafft & Singh 2010:283; Stock 2014:536; Gruner, Homburg & Lukas 2014:34), there are different antecedents linked to customer coordination such as senior management involvement, early customer involvement as well as cooperation among teams and departments. These antecedents are discussed below.

Senior management involvement

From the top management perspective, the new product development process must positively satisfy the customers' expectations as well as guarantee the construction industry's survival because of the welfare and the development of the national economy as the construction industry contributes enormously towards the economy of all countries (Sholeh, Ghasemi & Shahbazi 2018:183).

Early customer involvement

Customer coordination enables the construction industry to effectively simplify the NPD process with superior certainty and clearness, thus providing the industry entry to market information and primary solutions by increasing the quantity and quality of ideas (Morgan, Anokhin, Song & Chistyakova 2019:123).

Cooperation among teams and departments

Customer coordination indicates an explicit commitment, enables the construction members to resolve crises and personal problems by creating interpersonal interactions as well as cross-functional teams, thus improving performance and innovation of new products (Pemartín, Sánchez-Marín & Munuera-Alemán 2019:58).

3.4.2.5 Outcomes of Customer Coordination

The study, according to Bowen and Schneider (2014:13), indicates that customer coordination contributes to a general satisfactory service atmosphere, which provides superior performance for the construction industry. Similarly, Fidel, Schlesinger and Cervera (2015:1427) posit that effective customer coordination competency determines the construction industry's ability to acquire the knowledge for a competitive advantage in terms of special resource allocation for the development and customisation of products to reduce waste.

3.4.3 COORDINATION EFFECTIVENESS

Coordination effectiveness is required in the construction industry for stability to produce materials without quality defects, late deliveries and cost overruns as well as no accidents or injuries for participants (Pagell, Klassen, Johnston, Shevchenko & Sharma 2015:2). Therefore, this section defines coordination effectiveness, discusses the importance of coordination effectiveness, provides dimensions of coordination effectiveness as well as its antecedents and the outcomes of coordination effectiveness.

3.4.3.1 Definition of Coordination Effectiveness

Coordination effectiveness is defined by several researchers (Cooke & Hilton 2015:8 & Miloslavic, Wildman & Thayer 2015:5) as the ability of the construction industry to achieve satisfactory results for the team and its stakeholders as well as to attain the industry's primary objectives. Besides, Pavlou and El Sawy (2011:246) define coordination effectiveness as an active capability that enables the project team members to manage their dependencies such as sharing of resources, scheduling and synchronisation of constraints as well as goal selection when completing a project. Similarly, Hsu, Hung, Shih and Hsu (2016:96) define coordination effectiveness as the process of managing interdependencies between supply chain members, hence the degree of effective coordination in a project is determined by the way players can manage the interdependencies. To support this study, the definition by Cooke and Hilton (2015:8) and Miloslavic, Wildman and Thayer (2015:5) is used as an operational one.

3.4.3.2 The Importance of Coordination Effectiveness

Coordination effectiveness is beneficial in saving the cost of wasted materials, cost of storage, landfill tax and cost of disposal since reducing waste in construction projects has major economic benefits (Ajayi & Oyedele 2018:302). For this, Yuan (2013:477) postulates that coordination effectiveness enables the construction industry to achieve its main objectives namely economic, environmental and social performance when implementing construction and demolition (C&D) waste management. Sarker, Ajuja, Sarker and Kirkeby (2011:275) state that coordination effectiveness leads to trust in team performance, the capability of teams to resolve conflicts, mutual understandings of goals and organised task achievement dutifully. Furthermore, Paul, Drake and Liang (2016:190) mention that higher coordination effectiveness leads to higher team cohesion by increasing the attractiveness of the group, the enthusiasm to work for the group and the general incorporation of the group.

Generally, coordination effectiveness, according to Werder, Li, Maedche and Ramesh (2019:4), improves the management of the project’s process and allocation of resources, which are fundamental tools of effective coordination through progression procedure.

3.4.3.3 Dimensions of coordination effectiveness

Effective coordination of construction members enhances goal alignment and establishes clarity about goals and practices (Gochhayat, Giri & Suar 2017:693). In this way, the same authors postulate that goal alignment will facilitate coordination amongst construction workers' efforts, goals and practices, leaving less scope for deviation of different views about the industry's best interests. Michael, Sebanz and Knoblich (2016:106) posit that when construction members effectively coordinate their contributions to a cooperative action, they form and implement interdependency and increase perceived commitment, thus leading to the successful completion of the project.

3.4.3.4 Antecedents of Coordination Effectiveness

Previous research shows that coordination effectiveness is required to guarantee the effectiveness of services to avoid repetition and improve fairness in the construction industry (Akl, El-Jardali, Bou Karroum, El-Eid, Brax, Akik, Osman, Hassan, Itani, Farha, Pottie & Oliver 2015:1 & Momen 2019:2). For this, Khorasani and Almasifard (2017:135) postulate that the principle of dividing construction workers according to their skills, tasks, knowledge, performance and rewards improves the effectiveness of production within the construction industry. Furthermore, Paul *et al* (2016:189) posit that for coordination to be effective, communication must be both meaningful and timely to avoid lengthy delays in responses, slowing the rate of feedback and limiting coordination efforts.

3.4.3.5 Outcomes of Coordination Effectiveness

Usage BIM will facilitate effective coordination amongst design disciplines as well as increase the architecture, engineering and construction (AEC) industry throughput (Cao, Li, Wang & Huang 2017:660). Furthermore, Akhtar, Kaur and Punjaisri (2017:521) state that coordination effectiveness leads to good relationships, better market share, good service quality and increased sales for the industry.

3.4.4 OPERATIONAL PERFORMANCE

Meanwhile, operational performance is regarded as the main source of competitiveness and general business performance; construction industry participants must understand the influences of multifaceted product offerings on operational performance such as time, cost, quality and delivery (Trattner, Hvam, Forza & Herbert-Hansen 2019:70). Therefore, the operational performance is defined in detail below, the importance of operational performance is discussed, dimensions of operational performance as well as its antecedents are provided and the outcomes of operational performance are also explained.

3.4.4.1 Definition of Operational Performance

Operational performance refers to the flexibility, delivery time, order efficiency and inventory turnover of corporations, which are significant ways to endure competitive advantages (Adams, Richey, Autry, Morgan & Gabler 2014:302; Freeman & Styles 2014:189). Moreover, operational performance is defined by Croom, Vidal, Spetic, Marshall and McCarthy (2018:2348) as the mixture of product development efficiency, process developments, quality conformity and short lead times within the organisation. Consequently, Ojokuku (2013:20) defines operational performance as one of the utmost significant work outcomes and particularly an imperative principle that determines the construction industry's destination. Similarly, Uddin, Rahman, Abdul, Mansor and Reaz (2019:421) define operational performance as a behaviour that consists of directly visible activities of an employee and also conceptual involvement such as answers or decisions, which result in organisational outcomes in the form of accomplishment of set goals. Moreover, Kamau (2014:4) refers to operational performance as the backbone of every construction industry to achieve the set standards in terms of waste reduction, productivity, cycle time, environmental responsibility and regulatory compliance. Generally, operational performance is the capability of the construction industry to fulfill its mission. To support this study, the definition of Uddin, Rahman, Abdul, Mansor and Reaz (2019:421) is used as an operational one.

3.4.4.2 The Importance of Operational Performance

Operational performance is regarded as the main indicator for evaluating the construction industry's supply chain productivity (Quang, Sampaio, Carvalho, Fernandes, An & Vilhenac 2016:457; Truong & Hara 2017:1377). For this, Truong and Hara (2018:222) state that operational performance includes those indicators that reflect the main objectives of the industry by minimising costs and waste that results in higher performance. However, Duong, Truong, Sameiro, Sampaio, Fernandes, Vilhena, Bui and Yadohisa (2019:10) view operational performance as the capability of the construction industry to decrease its management costs, order-times, lead-times and increase the effectiveness of its raw material use and distribution ability. Moreover, Vencataya, Seebaluck and Doorga (2016:64) state that operational performance enables the construction industry to achieve its main objectives in terms of the following:

Cost: The ability to manufacture at a low cost

Quality: To be able to construct according to specification and with no defects

Speed: The capability to respond quickly to customer demands and offer short lead times

Dependability: The ability to produce according to contract terms

Flexibility: The ability to change operations.

3.4.4.3 Dimensions of operational performance

Operational performance within the construction industry is guaranteed by the application of lean practices that reduce operating costs through improving quality and productivity; reducing inventory, the production line, processing time and space as well as machine interruption (Dos Santos Bento & Tontini 2018:980). However, Ju, Park and Kim (2016:9) postulate that since the construction industry's performance is accomplished through the several activities of the management process, operational performance is in control for the alignment of the strategic goals of the industry and the executions of its plan.

3.4.4.4 Antecedents of Operational Performance

Previous research has shown that the application of lean practices such as Total Quality Management, Just-in-Time, staff development, customer and supplier collaboration as well as integration of activities improves the operational performance by making the construction industry more competitive (Netland, Schloetzer & Ferdows 2015:93; Boscari, Danese & Romano 2016:55; Negrão, Filho & Marodin 2016:33). Thus, Rasi, Rakiman and Ahmad (2015:3) indicate that lean practices decrease large operational costs by improving quality and production while reducing inventory, processing time and space, equipment downtime and in the meantime, ensuring high operational performance. These antecedents that contribute towards the operational performance of the construction industry are discussed below.

Total Quality Management (TQM)

TQM is a powerful tool that focuses on uninterrupted improvement and process management to deliver a sustainable high-quality product that fulfills or goes beyond customer anticipations within the construction industry (Phan, Nguyen, Nguyen & Matsui 2019:1). For this, Chen and Tan (2011:213) posit that TQM practice brings improved product quality, lower cost for production and quicker delivery.

Just-in-Time (JIT)

JIT focuses on reducing raw material, work-in-process and finished goods inventory to reduce inventory costs as well as exposing more serious inefficiencies in the manufacturing section, thus minimising risk for construction personnel (Wakchaure, Nandurkar & Kallurkar 2014:1). For this, the same authors conclude that joint application of JIT and TQM bring about significantly greater operational performance levels for the construction industry than the outcomes of executing each one of them.

Staff development

Staff development, according to Srinivasan and Kurey (2014:23), refers to the level of employee independence for making effective decisions involving situations and requirements that are beyond determined rules. To enhance the operational performance of the construction industry, Iden and Bygstad (2018:488) suggest that project members must be equipped with the necessary skills and training to integrate the activities within the project to make it a success.

Customer and supplier collaboration

Collaboration between customers and suppliers has a more positive impact on the construction industry in terms of innovativeness, quality and reliability (Eslami & Melander 2019:50). Given this, Coviello *et al.* (2012:87) and Eslami, Lakemond and Brusoni (2018:146) state that customers are a foundation of information for new products, ideas or designs whereas suppliers provide solutions according to the customer's needs. Therefore, the collaboration between customers and suppliers has a positive impact on the operational performance of the construction industry.

3.4.4.5 Outcomes of Operational Performance

Human capital development programmes (HCDP) yield a competitive advantage that significantly improves employee productivity, quality of product, on-time delivery and flexibility to adapt to all that make up an industries' operational performance (Bendickson & Chandler 2019:166). For this, Alkhalidi and Abdallah (2018:92) regard operational performance as an internal process associated with core improvements in a firm's response to a dynamic environment with respect to its competitors and customers.

3.4.5 FINANCIAL PERFORMANCE

Effective operational activities, investment activities as well as financing activities are regarded as the most important aspects to boost the financial performance of the construction industry (Azim, Ahmed & Shibbir Khan 2018:63). As a result, this section defines financial performance, discusses the importance of financial performance, provides dimensions of financial performance as well as its antecedents and the outcomes of financial performance are also explained.

3.4.5.1 Definition of Financial Performance

Financial performance is the ability of the construction industry to measure its financial condition over a certain period (Fatihudin & Mochklas 2018:553). Naz, Ijaz and Naqvi (2016:82) view financial performance as an act used by corporations to generate more sales, profitability and value for their stakeholders through the management of current and non-current assets. Furthermore, Ravinder and Anitha (2013:10) define financial performance as an extent to which financial objectivities have been accomplished as well as the process of evaluating the results of a corporation's policies and operations in monetary terms. To support this study, the definition of Fatihudin and Mochklas (2018:553) is used as an operational one.

3.4.5.2 The Importance of Financial Performance

The importance of measuring the financial performance of the construction industry is to gain valuable information associated with the flow of funds, use of funds, effectiveness and efficiency (Amal, Sameer & Yahya 2012:269). Gerschewski and Xiao (2015:616) state that financial performance indicators such as profitability, sales growth and earnings per share (EPS) help in achieving the economic goals of the construction industry. Furthermore, Ortas, Álvarez and Garayar (2015:1936) state that the financially successful industries have more financial capitals that they can spend on environmental, social and governance (ESG) matters and therefore achieve greater performance. In general, the financial performance enables management to provide effective financial and economic management while stakeholders can monitor managers on capital, which draws private investment and boosts the economy (Osadchy & Akhmetshin 2015:391).

3.4.5.3 Dimensions of financial performance

Corporate social responsibility (CSR) not only benefits the construction industry by increasing morale and productivity but also increases benefits while saving on costs for employment and training of new employees, thus increasing shareholder satisfaction and eventually financial performance (Cegarra-Navarro, Reverte & Gómez Melero 2016:532). Shen, Chen and Wang (2016:131) postulate that enterprise resource planning (ERP) indicates the construction industry's commitment to improve processes and increase integration thus, resulting in positive and higher profits.

3.4.5.4 Antecedents of Financial Performance

A study conducted by Chiliya, Rungani, Chiliya and Chikandiwa (2015:226) state that financial performance can be one of the major challenges encountered by the construction sector in terms of their survival if management is incompetent to manage finance and measure performance. In line with this, Kakwezi and Nyeko (2019:177) postulate that industries need to measure their financial performance often to know how well they are performing to avoid risks.

3.4.5.5 Outcomes of Financial Performance

Poor financial performance in private and public construction projects leads to economic and social damages (Ibn-Homaid & Tijani 2015:80). For this, Ibn-Homaid, Al-Sulaih and Tijani (2016:1201) state that the construction industry must identify deteriorating financial performance at the earliest stage to reduce the damages and control the economic and social significances that may negatively affect the construction industry.

3.4.6 SOCIAL PERFORMANCE

Social performance is the accountability of the construction industry to use its resources in ways that benefit the society through dedicated involvement as well as enlightening the welfare of the society independently and financially (Maliwa 2017:1). Therefore, this section defines social performance, discusses the importance of social performance, provides dimensions of social performance as well as its antecedents and the outcomes of social performance are also explained.

3.4.6.1 Definition of Social Performance

According to Dominicé and Narayanan (2017:8), social performance refers to the degree of fulfilment of a commitment to increase or decrease the interactions of individuals within a group. However, Wardle (2017:10) views social performance as the system that the construction industry uses to accomplish its set social goals and put customers at the focus point of strategy and operations. Furthermore, Lassala, Apetrei and Sapena (2017:3) view social performance as an extent to which the set of values and procedures of social accountability within the construction industry as well as guidelines, programmes and recognisable externalities are applied to different shareholders. To support this study, the definition of Lassala, Apetrei and Sapena (2017:3) is used as operational one.

3.4.6.2 The Importance of Social Performance

Social performance achieves the sustainable development goals of the construction industry (Xia, Olanipekun, Chen, Xie & Liu (2018:342). However, Charlo, Moya and Muñoz (2017:224) mention that social performance reflects the concern of its management in environmental and social matters as a method of accomplishing its competitive differentiation in a global market. Alternatively, Avolio, Calderón and Rojas (2015:82) view the importance of social performance as being able to create a decent relationship between the construction industry and the society, because if the industry succeeds in developing the idea of social compassion, it can meet the expectations of the society according to its business sector. Hou (2019:20) states that social performance can enable the construction industry to attain social fairness and economic wealth by creating welfare for social groups whilst extending their reach beyond organisations and their shareholders.

3.4.6.3 Dimensions of social performance

Seven dimensions such as industrial governance, human rights, labour practices, the environment, fair operating practices, consumer issues and community involvement and development were established to assess the social performance of the construction industry employees (Zhu, Liu & Lai 2016:419). However, Cegarra-Navarro *et al* (2016:530) state that the construction industry needs to be involved in charitable activities that need to operate in an economic, social and environmentally sustainable way to embrace social performance.

3.4.6.4 Antecedents of Social Performance

Since Luth and Schepker (2017:340) indicate that social performance is believed to improve the cost or profit by permitting the construction industry to charge price premiums while reducing expenses because of greater employee loyalty and commitment, social performance can serve as a tool managers use to improve performance in the construction industry. Yadav, Dash, Chakraborty and Kumar (2018:140) state that social performance is associated with financial performance, customer trust, stakeholder trust, employee satisfaction and construction industry attractiveness.

3.4.6.5 Outcomes of Social Performance

Social performance reflects the concerns of management in accomplishing the competitive differentiation in a global market (Charlo, Moya & Muñoz 2017:224). Therefore, a socially sustainable building project is supposed to respond to the diverse necessities of several stakeholders involved in the entire development of the building project including construction personnel, suppliers and local communities (Valdes-Vasquez & Klotz 2012:81; Wong & Fan 2013:139). Similarly, Alotaibi, Edum-Fotwe and Price (2019:14) declare that any unawareness of societal demands could result in loss or mismanagement of resources such as buildings or infrastructure projects in an unsustainable manner.

3.5 CONCEPTUAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

This sub-section provides the conceptual framework and discusses the development of hypotheses. A framework was conceptualised specifically to study the relationship between the constructs.

3.5.1 Conceptual framework

A framework was conceptualised specifically to study the relationship between supply chain coordination, which comprises supplier coordination and customer coordination towards coordination effectiveness and how they improve firm performance that also consists of operational performance, financial performance and social performance.

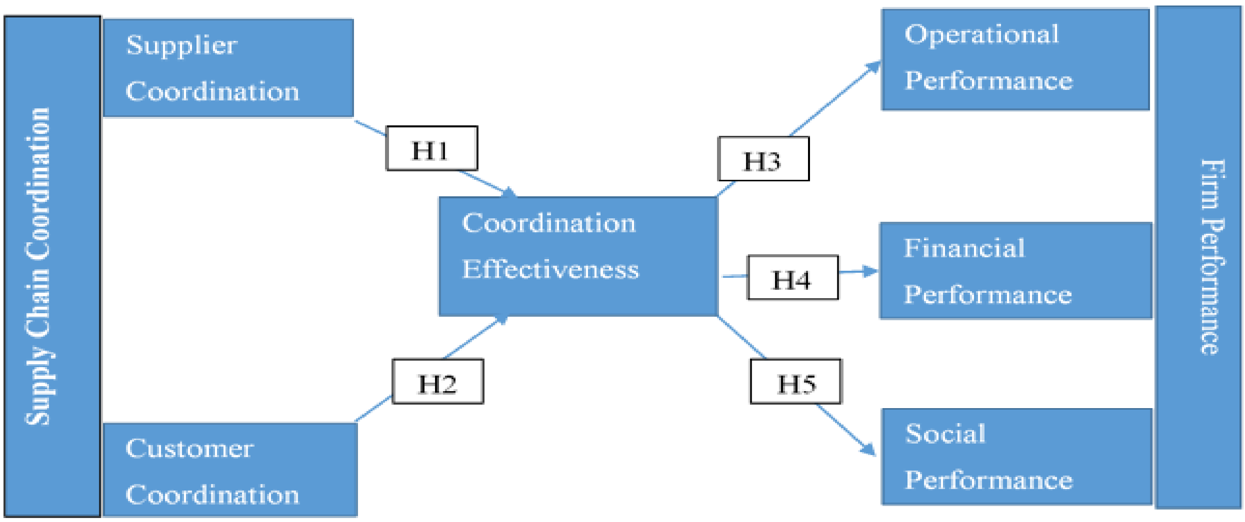


Figure 3.2 Conceptual framework

Source: Own

3.5.2 Hypotheses Development

This section provides a development of the hypotheses illustrated in Figure 3.1.

3.5.2.1 Supplier coordination and coordination effectiveness

Based on the study by Bouchery, Ghaffari, Jemai and Tan (2017:522), it is emphasised that supplier coordination leads to superior delivery and flexibility performances. In this way, suppliers work collaboratively with the main aim of effectively delivering materials, services, information and capital to customers (Lii & Kuo 2016:143). This shows that coordination of suppliers effectively uses decisions to minimise costs and offer superior value to consumers in the shortest time. Moreover, according to Chavez, Yu, Jacobs, Fynes, Wiengarten and Lecuna (2015:159), supplier coordination enhances effectiveness in the construction industry by developing mutual planning, joint problem solving to enhance communication speed, commitment, compliance and flexibility. Similarly, Jayaram, Xu and Nicolae (2011:60) claim that supplier coordination has a great impact on cost, quality, technology, speed and responsiveness of purchasing firms through managing interdependence and eliminating supply chain sub-optimisation and attaining anticipated performance results. Moreover, Blonska, Storey, Rozemeijer, Wetzels and De Ruyter (2013:1298) posit that supplier coordination effectively enhances operations of the entire supply chain through the accomplishment of performance-related benefits such as reduced cost, superior quality and flexibility, more reliable delivery and shorter product improvement cycle periods. Similarly, Yin, Nishi and Grossmann (2015:1173) state that effective coordination decisions for developing a short project life cycle under demand uncertainty are established to reduce manufacturing period and overheads so that a long-term partnership with contracted suppliers is built. Additionally, previous researchers pointed out that supplier coordination leads to various advantages such as knowledge sharing and new product development, thus leading to operational effectiveness within the construction industry (Cheung, Myers & Mentzer 2010:473; Flynn, Huo & Zhao 2010:59; Cao & Zhang 2011:164). Similarly, Glenn Richey, Adams and Dalela (2012:40) state that supplier coordination enables the construction industry to plan and conduct several activities in a cooperative and coordinated way. As a result, the construction participants will be able to share information and this will help them resolve their differences in time and learn from each other over time. This being the case, the following hypothesis has been formulated:

H1: There is a positive and significant relationship between supplier coordination and coordination effectiveness.

3.5.2.2 Customer coordination and coordination effectiveness

It is highlighted that customer coordination mostly leads to superior quality effectiveness in the supply chain (Ramanathan, Bentley & Pang 2014:233). Wang, Lee, Fang and Ma (2017:140) state that customer coordination enables the supplier to modify its products better, which should increase the value of project development and improve the supplier’s sales performance by reducing costs. The same authors postulate further that customer coordination is proven to make interactions more effective by decreasing costs and making investments more efficient by targeting the exact needs of an individual. For this, customer coordination has a strong impact on the effectiveness of the efforts of the industry, as the customer is the main contributor of inputs to the service production process (Nullmeier, Wynstra & Van Raaij 2016:26). Similarly, Selviaridis and Norrman (2014:155) report that careful coordination of customer contributions with the supplier's service production processes can help decrease the impact of customer roles on outcome uncertainty, thus making the coordination process more effective for the construction industry. Moreover, Jayaram *et al*. (2011:60) highlight that customer coordination guarantees that the opinion of the customer is rooted in the product development effort, thus improving the efficiency of the construction industry by improving the industry's project life-cycle and quality performance. Resulting from the above-mixed results, the following hypothesis is suggested:

H2: There is a positive and significant relationship between customer coordination and coordination effectiveness.

3.5.2.3 Coordination effectiveness and operational performance

Coordination effectiveness has been regarded as an important factor benefitting the building end-user through reduction of faults, lead times and costs in design and construction during operations (Gerrish, Ruikar, Cook, Johnson, Phillip & Lowry 2017:219). Thus, Santa, MacDonald and Ferrer (2019:40) postulate that for the construction industry to fulfill its operational performance effectively, five performance dimensions such as cost, quality, reliability, flexibility and speed need to be attained. According to Wacker, Yang and Sheu (2016:1557), these five factors are effectively coordinated to make a single construct that will simplify general operational attractiveness since the effectiveness of an industry is based on total competitiveness and not on a single factor. For the industry to achieve supply chain effectiveness and productivity developments, interdependency from different operational areas of an organisation and diverse supply chain partners is required (Sanders, 2014:21 & Yu, 2015:947). Moreover, Ramanathan (2014:211) posits that effective supply chain activities advance the operational performance of construction members in an organised structure to maximise profit through enhanced logistical services. Furthermore, Hsu, Shih, Chiang and Liu (2012:331) suggest that it is important for the construction industry to have effective coordination mechanisms to resolve issues such as unproductive controlling of work procedures that lead to increased prices for pointless work and extra time to complete the project. Similarly, Hai, Yusof, Ismail and Wei (2012:5) postulate that coordination effectiveness is highly required amongst project teams and throughout the construction processes so that an outstanding operational performance can be accomplished for a project. Moreover, Fadiya, Georgakis, Chinyio and Nwagboso (2015:264) point out that effectively coordinated supply logistics activities as well as site logistics activities will enable the construction industry to accomplish greater operational performance. Similarly, Ying, Tookey and Seadon (2018:1931) note that major players such as main contractors, subcontractors and material suppliers need to coordinate and integrate to avoid tensions among them to improve operational performance. Furthermore, Mackelprang, Robinson, Bernardes and Webb (2014:72) claim that the industry's coordination with its supply chain partners improves operational performance through processes such as joint commitments, dedicated relationships, knowledge sharing and developed products design. This discloses the influence of coordination effectiveness leading to the following hypothesis:

H3: There is a positive and significant relationship between coordination effectiveness and operational performance.

3.5.2.4 Coordination effectiveness and financial performance

Based on the study by Dobrzykowski, McFadden and Vonderembse (2016:40), coordination effectiveness reduces lead times, improves space utilisation, increases production, enhances quality while financial performance is generated. Li, Chow, Choi and Chan (2016:58) reveal that financial performance is one of the common methods used by the construction industry to assess the welfare of supply chain effectiveness as it can calculate the comparative operations efficiency in respective to the competitors. For this, Hoberg and Alicke (2013:48) suggest that it is important to coordinate core competencies to facilitate quicker delivery, advance production flexibility and respond quickly to any market changes to improve financial performance. Moreover, coordination effectiveness provides knowledge about the market and acts as an internal function to incorporate existing resources to achieve performance goals, improving the industry's capability to generate more sales and gain market share, thus improving financial performance (Lengler, Sousa & Marques 2013:442). Kim, Shin, Kim and Lee (2011:491) report that effective coordination of operational resources improves communication, information-sharing, timely and accurate decision making, thus improving the financial performance of the construction industry through customer satisfaction, lower costs as well as higher product or service quality. Furthermore, Ralston, Blackhurst, Cantor and Crum (2015:52) posit that coordinated effective utilisation of the industrial resources may realise great financial expansion when it reacts faster to changes in consumers' requests. Consequently, Behera, Mohanty and Prakash (2015:1334) state that effective coordination of activities provides the industry with opportunities for considerable developments in customer and shareholder value as well as decreases in general costs. Moreover, Chang, Ellinger, Kim and Franke (2016:283) point out that effectively coordinated activities in the supply chain enhance financial performance through developed intermediary types of performance linked with lower cost and superior customer value. Furthermore, Rapp, Beitelspacher, Schillewaert and Baker (2012:930) share that effective coordination allows faster communication as well as responding faster to customer demands among construction participants, thus leading to greater sales and successful completion of projects at the set time. Niesten, Jolink, de Sousa Jabbour and

Chappin (2017:3) postulate that the application of effective coordination mechanisms such as buyer-supplier coordination enables the construction industry to achieve certain coalition goals such as access to capital, new markets, technical and marketing know-how as well as reductions in costs and risks. Consequently, Wandfluh, Hofmann and Schoensleben (2016:202) suggest that effective coordination of construction participants, alignment of processes, approaches and decisions as well as the sharing of required information improve the financial efficiency and effectiveness, thus allowing the construction industry to achieve its goal in terms of financial performance. Therefore, the following hypothesis can be formulated:

H4: There is a positive and significant relationship between coordination effectiveness and financial performance.

3.5.2.5 Coordination effectiveness and social performance

Team members carrying out difficult and dependent jobs in the construction industry rely severely on coordination to effectively complete team objectives (Sui, Wang, Kirkman & Li 2016:564). For this, Osmonbekov, Gregory, Chelariu and Johnston (2016:810) report that social performance effectively coordinates the relationship, keeps team members honest in dealing with one another and aligns tasks within the industry. As a result, previous researchers regarded social performance as an indicator for the construction industry's economic performance and believed that the effective industry's commitment to social responsibility issue would be able to generate progressive and an improved performance in the future (Lys, Naughton & Wang 2015:57; Klynveld Peat Marwick Goerdele (KPMG) 2017:7; Liu, Quan, Xu & Forrest 2019:436). Furthermore, Knight and Eisenkraft (2014:1215) reveal that the way members are related to one another and as a group has consistent positive effects on group performance. As such, Peñalver, Salanova, Martínez and Schaufeli (2019:379) state that coordination effectiveness promotes social performance since the members of socially combined groups are coordinated and committed to group goals. Consequently, McDermott, Conway, Cafferkey, Bosak and Flood (2019:440) postulate that the effectiveness of coordination in the construction industry is determined by information processing and sharing thereof amongst participants performing interdependent activities. Eastman, Teicholz, Sacks and Liston (2011:16) as well as Bryde, Broquetas and Volm (2013:971) report that to achieve efficient coordination of information flow between the construction supply chain parties, the use of information technology systems as well as building information modelling mechanism is required. Moreover, according to Lavikka *et al.* (2015:211), due to effective coordination, construction industry participants succeeded in understanding each other's working processes and building relationships that enriched trust and reduced inactivity in decision making amongst them. Furthermore, Taggart, Koskela and Rooke (2014:834) suggest that coordination and cooperation among participants will enable the construction industry to achieve improvement in terms of early discovery of defects as well as distribution of information and a combined approach to problem-solving. Moreover, Ibrahim, Costello and Wilkinson (2013:133) postulate that teams and individuals with considerable skills, knowledge and expertise must be able to coordinate and cooperate to fully utilise their knowledge and experience to guarantee that the information can be shared and transferred effectively throughout the project life cycle. In light of the above-mentioned evidence, the present relationship hypothesis that:

H5: There is a positive and significant relationship between coordination effectiveness and social performance.

3.6 CONCLUSION

This chapter focused on the background of the research constructs through a literature review. It also formulated the hypotheses. This research study has conducted a literature review on six variables, which are supplier coordination, customer coordination, coordination effectiveness, operational performance, financial performance as well as social performance. The definitions of supplier coordination, customer coordination,coordination effectiveness, operational performance, financial performance and social performance as well as importance, dimensions, outcomes and measurements were dealt with in detail. Based on the above, it appears each of these variables has an impact on each other to achieve the performance of the construction industry, other factors such as communication, coordination, joint decision-making and knowledge sharing should be considered. The implementation of BIM has also been used to show how it can save costs and enhance productivity for the construction industry. Furthermore, a research framework has been outlined based on the literature review to support this study. The statements on different hypotheses were also shown to indicate the relationships that exist between the variables. It has been postulated that the hypotheses have a positive relationship with each other. The next chapter will elaborate on the procedures used to collect data and the results will support the accuracy of the literature review. This will be done by using questionnaires, the Statistical Package for Social Science (SPSS) and Analysis of Moment Structure (AMOS).

CHAPTER 4

RESEARCH METHODOLOGY AND DESIGN

4.1 INTRODUCTION

The previous chapter discussed the literature review and theory perspective on supply chain coordination, its flexibility and influence on the performance of the construction industry. This chapter aims to give a clear view of the methodology and design applied in this study. The research design and methodology help to define the validation for the application of detailed techniques or methods used to describe, identify, select, and analyse the information applied to understand this study. The first section outlines the research paradigm and research approach. The second section elaborates on the research design. In this section, the researcher identifies the data sources, describes the population as well as the sample. Additionally, in this section, the data collection methods are described while the data preparation process is discussed. The last section of this study details the data analysis wherein more explanations are provided on confirmatory factor analysis, structural equation modelling and model fit assessment. The final section discusses the ethical considerations considered in the study.

4.2 RESEARCH DESIGN AND PARADIGM

In research, it is crucial to have a clear framework to conduct a proficient study. Therefore, this framework discusses the research paradigm and research approach.

4.2.1 Research paradigm

Research paradigm is a systematic new and useful information on the basic belief system and theoretical framework with assumptions about ontology, epistemology, methodology and methods (Rehman & Alharthi 2016:51). Kivunja and Kuyini (2017:26) define research paradigm as beliefs and principles that shape how a researcher observes the methodological aspects of a research project to determine the research methods that will be used and how the data will be analysed. Furthermore, Mangoukou (2018:82) refers to a paradigm as a set of simple and arranged beliefs that support the frame of reference, mode of hypothesising and ways of working in a group. Based on the definition by Kivunja and Kuyini (2017:26), all researchers need to have an understanding of research philosophy since it influences research approach decisions (Hove 2015:87). There are three main types of research paradigms namely positivism, interpretivism and transformative.

Positivism is defined by Aliyu, Bello, Kasim and Martin (2014:81) as a research strategy and approach that is embedded in the ontological principle and policy that fact and actuality are unlimited and free for the observer. Interpretivism is defined by Pulla and Carter (2018:9) as a philosophy that subjectively views people's lives in terms of behaviour and interactions. A transformative paradigm is a philosophy links the results of social inquiry to action and connects the results of the inquiry to broader enquiries of social injustice and social justice (Jackson, Pukys, Castro, Hermosura, Mendez, Vohra-Gupta, Padilla & Morales 2018:111). These types of paradigms, which are explicitly associated with quantitative, qualitative and mixed research methods, are briefly explained in the following section.

4.2.1.1 Positivism, interpretivism and transformative paradigms

Positivist researchers consider positivism as a research philosophy adopted in natural sciences to detect that matters under analysis are inclined to an objective inspection (Irshaidat 2019:3). De Villiers, Dumay and Maroun (2019:1460) postulate that the positivism paradigm is associated with quantitative methods as it can simplify complex results into numbers for statistical analysis. For this, Antwi and Kasim (2015:220) state that the quantitative research approach mainly follows the confirmatory scientific method because its concentration is on hypothesis and theory testing. Hence, it is stated by Raddon (2012:3) that the positivism paradigm is used by many researchers and academics as it helps them in collecting an excessive amount of data, testing hypotheses as well as allowing them to sustain and control the research process. Therefore, this paradigm is considered empirical research that follows strict guidelines, which should be carried out by appropriately trained researchers or scientists.

Contrary to the positivism paradigm is the phenomenological (interpretivist) paradigm, which is concerned with understanding human behaviour from the candidate's belief system. Interpretivism follows an idealist than a pragmatist social ontology, meaning that individuals' actions are not determined by recognisable factors although they may surely be influenced by them (Packard 2017:537). Similarly, Gemma (2018:8) states that interpretivism highlights truth and knowledge are subjective as well as traditionally situated according to an individual's capabilities and thoughtfulness. Collis and Hussey (2014:46) confirm that interpretivism is used in the qualitative method because it is more subjective, humanist and phenomenological.

The transformative paradigm focuses on what works without much stress on methodology, thus enabling researchers who apply this paradigm to the flexibility of information and the chance to apply more than one method to a single study (Kankam 2019:88). Scott (2016:255) posits that transformative researchers attempt to emphasise the significance of applying unrelated methods and then assessing them concerning their effectiveness. McCrudden, Marchand and Schutz (2019:1) suggest that a mixed method approach is used by several researchers using both quantitative and qualitative approaches to conduct their studies.

The current study is based on the positivist paradigm. The reason for this is that positivism is associated with the quantitative approach due to its objective, observable and absolute truths characteristics (Kelly, Dowling & Millar 2018:6). For this, statistical evidence for every hypothesis made in this study is provided. Moreover, as stated by Bonell, Moore, Warren and Moore (2018:11), the purpose of this study is to test the relationship between the research variables (which are supply chain coordination comprising supplier coordination and customer coordination, coordination effectiveness, operational performance, financial performance as well as social performance). Therefore, the positivist paradigm is appropriate in this study because it allows for the measurement of research variables' reliability and validity levels. Furthermore, the positivism paradigm's statistical methods are used to gather an enormous amount of data because of its sample sizes being larger than those normally found in qualitative research (Ulrich, Boring & Lew 2018:1674).

4.2.2 Research approach

The research approach focuses on the method used to conduct the study. Research methods involve quantitative and qualitative approaches as well as a combination of these two approaches namely mixed methods. According to Schoonenboom and Johnson (2017:108), mixed methods research is the type of research where a researcher combines fundamentals of qualitative and quantitative research approaches for the breadth and depth of understanding and validation. Qualitative methods generally wish to understand the experiences and attitudes of participants and to answer questions about the 'what', 'how' or 'why' of a phenomenon (McCusker & Gunaydin 2015:537). Moreover, Queirós, Faria and Almeida (2017:369) postulate that the quantitative approach pursues to achieve accurate and reliable measurements that allow statistical analysis. Therefore, the difference between qualitative and quantitative research is a methodological issue.

In addition, quantitative research was desirable since numeric data about the views of respondents were to be collected using a questionnaire. As a result, the quantitative approach was adopted since this study was testing relationships between several variables and hypotheses were to be tested. Furthermore, quantitative research is easy to conduct since the data can be collected with ease and can be compared using graphs and charts. For these reasons, the quantitative method was selected. Furthermore, this study discussed in detail the different approaches which are inductive, abductive and deductive.

4.2.2.1 Inductive approach

The inductive approach, according to Park, Bahrudin and Han (2020:6), is the objective opinion of constructivism, of which a matter and reality are remodelled and built through circumstantial explanations to provide evidence for the truth of the conclusion. Khotimah and Faizah (2021:63) posit that the inductive approach refers to lessons that begin by offering several superior situations and can then be combined up into a theory, principle or regulation. Furthermore, Barnes and Forde (2021:36) postulate that inductive reasoning is a process of research that reverses the systematic method from the approach of approving present theory and overviews to one that constructs support for making generalisation and emerging theory. Generally, an inductive approach begins with observation and findings, assumes and concludes the suggestions of the findings that presented the theory (Dalati 2021:96).

This approach aims to generate meanings from a set of data collected to identify patterns and relationships to build a theory. Streefkerk (2019:1) states that inductive reasoning aims at developing a theory. Therefore, it is concluded that the decision drawn based on an inductive method can certainly not be proven but can be nullified.

4.2.2.2 Abductive approach

An abduction method is a process of generating a reason as the best clarification for an experimented occurrence based on existing rules or theoretical knowledge (Upmeier zu Belzen, Engelschalt & Krüger 2021:2). Shani, Coghlan and Alexander (2020:65) mention that abductive reasoning is the method that provides reasonable clarifications about confusing phenomena, hence, it agrees with the operation of perception to an experience succeeded by a question such as “What is going on?”

Abductive reasoning aims at assuming the best reasonable clarification for observed actions, which would play important roles in several language processing applications such as reading comprehension and question answering (Du, Ding, Liu & Qin 2021:5181). Similarly, Bhagavatula, Le Bras, Malaviya, Sakaguchi, Holtzman, Rashkin, Downey, Yih and Choi (2020:1) claim that abductive reasoning aims at searching for the greatest explanations for incomplete observations. Generally, the abductive approach permits the addition of professional knowledge, providing theoretical supervision while inspecting user views and ideas and extending understanding beyond known effective approaches (Hurley, Dietrich & Rundle-Thiele 2021:1).

4.2.2.3 Deductive approach

Deductive reasoning is the technique of making conclusions of reasonable validity based on a specified set of principles (Brisson & Markovits 2020:920). Similarly, Doyle (2019:1) argues that an inductive approach is a sound thought that depends on general knowledge, which is occasionally called evidence held to be accurate to reach a definite conclusion. In general, deductive approach or reasoning is the cognitive process that endeavours to generate required conclusions based on specified premises that are expected to be true (de Chantal, Gagnon-St-Pierre & Markovits 2020:1081).

Using deduction reasoning is linked to the quantitative method of data collection and data analysis (Stainton 2020:1). For this reason, Park *et al.* (2020:5) argue that deductive reasoning is normally suitable for research because outcomes are usually recognisable and quantifiable. Also, the same authors indicated that the deductive method is based on existing knowledge and the supposed theory or model is verified repeatedly, with many quantifiable data points. Therefore, this study applied a deductive method as it offered the researcher the opportunity to analyse the relationship among the research variables, measure them quantitively and generalise the results (Altesor, Gallego, Ferrón, Pezzani, López-Mársico, Lezama & Paruelo 2019:2).

4.3 Research Methodology

Generally, research methods include designing studies, collecting data, analysing collected data, testing for relevant relationships or differences amongst variables, making sense out of research results and reporting the results to the relevant audience in the appropriate format (Osuagwu 2020:48). Research methodology mainly involves quantitative and qualitative approaches; but, sometimes researchers combine these two methods (known as mixed method) to conduct their studies. Mixed method is defined by Åkerblad, Seppänen-Järvelä and Haapakoski (2021:152) as the process of bringing together different approaches and data sets namely qualitative and quantitative in research settings. Quantitative data is statistical and typically more rigid and defined, thus can be measured using numbers and values, making it more suitable for data analysis (Pickell 2021:2). Elliott (2018:1) states that qualitative data represent opinions or feelings and cannot be represented by a numerical statistic such as an average.

For this study, the quantitative approach was selected and adopted since the relationship between several variables and hypotheses was to be tested. Furthermore, quantitative research was preferable since numeric data about respondents were collected using questionnaires. Through the quantitative approach, a larger sample size can be used, thus, allowing the researcher to reach an accurate generalised conclusion for any hypothesis (Miller 2020:1). Furthermore, it has been concluded by Hayashi, Abib and Hoppen (2019:99) that quantitative research is more objective and scientific and provides more valid and reliable results. Therefore, the above reasons justify the selection of a quantitative approach for this study.

4.3.1 Research Design

Research design is defined by Grover (2015:1) as the general approach chosen by a researcher to tackle the problem that requires a combination of different components of the study coherently and logically, thereby guaranteeing to resolve the tricky situation efficiently. Babbie and Mouton (2012:74) define research design as how the study is structured to enable the researcher to conduct the study successfully. Moreover, research design according to Creswell and Poth (2016:6), refers to the whole process of research from abstracting a problem to writing research questions and on to data collection, analysis, interpretation and report writing.

This study was subject to the cross-sectional survey design. Cross-sectional study design is a kind of observational study design where the researcher measures the result and the experiences during the same period (Setia 2018:261). The purpose of cross-sectional studies is to acquire reliable data that make it possible to generate robust conclusions and create new hypotheses that can be explored with new research (Zangirolami-Raimundo, Echeimberg & Leone 2018:3656). The cross-sectional survey design was selected for this study to show that relationships occur between the different constructs and because it was cheap and used to investigate an enormous number of respondents. Furthermore, a cross-sectional survey was chosen because it involves looking at respondents who are different on one key feature (such as age) but share other features such as the construction industry in the case of this study.

4.4 LITERATURE REVIEW

A literature review was conducted covering two main chapters, which are chapters 2 and 3. Chapter 2 of this study was about the background of the construction industry and composed of eight sections. The first section defined what the construction industry is. The second section outlined the historical background of the construction industry in South Africa. The third section discussed the composition of the construction industry in South Africa. The fourth section highlighted the legislative framework in the construction industry in South Africa. The fifth section elaborated on the contribution of the construction industry in South Africa. The sixth section discussed the challenges and solutions facing the construction industry in South Africa. The seventh section discussed the previous supply chain management-related research in the construction industry in South Africa. The chapter closed with a conclusion.

Chapter 3 was subject to three sectors. The first segment discussed the theoretical framework, which is the game theory. The second segment elaborated on the literature review of the research constructs, which are supplier coordination, customer coordination, coordination effectiveness, operational performance, financial performance and social performance. The last segment of this chapter examined in detail the conceptual framework and hypotheses development. The information used in the literature review was attained from databases such as Google Scholar, Emerald, InformaWorld (Taylor & Francis), JStor and Science Direct, books and other internet sources.

4.4.1 Empirical study

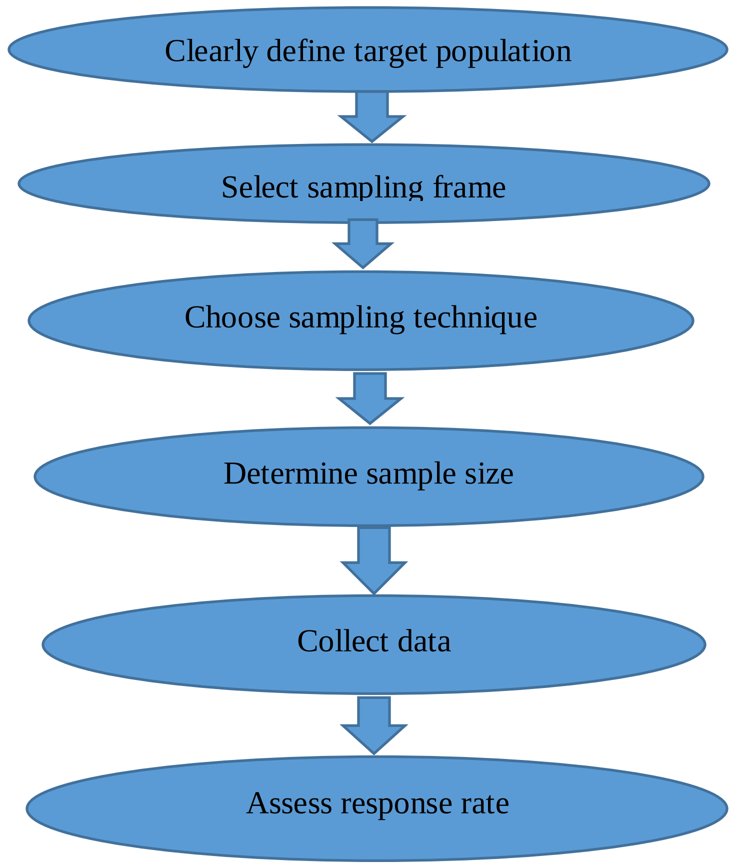
An empirical study is defined by Jasti and Kodali (2014:1081) as the methodical process of deriving and examining data from direct or indirect observation. Therefore, an empirical study is gathering of data from which conclusions that can be tested may be drawn. It involves the sampling design, data collection procedures and data analysis.

4.4.2 Sampling design

A sampling design is a process that encompasses six stages. It involves defining the target population, selecting a sample frame, choosing sampling techniques, determining sample size, collection of data and assessing the response rate (Taherdoost 2016:19**).** Furthermore, Etikan, Musa and Alkassim (2016:2) state that a well-structured and organised sampling design can lead to the acquisition of accurate and consistent results of the research. As a result, the study by Christensen and Johnson (2014:343) suggests that the target population, sample frame, sample size and method should be performed in designing the sample.

Figure 4.1 presents the stages that the researcher is likely to go through when conducting sampling.

Figure 4.1: Stages in conducting sampling



Source: Taherdoost (2016:19)

4.4.2.1 Target population

A target population is a quantity of components, organisations or individuals that are selected to be measured as the sample of the study (Al Zefeiti & Mohamad 2015:4). In the view of Saunders, Lewis and Thornhill (2019:728), a target population is referred to as a total set of cases or group members that are the final focus of the research analysis and from which a sample may be drawn.

Therefore, to support this study, the definition of Saunders *et al*. (2019:728) is used as an operational one.

The target population for this study was the construction firms in the Gauteng province. Gauteng Province was selected as it is the major economic hub of South Africa and boasts of many construction firms. In this study, the target population was 400 supply chain managers and operations management professionals of registered construction industries such as Grinaker-LTA, Wilson Bayly Holmes Ovcon (WBHO), Group Five, Aveng Group, Motheo and Reubex.

The population group comprised both female and male employees. Permission to conduct the study was obtained from the construction industries after the Higher Degree Committee of the Vaal University of Technology approved the proposal. The following section explores the sample frame.

4.4.2.2 Sample frame

The sample frame is defined by Martínez-Mesa, González-Chica, Duquia, Bonamigo and Bastos (2016:327) as the group of individuals that can be nominated from the target population given the sampling process used in the study. Therefore, the sample frame for this study will be obtained from the construction industries in the Gauteng Province.

4.4.2.3 Sampling technique

There are two major kinds of sampling approaches namely probability and non-probability sampling techniques. Each sampling technique comprises four types of samples. For this, Bhardwaj (2019:158) mentions that in probability sampling, there is a known probability of each member of the population being nominated in the sample, whereas in non-probability sampling, each member of the population does not have a known probability of being chosen in the sample. There are four types of probability sampling methods namely simple random sampling, systematic sampling, stratified sampling and cluster sampling. However, in this study, the probability sampling approach was used to yield results that represent the entire research population . Different from probability sampling, non-probability sampling is a sampling technique that does not involve a broad survey frame it is a quick, easy and cheap way of attaining data (McCombes 2021:1). Non-probability sampling comprises quota sampling, snowball sampling, judgemental sampling and convenience sampling.

Purposive sample is a non-probability technique built on the decision of the researcher as to who will make available the greatest information to thrive for the objectives of the study (Etikan & Bala 2017:215). This type of sampling can be very advantageous in circumstances when the researcher needs to reach a targeted sample quickly and where sampling for proportionality is not the main concern (Crossman 2020:1). The goals of purposive sampling are to purposefully select units such as individual people, events or objects that are suitable to enable the researchers to address their research questions (Frey 2018:1).

Therefore, the purposive sampling was used for this study to obtain data from the supply chain manager and operations management professionals in the construction industries in the Gauteng province. Based on the above statement, purposive sampling was chosen because the expertise and the understanding of the construction industry managers and employees are required to achieve truthful results (Ayres 2019:1). Moreover, Andrade (2020:103) suggests that purposive sampling be used as a result of the simplicity of access in terms of environmental nearness and the nature of the sample units to take part in this study. Furthermore, purposive sampling was nominated due to the circumstance that it is extremely time and cost effective when compared to other sampling methods (Yousaf 2020:1). Generally, the absence of a sample frame for construction companies in the Gauteng province justifies the selection of this technique.

4.4.2.4 Sample size

There are numerous aspects to be taken into consideration when estimating a suitable sample size (Memon, Ting, Cheah, Thurasamy, Chuah & Cham 2020:2). The same authors state that those aspects include the research approach, analytical method, number of variables or model complexity, time and resources, completion rate, sample size used for similar studies and data analysis programme. The sample size is defined by Kibuacha (2021:1) as the overall number of respondents involved in a study and that number gets broken down into sub-groups by demographics such as age, gender and location so that the whole sample attained signifies the total population. Sarmah and Hazarika (2012:1) define the sample size as the process of selecting the number of observations or replicates to include in a statistical sample. Furthermore, Singh and Masuku (2014:6) outline the sample size as the technique of selecting the number of observations to include in a sample. Under these circumstances, Adwok (2015:97) suggests that it would be wise to select a larger sample than needed to make up for those participants in the sample who refuse to take part in the study or drop out. A large sample size represents the population sufficiently while a small sample size may obstruct some important statistical tests.

This study's sample was 400 because a larger sample size was required to get an optimum level of correctness (Andrade 2020:102). As a result, the study required the distribution of 400 questionnaires to supply chain managers and operations management professionals in the Gauteng Province for the data to be valid. Previous researchers such as Hu, Zou, Wang and Pang (2021:1) posit that if the training sample size is too small, it is easy to imprecise the model during training and fail to achieve satisfactory or significant, accurate and reliable results. Therefore, to ensure the correctness of the study, Kibuacha (2021:1) proposes a sample size of 400 as it will yield valid results and satisfactorily represent the realities of the population being studied. Similarly, Serdar, Cihan, Yücel and Serdar (2021:3) approve that the purpose of the larger sample size is vital to qualify the study with greater importance, thus increasing the positive outcome of the results.

However, a small population of 200 is recommended for studies as it reduces sampling inaccuracies and provides data on all the individuals in the population (Israel 2019:2). The same author states that costs such as questionnaire design and developing the sampling frame are fixed and most importantly, the entire population would be sampled in small populations to achieve a desirable level of precision. Faber and Fonseca (2014:27) suggest that samples should not be too big or too small as the smaller sample may obstruct the results from being concluded whereas a larger sample may enlarge the discovery of differences, emphasising statistical variances that are inapplicable.

4.4.2.5 Procedures for data collection

As mentioned in section 4.3.3, this study made use of the purposive sampling technique to collect data from respondents. There are various methods used to collect quantitative data in survey research, which include emails, telephone, postal, questionnaires and interviews (Osang, Udoimuk, Etta, Ushie & Offiong 2013:61). Since the current study made use of the structured self-administered questionnaire to collect data, physical distribution of questionnaires by the researcher was used. This method is mainly suitable because it increases the response rate.

Due to the nature of the research, the targeted respondents were supply chain managers and operations management professionals in the Gauteng province. This was done to ensure the relevance of the data in evaluating the implementation of supply chain coordination (SCC) and the firm performance. Structured questionnaires were administered on a hard copy from November 2019 to February 2020. A total of 400 questionnaires were distributed physically to the selected respondents and then followed up on any feedback by the researcher.

The selected construction industries were contacted through email and telephone to set appointments before the administration of the questionnaires. This was challenging at times as some terms were purely technical and the researcher had to explain what the study entailed, which was time consuming in certain cases.

4.5 Measurement scales

The questions for this study were developed from pre-existing scales in the literature. The existing items were adapted to suit this study. For this reason, questions were reformulated. The measurement instruments from Sections B to H were measured using five-point Likert-type scales with the following representative values: 1=strongly disagree, 2=disagree, 3=moderately agree, 4=agree and 5=strongly agree. The Likert scale, according to Joshi, Kale, Chandel and Pal (2015:397), is a set of statements presented for an actual or theoretical situation under the study where participants are requested to demonstrate their level of agreement (from strongly disagree to strongly agree) with the given statement on a metric scale.

Five-point Likert scales were used in this study because they were easy for respondents to understand while filling in the questionnaires. Moreover, they were used because the answers were countable and subject to scientific examination. Five-point Likert scales were used because respondents did not give a modest and real answer such as yes or no; thus, respondents were not forced to take a position on a specific topic. The scales allowed them to respond to a degree of agreement or disagreement.

4.5.1 Supplier coordination

This section was related to supplier coordination that was measured from two dimensions namely competency and capability. A maturity model is a valuable tool to assess supplier coordination improvement in terms of competency and capability (Broft, Badi & Pryke 2016:187). As such, this model is extensively used in software engineering, information technology services, systems engineering, project management, risk management and personnel management in the construction industry (Correia, Carvalho, Azevedo & Govindan 2017:1). Furthermore, supplier coordination as highlighted by Addae (2015:17) is measured by the degree to which suppliers constantly deliver materials, components or products to an organisation timeously and in good condition. Further details regarding this scale are provided in Table 4.1.

Table 4.1

Item code	**Code description**	**Author(s) and Year**	**Industry and region where the scale was applied**	**Reliability (Cronbach's Alpha) (α)**
SC1	Supplier process integration improves product innovation capabilities in a low equivocality environment	Jayaram *et al* (2011:85)	Production research – Chinese manufacturing firms	0.850
SC2	Supplier product integration improves quality in high equivocality environments			
SC3	Dedicated workforce is required to gather and share information and knowledge across the supply chain			
SC4	Dedicated capacity, tools and equipment are kept simple and clear to reduce ambiguity			
SC5	Dedicated storage and transportation facilities help to improve synchronisation and delivery times			

Source: Jayaram *et al* (2011:85)

As shown in Table 4.1, the SC scale used in this study attained a Cronbach alpha value of 0.850 in the studies by Jayaram *et al*. (2011:85). It makes the measurement instruments for supply coordination reliable to be used in this study.

4.5.2 Customer coordination

Customer coordination in this study was measured from three dimensions namely performance, new product development and innovation. According to Babu (2018:703), customer coordination in the construction industry measures performance procedures such as service quality, customer retention, customer satisfaction, customer loyalty, financial performance, new product development as well as innovation performance. For this, Bolander, Satornino, Hughes and Ferris (2015:2) suggest that customer coordination increases the amount of resources directed towards addressing customer opportunities and information necessities as well as increasing the number of relations amongst the selling and buying organisations. Further details regarding this scale are provided in Table 4.2.

Table 4.2

Item code	Code description	Author(s) and Year	Industry and region where the scale was applied	Reliability (Cronbach's Alpha) (α)
CC1	We are able to identify our customers' needs and wants	Jayaram *et al* (2011:85)	Production research – Chinese manufacturing firms	
CC2	We use information from customers in designing products and services			
CC3	We are frequently in close contact with our customers			
CC4	We are committed to satisfying customers			

CC5	We maintain a good relationship between the company's goals and customers' expectations			0.898

Source: Jayaram *et al* (2011:85)

As shown in Table 4.2, the CC scale used in this study attained a Cronbach alpha value of 0.898 in the study by Jayaram *et al.* (2011:85). It makes the measurement instruments for customer coordination reliable to be used in this study.

4.5.3 Coordination effectiveness

Coordination effectiveness in this study was categorised into two dimensions namely cost performance and team performance. According to Sinesilassie, Tabish and Jha (2018:111), the effectiveness for projects is measured based upon cost performance standards for successful and failed projects. However, Gorman, Grimm and Dunbar (2018:61) state that the coordination effectiveness can be measured through differences in team performance when experiencing new encounters as well as unpleasant behaviours of the individual as team members cooperate to reach the common goal. Furthermore, Werder, Li, Maedche and Ramesh (2019:6) measure coordination effectiveness by the extent to which the completed project meets specified customer requirements and needs and the degree to which that project incorporates changes in the requirements during the development process. Further details regarding this scale are provided in Table 4.3.

Item code	Code description	Author(s) and Year	Industry and region where the scale was applied	Reliability (Cronbach's Alpha) (α)
CE1	Respond effectively to changing requirements of design	Zhang *et al* (2014:145).	Strategic marketing – UK service industry	0.780
CE2	Improves the efficiency of operation between our suppliers and us			

CE3	Able to meet special customer specification requirements			
CE4	Coordinate production and information efficiently across suppliers and product lines			
CE5	Maintains a higher capacity buffer of response to volatile market			

Table 4.3. Source: Zhang *et al*. (2014:145).

As shown in Table 4.3, the CE scale used in this study attained a Cronbach alpha value of 0.780 in the study by Zhang *et al.* (2014:145). It makes the measurement instruments for coordination effectiveness reliable to be used in this study.

4.5.4 Operational performance

Operational performance in this study was measured from five dimensions namely cost, quality, delivery, flexibility and speed. Prompt delivery, low production cost, high product quality and flexibility of the production coordination are determined to measure the operational performance of manufacturing systems (Wong, Boon-itt & Wong 2011:606; Kazemian & Aref 2016:358). For this, Othman, Rahman, Sundram and Bhatti (2015:649) claim that the ability of the construction industry to measure operational performance is dependent on the successful management of building material as well as being able to test the finished product such as a building. According to Dos Santos Bento and Tontini (2018:980), the best common indicators for measuring operational performance are cost, quality, delivery, flexibility as well as the rate and speed at which projects are successfully completed. Further details regarding this scale are provided in Table 4.4.

Item code	Code description	Author(s) and Year	Industry & region Where the scale was applied	Reliability (Cronbach's Alpha) (α)
OP1	Orders from our customers are fulfilled in a short lead time			

OP2	Deliveries to our customers are fulfilled as scheduled	Gu *et al* (2017:230)	Production economics - USA	0.851
OP3	Offer very flexible options for changing orders' quantity			
OP4	Product defective rate is very low			
OP5	Provide 100% products' safety certification			

Source: Gu *et al.* (2017:230)

As shown in Table 4.4, the OP scale used in this study attained a Cronbach alpha value of 0.851 in the study by Gu *et al.* (2017:230). It makes the measurement instruments for operational performance reliable to be used in this study.

4.5.5 Financial performance

The financial performance of this study is categorised into four dimensions namely Return on Assets (ROA), Return on Investments (ROI), net margin and sales growth. According to Platonova, Asutay, Dixon and Mohammad (2018:453), financial performance can be measured with different financial ratios such as the financial ratio of Return on Assets that is used to measure financial performance from a management viewpoint. Similarly, Huo, Han, Zhao, Zhou, Wood and Zhai (2013:83) as well as Zhang and Huo (2013:550) suggest that the financial performance can be measured using the traditional indicators such as sales, profits, market share, return on investment and return on sales. Mithas, Ramasubbu and Sambamurthy (2011:242) argue that financial performance is measured through competitive position, net margin and profitability of the firm. Furthermore, Hasan, Jackowicz, Kowalewski and Kozlowski (2017:143) measure the financial performance of the construction industry using investments in tangible assets, sales growth and return on sales. Generally, since financial performance is characterised by price, financial conditions, quality and period of implementation, the project accomplishment is dependent on value. Further details regarding this scale are provided in Table 4.5.

Item Code	**Code description**	**Author(s) and Year**	**Industry & region where the scale was applied**	**Reliability (Cronbach's Alpha) (α)**

FP1	My firm's sales growth is better than that of our major competitors	Yasar *et al* (2017:15)	Total quality management & business excellence - manufacturing firms in Turkey	0.703
FP2	My firm's return on assets is higher than that of our major competitors			
FP3	My firm's market share growth is higher than that of our major competitors			
FP4	My firm's return on investment is higher than that of our major competitors			
FP5	My firm's total cost reduction is better than that of our major competitors			

Source: Yasar *et al.* (2017:15)

As shown in Table 4.5, the FP scale used in this study attained a Cronbach alpha value of 0.703 in the study by Yasar *et al.* (2017:15). It makes the measurement instruments for financial performance reliable to be used in this study.

4.5.6 Social performance

The social performance in this study is measured from three dimensions namely social governance, economic and environmental dimensions and industry participation in corporate social activities. Social responsibility indicators are regarded as valued instruments to measure social performance within a period and identify complications related to improvement in the construction industry (Alotaibi, Edum-Fotwe & Price 2019:16). Furthermore, Jørgensen, Dreyer and Wangel (2012:828) state that conducting the Social Life Cycle Assessment (SLCA) will stimulate the progress of social conditions and the general socioeconomic performance of a project during its life cycle for the stakeholders. Moreover, Esteban-Sanchez, De La Cuesta-Gonzalez and Paredes-Gazquez (2017:1103) state that social performance is measured through social governance, economic and environmental dimensions as well as how the industry participates in corporate social activities.

Generally, Tang, Hull and Rothenberg (2012:1285) posit that the social performance measure is proved to yield reliable results such as:

- Pace to specify how rapidly an industry can embrace social responsibility principles into its operations.
- Relatedness to determine the degree to which the social responsibility dimensions in which an industry operates are coordinated and interrelated to one another.
- Consistency to reveal whether an industry's changes in social responsibilities over a certain period are organised, systematic and constant.

Table 4.6

Item Code	**Code description**	**Author(s) and Year**	**Industry & region where the scale was applied**	**Reliability (Cronbach's Alpha) (α)**
SP1	Relationships with main partners are satisfactory	Akhtar *et al* (2017:533)	Operational and social performances - New Zealand-Euro agri-food supply chains	0.710
SP2	Main partners are not good companies for business			
SP3	Partners are satisfied with main partners performance			
SP4	Partners have successful coordination with main partners			
SP5	Partners do not have high confidence in main partners			

Source: (Akhtar *et al.* 2017:533)

As shown in Table 4.6, the SP scale used in this study attained a Cronbach alpha value of 0.710 in the study by Akhtar *et al.* (2017:533). It makes the measurement instruments for social performance reliable to be used in this study.

As stated earlier, the measurement instruments used had already been used by previous studies.

Therefore, since these measurements had been confirmed and applied in past studies to measure the same construction, it can be concluded that these measurement items are significant and satisfactory for this study. This is supported by Middleton (2019:1) who mentions that to obtain useful results, the methods the researcher uses to collect data must be valid and the research must be measuring what it ascertains to measure. Tables 4.1 - 4.6 showed that the measurement instruments selected are all reliable and valid as they meet and exceed the reliability (Cronbach's alpha) benchmark of 0.7 as required by Taber (2018:1276).

4.6 Data preparation

As soon as the data have been collected, it has to be processed. The process of preparing data requires attention and time to avoid inaccuracies and draw attention to the importance of the study. In this study, the data preparation process included editing and coding the data using Excel spreadsheets.

4.6.1. Data Cleansing

Several researchers refer to data cleaning as one of the main challenges in the area of data analysis and failing to do so can result in inaccurate analyses and poor decision making (Camacho-Olarte, Torres, Jimenez, Medina, Vargas, Cardenas, Gutierrez-Osorio, Rueda, Vargas, Burgos, Bonilla, Esmeral & Restrepo-Calle 2020:2). In other words, data cleaning is the process of correcting and deleting inaccurate records so that all data sets should be consistent and free of any errors that could be problematic during later use or analysis (Dilmegani 2021:1). For instance, data cleansing is applied to remove incorrect data such as fixing wrong spelling and syntax errors, correcting mistakes such as missing codes and empty fields (Gimenez 2018:1). However, the same author suggests that to achieve the goals and objectives of this process, the researcher must implement six different steps. The data must be monitored, standardised, validated, scrubbed for duplicates, analysed and communicated with team members (Gimenez 2020:1). However, it is necessary to note that there is no specific step in the data cleaning process as the process varies from dataset to dataset.

4.6.2 Editing

Editing is the process whereby the researcher analyses the data and refines the questionnaire, removing items that do not measure the exact phenomena or do not measure reliability (Baždarić

(2018:74). Editing was used in this study to identify inaccuracies and errors, correct them and confirm that the data were of a quality standard. To expand on this, the objective of editing in this study was to ensure that the data were:

- Exact
- Dependent on the measurement instruments and other information in the questionnaire
- Consistently edited.

4.6.3 Coding using Excel spreadsheet

Coding is defined by Creswell (2018:156) as the process of grouping and assigning numbers to various responses to see what they yield before putting the data back together meaningfully. Elliott (2018:2851) posits that coding is a method of indexing or planning data to provide an outline of dissimilar data that permits the researcher to make sense of them about the research questions. In this study, coding was used by assigning a number for each questionnaire before entering it into the spreadsheet for upcoming verification.

4.7 DATA ANALYSIS

Data analysis is the technique used for treating and analysing the data. It is necessary to obtain objective reliability results for this research. These results were obtained through the application of the Statistical Packages for the Social Sciences (SPSS version 27.0) and Analysis of Moments Structure (AMOS version 27.0). The SPSS is a statistical software developed by international Business machines (IBM) used by researchers to to obtain data results (George & Mallery 2021:1). However, the AMOS 27.0 enables the researcher the power to easily perform structural equation modeling (Arbuckle 2013:5). The use of these statistical software enabled the use of techniques such as confirmatory factor analysis (CFA), structural equation modelling (SEM) and path analysis to obtain the accepted results.

4.7.1 Descriptive statistics

In descriptive statistical analysis, the objective is to review data. Descriptive statistics encompass the description of data in terms of incidents, mean, middle, quartiles, standard nonconformity and inter-quartiles variety (Hussain 2012:741). Lani (2010:1) postulates that descriptive statistics are used to describe the fundamental features of data such as the general statistics for variables and measures of data. Moreover, de Sousa Rodrigues, de Lima and Barbosa (2017:620) state that descriptive statistics enable the researcher to describe data using numbers or statistical processes that may best represent all data collected throughout research. In this study, data were presented in tables, graphs and other graphical methods. Therefore, this study presented statistics using frequency tables and percentage pie charts. The different types of descriptive statistics are defined below:

Incident reporting systems: Critical incident method is considered a systematic, open-ended technique that involves analysing specific situations to determine which communicative actions or behaviours would lead to the best possible outcome of a given situation (Allen 2017:1).

Mean: The arithmetic mean of a variable, often called the average, is computed by adding up all the values and dividing by the total number of values (Bhandari 2020:1).

Middle: Median is the value that divides the data into 2 equal parts, that is, the number of terms on the right side is the same as the number of terms on the left side when data is arranged in either ascending or descending order (Narkhede 2018:2).

Quartiles: A quartile is a statistical term that describes a division of observations into four defined intervals based on the values of the data and how they compare to the entire set of observations (Liberto 2021:1).

Standard nonconformity: Nonconformity is defined by Keen (2021:1) as the failure to meet one or more of the existing requirements for a quality management system (QMS).

Inter-quartiles variety: The Inter-quartiles variety is defined to be the distance between the 75th and 25th percentile in the sample (Wilcox 2017:45).

The descriptive statistics used in this study include the mean and the standard deviation. The mean was used as the primary indicator of the perceptions of respondents regarding the implementation of the research constructs in their firms. The standard deviation was also used as an indicator of central tendency, to check how scattered all computed values were scattered away from the mean. The results are presented in Section 5.7 and Table 5.15 of this dissertation.

4.7.2 Confirmatory factor analysis (CFA)

According to Prudon (2015:1), confirmatory factor analysis (CFA) is a statistical technique used by researchers to validate the factor structure for a set of observed variables. Steiger (2013:1) posits that (CFA) makes available a clear summary for confirming previous notions about the framework of a domain of content. Moreover, Nagy, Brunner, Ludtke and Greiff (2017:574) state that (CFA) is a resourceful tool for evaluating theoretically systematic measurement models by identifying the number of latent constructs that are expected to affect obvious measures and the pattern of these impacts. Based on the above definitions, CFA is significant for this research study due to the following benefits:

- CFA-based measurement models are readily implanted in wider structural equation modelling (SEM) to test hypotheses about relations between latent constructs and other essential variables taking advantage of the condensed measurement error in the latent construct (Lahey, McNealy, Knodt, Zald, Sporns, Manuck, Flory, Applegate, Rathouz & Hariri 2012:2)
- CFA also measures the validity of an instrument across groups to specify if an instrument measures the same latent construct across dissimilar populations or settings (Hoofs, Van de Schoot, Jansen & Kant 2018:538)
- CFA permits testing the presence of an attribute that cooperatively clarifies the indications and collects the information in a single general index (Peres, Eufrásio, Gouvêa, Diana, Santos, Swardfager, Abílio & Cogo-Moreira 2018:16).

In this study, the CFA was used to test for scale accuracy by considering reliability, validity and model fit. The results of the CFA are presented in Table 5.18 and further discussed in Section 5.7.

4.7.2.1 Reliability

Reliability is defined by Haradhan (2017:1) as the firmness of results, meaning that there is uniformity of measurement when used under similar conditions with the same subjects. The same author confirms that reliability concerns the confidence that a researcher can have in the data acquired from the usage of an instrument, that is, the extent to which any measuring tool controls for random error. Heale and Twycross (2015:66) define validity as the degree to which a notion is precisely measured in a quantitative study.

In this study, reliability was measured by Cronbach's alpha coefficient. For this study, it is important to include reliability to obtain firm, reliable and constant results.

4.7.2.2 Cronbach's alpha

Alpha was established by Lee Cronbach in 1951 to make available a measure of the internal uniformity of a test or scale articulated as a number between 0 and 1 (Tavakol & Dennick 2011:53). For this, Taber (2017:1) postulates that Cronbach's alpha is a measurement normally recited by authors to determine that tests and scales that have been constructed or adopted for research projects are fit for purpose. Bonett and Wright (2014:1) confirm that Cronbach's alpha reliability is one of the most commonly used measures of reliability in social and organisational sciences.

The threshold of this study is reported and stated in Tables 4.1 - 4.6, wherein the measurement instruments selected are all reliable and valid as they meet and exceed the reliability (Cronbach's alpha) benchmark of 0.7 as required by Taber (2018:1276). Similarly, Shemwell, Chase and Schwartz (2015:68) report that the results of "$\alpha = 0.70$" were fairly reliable as it seemed likely from the context that the statistic referred to was Cronbach's alpha although this was not explicitly stated.

The general rule is that a Cronbach's alpha of .70 and above is good, 0.80 and above is better and 0.90 and above is the best (De Vet, Mokkink, Mosmuller & Terwee 2017:45). If Cronbach's alpha is negative, then the data is invalid and unreasonable.

The results for the application of the Cronbach alpha coefficient in this study are reported in Section 5.6.1.

4.7.2.3 Validity

Validity is the articulation of the degree to which a measurement measures what it intends to measure (Bolarinwa 2015:195). Similarly, Oluwatayo (2012:391) defines validity as the extent to which a test or measuring instrument measures what it senses to measure or how well a test or an instrument accomplishes its purpose. Moreover, Knekta, Runyon and Eddy (2018:2) posit that validity is the extent to which evidence and theory support the analyses of the test score for the suggested use. To support this study, validity clarifies how well the accumulated data cover the actual area of study (Taherdoost 2016:28).

For this study, it is imperative to use validity to check the accuracy of the results. Therefore, this study further discusses the main types of validity namely face validity, content validity, convergent validity and discriminant validity.

Face validity

Face validity occurs when an individual who is knowledgeable about the research subject reviews the questionnaire and concludes that it measures the characteristic or quality of interest (Bölenius, Brulin, Grankvist, Lindkvist & Söderberg 2012:2; Bhattacharyya, Kaur, Kaur & Ali 2017:18). For this, Engel and Schutt (2013:97) posit that face validity is often said to be much unpremeditated and many researchers do not consider this as an active measure of validity.

At this phase of the study, after an inspection of the first draft of the questionnaire, the supervisors noticed that the questions were valid and suitable for the study. However, the terminology used to formulate the questions was biased against employees with a low level of education. Therefore, the supervisors requested the revision and improvement of the questions to make them fair and comprehensible or logical to all employees in the construction field. To address the supervisors' comments, the researcher revised and adjusted the vocabulary of each question contained in the questionnaire to make it relevant for all educational backgrounds. Once addressed, the questionnaire was considered suitable and adequate for the study.

Content validity

Content validity relates to the extent to which the tool entirely measures the construct of interest and discloses how well the dimensions and the elements thereof are distinct (Sangoseni, Hellman & Hill 2013:3). Sekaran and Bougie (2010:206) advocate that content validity guarantees that the measure includes a sufficient and demonstrative set of items that matches the notion, hence it assesses the existing performance than predicting upcoming performance.

In this study, to address the content validity, a pilot study was conducted prior to the main study. At this stage of the study, 50 respondents that knew supply chain coordination and firm performance in the construction industry were purposely selected to assess content validity. The chosen ones were asked to complete the questionnaire. Once returned, the answers were coded on an Excel sheet and analysed with SPSS (27.0) to assess the reliability and the feasibility of the study. The reliability was assessed using the coefficient alpha (≥0.7) as prescribed by Purwanto and Sudargini (2021:119). The results of the content validity are represented in Section 5.2 entitled "Pilot study."

Convergent validity

Convergent validity refers to the degree that diverse measures of the same construct converge or strongly relate with each other (Engellant, Holland & Piper 2016:39). Carlson and Herdman (2012:19) reveal the degree to which two measures capture similar information, thus the more related the information they capture, the more probable they are to yield comparable research results.

In this study, convergent validity was determined through the item to total correlations, item loadings and average variance extracted (AVE) value and estimated factor loadings. In this study, convergent validity was assessed using the factor loading (≥0.5) and the Average Variance Extracted (AVE ≥0.5) as prescribed by Wellner (2015:115). The results for the testing of convergent validity are reported in Table 5.12 and further discussed in Section 5.6.5.

Discriminant validity

According to Henseler, Ringle and Sarstedt (2015:115), discriminant validity has developed into a commonly acknowledged requirement for analysing relationships between latent variables. For this reason, it enables the researcher to ensure that the latent constructs used for measuring the causal relationships under study are truly distinct from each other (Ab Hamid, Sami & Sidek (2017:1). Moreover, Hair, Hult, Ringle and Sarstedt (2014:115) declare that discriminant validity measures the degree of variances amongst the overlapping construct. In this study, discriminant validity was checked with an inter-construct correlation matrix (P<0.01) as prescribed by Farrell (2010:325). The results for the testing of discriminant validity are reported in Chapter 5, Section 5.6.6.

4.7.3 Model fit assessment

Numerous fit indices determine how well a model fits the sample data and establishes which proposed model has the greatest superior fit (Cangur & Ercan 2015:152). Model fit indices were established to quantitatively and objectively evaluate the model fit, thus it is vital to identify the best model for the data to achieve meaningful results (Rose, Markman & Sawilowsky 2017:71). Chinomona (2011:102) mentions that several standards have been hypothesised to offer an effective and efficient analysis of a study's CFA and SEM. Table 4.7 shows the different fit indices criteria and their thresholds.

Table 4.7 The model fit indices criteria

Goodness of fit criteria	**Recommended level**	**Level interpretations**
1. Chi-square (x2)	≤3	Values close to 1 reflect good model fit, values <3 reflect acceptable fit.
2. Goodness of fit index (GFI)	≥ 0.9	Values = or >0.9 reflect a good fit.
3. Norm- fit- index NFI	≥ 0.9	Values = or >0.9 reflect a good fit
4. Relative fit index RFI	≥ 0.9	Values = or >0.9 reflect a good fit
5. Incremental Fit Index	≥ 0.9	Values = or >0.9 reflect a good fit
6. Augmented goodness of fit index (AGFI)	≥ 0.9	Values = or >0.9 reflect a good fit
7. Comparative Fit index (CFI)	≥ 0.9	Values = or >0.9 reflect a good fit
8. Tucker Lewis index	≥ 0.9	Values = or >0.9 reflect a good fit
9. Root mean square error of approximation (RMSEA)	≤0.08	Values <0.05 reflect a good fit; values between 0.05 and 0.08 reflect acceptable fit.

Source: Own

This study executed a CFA to establish the factor model fit to assess if the sample data fits or supports the hypothesised research factor model. Using Amos 21, the model fit indices tested in CFA to evaluate the factor model fit include the Chi-square of freedom, Goodness of Fit Index (GFI), Augmented Goodness of Fit Index (AGFI), Normed Fit Index (NFI), Incremental Fit Index (IFI), Tucker Lewis Index (TLI), Composite Fit Index (CFI), Root mean square residual (RMR) and Root mean square error of approximation (RMSEA). Based on the above, Kraiczy (2013: 67) state that CFI, NFI and RMSEA are frequently used in literature to examine the validity of the constructs. The CFA leads to the performance of path analysis, which is discussed in the next section.

The chi-square test permits researchers to assess the fitness of a model using the null hypothesis significance test approach (Shi, Lee & Maydeu-Olivares 2019:311). An acceptable chi-square value should be low as 2 and high as 5 to be acceptable.

A good fit indicator occurs when the RMSEA low value is less than 0.05 and the high value is less than 0.10 (Kline 2011:319). As a result, RMSEA estimates the inconsistency correlated to the estimation, thus clearly the reason for unsolved variance. Schumacker and Lomax (2016: 115) postulate that RMSEA takes into consideration the level of freedom and the sample size. Generally, the lower limit of RMSEA is near 0 while the higher limit should be below 0.08. Therefore, to be acceptable in this study, RMSEA should be less than 0.08.

GFI is defined by Henseler and Sarstedt (2013:566) as the model that takes both the measurement and structural models' performance into consideration. As a result, GFI measures how well the model accounts for the covariance and its value should be equal to or greater than 0.90 to specify a good fit (Hammervold & Olsson 2012:1550).

The NFI is among the family of incremental fit indices and indicates the ratio of the difference in the value for the fitted model and the null model (Maiyaki 2012:9932). Moreover, the same author mentions that NFI's acceptable value ranges between 0 and 1. Additionally, Okoumba (2015:89) states that CFI compares the covariance matrix anticipated by the model to the detected covariance matrix and compares the null model with the observed covariance matrix. The CFI is a revised method of the normed fit index that considers sample sizes that perform well even when the sample size is lesser and the acceptable value should be between 0.0 and 1 for it to fit the model (Rogers & Schmitt 2010:399).

The results for the testing of model fit in this study are reported in Table 5.19.

4.7.4 Structural equation modelling (SEM)

The structural equation model was developed in the early 1970s by Reskog, Keesling and Wiley and is regarded by West, Taylor and Wu (2012:209) as one of the best models that can examine models that symbolise a compound set of theoretical hypotheses. According to Stein, Morris and Nock (2012:495), structural equation modelling is a multivariate statistical method that incorporates the approximation of limitations for a system of synchronised equations. Sikhwari (2015:115) defines SEM as the model that shows the relationships between the variables while taking into consideration measurement errors. The model is progressively used in scientific studies in the field of social sciences (Civelek 2018:6). As a result of this, the same author posits that this statistical technique is significant in the sense that the direct and indirect relationships between contributing variables can be measured using a single model.

SEM reduces the dimensionality of duplicated data acquired from several individuals down to a smaller number of components and observes the variance in those weighting components (Grimm, Ram & Estabrook 2016:8). Lefcheck (2016:573) adds that SEMs are probabilistic models using path diagrams to unite several predictor and response variables in a single fundamental network. Furthermore, Asparouhov and Muthén (2016:1) mention that structural equation models decrease data modelling down to fit means and covariances. Therefore, it can be remarked that SEM allows the researcher to perform some type of multilevel regression on factors. In general, SEM tolerates compound phenomena to be numerically displayed and because of the quantitative approach method it offers, it is becoming a frequently used technique for theoretical models validation or disapproval (Ilieva, Anguelov & Nikolov 2018:2).

In this study, SEM is a method for testing and understanding the effectiveness of supply chain coordination to achieve and improve performance in the construction industry. The results for SEM are reported in Chapter 5, Table 5.20.

4.7.4.1 Path modelling

Path modelling or analysis is an extensively used multivariate technique that allows researchers to deduce and assess an arrangement of contributing relations between constructs in a study (Barbeau, Boileau, Sarr & Smith 2019:38). For this, path analysis is beneficial in making obvious the validation of predictable regression calculations. Moreover, Nugroho and Surendro (2013:326) state that path modelling is mostly required in research to assist researchers in understanding the complication of relationships and control the most important relationships. According to Madu and Akobi (2014:117), path analysis is a statistical technique used mainly to inspect the relative strength of direct and indirect correlation between variables. Generally, path analysis method offers sequences of hypothetical propositions that are normally associated with the cause and effect without influencing the variables, thus can be conducted as progressive multiple regression analysis (Wuensch 2016:2).

The results for path analysis as applied in this study are reported in Table 5.21.

4.8 ETHICAL CONSIDERATIONS

Ethics are values that deal with the behaviour of people and monitor the rules or standards of behaviour of people and interactions with one another (Akaranga & Makau 2016:1). Besides, Shah (2011:205) as well as Akaranga and Ongong'a (2013:8) refer to ethics as social standards for behaviour that differentiate between satisfactory and undesirable conduct.

Several ethical considerations were applied during the study. Respondents were made aware that their participation was voluntarily and no discrimination would ever take place against those who did not intend to participate. The nature and purpose were of the study were discussed with the respondents. Therefore, in line with the subject of this study, the following procedures listed by Harriss, Macsween and Atkinson (2017:1124) aid the researcher in respecting the code of research ethics and respondents' information:

- Voluntary participation: researcher ensured that potential participants understand that they have the right to decide whether or not to participate in research studies voluntarily and that declining to participate in any research will not affect in any way their access to current or subsequent care (Barrow, Brannan & Khandhar 2021:1)
- Informed consent: this principle is giving informed consent to intending subjects of research by ensuring that participants are given the privilege of accepting willingly or rejecting to take part in the research (Ubi, Orji & Osang 2020:55 This implies that much information is required for participants to knowingly, intelligently and voluntarily understand before their decision to participate is valid (Xu, Baysari, Stocker, Leow, Day & Carland 2020:2). Therefore, in this study, clear and explicit information about the research objectives was provided to participants before completing the questions
- Anonymity and confidentiality: in this aspect, the researcher will ensure confidentiality of all research subjects, including data stemming from systematic reviews of documents, which might be considered sensitive due to race, ethnicity, religion, marital status or qualification (Dooly, Moore & Vallejo 2017:353). Akaranga and Makau (2016:6) suggest that during research, a researcher must promise to protect the information given in

confidence by the respondent thereby developing honesty towards the research subject by protecting them from physical and psychological harm

In this study, by protecting and keeping respondents' personal, informal information, animosity and confidentiality were observed.

- Protection from victimisation: participants should be treated with equal respect. For example, pregnant women, minorities, children and other groups considered to be 'vulnerable' should not be routinely excluded from research participation without a reasonable scientific and ethical justification (World Health Organisation 2016:3). Therefore, this study avoided any kind of discrimination or abuse by not harming respondents and respecting their human dignity and autonomy.
- Honesty was observed in this study by coding and reporting on the data and results the way they were. The study did not fabricate the data. In addition, the researcher acknowledged the works of scholars used in the dissertation by using the Harvard referencing system.

4.9 CONCLUSION

This chapter conferred literature related to research methodology and design adopted in this study. The chapter covers three main sections. The first section presented a pure statement of research paradigms through a thorough description of positivism and interpretivism paradigms as well as a research approach. A research approach is about what constitutes quantitative and qualitative procedures based on their dissimilarities. The second section of this chapter discussed research designs whereby the techniques used to conduct this study were outlined. The third section outlined the ethical considerations that were followed in this study. Data analysis techniques were also described in this chapter. From the data analysis, the researcher expounded on the techniques that treat and analyse data and these techniques included the use of SPSS and AMOS. This was done to provide detailed insights into how the data was going to be analysed in this study and the different indicator criteria that were used to ascertain the relevance of the results.

The next chapter of this study will address the analysis, interpretations and evaluations of the research results.

CHAPTER 5

DATA ANALYSIS AND INTERPRETATION OF THE RESULTS

5.1 INTRODUCTION

In the previous chapter, the researcher discussed the research methodology and research design that underpinned this study.

In the present chapter, the researcher analyses and interprets the results obtained through a questionnaire. Therefore, it is also the aim of this chapter to determine the impact of supply chain coordination on operational, financial and social performance in the construction industry in the Gauteng Province. These questionnaires were distributed to supply chain managers and operational management professionals in several construction industries in and around Gauteng Province. Moreover, the main purpose of this chapter is to analyse data to obtain usable and useful information.

In Chapter 1, the researcher mentioned that a pilot study was conducted on 50 supply chain management and operations management professionals that were working on the construction site at a selected university of technology in 2019. The pilot study was carried out to identify whether or not the questionnaires answered the objectives of this study. The chapter first discusses the pilot study and its results. This will be followed by detailed results of the main survey.

5.2 Pilot study

This section entails details and results of the pilot study. As mentioned, a pilot study was conducted among the accessible sample of 50 supply chain management and operations management professionals to identify whether or not the questionnaire answered the set objectives. Moreover, the pilot study was used to ensure that the questionnaire was understandable to supply chain managers and operational management professionals in the construction industry. After conducting the pilot study, there were no changes made to the questionnaire. The questionnaire was understandable and measured the study objectives. For the reliability of the pilot study collected, a response value of 0.789 was obtained using the Cronbach alpha. The value well exceeds the 0.70 level suggested by Full, Malhotra, Crist, Moran and Kerr (2019:20). Table 5.1 reports on the results of the pilot results.

Table 5.1 Summary of the pilot research results

Constructs	Number on question asked	Cronbach Alpha	Mean Score (μ)	SD (σ)
Supplier Coordination (SC)	5	0.722	4.372	3.543
Customer Coordination (CC)	5	0.745	4.324	3.569
Coordination effectiveness (CE)	5	0,768	4.580	3.873
Operational Performance (OP)	5	0.709	4.384	3.720
Social Performance (SP)	5	0.755	3.308	2.411
Financial Performance (FP)	5	0.744	4.120	2.603

Judging from the 36 questionnaires returned, the pilot study confirms the validity of the research instruments. Table 5.1 indicates that the mean score for the 6 variables ranged between 7.24 and 12.33. The results of the pilot study showed that supply coordination scored the highest mean (X=26.92: SD=3.39). This implies that most respondents ranked this variable as the most significant variable of the study. From the results provided in Table 5.1, the Cronbach's alpha value for each research construct ranges from 0.709 to 0.768. The lowest value is 0.709, which is above the 0.7 recommended threshold endorsed by Purwanto and Sudargini (2021:119). Therefore, a higher degree of internal reliability and consistency of the measures used in the current study confirmed the feasibility of the study.

5.3 Main data results

This section discusses the results of the main study in reference to descriptive statistics and inferential statistics. It is important to note that the total sample size of this study is 364 construction supply chain managers and operations management professionals. From the total sample, 36 questionnaires were not fully completed. Therefore, those incomplete questionnaires were rendered void and did not form part of the final data analysis. The analysis and interpretation of data were done on 364 questionnaires. For the reliability of the main survey, a response value of 0.870 was obtained using Cronbach alpha. The value well exceeds the 0.70 suggested by Full, Malhotra, Crist, Moran and Kerr (2019:20). These interpretations of data were done in the same format as in the questionnaire. Table 5.2 shows the response rate.

Table 5.2: Response rate

Total number of questionnaires distributed	400
Valid questionnaires retained	364
Unusable responses	36
Usable response rate	91.0%

The response rate is defined by Barnes, Barclay, McCaffery, Rolfe and Aslani (2021:866) as the number of participants divided by the number of accurately completed units in the sample. The study's response rate was 91%, which indicated a reliable and excellent response rate for analysis. Esinah (2014:22) finds that a response rate of 50% and over is considered adequate for analysis and interpretation.

5.4 DEMOGRAPHIC PROFILE OF THE RESPONDENTS

In this section, the researcher asked questions on the demographics of the respondents, which in this case are the 364 construction supply chain managers and operations management professionals. Questions asked about demographics include gender, age, race, marital status and qualification.

5.4.1 Gender

The frequencies and percentages for the respondents' gender are provided in Table 5.3 and Figure 5.1 below.

Table 5.3: Gender Respondents

Variable	**Category**	**Questionnaires**	**Respondents**	**Percentage (%)**
Gender	Male	364	332	91.0
	Female	364	32	9.0

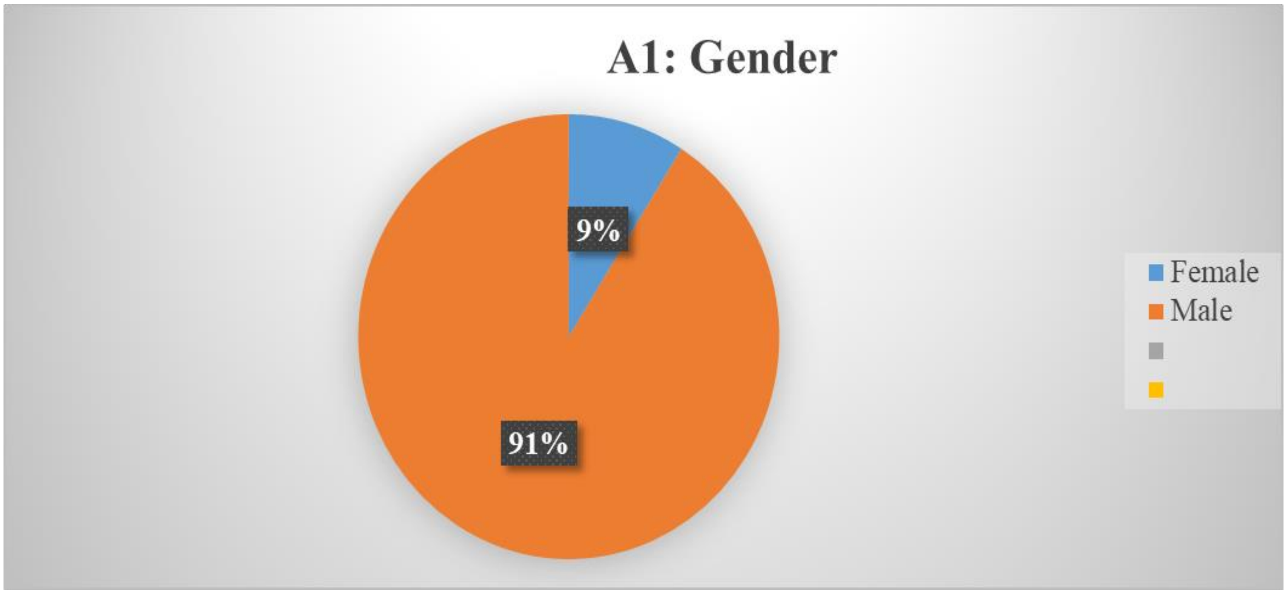


Figure 5.1: Gender Respondents

Table 5.3 and Figure 5.1 indicate that 91.0 percent (n=332) were males while 9.0 percent (n=32) were females. The overall stereotype is that there are no women in the construction sector because men are often more physical than women, thus able to lift heavier weights. For this, Haupt and Ndimande (2019:3) state that women are still underrepresented in the construction industry, not only in South Africa but also around the world.

5.4.2 Age

The frequencies and percentages of the respondents' ages are illustrated in Table 5.4 and Figure 5.2.

Table 5.4

Variable	Category	Questionnaires	Respondents	Percentage (%)
Age	Below 30 years	364	150	41.0
	30-39 years	364	142	39.0
	40-49 years	364	50	14.0
	50-59 years	364	14	4.0
	60 years & above	364	8	2.0

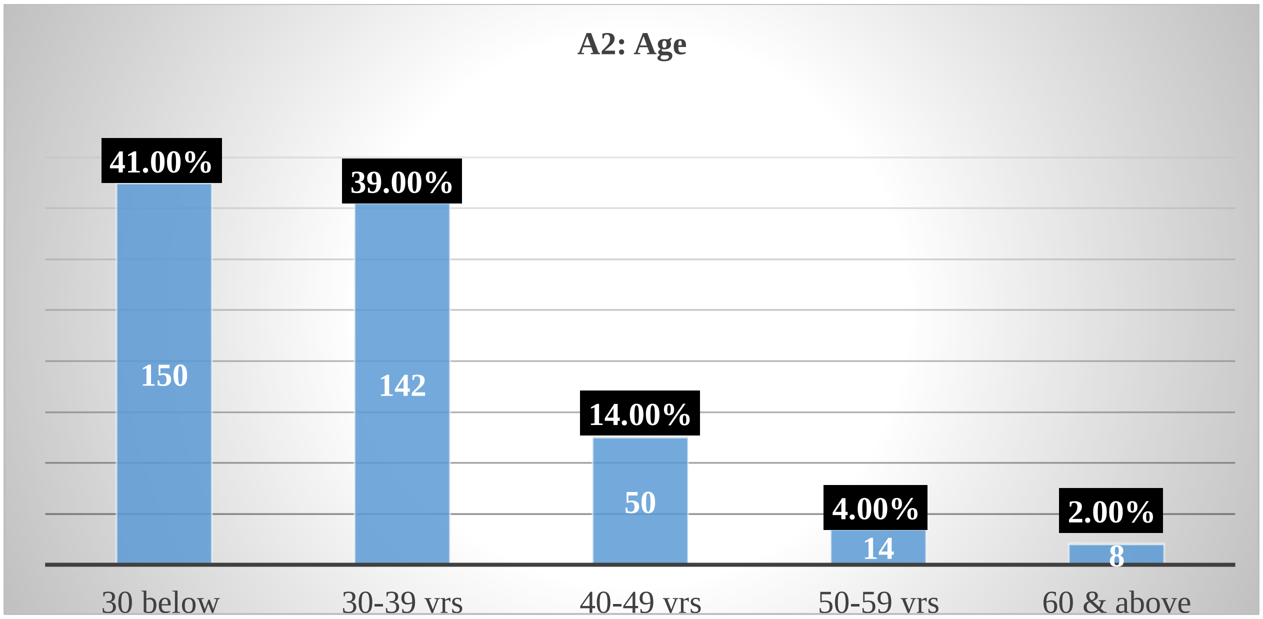


Figure 5.2

Table 5.4 and Figure 5.2 show that most of the employees in the construction industry are below the age of 40 whereas the smallest number of employees is 40 and above. Young and average employees can perform physically demanding tasks whereas older employees may be faced with problems such as chronic diseases and a lack of strength (Schwatka, Butler & Rosecrance 2012:157). Table 5.4 and Figure 5.2 show that out of 364 respondents, 80.0 percent (n=292) of respondents were aged between 39 and below. Other respondents that aged between 40 and 60 years old equaled 20.0 percent (n=72).

5.4.3 Race

The frequencies and percentages of respondents' races are shown in Table 5.5 and Figure 5.3.

Table 5.5

Variable	Category	Questionnaire	Respondents	Percentage (%)
Race	Black	364	313	86.0
	White	364	29	8.0
	Indian	364	0	--
	Coloured	364	22	6.0
	Other (specify)	364	0	--

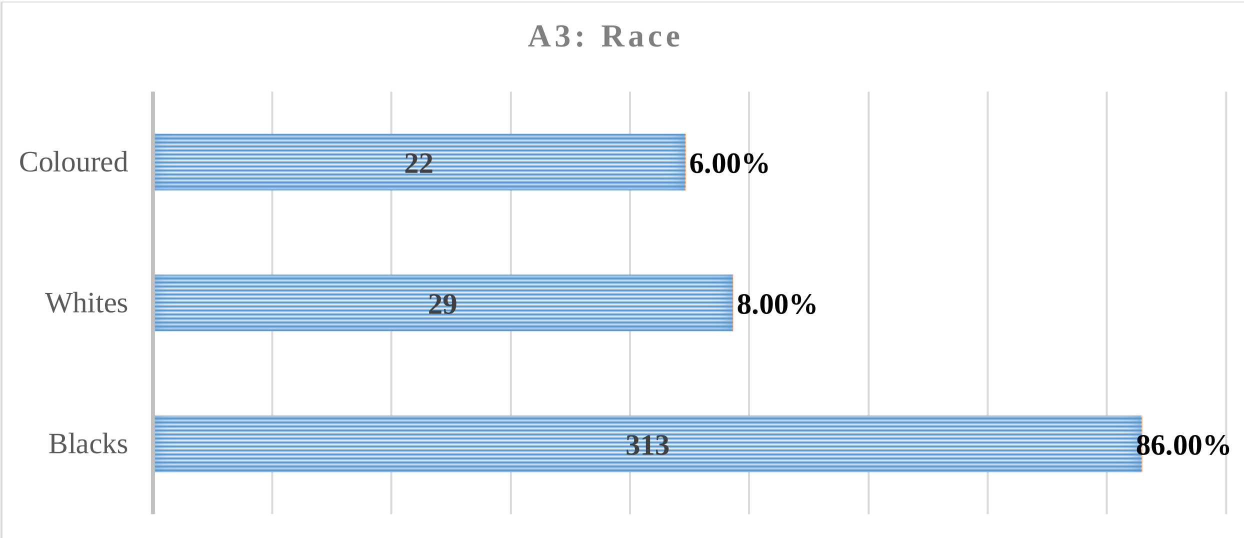


Figure 5.3

The results presented in Table 5.5 and Figure 5.3 show that majority of the employees in the construction industry are Blacks with a percentage of 86,0 (n-313) followed by Whites with a percentage of 8.0 (n=29) and Coloureds with a percentage of 6.0 (n=22). Therefore, Table 5.5 and Figure 5.3 support Gradín's (2019:555) claim that the construction industry constitutes more Black employees because they are mostly unskilled as compared to Whites.

5.4.4 Marital Status

The frequencies and percentages of respondents' marital status are indicated in Table 5.6 and Figure 5.4.

Table 5.6

Variable	Category	Questionnaires	Respondents	Percentage (%)
Marital Status	Married	364	11	3.0
	Single	364	251	69.0
	Divorced	364	55	15.0
	Widowed	364	47	13.0

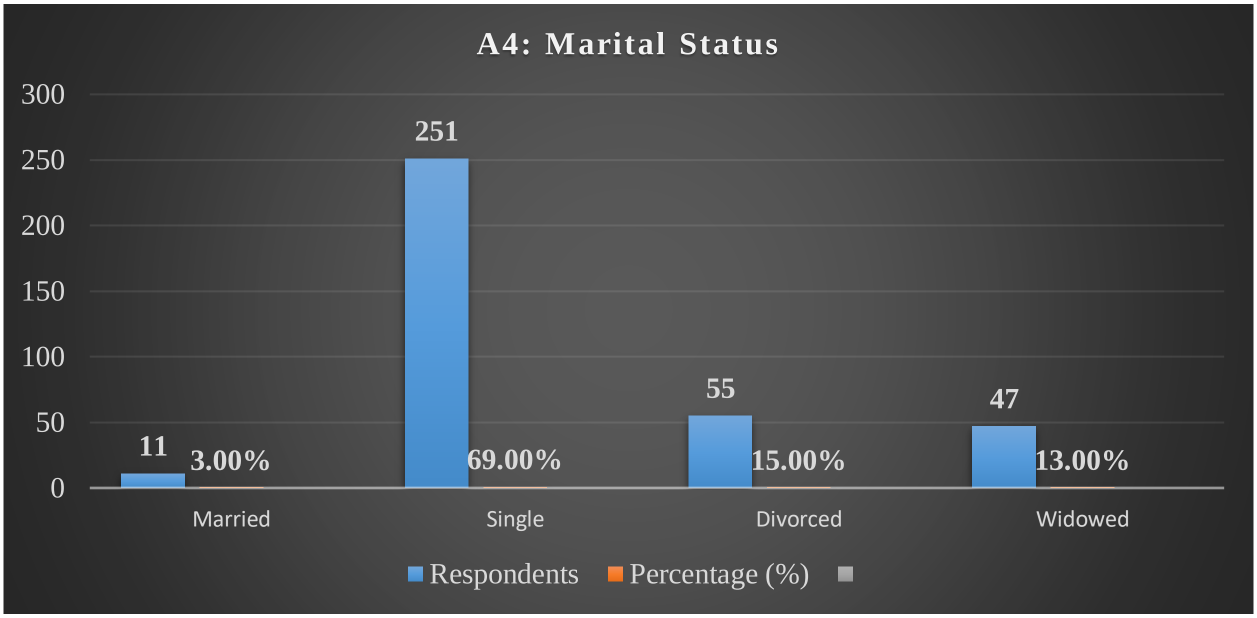


Figure 5.4

Table 5.6 and Figure 5.4 show that a large number of respondents are single with a percentage of 69.0 (n=251) followed by divorced respondents with a percentage of 15.0 (n=55). Then, the widows constitute a percentage of 13.0 (n=47) and married employees have a percentage of 3.0 (n=11). This shows that the construction industry requires personnel that can do many types of work, regardless of marital status to finish the project in time. Again, the construction industry requires young and innovative people with technological ideas.

5.4.5 Qualification

The frequencies and percentages of the respondents' qualifications are illustrated in Table 5.5 and Figure 5.5.

Table 5.7

Variable	Category	Questionnaires	Respondents	Percentage (%)
Qualification	Matric or below	364	164	45.0
	Post-matric certificate	364	95	26.0
	Diploma	364	55	15.0
	Degree	364	33	9.0
	Postgraduate	364	18	5.0

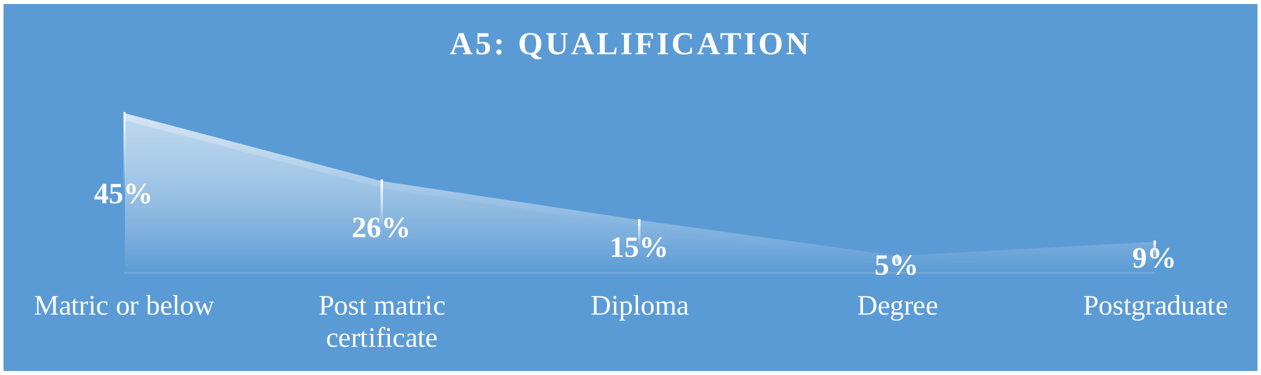


Figure 5.5

Table 5.7 and Figure 5.5 show that out of the 364 respondents, a large number of respondents with a percentage of 45.0 (n=164) is construction employees having Matric or below. This is followed by employees with Matric certificates at a percentage of 26.0 (n=95). Employees with Diploma constitute 15.0 percentage (n=55) while 9.0 percent (n=33) are employees with Degree and 5.0 percent (n=18) are Postgraduate construction employees. This implies that the construction industry targets the right group of young people for field positions, mainly those out of high school but not in colleges. To support the above statement, World Economic Forum (2016:5) stated that the future of construction projects requires commitment and inspiration of active participants who believe in a modern engineering and construction industry that will benefit all.

5.5 PERCEPTIONS OF RESPONDENTS TOWARDS RESEARCH CONSTRUCTS

Respondents' perceptions towards supply chain coordination and firm performance in the construction industry in the Gauteng province are analysed in the following sections.

5.5.1 Supply Chain Coordination

In this section, the researcher asked questions on supply chain coordination. Supply chain coordination is specified as the process that reflects the collaboration of internal activities between the manufacturer and its supply chain associates (Li, Zhao & Huo 2018:47). Similarly, Mathu (2019:2) postulates that supply chain coordination is synchronisation of internal and external activities. The results of Supply Chain Coordination are presented in Table 5.8 below:

Table 5.8: frequencies and percentages of Supply Chain Coordination

Item code	Item description	SD	D	N	A	SA
SO1	We actively plan supply chain activities	6 2%	12 3%	57 16%	133 37%	156 42%
SO2	We strive to manage each of our supply chains as a whole	8 2%	6 2%	33 9%	135 37%	182 50%
SO3	Our manager can communicate smoothly with managers in other sectors	8 2%	13 4%	11 3%	142 39%	190 52%
SO4	We consider our customers' forecasts in our supply chain planning	8 2%	2 1%	39 11%	109 30%	206 57%
SO5	We monitor the performance of members of our supply chains in order to adjust supply chain plans	8 2%	8 2%	33 10%	125 34%	190 52%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Table 5.8 provided detailed results about the respondents' view of the supply chain coordination in construction sites in and around the Gauteng Province. The results show that 79.0 percent (n=289) of the respondents agreed that they actively plan for supply chain activities. However, 16.0 percent (n=57) respondents were neutral while 5% (n=18) respondents disagreed with the statement.

The second item on the supply chain coordination (SO2) was the respondents' view that the construction industry strives to manage supply chain activities as a whole. The results show that approximately 87% (n=317) of the respondents agreed that supply chain activities are managed. However, 9% (n=33) respondents were neutral while 4% (14) of the respondents disagreed with the statement.

The third item on the supply chain coordination (SO3) was the respondents' view of whether managers communicate smoothly with managers in other sectors. The results show that 91%

(n=332) of the respondents agreed that managers communicate well with other managers from other sectors. However, 3% (n=11) of the respondents were neutral while 6% (n=21) disagreed with the statement.

The fourth item on the supply chain coordination (SO4) was the respondents' view of whether the construction industry considers the customers' forecast on the supply chain planning. The results show that 87% (n=315) of the respondents agreed that customers' forecast is considered on the supply chain planning. However, 39% (n=11) of the respondents were neutral while 3% (n=10) disagreed with the statement.

The fifth item of the supply chain coordination (SO5) was the respondents' view of whether the construction industry monitors the performance of members to adjust to supply chain plans. The results show that approximately 86% (n=315) of the respondents agreed that the construction industry monitors the performance of members to adjust to supply chain plans. However, 10% (n=33) of the respondents were neutral while 4% (n=16) disagreed with the statement.

5.5.2 Supplier Coordination

In this section, the researcher asked questions on supplier coordination. Supplier coordination is defined by Patrucco, Luzzini and Ronchi (2017:1272) as the process that involves information-sharing with key suppliers to gain better knowledge on developments, competencies and challenges, thus allowing more effective planning and forecasting as well as creation and process design for the industry. The results of supplier coordination are presented in Table 5.9 below:

Table 5.9: Frequencies and percentages of Supplier Coordination

Item code	Item description	SD	D	N	A	SA
SC1	Supplier process integration improves product innovation capabilities in a low equivocality environment	7 2%	6 2%	63 17%	126 35%	162 44%
SC2	Supplier product integration improves quality in high equivocality environments	6 2%	8 2%	28 8%	139 38%	183 50%

SC3	Dedicated workforce is required to gather and share information and knowledge across the supply chain	5 1%	8 2%	24 7%	213 59%	114 31%
SC4	Dedicated capacity, tools and equipment are kept simple and clear to reduce ambiguity	6 2%	12 3%	24 7%	84 23%	238 65%
SC5	Dedicated storage and transportation facilities help to improve synchronisation and delivery times	6 2%	8 2%	12 3%	143 39%	195 54%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Table 5.9 provided detailed results about the respondents' view of supplier coordination in the construction industry in and around Gauteng Province. The results show that 79% (n=288) of the respondents agreed that supplier process integration improves product innovation capabilities in a low equivocality environment. However, 17% (n=63) of the respondents were neutral while 4% (n=13) disagreed with the statement.

The second item on the supplier coordination (SC2) was the respondents' view of whether supplier product integration improves quality in high equivocality environments. The results show that approximately 88% (n=322) of the respondents agreed and that supplier product integration improves quality in high equivocality environments. However, 8% (n=28) of the respondents were neutral while 4% (n=14) disagreed with the statement.

The third item on the supplier coordination (SC3) was the respondents' view that a dedicated workforce is required to gather and share information and knowledge across the supply chain. The results show that approximately 90% (n=327) of the respondents agreed that a dedicated workforce is required to gather, share information and knowledge across the supply chain. However, 7% (n=24) respondents were neutral while 3% (n=13) disagreed with the statement.

The fourth item on the supplier coordination (SC4) was the respondents' view of "dedicated capacity, tools and equipment are kept simple and clear to reduce ambiguity". The results show that approximately 88% (n=322) of the respondents agreed and strongly agree that the dedicated capacity, tools and equipment are kept simple and clear to reduce ambiguity. However, 7% (n=24) respondents were neutral while 5% (n=18) respondents disagreed with the statement.

The fifth item on the supplier coordination (SC5) is that dedicated storage and transportation facilities help to improve synchronisation and delivery times. The results show that approximately 93% (n=338) of the respondents agreed that dedicated storage and transportation facilities help to improve synchronisation and delivery times. However, 3% (n=12) of the respondents were neutral while 4% (n=14) of the respondents disagreed with the statement

5.5.3 Customer Coordination

In this section, the researcher asked questions on customer coordination. According to Prior, Keränen and Koskela (2019:2), customer coordination is the process of resolving developing problems, coordinating difficult tasks and accomplishing task requirements within the construction industry. The results for customer coordination are presented in Table 5.10 below:

Table 5.10: Frequencies and percentages of Customer Coordination

Item code	Item description	SD	D	N	A	SA
CC1	We are able to identify our customers' needs and wants	8 2%	8 2%	22 6%	61 17%	265 73%
CC2	We use information from customers in designing products and services	7 2%	8 2%	27 7%	133 37%	189 52%
CC3	We are frequentlyin close contact with our customers	6 2%	6 2%	47 13%	147 40%	158 43%
CC4	We are committed to satisfy customers	6 2%	7 2%	59 16%	147 40%	145 40%
CC5	We maintain a good relationship between the company's goals and customers' expectations	6 2%	6 2%	29 8%	129 35%	194 53%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Table 5.10 provided detailed results about the respondents' view of customer coordination in construction industries in and around Gauteng province. The results show that 90% (n=326) of the respondents agreed that supply chain managers and operations management professionals identify their customers' needs and wants. However, 6% (n=22) respondents were neutral while 4% (n=8) of the respondents disagreed with the statement.

The second item on the customer coordination (CC2) was to identify whether construction supply chain managers and operations management professionals use information from customers in designing products and services. The results show that 89% (n=322) of the respondents agreed that information from customers is used in designing products and services. However, 7% (n=27) of the respondents were neutral while 4% (n=15) of the respondents disagreed with the statement.

The third item on the customer coordination (CC3) was to identify if construction supply chain managers and operations management professionals are frequently in close contact with customers. The results show that 83% (n=305) of the respondents agreed that construction supply chain managers and operations management professionals are frequently in close contact with their customers. However, 13% (n=47) of the respondents were neutral while 4% (n=12) of the respondents disagreed with the statement.

The fourth item on the customer coordination (CC4) was the respondents' view that supply chain management and operations management professionals are committed to satisfy customers. The results show that 80% (n=291) of the respondents agreed that the construction industry is dedicated and committed to satisfy customers. However, 16% (n=59) of the respondents were neutral while 4% (n=13) of the respondents disagreed with the statement.

The fifth item on the customer coordination (CC5) was the respondents' view that the construction industry maintains a good relationship between the company's goals and customers' expectations. The results show that 88% (n=320) of the respondents agreed that a good relationship between the construction industry's goals and customers' expectations is maintained. However, 8% (n=29) of the respondents were neutral while 4% (n=12) of the respondents disagreed with the statement.

5.5.4 Coordination Effectiveness

In this section, the researcher asked questions on coordination effectiveness. Coordination effectiveness is the process of managing interdependencies between supply chain members to determine the way players can rely on each other during the project (Hsu, Hung, Shih & Hsu 2016:96). The results of coordination effectiveness are presented in Table 5.11 below:

Table 5.11: Frequencies and percentages of Coordination Effectiveness

Item code	Item description	SD	D	N	A	SA

CE1	We respond effectively to changing requirements of design	6 2%	6 2%	7 2%	153 42%	192 53%
CE2	Improves the efficiency of operation between our suppliers and us	6 2%	6 2%	58 16%	179 49%	115 32%
CE3	We are able to meet special customer specification requirements	6 2%	19 5%	70 19%	154 42%	115 32%
CE4	We coordinate production and information efficiently across suppliers and product lines	6 2%	8 2%	45 12%	98 27%	207 57%
CE5	We maintain a higher capacity buffer of response to volatile market	6 2%	7 2%	40 11%	121 33%	190 52%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Table 5.11 provided detailed results about the respondents' view of the coordination effectiveness in construction industries in the Gauteng Province. The results show that 95% (n=345) of the respondents agreed that construction supply chain managers and operations management professionals respond effectively to changing requirements of the design. However, 2% (n=7) were neutral while 4% (n=12) disagreed with the statement.

The second item on the coordination effectiveness (CE2) was on respondents' view that coordination effectiveness improves the efficiency of operation between supply chain managers and operations management professionals and suppliers. The results show that 81% (n=294) of the respondents agreed that construction supply chain managers and operations management professionals improve the efficiency of operation between employees and suppliers. However, 16% (n=58) of the respondents were neutral while 4% (n=12) of the respondents disagreed with the statement.

The third item on coordination effectiveness (CE3) was the respondents' view of the construction industry's ability to meet special customer specification requirements. The results show that 74% (n=269) of the respondents agreed that the ability to meet special customer specification requirements is accomplished. However, 19% (n=70) of the respondents were neutral while 7% (n=25) of the respondents disagreed with the statement.

The fourth item on coordination effectiveness (CE4) was the respondents' view to identify whether the construction industry coordinates production and information efficiently across suppliers and product lines. The results show that 84% (n=305) of the respondents agreed that construction supply chain managers and operations management professionals coordinate production and information efficiently across suppliers and product lines. However, 12% (n=45) of the respondents were neutral while 4% (n=14) of the respondents disagreed with the statement.

The fifth item on the coordination effectiveness (CE5) was the respondents' view of maintaining a higher capacity buffer of response to a volatile market. The results show that 85% (n=311) of the respondents agreed that the construction industry maintains a higher capacity buffer of response to a volatile market. However, 11% (n=40) of the respondents were neutral while 4% (n=13) of the respondents disagreed with the statement.

5.5.5 Operational Performance

In this section, the researcher asked questions that focus on operational performance. Operational performance is a behaviour that consists of directly visible activities of an employee and also conceptual involvement such as answers or decisions, which result in organisational outcomes in the form of accomplishment of set goals (Uddin, Rahman, Abdul, Mansor & Reaz 2019:421). The results of operational performance are presented in Table 5.12 below:

Table 5.12: Frequencies and percentages of Operational Performance

Item code	Item description	SD	D	N	A	SA
OP1	Orders from our customers are fulfilled in a short lead time	6 2%	6 2%	24 6%	80 22%	248 68%
OP2	Deliveries to our customers are fulfilled as scheduled	8 3%	6 2%	16 4%	78 21%	256 70%
OP3	Offer very flexible options for changing orders' quantity	8 2%	12 3%	70 19%	84 24%	190 52%
OP4	Product defective rate is very low	23 6%	7 2%	37 10%	87 24%	210 58%
OP5	Provide 100% products safety certification	30 8%	24 7%	41 11%	172 47%	97 27%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Table 5.12 provided detailed results about the respondents' view of the operational performance in the construction industry in the Gauteng province. The results show that 90% (n=328) of the respondents agreed that orders from customers are fulfilled in a short lead time. Moreover, 6% (n=24) of the respondents were neutral while 4% (n=12) disagreed with the statement.

The second item on the operational performance (OP2) was on respondents' view of whether deliveries of customers are fulfilled as scheduled. The results show that 91% (n=334) of the respondents agreed that the deliveries of customers are fulfilled as scheduled. However, 4% (n=16) of the respondents were neutral while 5% (n=14) of the respondents disagreed with the statement.

The third item on the operational performance (OP3) was on respondents' view of whether construction workers offer very flexible options for changing order quantity. The results show that 76% (n=274) of the respondents agreed that construction supply chain managers and operations management professionals offer very flexible options for changing orders' quantity. However, 19% (n=70) of the respondents were neutral while 5% (n=20) of the respondents disagreed with the statement.

The fourth item on operational performance (OP4) was on the respondents' view of whether product defective rate in construction industries is low. The results show that 82% (n=297) of the respondents agreed that the product defective rate is very low. However, 10% (n=37) of the respondents were neutral while 8% (n=30) disagreed with the statement.

The fifth item on the operational performance (OP5) was the respondents' view of whether the construction industry provides 100% products safety certification. The results show that 74% (n=269) of the respondents in and around Gauteng province agreed that the construction industry provides 100% products safety certification. However, 11% (n=41) of the respondents were neutral while 15% (n=54) of the respondents disagreed with the statement.

5.5.6 Social Performance

In this section, the researcher asked questions that focus on social performance. Social performance is an extent to which the set of values and procedures of social accountability within the construction industry as well as guidelines, programmes and recognisable externalities are applied to different shareholders (Lassala, Apetrei & Sapena 2017:3). The results on social performance are presented in Table 5.13 below:

Table 5.13: Frequencies and percentages of Social Performance

Item code	Item description	SD	D	N	A	SA
SP1	Relationships with main partners are satisfactory	8 2%	45 12%	65 18%	112 31%	134 37%
SP2	Main partners are not good companies for business	7 2%	6 2%	48 13%	144 40%	159 44%
SP3	Partners are satisfied with main partners performance	15 4%	7 2%	65 18%	130 36%	147 40%
SP4	Partners have successful coordination with main partners	7 2%	6 2%	48 13%	144 40%	159 43%
SP5	Partners do not have high confidence in main partners	6 2%	6 2%	6 2%	163 44%	183 50%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Table 5.13 provided detailed results about the respondents' view of social performance in the construction industry in the Gauteng province. The results show that 68% (n=246) of the respondents agreed that their status of relationships with main partners is satisfactory. However, 18% (n=65) of the respondents were neutral while 14% (n=53) of the respondents disagreed with the statement.

The second item on the social performance (SP2) was on respondents' view of whether main partners are not good companies for business. The results show that 84% (n=303) of the respondents agreed that the main partners are not good companies for business. However, 13% (n=48) of the respondents were neutral while 4% (n=13) of the respondents disagreed with the statement.

The third item on social performance (SP3) was the respondents' view of whether partners are satisfied with main partners performance. The results show that 76% (n=277) of the respondents agreed that partners are satisfied with main partners performance. However, 18% (n=65) of the respondents were neutral while 6% (n=22) disagreed with the statement.

The fourth item on social performance (SP4) was the respondents' view of whether construction supply chain managers and operations management professionals have successful coordination with main partners. The results show that 83% (n=303) of the respondents agreed that construction workers have successful coordination with main partners. However, 13% (n=48) of the respondents were neutral while 4% (n=13) of the respondents disagreed with the statement.

The fifth item on the social performance (SP5) was the respondents' view of whether supply chain managers and operations management professionals do not have high confidence in main partners. The results show that 94% (n=382) of the respondents agreed that partners do not have high confidence in main partners. However, 2% (n=6) of the respondents were neutral while 4% (n=12) of the respondents disagreed with the statement.

5.5.7 Financial Performance

In this section, the researcher asked questions on financial performance. In the words of Fatihudin and Mochklas (2018:553), financial performance can be defined as the ability that the construction industry measures its financial condition over a certain period. In contrast, Naz, Ijaz and Naqvi (2016:82) view financial performance as an act used mainly by corporations to generate more sales, profitability and value for its stakeholders, which includes shareholders and employees through effective management of current and non-current assets. The results for financial performance are presented in Table 5.14 below:

Table 5.14: Frequencies and percentages of Financial Performance

Item code	Item description	SD	D	N	A	SA
FP1	My firm's sales growth is better than that of our major competitors	6 2%	6 2%	83 23%	81 22%	188 52%
FP2	My firm's return on assets is higher than that of our major competitors	1 2%	23 6%	66 18%	121 33%	153 42%
FP3	My firm's market share growth is higher than that of our major competitors	7 2%	76 21%	49 13%	128 35%	104 29%

FP4	My firm's return on investment is higher than that of our major competitors	11 3%	14 4%	60 16%	128 35%	151 41%
FP5	My firm's total cost reduction is better than that of our major competitors	0 0%	14 4%	69 19%	111 30%	170 47%

SD= Strongly Disagree D=Disagree N=Neutral A= Agree SA= Strongly Agree

Figure 5.14 provided detailed results about the respondents' view of the financial performance in the construction industry in the Gauteng province. The results show that 74% (n=269) of the respondents agreed that the firm's sales growth is better than that of major competitors. However, 23% (n=83) of the respondents were neutral while 4% (n=12) of the respondents disagreed with the statement.

The second item on the financial performance (FP2) was on respondents' view of the firm's return on assets being higher than that of major competitors. The results show that 75% (n=274) of the respondents agreed that the firm's return on assets is higher than that of major competitors. However, 17% (n=66) of the respondents were neutral while 8% (n=24) of the respondents disagreed with the statement.

The third item on financial performance (FP3) was the respondents' view of the firm's market share growth being higher than that of major competitors. The results show that 64% (n=232) of the respondents agreed that the firm's market share growth is higher than that of major competitors. However, 13% (n=49) of the respondents were neutral while 23% (n=83) of the respondents disagreed with the statement.

The fourth item on financial performance (FP4) was the respondents' view of the firm's return on investment being higher than that of major competitors. The results show that 77% (n=279) of the respondents agreed that the firm's return on investment is higher than that of major competitors. However, 16% (n=60) of the respondents were neutral while 7% (n=25) of the respondents disagreed with the statement.

The fifth item on the financial performance was the respondents' view of the firm's total cost reduction being better than that of major competitors. The results show that 77% (n=281) of the respondents agreed that the firm's total cost reduction is better than that of major competitors. However, 19% (n=69) of the respondents were neutral while 4% (n=14) of the respondents disagreed with the statement.

5.6 COMMON METHODS BIAS

Common methods bias has been developed and widely used in the past decades to deal with limitations of human decision making that occur when complex decision environments are involved (Melnik-Leroy & Dzemyda 2021:1). Thus, the same authors posit that common bias methods aim at dealing with certain limitations of human information processing. Turskis, Dzitac, Stankiuviene and Šukys (2019:91) suggest that superior results can be achieved by applying multi-criteria decision-making (MCDM) techniques that can deal with enormous amounts of information and calculations. Furthermore, Jakobsen and Jensen (2015:4) mention that common method bias occurs when the researcher makes use of the same survey respondent to measure both the independent and dependent variables that produce a positive correlation between the two variables. Consequently, according to Chang, van Witteloostuijn and Eden (2010:178), the results can display an incorrect internal consistency and an obvious correlation amongst the variables as same respondent studies can suffer from common method variance (CMV). For this, Jakobsen *et al*. (2015:18) suggest that the best way to minimise common method bias, when it is unlikely to use different methods or sources to measure the independent and dependent variables, is through survey design as well as measuring directly the important sources of common method bias.

Notwithstanding CMB being a well-known problem, it is still considered an enduring concern by Podsakoff, MacKenzie and Podsakoff (2012:539) and Spector (2019:125) within research as the problem occurs from a single administration survey in which independent variables and dependant variables (or certainly all variables) are collected at once with a similar format (for instance, the use of consistent Likert-type scales).

5.6.1 Addressing common methods bias

The sections below elaborate on how the bias of the common method was addressed in this study.

5.6.1.1 Preventative measures

At the early stage of the questionnaire design, procedures were implemented to prevent CMB effects. Initially, when designing the questionnaire, diverse sources of information were consulted. Successfully, the questions included were adapted from different studies as mentioned in Chapter 1, Section 8.4 and Chapter 4, Section 4.4. Furthermore, under the supervision of the main supervisor and co-supervisor, the items expressed were refined into clear, concise and relevant wording for all educational backgrounds, as stated in Chapter 4, Section 4.3.2.1. In addition to these procedures, through the ethics reflected and applied in this study, guaranteed anonymity and protection for the research respondents and explanations that there are no incorrect or correct answers helped reduce their hesitation and made them less likely to provide answers that were generally anticipated. Finally, as preventive measures, the survey instruments were confirmed to support the measurement items' content validity.

5.6.1.2 Statistical techniques

Numerous techniques have been proposed by Podsakoff *et al*. 2012:545 for testing and monitoring for common method bias in cases the sources of bias cannot be measured. Moreover, the same authors (2012:540) identify that if total variance for a single factor is over 50%, it indicates that CMB affects the data; the total variance of less than 50% indicates that CMB does not affect the data of the survey. In this study, Harman's single factor was assessed through SPSS (27.0). The techniques as proposed by Podsakoff *et al*. (2012:545) are the following:

- the unmeasured latent method factor technique
- the correlation-based marker technique
- the regression-based marker technique
- the instrumental variable technique and
- the CFA marker technique.

5.7 SCALE ACCURACY ASSESSMENT

Scale accuracy was assessed through testing for reliability, validity and model fit in what is known as the Confirmatory Factor Analysis (CFA). CFA is the first phase of the structural equation modelling technique applied in this study to test the hypotheses. To assess the reliability of the constructs measurement, three tests namely Cronbach's Alpha, Composite Reliability (CR) and Average Variance Extracted (AVE) were conducted. These tests are required to determine the measure of reliability. For instance, the Cronbach's Alpha test is anticipated to certify if there is reliability while CR and AVE tests pursue to confirm and validate the presence of reliability. The results of the tests are reported in Table 5.16, which will be explained thereafter. The scale item column indicates the mean value concerning responses described above as well as respective Standard Deviation values.

Table 5.15: Scale accuracy analysis

Research constructs		Descriptive statistics		Cronbach's test		CR value	AVE value	Factor loading
		Mean	**SD**	**Item total**	**α Value**			
SUPPLY CHAIN CORDINATION	SCC1	**4.381**	**3.552**	0.735	**0.719**	**0.87**	**0.53**	**0.752**
	SCC2			0.628				**0.653**
	SCC3			0.783				**0.684**
	SCC4			0.773				**0.779**
	SCC5			0.681				**0.475**
SUPPLIER COORDINATION	SC1	**4.418**	**3.663**	0.791	**0.844**	**0.92**	**0.73**	**0.687**
	SC2			0.895				**0.805**
	SC3			0.845				**0.896**
	SC4			0.899				**0.779**
	SC5			0.783				**0.791**
CUSTOMER COORDINATION	CC1	**4.614**	**3.907**	0.756	**0.813**	**0.88**	**0.66**	**0.553**
	CC2			0.845				**0.791**
	CC3			0.786				**0.789**
	CC4			0.847				**0.634**
	CC5			0.832				**0.726**
COORDINATION EFFECTIVENESS	CE1	**4.394**	**3.630**	0.856	**0.757**	**0.782**	**0.59**	**0.705**
	CE2			0.636				**0.727**
	CE3			0.704				**0.735**
	CE4			0.837				**0.698**
	CE5			0.754				**0.719**
OPERATIONAL PERFOMANCE	OP1	**4.497**	**3.599**	0.766	**0.784**	**0.760**	**0.64**	**0.789**
	OP2			0.842				**0.645**
	OP3			0.864				**0.739**
	OP4			0.705				**0.791**
	OP5			0.742				**0.678**

SOCIAL PERFOMANCE	SP1	**3.724**	**2.207**	0.956	**0.851**	**0.87**	**0.77**	**0.801**
	SP2			0.853				**0.811**
	SP3			0.785				**0.778**
	SP4			0.892				**0.591**
	SP5			0.772				**0.671**
FINANCIAL PERFOMANCE	FP1	**4.245**	**3.359**	0.785	**0.747**	**0.721**	**0.53**	**0.706**
	FP2			0.689				**0.653**
	FP3			0.769				**0.717**
	FP4			0.674				**0.752**
	FP5			0.821				**0.712**

CR= Composite reliability; AVE=Average variance extracted.
** Scores: 1 – Strongly Disagree; 2-Disagree; 3 – Neutral; 4-Agree; 5 – Strongly Agree*

Validity and reliability are the main yardsticks used in quantitative research (Mohajan 2017:58). In the previous chapter, it was mentioned that validity and reliability would be assessed to evaluate the internal consistency in the research constructs as well as to conduct composite reliability in this research study.

Reliability tests

5.7.1 Cronbach's Alpha Test

In the previous chapter, the study employed Cronbach alpha analysis to obtain the accepted results. It was mentioned that a high level of Cronbach's alpha coefficient shows reliability that is high of the scale (Chinomona 2011:108). The Cronbach's alpha values in this research range from 0.79 to 0.91. Moreover, Taber (2018:1277) mentions that a set of items that can be considered is from a minimum of 0.7. Therefore, the scales used in this study are reliable.

5.7.2 Composite Reliability

The study also used the Composite Reliability to test for internal consistency. The following formula was used to calculate composite reliability.

Formula 1: Composite reliability

(CR): CRη= (∑λyi) 2 / [(∑λyi) 2 + (∑Ɛi)] **Therefore, CR= (square of the summation of the factor loadings)/ [(square of the summation of the factor loadings) + (summation of error variances)]**

Source: Hair, Babin, Anderson and Tatham (2010: 334)

A CR value equal to or higher than 0.7 reflects a good internal consistency of the variable (Hair, Babin, Anderson & Tatham 2010: 334). The CR values calculated through the application of the above formula are indicated in Table 5.16.

Table 5.16 Composite reliability

Accuracy analysis statistics: Composite reliability research construct	**Composite reliability**
Supply chain coordination (SCC1, SCC2, SCC3, SCC4, SCC5)	0.761
Supply coordination (SC1, SC2, SC3, SC4, SC5)	0.872
Customer coordination (CC1, CC2, CC3, CC4, CC5)	0.754
Coordination effectiveness (CE1, CE2, CE3, CE4, CE5)	0.886
Social Performance (SP1, SP2, SP3, SP4, SP5)	0.786
Operations performance (OP1, OP2, OP3, OP4, OP5)	0.864
Financial performance (FP1, FP2, FP3, FP4, FP5)	0.784

Source: Own Compilation

As shown in Table 5.16, CR values between 0.754 and 0.886 were obtained for all the measurement scales. This suggests that reliability was acceptable in this study since these values surpassed the 0.7 minimum cut-off value.

5.7.3 Face validity

Face validity occurs when an individual who is knowledgeable about the research subject reviews the questionnaire and concludes that it measures the characteristic or quality of interest in the study

(Hufford 2021:1). For this study, the academic supervisors reviewed the questionnaire and concluded that it measured the expected content of the study.

5.7.4 Content validity

Content validity sums up the data to easily understand the relationships and patterns of observed constructs in the measuring instrument (Sürücü & Maslakçı 2020:2699). For this study, the pilot study was used to ascertain content validity.

5.7.5 Convergent validity

In testing for validity, the study mentioned in the previous chapter that convergent validity would be tested. This is done to check whether the study tests what it is intended to measure. In this study, the item-total correlation and factor loadings were examined. As seen in Table 5.15, the item-total values are within the range of 0.628 to 0.956. As observed, all the values are above the required threshold of 0.5, which indicates that the item-total values are acceptable. The accepted recommended threshold suggested by Wellner (2015:115) should be above 0.5. As the values obtained in this study, construct loadings were greater than 0.5. These results mean that all the items are acceptable and that there is a relationship between each construct and each item.

5.7.6 Discriminant validity

The discriminant validity is established to show that the relationships between the research constructs are correct (Farrell 2010:325). Using Table 5.17 below, values for discriminant validity are presented using correlations drawn from the CFA.

Table 5.17 Correlation Results

Research Constructs	**SC**	**CE**	**CC**	**OP**	**FP**	**SP**
SC	1.00					
CE	0.888	1.00				
CC	0.878***	0.877**	1.00			
OP	0.732	0.786	0.612	1.00		

FP	0.851***	0.886***	0.545**	0.529	1.00	
SP	0.978**	0.743**	0.745**	0.829	0.758	1.00

** indicates significant at the 0.01 level (2-tailed).

Note: SC = Supplier Coordination; CE = Coordination Effectiveness; CC = Customer Coordination; OP = Operational Performance; FP =Financial Performance; SP = Social Performance

As shown in Table 5.17, correlations between the constructs were below 1.0 indicating that there is acceptable discriminant validity in the study. The correlation between CE and SC has a value of (p=0.888; p<0.01). The correlation between CC and SC shows a positive relationship (p=0.878; p<0.01) followed by correlation between OP and CE (p=0.877; p<0.01). Furthermore, the inter factor correlation values between OP and SC (p=0.732; p<0.01) followed by correlation between OP and CE (p=0.786; p<0.01) and correlation between OP and CC (p=0.612; p<0.01), a significant relationship exists between FP and SC (p=0.851; p<0.01); FP and CE (0.886; p<0.01); FP and CC (p=0.545; p<0.01) and FP and OP (p=0.529; p<0.01). Moreover, the correlation between SP and SC has a value of (p=0.978; p<0.01); SP and CE (p=0.743; p<0.01); SP and CC (p=0.745; p<0.01); SP and OP (P=0.829; p<0.01) as well as SP and FP (P=0.758; p<0.01).

5.8 Model fit assessment for confirmatory factor analysis

The current study used the model for confirmatory factor analysis (CFA) to examine or test the relationship between a set of observed constructs. CFA is essentially a procedure of SEM with which the study hypothesises that the items selected to represent the latent construct (the model) really do so (El-Den, Schneider, Mirzaei & Carter 2020:332). Table 5.18 below outlines the goodness of fit criteria, the acceptable levels and the interpretation of nine fit indices that the researcher employed in this research study.

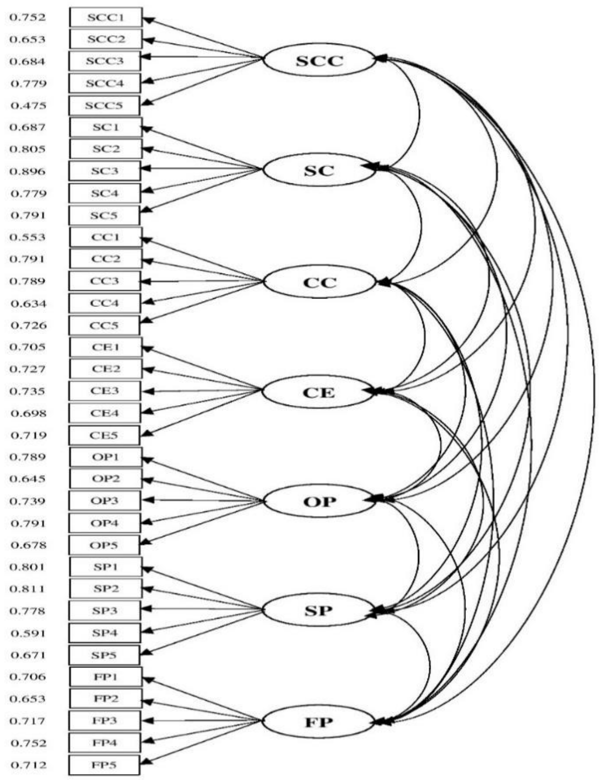


Figure 5.16: CFA model fit results from the data collected in this research study.

Table 5.18: CFA model fit results.

Fit index	**Results**
Chi-square (x2)	3.458
Goodness of fit index (GFI)	0.901
Norm- fit- index NFI	0.943
Relative fit index RFI	0.903
Incremental Fit Index	0.951

Augmented goodness of fit index (AGFI)	0.932
Comparative Fit index (CFI)	0.919
Tucker Lewis index (TLI)	0.945
Root mean square error of approximation (RMSEA)	0.067

Table 5.18 shows the degrees of freedom of the chi-square (x2) at a level of 3.458. As indicated in the table, the CFA normal threshold is above 3. Therefore, this value indicates an acceptable model fit as asserted by Arbuckle (2013:185). Moreover, the above table shows that the GFI (0.901); NFI (0.943); RFI (0.903); IFI (0.951); TLI (0.932); CFI (0.951) and AGFI (0.932) meet the recommended threshold of 0.9 as suggested by Chang, Suki and Tam (2014: 108), which signifies a good model fit. Finally, Hoe (2008:77) states that the RMSEA threshold should be less than 0.08 to confirm a good model fit. Therefore, Table 5.18 above shows the RMSEA of 0.067, which is a good model fit as it is less than the minimum threshold of 0.08. In conclusion, the examination of the nine goodness fits statistics of CFA conclude that all the fit index is acceptable and that they fit the model.

5.9 Structural Equation Model

The study employed structural equation modelling to evaluate the relationships between the research constructs. The model fit assessment approach is also referred to as the standard approach or the conventional method in which the goodness of fit is examined for the entire multilevel structural equation model simultaneously (Ryu 2014:1). Figure 5.16 presents the structural modelling model fit indices results for this study.

Table 5.19: Structural equation modelling model fit indices outcomes

Fit index	Recommended level
Chi-square (x2)	Less or equal to 3
GFI	Less or equal to 0,9
NFI	Above or equal to 0,9

RFI	Above or equal to 0,9
RMSEA	Less or equal to 0,8

Source: Hinterhuber & Liozu 2013:93

Table 5.20 below presents model fit assessment results. Before presenting these results, it is important to note that the standard approach parallels the model fit evaluation in single-level SEM.

Table 5.20: SEM model fit assessment indices results

Fit index	Results
Chi-square (x2)	2.519
GFI	0.876
NFI	0.992
RFI	0.911
RMSEA	0.771

Table 5.20 above shows the results of chi-square value (x2) of 2.519. Hinterhuber and Liozu (2013:93) recommend a threshold of below 3 and this study indices result is 2,519. Therefore, this value is an acceptable model fit result. Additionally, the GFI, NFI, RFI and RMSEA are 0.876, 0.828, 0.711 and 0.771 respectively. The GFI of 0.876 is close to the normal standard. However, Lytras, De Pablos, Ziderman, Roulstone, Maurer and Imber (2010:80) suggest that the adjusted GFI is 0.900, which is equal to the normal standard value. The NFI and RFI are all above the recommended value of 0.9, which means the results are satisfactory. The value of RMSEA is 0.771, which is below the required threshold of 0.08, thus confirming an acceptable fit of the data to the model.

In total, examining these five goodness fit statistics, it is concluded that they are all acceptable and that the data fits the model.

5.10 Hypothesis testing

In this section, the 5 hypotheses addressing their acceptance or validity with the structural equation modelling are discussed. The study has anticipated that supplier coordination, customer coordination, operational performance financial performance and social performance have coordination effectiveness in the construction. The results indicated in the above tables support these results;

Table 5.21: Results of hypotheses testing (path modelling)

Proposed hypothesis Relationship	**H**	**PCE**	**P-V**	**D**
Suppliers coordination to coordination effectiveness	H1	0.885	***	Accepted
Customers coordination to coordination effectiveness	H2	0.553	***	Accepted
Coordination effectiveness to Operational Performance	H3	0.564	***	Accepted
Coordination effectiveness to Financial Performance	H4	0.505	***	Accepted
Coordination effectiveness to Social performance	H5	0.678	***	Accepted

H= Hypothesis PCE= Path Coefficient Estimates PV= P- Value D=Decision

As shown in Table 5.22 and Figure 5.6 below, the researcher presents the level of coefficients of all the 5 hypotheses and the level of $p<0.01$. The significance levels of $p<0.05$, $p<0.01$ and $p<0.01$ are indicators of either positive, strong and significant relationships between the research constructs (Chinomona, Lin, Wang & Cheng 2010:191). Based on that, all of the five hypotheses proposed in this research study were supported and accepted.

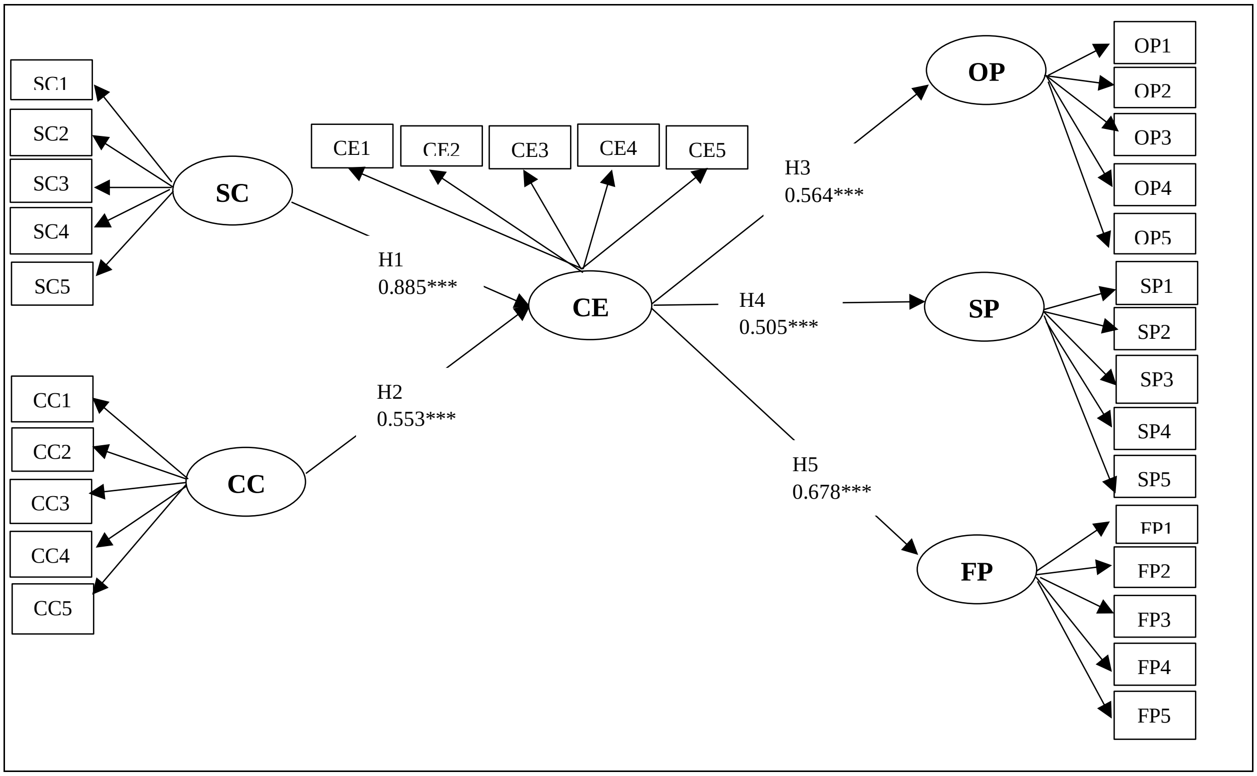


Figure 5.17: Resultant conceptual model

Discussion of the results

In this subsection, the study presented that the results of the hypotheses (H1 to H5) are at a significant level and support at a confidence level of p<0.01. The following subsections present and discuss the hypotheses as indicated in Figure 5.6 and Table 5.12.

5.10.1 Results for hypothesis 1

The first hypothesis (H1) in this study stated that there is a positive relationship between supplier coordination (SC) and coordination effectiveness. Supply chain coordination (SC) is the process that reflects the collaboration extent between the manufacturer and its supply chain (SC) associates and among its internal activities (Li, Zhao & Huo 2018:47). Mathu (2019:2) views supply chain coordination as the synchronisation of activities within an organisation and external relationships with other supply chain partners. Based on the definition of Lavikka, Smeds and Jaatinen (2015:206) that supply chain coordination is the integration of different tasks to accomplish one common goal, those activities are planning, sourcing, execution, processing and reduction of delays. The path coefficient of (H1) is 0.885. This value indicates a very strong relationship between supplier coordination and coordination effectiveness. Thus, the p-value is significant at 99% (r=0.001), which means this hypothesis is supported and significant. These results are in line with a study conducted by Gay and Norrman (2016:22), which showed that proper supplier coordination leads to proper coordination effectiveness.

5.10.2 Results for hypothesis 2

About the second hypothesis (H2), the study hypothesised that there is a positive relationship between customer coordination and coordination effectiveness. Table 5.21 and Figure 5.6 show the path coefficient value of (r=0.553) with p-value is significant at 99%.

The path coefficient confirms the existence of a reasonable relationship between customer coordination and coordination effectiveness. The positive correlation found between customer coordination and coordination effectiveness is consistent with the results provided by Jayaram *et al*. (2011:69) as well as Rahardja, Anandya and Setyawan (2018:46). Customer coordination enables relationships between the construction industry and the customer by persuading the industry to adapt to the needs of customers, provide better services and products whilst creating good financial returns for the construction industry (Yu, Jacobs, Salisbury & Enns 2013:347). Drawing from a study conducted by Rahardja, Anandya and Setyawan (2018:46), trust is an indispensable prerequisite for operational relationships between customer coordination and coordination effectiveness. From this research study, it can be concluded that the relationship between customer coordination and coordination effectiveness increases performance in the construction industry. These authors further point out that trust plays a vital role in attaining a relationship between customer coordination and coordination effectiveness because it can upturn profits for supply chain partners.

5.10.3 Results for hypothesis 3

A positive correlation was hypothesised between coordination effectiveness and operational performance. After testing H3, a path coefficient of (r=0.564) was obtained. The result confirms that there is a positive relationship between coordination effectiveness and operational performance. The relationship between these two constructs is highly significant at 99% indicated by a ($p<0.001$). Operational performance is regarded as the main indicator for evaluating the construction industry's supply chain productivity (Quang, Sampaio, Carvalho, Fernandes, An & Vilhenac 2016:457; Truong & Hara 2017:1377). For this, Truong and Hara (2018:222) state that operational performance includes those indicators that reflect the main objectives of the industry by minimising cost and waste that results in higher performance. The results confirm or validate the existence of the relationship between coordination effectiveness and operational performance. These results are consistent with the results of Le Tuong and Vo Hong (2014:11) whereby commitment was found to be the most significant factor to influence the relationship between coordination effectiveness and operational performance.

5.10.4 Results for hypothesis 4

A positive correlation was hypothesised between coordination effectiveness and financial performance. The importance of measuring the financial performance of the construction industry is to gain valuable information associated with the flow of funds, the use of funds, effectiveness and efficiency (Amal, Sameer & Yahya 2012:269). However, Gerschewski and Xiao (2015:616) state that financial performance indicators such as profitability, sales growth and earnings per share (EPS) help in achieving the economic goals of the construction industry. Furthermore, Ortas, Álvarez and Garayar (2015:1936) mention that the financially successful industry has more financial capitals that it can spend on environmental, social and governance (ESG) matters, therefore achieving greater performance.

The relationship is validated based on the results of the path coefficient ($r=0.505$) and the regression path is highly significant ($P<0.001$). Therefore, the current study validates and supports that the relationship between coordination effectiveness and financial performance is significant. The results show that there is a positive relationship between coordination effectiveness and financial performance. In general, the results of this study show that financial performance plays an important role in the growth and sustainability of the construction industry.

5.10.5 Results for hypothesis 5

The fifth hypothesis (H5) was supported and accepted in this study. To confirm this, there was a positive and significant correlation ($r= 0.678$) obtained and the regression path is highly significant ($p<0.001$) between coordination effectiveness and social performance. Social performance is defined by Dominicé and Narayanan (2017:8) as the degree of fulfilment of a commitment to increase or decrease the interactions of individuals within a group. Mitwalli (2015:2) defines social performance as the process of managing the construction industry to attain its social mission. Similarly, Wardle (2017:10) views social performance as the system that the construction industry uses to accomplish its set social goals and put customers at the focus point of strategy and operations. Xia, Olanipekun, Chen, Xie and Liu (2018:342) state that social performance is responsible for achieving the sustainable development goals of the construction industry. Charlo, Moya and Muñoz (2017:224) report that social performance reflects the concern of its management in environmental and social matters as a method of accomplishing its competitive differentiation in a global market. This relationship is validated at a 99% confidence interval. Generally, the authors reveal the perception that social performance is good for both clients and the construction industry and considerably improves the effectiveness by allowing them to combine social outcome data into the management systems, thus achieving the goal of the construction industry. These results are consistent with a study conducted by Revilla and Knoppen (2015:1416) who associated construction performance between coordination effectiveness and social performance.

5.11 CONCLUSION

This chapter presented and interpreted the data of the study. It started by examining the demographic profile of the respondents, then it described the views of the respondents regarding the research constructs. This was followed by the confirmatory factor analysis (CFA) to examine or test the relationship between a set of observed constructs. The outcomes of the reliability have revealed positive values among all the constructs. The confirmatory factor analysis was conducted to assess and confirm that relationships occur between perceived variables and their fundamental latent constructs.

Furthermore, structural equation modelling was used to measure the relationship between the theoretical constructs through path coefficients. All the results proved to be reliable and valid. Therefore, the hypotheses in this study were positive and significant. The results attained suggested that the most effective way to accomplish supply chain performance in the construction industry is by building strong coordination between supplier and customer through coordination effectiveness.

The next chapter will elaborate on the conclusions, implications, recommendations and limitations of this study.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS OF THE STUDY

6.1 INTRODUCTION

This chapter aims to provide conclusions based on the results obtained from the previous chapters regarding the influence of supplier coordination, buyer coordination, coordination effectiveness in the operational, social and financial performance of the construction industry. This chapter is organised as follows: the first section provides a summary of the dissertation chapters. The second section draws conclusions based on the theoretical objectives of the study. The third section draws empirical conclusions based on the results obtained. The fourth section presents recommendations proposed for the construction industry. The fifth section provides the theoretical and practical contributions of the study. The sixth section explains the limitations that have been encountered while doing this study. The seventh section gives the overall recommendations of the study while implications for future research are discussed in the eighth section. Then, the chapter closes with a few final remarks.

6.2 SUMMARY OF THE CHAPTERS

The purpose of this study was to investigate how supply chain coordination influences the performance of the construction industry in the Gauteng Province. This study was structured into six chapters. Chapter 1, known as the introduction and backgroundof the study, introduced the research topic, discussed the problem statement, stated the research objectives, stated the research hypotheses, illustrated the research methodology and the ethical considerations under which the study was conducted. Chapter 2, known as the background of the construction industry gave a brief explanation of the construction industry, historical background, composition as well as the legislative framework of the construction industry. Moreover, the contributions of the construction industry towards the country were discussed as well as challenges and solutions that the industry is facing. The third chapter of this study discussed the literature review of research variables known as supplier coordination, buyer coordination, coordination effectiveness, operational performance, social performance and financial performance. The conceptual framework was presented and the hypotheses were examined in this chapter. Chapter 4 discussed the research methodology and design applied in this study. The research paradigm, research approach, the method of sampling and data collection were also discussed. Furthermore, this chapter described the method of data analysis and the statistical techniques such as confirmatory factor analysis and structural equation modelling through the application of SPSS and AMOS. Chapter 5 presented and interpreted the research results acquired in this study. The last chapter of this study is Chapter 6. In this chapter, conclusions are drawn based on the results obtained, contributions, limitations and recommendations for future studies are presented.

6.3 CONLUSIONS BASED ON THE THEORETICAL OBJECTIVES

The following section provides conclusions based on the theoretical objectives of this study. The following were the theoretical objectives that were set for the study:

- to conduct an extensive review of literature focusing on the construction industry
- to conduct a review of literature focusing on supplier coordination
- to conduct a review of literature focusing on customer coordination
- to conduct an extensive review of literature focusing on coordination effectiveness
- to conduct a review of literature focusing on operational performance
- to conduct a review of literature focusing on social performance and
- to conduct a review of literature focusing on financial performance.

6.3.1 Conclusions based on literature review of the construction industry

The first theoretical objective of this study was to conduct an extensive review of the literature focusing on the construction industry. This study has analysed the history of the construction industry in the Gauteng Province. In that analysis, it was concluded by Nel *et al.* (2018:9) that the construction industry in South Africa has been more involved in projects such as the building of malls, renewal of central business districts (CBD) and convention centre improvement. For this, the construction industry contributed enormously to the GDP of South Africa. Furthermore, CIDB (2020:25) indicates that the construction industry plays an important role in job creation as well as other sectors of the economy in South Africa.

Despite all these contributions, the construction industry was still facing challenges such as occupational health and safety, a lack of human and working capital, poor communication, organisational culture, skill shortage and resource scarcity, cost escalation as well as a lack of technology. However, the industry is now well established with improvements to enhance productivity. For this, Jaafar *et al.* (2018:493) suggest that a well-organised safety management programme should be implemented to provide a safer working environment to reduce accidents and increase productivity at construction sites. Afolabi *et al.* (2019:2) state that the occurrence of information and communication technology (ICT) in the construction industry has assisted professionals in creating a reasonable position in their activities compared to their old-fashioned counterparts. Innovation has been regarded by Ugwuoke *et al.* (2018:1) as a powerful tool for sustainable economic and social change as well as new developments in the construction industry.

6.3.2 Conclusions based on literature review supplier coordination

The second theoretical objective of this study was to conduct an extensive review of the literature focusing on supplier coordination. The study provided various definitions of supplier coordination. Patrucco *et al.*'s (2017:1272) definition provided in section 3.4.1.1 accurately suits this study. The literature emphasised that supplier coordination enhances information sharing among key suppliers to gain better knowledge on developments, competencies and challenges, thus allowing more effective planning and forecasting as well as creation and process design for the construction industry. The literature review has also shown that supplier coordination is a multidimensional construct that considers integrative framework strategies such as purchasing strategies, supplier selection, supplier evaluation as well as supplier development to have continuous improvement and developments in the construction industry (Gupta, *et al.* 2016:258).

6.3.3 Conclusions based on literature review customer coordination

The third theoretical objective of this study was to conduct an extensive review of the literature focusing on customer coordination. As shown in extensive literature, for example, Dong and Sivakumar (2017:944), Dong, Sivakumar, Evans and Zou (2015:160) and Mustak, Jaakkola and Halinen (2013:342), customer coordination is the degree to which individual customers are involved in service production and delivery by contributing effort, knowledge, information and other resources. Clarifying on the importance of customer coordination, researchers posit that customer coordination increases the simplicity of new product development (NPD) management, granting customers more independence while decreasing the construction industries' control over NPD activities (Chan, Yim & Lam 2010:49; Hoyer, Chandy, Dorotic, Krafft & Singh 2010:283; Stock 2014:536; Gruner, Homburg & Lukas 2014:34). According to Smirnova *et al.* (2018:457), customer coordination enhances the construction industry's capability to serve its customers successfully, thus improving customer satisfaction and enabling the industry to distinguish its offering to customers in a meaningful way. The above statement proves that customer coordination is a unique multidimensional construct that improves innovativeness, enhances performance and influences the overall effectiveness of the construction industry (Frambach, Fiss & Ingenbleek 2016:1431; Reed, Goolsby & Johnston 2016:3592).

6.3.4 Conclusions based on literature review of coordination effectiveness

The fourth theoretical objective of this study was to conduct an extensive review of the literature focusing on coordination effectiveness. Various definitions of coordination effectiveness were provided and the definition of Hsu *et al*. (2016:96) was applied in this study. Basing on existing literature, it has been noted that coordination effectiveness is beneficial in saving the cost of wasted materials, cost of storage, landfill tax and cost of disposal since reducing waste in construction projects has major economic benefits (Ajayi *et al*. 2018:302). For this, Yuan (2013:477) postulates that coordination effectiveness enables the construction industry to achieve its main objectives namely economic, environmental and social performance when implementing construction and demolition (C&D) waste management. Coordination effectiveness facilitates construction workers' efforts, goals and practices, leaving less scope for deviation of different views about the industry's best interests (Gochhayat *et al*. 2017:693). Michael *et al*. (2016:106) claim that contributions of the construction members form and implement interdependency and increase perceived commitment, thus leading to the successful completion of the project. In this regard, coordination effectiveness has been discussed as a unique multidimensional construct.

6.3.5 Conclusions based on literature review of operational performance

The fifth theoretical objective of this study was to conduct an extensive review of the literature focusing on operational performance. Various definitions of operational performance were provided and the definition of Uddin *et al*. (2019:421) was applied to this study. Drawing from existing literature, Duong *et al*. (2019:10) indicate that operational performance enables the construction industry to decrease its management costs, order-times, lead-times and increase the effectiveness of its raw material use and distribution ability. Furthermore, Vencataya *et al*. (2016:64) state that operational performance allows the construction industry to achieve its main objectives in terms of cost, quality, speed, dependability and flexibility. Moreover, operational performance is in control of several activities such as management process, alignment of the strategic goals and the executions of plans in the construction industry (Ju, Park & Kim 2016:9). In this study, operational performance has been discussed as a unique, multidimensional construct.

6.3.6 Conclusions based on literature review of financial performance

The sixth theoretical objective of this study was to conduct an extensive review of the literature focusing on financial performance. Different definitions of financial performance have been provided and the definition by Fatihudin and Mochklas (2018:553) was applied to this study. Drawing from existing literature, Osadchy *et al*. (2015:391) indicate that the construction industry's financial performance enables management to provide effective financial and economic management while the stakeholders can monitor managers on capital, which draws private investment and boosts the economy. In regards to this, Kakwezi *et al*. (2019:177) suggest that construction industries need to measure their financial performance often to know how well they are performing to avoid risks. In this study, financial performance has been discussed as a unique and multidimensional construct.

6.3.7 Conclusions based on literature review of social performance

The seventh theoretical objective of this study was to conduct an extensive review of the literature focusing on social performance. Various definitions of social performance have been provided and the definition by Lassala *et al*. (2017:3) was applied to this study. Drawing from existing literature, Dominicé *et al*. (2017:8) refer to social performance as the degree to which the construction industry fulfils the commitment to increase or decrease the interactions of individuals within a group. Wardle (2017:10) views social performance as the system that construction industries use to accomplish their set social goals and put customers at the focus point of strategy and operations. In this study, social performance has been discussed as a unique and multidimensional construct.

6.4 CONCLUSION BASED ON THE EMPIRICAL OBJECTIVES

To achieve the empirical objectives, the following conclusions were addressed based on the results provided in Chapter 5 through tables, figures and interpretations:

- to determine the relationship between supplier coordination and coordination effectiveness in the construction industry in the Gauteng Province

- to determine the relationship between customer coordination and coordination effectiveness in the construction industry in the Gauteng Province
- to determine the relationship between coordination effectiveness and operational performance in the construction industry in the Gauteng Province
- to determine the relationship between coordination effectiveness and financial performance in the construction industry in the Gauteng province and
- to determine the relationship between coordination effectiveness and social performance in the construction industry in the Gauteng Province.

6.4.1 Conclusions on the relationship between supplier coordination and coordination effectiveness

The first empirical objective was to determine the relationship between supplier coordination and coordination effectiveness in the construction industry in the Gauteng province. After conducting the analysis, it was established that there is a positive and significant relationship between supplier coordination and coordination effectiveness in the construction industry, as illustrated in section 5.8.1. This investigation finds support in studies conducted Odhiambo and Nassiuma (2017:100) that supplier coordination enables awareness in meeting quick changes in demand whilst allowing the construction industry to offer competitive pricing and invention of diversification. Song, Cai and Feng (2017:4) suggest that supplier coordination is used to provide the construction industry with core resources and technologies as well as information sharing to improve the performance of the industry. Therefore, coordination of suppliers is more important in this regard to achieve greater performance in the construction industry. Furthermore, this study has shown that sharing knowledge and expertise is a great opportunity for both the suppliers and the stakeholders to achieve the effectiveness of the construction industry. In this study, several definitions of supplier coordination were provided. The study made use of the definition by Patrucco *et al.* (2017:1272), which defined supplier coordination as the process that involves information-sharing with key suppliers to gain better knowledge on developments, competencies and challenges, thus allowing more effective planning and forecasting as well as creation and processing design for the industry. For this, supplier coordination will easily focus on sustainability performance, collaboration practices to enable the incorporation of tacit knowledge and the joint development of sustainability resolutions to make the project a success. The study also shows that trust, honesty and dependability play an important role in the effectiveness of the construction industry. The above characteristics will lead to the willingness of management and partners as well as resources being utilised productively. In fact, through trust and honesty, the construction industry will be able to achieve improved learning abilities as well as enhanced competitiveness. The study further shows that good communication between buyers and internal stakeholders will lead to coordination effectiveness of the construction industry and less turnover of team members. For this, stakeholders will be able to meet clients' requirements as well as avoid inaccuracies that can result in rework, causing cost and schedule overruns to develop. These results are in line with a study conducted by Gay *et al.* (2016:22), which show that accurate supplier coordination leads to proper coordination effectiveness. It is, therefore, concluded that the relationship between supplier coordination and coordination effectiveness increases the performance in the construction industry.

6.4.2 Conclusion on the relationship between customer coordination and coordination effectiveness

The second empirical objective was to determine the relationship between customer coordination and coordination effectiveness in the construction industry in the Gauteng province The results indicated that there is a positive and significant relationship between these constructs. This investigation is supported by studies conducted by several researchers (Dong & Sivakumar 2017:944; Dong, Sivakumar, Evans & Zou 2015:160; Mustak, Jaakkola & Halinen 2013:342) whereby customer coordination is defined as the degree to which individual customers are involved in service, production and delivery by contributing effort, knowledge, information and other resources to improve the performance of the construction industry. According to Prior, Keränen and Koskela (2019:2), customer coordination deals with developing problems, coordinating difficult tasks and accomplishing task requirements within the construction industry. Customer coordination seeks for information on customer needs to be able to respond in time. It can be concluded from this study that the above backdrop will ease the functions of coordinating difficult tasks and accomplishing task requirements. For this, the study recognises that customer coordination enables relationships between the construction industry and the customer by persuading the industry to adapt to the needs of customers, providing better services and products whilst creating good financial returns for the construction industry. As for the studies conducted by several authors (Chan, Yim & Lam 2010:49; Hoyer, Chandy, Dorotic, Krafft & Singh

2010;283; Stock 2014:536; Gruner, Homburg & Lukas 2014:34), customer coordination increases the simplicity of new product development (NPD) management, granting customers more independence while decreasing the industries' control over NPD activities and limit the capability to influence technological knowledge. Generally, this study reveals that customer coordination improves customer satisfaction whilst improving the performance of the construction industry. It is, therefore, concluded that the relationship between customer coordination and coordination effectiveness increases the performance in the construction industry.

6.4.3 Conclusions on the relationship between coordination effectiveness and operational performance

The third empirical objective of this study was to determine the relationship between coordination effectiveness and operational performance in the construction industry in the Gauteng province. The results acquired after analysis show that there is a positive and significant relationship between these two constructs, which was reported in section 5.8.3. The reviewed literature presented various definitions of operational performance in the construction industry in the Gauteng province. Operational performance is defined by Uddin, Rahman, Abdul, Mansor and Reaz (2019:421) as a behaviour that consists of directly visible activities of an employee and also conceptual involvement such as answers or decisions, which result in organisational outcomes in the form of accomplishment of set goals. In addition, Kamau (2014:4) refers to operational performance as the backbone of every construction industry to achieve the set standards in terms of waste reduction, productivity, cycle time, environmental responsibility and regulatory compliance. Similarly, Yuan (2013:477) postulates that coordination effectiveness enables the construction industry to achieve its main objectives namely economic, environmental and social performance when implementing construction and demolition (C&D) waste management. The study, therefore, concludes that coordination effectiveness leads to greater operational performance in the construction industry. Also, when resources are utilised in a productive manner and labourers are skilled, the construction industry yields productive results. For this, the study reveals that commitment of employees plays a significant role in influencing the relationship between coordination effectiveness and operational performance. Furthermore, the study shows that coordination effectiveness leads to completion of projects on schedule, the effectiveness of quality and cost control and quality of finished products, which lead to greater operational performance. The study, therefore, concludes that coordination effectiveness is essential in enhancing the operational performance in the construction industry in the Gauteng Province.

6.4.4 Conclusions on the relationship between coordination effectiveness and financial performance

The fourth empirical objective of this study was to determine the relationship between coordination effectiveness and financial performance in the construction industry in the Gauteng province. The results acquired showed that coordination effectiveness determined the financial performance of the construction industry. The results have shown the positive impact of coordination effectiveness on financial performance. As stated by Kakwezi and Nyeko (2019:177), the construction industry needs to measure their financial performance often to know how well they are performing to avoid risks. For this, coordination effectiveness needs to be facilitated to yield good relationships, better market share, good service quality and increased sales for the industry. This is possible because financial performance indicators such as profitability, sales growth and earnings per share (EPS) will enable the construction industry in achieving the economic goals of the construction industry. Also, competency of management is essential to manage finance and measure financial performance for the survival of the construction industry. Similarly, previous research conducted by Akl, El-Jardali, Bou Karroum, El-Eid, Brax, Akik, Osman, Hassan, Itani, Farha, Pottie and Oliver (2015:1) shows that coordination effectiveness is required to guarantee the effectiveness of services to avoid repetition and improve fairness in the construction industry. Due to this, the construction industry will be able to measure their financial performance often to know how well they are performing to avoid risks. For this, coordination effectiveness and financial performance play an important role in the growth and sustainability of the construction industry. Based on the reviewed literature, it can therefore be concluded that coordination effectiveness has a positive influence on the financial performance of the construction industry.

6.4.5 Conclusions on the relationship between coordination effectiveness and social performance

The fifth empirical objective of this study was to determine the relationship between coordination effectiveness and social performance in the construction industry in the Gauteng province. The results revealed that coordination effectiveness has a positive correlation with social performance in the construction industry in the Gauteng province. This indicates that coordination effectiveness allows the social performance to apply the set of values and procedures as well as guidelines, programmes, and recognisable externalities within the construction industry on different shareholders. Previous researches conducted by Lys, Naughton and Wang (2015:57), Klynveld Peat Marwick Goerdele (KPMG) (2017:7) and Liu, Quan, Xu and Forrest (2019:436) reveal that social performance is an indicator for the construction industry's economic performance and that the effective industry's commitment in social responsibility issue will be able to generate progressive and improved performance in the future. For this to be achieved, Lavikka, Smeds and Jaatinen (2015:211) state that due to effective coordination, construction industry participants succeeded in understanding each other's working processes and building relationships that enriched trust and reduced inactivity in decision making amongst them. Generally, the authors reveal the perception that social performance is good for both clients and the construction industry and considerably improves the effectiveness by allowing them to combine social outcome data into the management systems, thus achieving the goal of the construction industry. In light of this, the study concludes that coordination effectiveness has a positive influence on the social performance of the construction industry.

6.5 RECOMMENDATIONS

The following recommendations are proposed for the construction industry.

6.5.1 Recommendations for supplier coordination

To improve supplier coordination, the construction industry is encouraged to implement the following recommendations:

- Supplier development: developed and talented suppliers will enable the industry to meet the buying firms' needs, thus, increasing the performance of the construction industry
- A long-term commitment in suppliers to be presented to achieve specific construction industry objectives while maximising the effectiveness of the industry
- Ensure transparency: trust is an important factor in developing supplier coordination and this could only be achieved by developing trust and transparency among suppliers
- Advance consistent communication: through communication, suppliers will be able to have strong relationships through which imperative information will be shared

- Management of supplier relationships: successful relationships with strategic suppliers will lead to high levels of coordination, trust, information sharing and creativity.

6.5.2 Recommendations for customer coordination

- Healthy relationships between the buying team to be implemented; this will influence the industry to adapt to the needs of customers, provide better services and products whilst creating good financial returns for the construction industry
- Improved customer coordination is to be practised to improve customer satisfaction and enable the industry to distinguish their offering to customers in a meaningful way
- Ensure that communication is healthy as it will help the buying team to contribute to awareness, selection of different characteristics of a new product offering and act as the main designer of new products and services for the construction industry
- Conserving and outstanding commitment will enable buyers to resolve emergencies and risks by creating interpersonal interactions as well as cross-functional teams, thus improving performance and innovating of new products.
- Regularly developed customers will enable the construction industry the ability to acquire the knowledge for a competitive advantage in terms of special resource allocation for the development and customisation of products to reduce waste.

6.5.3 Recommendations for coordination effectiveness

- Healthy communication procedures to be implemented to allow information sharing as well as reliably and predictably workflow on a construction site through the immaculate procedure of coordination process
- Ensuring effective collaboration among all participants to hand out accurate information on time is very important to enhance the construction industry's performance
- Allow transparency as it plays an important role in consenting project members to coordinate their work through methods such as meetings, plans and joint site visits
- Ensure that resources are available when commencing with the implementation of the project to achieve the set objectives for the construction industry
- Ensure that levels of coordination, supervision, performance, monitoring and control are always monitored to warranty timeous completion of the project efficiently and effectively.

6.5.4 Recommendations for operational performance

- Refining processes: processes should be streamlined to avoid uncertainty
- Regular staff training together with the facilitation of cross-departmental collaboration will improve operational efficiency and the culture of the construction industry
- Management should be involved in what is affecting the operations of the construction industry
- Ensuring efficient and effective communication amongst all stages of the construction business is vital in ensuring operational productivity. For this, members will understand what their role is and minimise the chances of misunderstandings, thus avoiding operational errors
- Project managers can apply the strategy of gamification to offer workers additional inspiration by providing goals, scores and prizes for employees to get work done.

6.5.5 Recommendations for financial performance

- Enterprise resource planning (ERP) must be implemented in the construction industry to improve processes and increase integration, thus resulting in positive and higher profits
- Management should be competent enough to measure the financial performance often to know how well they are performing to avoid risks
- Management must gain valuable information associated with the flow of funds as well as the use of funds to be able to measure the financial performance of the construction industry
- Management should continuously pursue to acquaint with strategies that differentiate the construction industry from competitors to gain a competitive advantage
- Management should evaluate the key financial statements regularly. This will help in assessing the statement of cash flows, help in understanding the impact of the construction industry's liquidity position from its operations, investments and financial activities.

6.5.6 Recommendations for social performance

- Top-management commitment is required in environmental and social matters as a method of accomplishing the construction industry's competitive distinction in a global market.
- Education and training to determine the development process is also required to create innovation, safety as well as adding momentous value to the team

- Ensure rigid attitude and behaviour of executive management towards quality. This will increase the morale of workers, thus, yielding more profits.
- Ensure employee commitment and understanding in terms of tools and resources to save cost and time in the completion of projects
- Generate awareness and educate project staff about risks incurred as well as how to comply with safety regulations.

6.6 OVERALL RECOMMENDATIONS

The supply chain coordination indicated in the study should be extensively implemented in the construction industry. This means that supplier coordination, customer coordination and coordination effectiveness will improve the performance of the construction industry. The recommendations identified in the study may help the construction industry in sustaining operational and financial feasibility. Furthermore, trust, commitment and transparency between supplier coordination and customer coordination will enable the construction industry in achieving the main goal, which is performance.

Construction workers should be given training to gain knowledge and practical guidelines regarding the implementation of projects as well as how to utilise tools and resources to avoid waste. Management should always support construction workers and involve them in the decision making of the business to increase their morale. Since the construction industry contributes towards the economy of the country, through the gross domestic product (GDP), gross fixed capital creation, the establishment of employment opportunities and industrial productivity, more regulations should be imposed to keep the industry sustainable.

Theoretical contributions have been made to the existing literature. The main results of this study support the game theory developed by Von Neumann and Morgenstern (1944:1), which focuses on collaboration amongst teams and how they make strategic decisions. In this regard, supply chain coordination has played an important role in the performance of the construction industry. The study also emphasised the significance of supply chain coordination by enlightening that supply chain partners may be engaged in a relationship to attain the main goal of the construction industry. Therefore, it is important to know and understand the importance of supply chain coordination in the construction industry.

6.7 LIMITATIONS OF THE STUDY

The present study had certain limitations that suggested directions for future studies. The study was limited only to the construction industries in the Gauteng province for additional provinces did not form part of this study. The study was carried out during the time of the Covid-19 pandemic. For this reason, questionnaires were distributed and collected at a later stage. This meant that the researcher could not monitor how respondents in this study completed the questionnaires. Also, at the beginning of the Covid-19 pandemic in March 2020, the country was on a total shut down. Thus , there has also been an obstacle with receiving requested quantitative data from the construction sites. It was difficult to get in contact with the general managers of the construction industries, hence, the questionnaires were dropped and collected later.Luckily, even during those difficult times, 364 supply chain managers and operational management professionals from different construction industries in the Gauteng province completed the questionnaires from a target of 400. Furthermore, the study focused on five variables and did not include other variables such as buyer supplier coordination and general performance appraisal. This study adopted a quantitative method, which limited respondents from providing detailed narrative experiences.

6.8 IMPLICATIONS FOR FUTURE RESEARCH

About restricted access in the construction industry due to Covid-19 pandemic, future researchers can also conduct this study in a different province and country to see if it will yield the same results. Necessary arrangements should be made with construction managers in time for the distribution of questionnaires. When conducting a study on the construction industry, other provinces should be considered to yield greater results. For this, data can be collected online. Additionally, future studies should also make use of a qualitative method to obtain in-depth insight into the influence of supply chain coordination and firm performance in the construction industry. Moreover, further research within the construction industry may be to identify a general measurement that can be used to measure the effectiveness of a coordinated supply chain. This experience will help in the future to better understand supply chains and their complexity. Also, the supply chain coordination subject, which is the key ground of this study, will become more significant in the future as there occurs an increased opposition between supply chains and a need for collaboration beyond the construction industry’s borders.

6.9 FINAL REMARKS

This study examined supply chain coordination and firm performance in the construction industry in the Gauteng province. After analysis of all the postulated hypotheses, the outcomes of this study established that there is a positive and significant relationship between SC and CE; CC and CE; CE and OP; CE and FP; CE and SP. The results discovered how supplier coordination and customer coordination contribute towards the greater performance of the construction industry. Furthermore, the study has analysed how suppliers' and customers' information ease of use contribute to knowledge about coordination within the construction industry and how the lack thereof can influence the supply chain performance. To achieve firm performance, buyers and suppliers in the Gauteng province have to improve dependence, commitment, transparency and have healthy communication. Through these factors, buyers and suppliers may gain a competitive advantage. Then, the conclusions based on empirical objectives were made. Recommendations to be implemented by management and construction workers were provided. It is vital, therefore, for the construction industry to work in partnership with suppliers and customers throughout the supply chain since the study has shown that partnerships contribute to the firm's performance. The chapter concludes by highlighting the limitations of the study and implications for future studies.

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APPENDIX A

Faculty of Management Sciences

Research conducted by

Ms Mosidi Montso

Cell: 0748994960

Email: mosidim@vut.ac.za

Dear Respondent,

My name is Mosidi Montso, a Master student from the Department of Logistics at the Vaal University of Technology. You are requested to participate in an academic research study that I am conducting, which is aimed at gathering information on supply chain coordination and firm performance in the construction industry in the Gauteng Province. You have been chosen to participate in the study based on your experience of working in the construction industry. I, therefore, believe that you will provide relevant information.

Please take note of the following:

1. This study will provide an anonymous survey. Your name will not appear on the questionnaire and the answers you provide will be treated as strictly confidential. You cannot be identified in person based on the answers you give.
2. Your participation in this study is very important. You may, however, choose not to participate and you may also stop participating at any time without any negative consequences.

3. Please answer the questions in the attached questionnaire as completely and honestly as possible.

4. The results of the study will be used for academic purposes only and may be published in an academic journal. A summary of the findings can be provided to you on request.

5. Please contact my supervisors, Dr E. Chinomona (elizabethc@vut.ac.za) and Prof C Mafini (chengedzaim@vut.ac.za) if you have any questions or comments regarding the study.

You have an option of signing this letter to indicate that:

- You have read and understood the information provided above.
- You give your consent to participate in the study voluntarily.

SECTION A: DEMOGRAPHIC INFORMATION

This section seeks some background information about yourself. Please indicate your answer by ticking (X) on the appropriate block.

A1: Gender	1. Male	2. Female

A2: Age	1.Under 30 years	2. 30-39 years	3. 40-49 years	4. 50-59 years	5.60years and above

A3: Race	1. Black	2. White	3. Indian	4. Coloured	5. Other (specify)

A4: Marital Status	1. Married	2. Single	3. Divorced	4. Widowed

A5:Highest Qualification	1.Matric or below	2.Post-matric certificate	3.Diploma	4.Degree	5.Postgraduate	6. Professionals

	Other (Please specify) ……………..

SECTION B: Supply Chain Coordination

Below are statements about supply chain coordination. Kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

SO1	We actively plan supply chain activities	Strongly disagree	1	2	3	4	5	Strongly agree
SO2	We strive to manage each of our supply chains as a whole	Strongly disagree	1	2	3	4	5	Strongly agree
SO3	Our manager can communicate smoothly with managers in other sectors	Strongly disagree	1	2	3	4	5	Strongly agree
SO4	Our manager can communicate smoothly with managers in other sectors	Strongly disagree	1	2	3	4	5	Strongly agree
SO5	We monitor the performance of members of our supply chains in order to adjust supply chain plans	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION C: Supplier Coordination

Below are statements about supplier coordination. Kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

SC1	Supplier process integration improves product innovation capabilities in a low equivocality environment	Strongly disagree	1	2	3	4	5	Strongly agree
SC2	Supplier product integration improves quality in high equivocality environments	Strongly disagree		2	3	4	5	Strongly agree
SC3	Dedicated workforce is required to gather and share information and knowledge across the supply chain	Strongly disagree		2	3	4	5	Strongly agree
SC4	Dedicated capacity, tools and equipment are kept simple and clear to reduce ambiguity	Strongly disagree		2	3	4	5	Strongly agree
SC5	Dedicated storage and transportation facilities help to improve synchronisation and delivery times	Strongly disagree		2	3	4	5	Strongly agree

SECTION D: Customer Coordination

Below are statements about customer coordination. Please kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

CC1	We are able to identify our customers' needs and wants	Strongly disagree	1	2	3	4	5	Strongly agree
CC2	We use information from customers in designing products and services	Strongly disagree	1	2	3	4	5	Strongly agree
CC3	We are frequentlyin close contact with our customers	Strongly disagree	1	2	3	4	5	Strongly agree

CC4	We are committed to satisfy customers	Strongly disagree	1	2	3	4	5	Strongly agree
CC5	We maintain a good relationship between the company's goals and customers' expectations	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION E: Coordination Effectiveness

Below are statements about coordination effectiveness. Please kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

CE1	We respond effectively to changing requirements of design	Strongly disagree	1	2	3	4	5	Strongly agree
CE2	Improves the efficiency of operation between our suppliers and us	Strongly disagree	1	2	3	4	5	Strongly agree
CE3	We are able to meet special customer specification requirements	Strongly disagree	1	2	3	4	5	Strongly agree
CE4	We coordinate production and information efficiently across suppliers and product lines	Strongly disagree	1	2	3	4	5	Strongly agree
CE5	We maintain a higher capacity buffer of response to a volatile market	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION F: Operational Performance

Below are statements about operational performance. Please kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

OP1	Orders from our customers are fulfilled in a short lead time	Strongly disagree	1	2	3	4	5	Strongly agree
OP2	Deliveries to our customers are fulfilled as scheduled	Strongly disagree	1	2	3	4	5	Strongly agree
OP3	Offer very flexible options for changing orders' quantity	Strongly disagree	1	2	3	4	5	Strongly agree
OP4	Product defective rate is very low	Strongly disagree	1	2	3	4	5	Strongly agree
OP5	Provide 100% products safety certification	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION G: Social Performance

Below are statements about social performance. Please kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

SP1	Relationships with main partners are satisfactory	Strongly disagree	1	2	3	4	5	Strongly agree
SP2	Main partners are not good companies for business	Strongly disagree	1	2	3	4	5	Strongly agree

SP3	Partners are satisfied with main partners performance	Strongly disagree	1	2	3	4	5	Strongly agree
SP4	Partners have successful coordination with main partners	Strongly disagree	1	2	3	4	5	Strongly agree
SP5	Partners do not have high confidence in main partners	Strongly disagree	1	2	3	4	5	Strongly agree

SECTION H: Financial Performance

Below are statements about financial performance. Please kindly indicate the extent to which you agree or disagree with the statement by ticking the appropriate number below.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

FP1	My firm's sales growth is better than that of our major competitors	Strongly disagree	1	2	3	4	5	Strongly agree
FP2	My firm's return on assets is higher than that of our major competitors	Strongly disagree	1	2	3		5	Strongly agree
FP3	My firm's market share growth is higher than that of our major competitors	Strongly disagree	1	2	3	4	5	Strongly agree
FP4	My firm's return on investment is higher than that of our major competitors	Strongly disagree	1	2	3	4	5	Strongly agree
FP5	My firm's total cost reduction is better than that of our major competitors	Strongly disagree	1	2	3	4	5	Strongly agree

THE END

THANK YOU!!!

APPENDIX B

Vaal University of Technology

Your world to a better future

VUT

RESEARCHER: Ms ME Montso

SUPERVISOR: DR E Chinomona

PROJECT TITLE: Supply chain coordination and firm performance in the construction industry in the Gauteng Province

Decision: APPROVED	**Ethics Reference Number: FRECMS-04122019-A016** **214125262**

Dear Ms ME Montso

Thank you for submitting the above-mentioned project for ethical consideration. The application was detailed and provided useful information. You may commence with your research and data collection providing that you keep the informed consent signature form separate from the questionnaire.

Vanderbijlpark Campus - Private Bag X021 - Vanderbijlpark - 1911 - Andries Potgieter Blvd South Africa - Tel: +27(0)16 950 9000 - Fax: +27(0)16 950 9999 - www.vut.ac.za

Please also note the following:

The Ethics Reference number, as stated above, should be used in all correspondence regarding this research project. The Research Ethics approval is in effect from the date of this letter to December 2023.

As the primary researcher you undertake to:

- *Only follow the procedures for which approval has been given.*
- *Inform the FREC of any significant deviations that may occur in the research project which directly influences what has been approved.*
- *Report any adverse events that might occur, within 14 days of the event, to the FREC. (Refer to the Ethical Guidelines as to what procedure you will need to follow in such an event).*
- *Submit a progress report every year for the duration of the study, to the Ethics committee by the 15 June of each year.*
- *Inform the FREC once the research project has reached completion and the findings have entered the public domain.*

The FREC would like to take this opportunity to wish you well with your research project. Kind

Regards

Dr FE Mahomed

Faculty Research Ethics Committee Chair

Faculty of Management Sciences

Telephone: 016 950 6686

Email: fathima@vut.ac.za

APPENDIX C

LANGUAGE EDITING CERTIFICATE

Registered with the South African Translators' Institutes (SATI) Reference number 1000363

SACE REGISTERED

27 MARCH 2022

SUPPLY CHAIN COORDINATION AND FIRM PERFORMANCE IN THE CONSTRUCTION INDUSTRY IN GAUTENG PROVINCE

This serves to confirm that I edited substantively the above document including a Reference list. The document was returned to the author with various tracked changes intended to correct errors and to clarify meaning. It was the author's responsibility to attend to these changes.

Yours faithfully

Dr. K. Zano

Ph.D. in English

kufazano@gmail.com/kufazano@yahoo.com

0631434276

APPENDIX D

SUPPLY CHAIN COORDINATION AND FIRM PERFORMANCE IN THE CONSTRUCTION INDUSTRY IN GAUTENG PROVINCE

ORIGINALITY REPORT

3%	3%	5%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	clutejournals.com Internet Source	2%
2	www.tandfonline.com Internet Source	1%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		

SUPPLY CHAIN COORDINATION AND FIRM PERFORMANCE IN THE CONSTRUCTION INDUSTRY IN GAUTENG PROVINCE

GRADEMARK REPORT

FINAL GRADE /100

GENERAL COMMENTS

Instructor