



ADDIS COLLEGE

MASTERS OF PROJECT MANAGEMENT

**SUPPLY CHAIN MANAGEMENT IN THE
CONSTRUCTION INDUSTRY;**

**CASE STUDY ON INFRASTRUCTURES PROJECTS IN
ETHIOPIA FEDERAL PRISON COMMISSION**

BY

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DECLARATION

This is to certify that the thesis I submitted to Addis College's Department of Project Management in partial fulfillment of the requirements for the degree of Master of Science in Project Management, with the title "**Supply Chain Management in the Construction Industry: Case Study on Infrastructures Projects in Ethiopia Federal Prison Commission,**" is a record of my original work and has never been submitted to this or any other institution to obtain any other degree. I have properly acknowledged the aid and support I got throughout this investigation. No part of any section may be entirely or partially taken from another source unless it is specifically acknowledged in quotation marks and with comprehensive, accurate, and precise reference.

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ACRONYMS

CRM	Customer Relationship Management
CSC	Construction Supply Chain
ECDSWCo.	Ethiopian Construction Design Supervision Works Corporation
FGD	Focused Group Discussion
FIDIC	Federation Internationale des Ingenieurs Conseils (International Federation of Consulting Engineers)
FPC	Federal Prison Commission
FY	Fiscal Year
GDP	Gross Domestic Product
LS	Lump sum
MoWUD	Ministry of Works and Urban Development
NBE	National Bank of Ethiopia
PPA	Public Procurement Agency
RII	Relative Important Index
SCL	Society of Construction Law
SCM	Supply Chain Management

Abstract

*Supply chain is defined as the sequence of events that cover a product's entire life cycle, from the conception to consumption. Construction Supply Chain (CSC) is the collective term for all organizations involved in the construction process, including the owner, designer, general contractors, subcontractors, suppliers, consultants, etc. The researcher was therefore attempt to evaluate the state of supply chain management in the construction sector through a case study of infrastructure projects at the Ethiopia Federal Prison Commission as well as the impact (the magnitude, in some quantifiable parameter) of SCM on infrastructure projects. A review of the literature that aids in answering the questions prompted by the analysis of the study is given. In order to demonstrate the relationship between the independent variables of SCM practice and firm performance, the research used a descriptive study to describe SCM practice and a causal study to demonstrate that association. The Federal Prison Commission's construction and management staffs, as well as some of its main suppliers, were the primary sources of data for the study's primary data gathering method, which also included interviews and focused group discussions. The firm profile, a particular research paper, articles, and reports are where secondary data is gathered. Research used the Relative Important Index (RII) approach to evaluate the relative relevance of various parameters. The questionnaire achieved acceptable reliability, according to Cronbach's alpha, which was 0.863. A total of 87 questionnaires were given out to targeted corporate employees, and 76 (87.36%) of them were returned; of those, 71 (81.61%) were legitimate and used for analysis. With the aid of the statistical program IBM SPSS (version 23), the gathered data were displayed and examined. Based on the result, priorities were given to **Customer Relationship** (average mean value of 3.23), **Strategic Supplier Partnership** (the group mean 3.16), **Level of Information Sharing** (group mean value of 3.14), **Level of Information Quality** (average mean value of 3.08), **Supply Chain Collaborations** (average mean value 3.05) and **Information Technology** (the groups mean value was 3.04) in descending order.*

Key words: Supply chain management practices, SPSS, operational performance

CHAPTER ONE

Introduction

1.1. Background of the study

The physical creation of infrastructure, superstructures, and related facilities is referred to as construction. Thus, it includes all civil engineering projects, all kinds of building projects, including residential ones, as well as the upkeep and repair of existing structures. (Wells, 1984)

A vital part of every economy in the globe, the construction industry produces goods and services that help each nation's economy advance and foster socioeconomic development. The primary reason that industries around the world help to expand economies is that they support those economies by supplying the necessary infrastructure to support the expansion of other industries (Ofori, 2012).

The supply chain in construction involves all the partners and stakeholders who work together on specific projects throughout the construction process. The owner, designer, architect, engineer, construction manager, general contractor, subcontractors, suppliers, distributors, and manufacturers are all part of the supply chain for a project. It also comprises the components, such as human resources, equipment operations, accounting, etc.

The administration of information and material resources across a network of businesses engaged in the design and production process is the subject of supply chain management. Being able to have the appropriate items in the right quantities at the right location at the right time for the lowest possible price is the goal of supply chain management.

Construction Supply Chain (CSC) is the collective term for all organizations involved in the construction process, including the owner, designer, general contractors, subcontractors, suppliers, consultants, etc. CSC includes everything from client demands to conceptual design to construction and maintenance. CSC is a network of numerous organizations and relationships that involves the flow of information and material, as opposed to a chain of construction companies with business-to-business relationships.

In Ethiopia, numerous studies on SCM techniques had been done on various manufacturing industries. Admaw (2010) investigated how SCM was used in Ethiopian textile companies. It was discovered that Ethiopian textile companies' SCM procedures are subpar and that they do not view SCM as a competitive strategy instrument. Textile company business managers paid little attention to SCM ideas and practices. Temesgen Tagesse's (2017) investigation into Yotek Construction Plc's supply chain management practices and their effects on business performance. His research concentrated on the use of SCM and its effects on business success as measured by organizational and operational effectiveness. By choosing five companies, Moges (2015) studied the use of SCM and its challenges in Ethiopian private grade one road construction companies.

The relationship between supply chain management and organizational performance, customer satisfaction, and competitive position are some of the SCM studies carried out in Ethiopia (Mohammed, 2014; Hana, F. 2016; Belay, M. 2011). On the other hand, other SCM studies focused on supply chain management practice case studies (Bogal A., 2015; Balda, 2011); and supply chain performance by (H/Michael D. 2011).

This study focuses on the SCM practice and its impact on firm performance assessment that is defined in terms of supply chain responsiveness and the business's competitive advantage, in an effort to fill in the gaps of the prior study based on the setting of the Ethiopian construction sector (operational performance). By gathering information from the fundamental participants in construction firms—client side, contractor side, consultant side, and supplier side—the study focuses on Ethiopia Federal Prison Commission Infrastructure construction SCM practice and how this affects at SCM responsiveness on their operational performance. The Federal Prison Commission's infrastructure projects in Shewa Robit, Ziway, Dire Dawa, New Addis Ababa Prison Facilities (Hospital), and Akaki Kaliti Prison House are affected by a number of factors, including those that are difficult to identify for the construction industry's SCM practices. As a result, this research tries to identify the major factors that have an impact on those practices.

1.2. Statement of the problem

1.2.1 Overview

It is usual to hear that the construction sector must come up with new ideas and methods for increasing productivity and efficiency because it is completely different from other sectors. Is it a myth or the truth? It is common to think that some aspects of construction, such as unique goods, transitory planning, and on-site production, preclude the achievement of manufacturing-like flow rates (Koskela, 1992). As an illustration, the main construction company in charge of a construction project typically only completes a tiny portion of the "product" using its own workforce and manufacturing equipment. Around 75% or more of the value of the product is created with the assistance of suppliers and subcontractors (Dubois and Gadde, 2000). It's frequently accepted

- converging at the construction site where the object is assembled from incoming materials;
- temporary producing one-off construction projects through repeated reconfiguration of project organizations separated from the design; and
- typical make-to-order supply chain, with every project creating a new product or prototype

Modularization and standardization of semi-manufactured goods have historically been used in manufacturing to boost productivity, cut costs, speed up delivery, and even expand product flexibility and diversity to meet consumer expectations. The introduction of a strategic inventory to store common subassemblies and only finish the final assembly or configuration when the exact client demand is understood is covered in Christopher's (2001) discussion. The mass customization sector uses this kind of postponement approach to move the client order point upstream to separate "base" from "surge" needs. In contrast to the construction sector, the lead firm or system integrator frequently develops the product design in a distinct product development process in the manufacturing sector.

Problems of the Construction Supply Chains

Client relationships that are needed to complete a construction project, the interfaces between the several parties of the chain and the various problems that affect the construction supply chain as these have been reported by several authors [Vrijhoef and Koskela, (1999), Vrijhoef, (1998), Hong-Minh et al., (2000); Akintoye et al., (2000), O'Brien, (1999), Ofori, (2000), Vrijhoef et al., (2001)]. Most of these problems are not generated in the conversion process but in the different interfaces of different parties or functions, that exist within the supply chain.

The current practice of supply chain management suggests controlling the supply chain as an integrated value-generating flow, rather than only as a series of individual activities. For this generic model of the problems in the construction process, the term "supply chain" refers to the stages through which construction materials factually proceed before having become a permanent part of the project. The term covers thus both permanent supply chains, that exist independent of any particular project, and temporary supply chains, configured for a particular project.

Thatte (2007) stated that strong supply chain management methods, such as solid supplier and customer relationships and information sharing, are required for the SCM to be effective. When there is trust and honesty among the supply chain participants, this would be applied to the extent of the expected degree. The inability of domestic construction companies to effectively and efficiently manage their supply chains is one of their biggest problems today. Therefore, a practical strategy must be created; taking into account the availability and managing effectively and efficiently its supply chain practices that let the company build up gradually to achieve the necessary capacity as well as adapting the company towards their responsibility and function of construction contracts (Saad, et al., 2003).

Customer-supplier relationships in construction are generally of the arms-length type rather than being partnerships because the commonly used competitive tendering to procure

projects assures that sub-contracting is provided by the lowest-price supplier with little or no guarantee (or even incentive) to future work. Traditionally, project information exchange between designers and contractors has been mainly based on paper documents. These documents come in the form of architectural and engineering drawings, specifications, and bills of quantities and materials. This practice is far from being satisfactory, with about two-thirds of construction problems being caused by inadequate communication and exchange of information and data. Although there is a need for integration of the various actors in construction sector and with the increasing complexity of construction projects, availability of inadequate support of information technology was another challenge in the industry (Tucker, Mohamed, Johnston, McFallan & Hampson, 2001).

A number of studies on SCM practices had been conducted in Ethiopia on various manufacturing industry. Admaw (2010) studied the practice of SCM for Ethiopian textile firms. It was found that, SCM practices in Ethiopian textile firms are weak and not considering SCM as a strategic tool for competition. Business managers of the textile firms didn't give attention for SCM theories and practices. Temesgen Tagesse (2017) study on supply chain management practice and impact on firm performance in the case of Yotek construction plc. His study was focus on SCM practice and impact on firm performance that determined in terms of operational and organizational performance. Mintesinot Abay (2018) test if there is a relationship between SCM practices, supply chain responsiveness, and operational performance in manufacturing industry in Bahir Dar. Moges (2015) study Practice and challenge of SCM on Ethiopian Private Grade one Road Construction Companies by selecting five companies among the twenty three companies and select seven sample sizes from each company. His study was focus on the practice and challenge of SCM practice as well as assessing collaboration level within supply chain members.

The relationship between supply chain management and organizational performance, customer satisfaction, and competitive position are some of the SCM studies that have been carried out in Ethiopia (Mohammed, 2014; Hana, F. 2016; Belay, M. 2011). On the other hand, other SCM studies focused on supply chain management practice case studies (Bogal A., 2015; Balda, 2011); and supply chain performance by (H/Michael D. 2011). Higher levels of SCM practices can result in greater supply chain responsiveness and increased

competitive advantage for a firm, according to research on supply chain responsiveness (Ashish A. Thatte, Subba S. Rao, and T. S. Ragu-Nathan, 2013).

Undoubtedly, there is a dearth of comprehensive and in-depth research on supply chain network systems and logistics for construction materials. This study aims to fill that gap.

The researcher will therefore attempt to evaluate the state of supply chain management in the construction sector through a case study of infrastructure projects at the Ethiopia Federal Prison Commission as well as the impact (the magnitude, in some quantifiable parameter) of SCM on infrastructure projects.

1.3. Objectives of the study

Based on the research question, the research has the following general and specific objectives:

1.3.1. General objective

In this study, supply chain management techniques in the construction industry are examined in relation to infrastructure projects at Ethiopia Federal Prison Commission. The objectives are to identify, evaluate, and offer potential future solutions to this issue.

1.3.2. Specific objectives

1. To identify and analyze the current practices and challenges in the supply chain management process in Ethiopia Federal Prison Commission.
2. To assess the perception of the construction industry stakeholders on the need and importance of supply chain management in infrastructure construction project.

1.4. Research questions

The following research topics, which should be investigated in the context of Ethiopia with a specific focus on Federal Prison Commission Infrastructure projects, were developed based on the literature review.

The major research question is “What are the major factors that affect supply chain performance of construction projects in the case of Federal Prison Commission?”

The following are specific research questions;

1. What are the current practices and challenges in the supply chain management process in Ethiopia Federal Prison Commission infrastructure projects?
2. What are the perception of the construction industry stakeholders on the need and importance of supply chain management in infrastructure construction project?

1.5. Significance of the Study

The researcher anticipates that this study will be crucial in identifying and analyzing the current practices and difficulties in the supply chain management process in the construction industry, using infrastructure projects in Ethiopia Federal Prison Commission as a case study, and in formulating suggestions for potential future solutions to the issue.

By outlining the primary issues pertaining to SCM assessment and collection procedures, the study's findings will help increase the government's and the client's (Ethiopia Federal Prison Commission) general awareness, empowering them to take action to successfully address the problems they have identified. Additionally, the knowledge gained from this research will help construction industry participants manage their supply chains effectively. Additionally, they aid in determining the primary influences on SCM practices, the ones that have the biggest impact, and strategies for avoiding them. Future researchers may use this study as a resource and a launch pad for their own work in the field. This research may also be crucial for identifying and addressing supply chain management-related queries. The choices made in light of the analysis may be crucial for enhancing supply chain performance as a whole.

1.6. Scope of the Study

The difficulties in supply chain management and competitive positioning are significant topics that will be addressed. However, the focus of this study is on topics that are crucial to supply chain management problems and their implications for upcoming public construction projects. The conceptual focus of the study is also restricted to aspects of supply chain management techniques, such as supplier relationships, customer relationships, information sharing with associated issues, and the firm's competitive advantage (operational performance). It was primarily concerned with the building phase, and more specifically, the

flow (chain) of the material supply chain process from the client, principal contractor, supplier, and consultant sides. Among the numerous projects being carried out throughout Ethiopia, the analysis is limited to infrastructure projects being developed and completed (from 2012 to 2021) by the Federal Prison Commission.

There are several restrictions that can affect the study's quality as far as limitations are concerned. The majority of the restrictions will result from the targeted population's or respondents' potential refusal to return the questionnaire and others' negligent filling out of the questionnaires. Because the study's target demographic won't comprehend how one characteristic is related to another, the results will appear incongruous. As a result, it is advised that other researchers explain how one characteristic is related to another before filling out questionnaires. Additionally, the study is limited by the researchers' lack of research expertise.

The geographical scope of the research is on all infrastructure projects in Ethiopia Federal Prison Commission. These are Shewa Robit Infrastructure projects found in Federal Prison Commission compound which located in Amhara Region commenced on June 14, 2012, Dire Dawa Federal Prison Infrastructure Projects located in Dire Dawa city, Akaki Kaliti Federal Prison Infrastructure projects located in Akaki Kaliti Sub city, Addis Ababa, Ziway Federal Prison Infrastructure Projects which located in Oromia Region, Federal Prison Referral Hospital infrastructure projects located in Kaliti Subcity, Addis Ababa, Federal Prison Head quarter Infrastructure projects.

The technique Using interviewers and open-ended questions is within the study's scope. The survey is only open to 87 construction-related respondents who will be contacted via email and telegram as well as in person with some of them. And 71 of the valid questionnaires from those respondents were employed in this study. The length of this research session will not exceed four months. To assess the firm's SCM procedures, each respondent will be required to complete a brief questionnaire.

1.7. Limitation of the Study

This study contains certain shortcomings as well as major theoretical and practical advances. It is challenging to cover the full field of supply chain procedures in this study. The research was done in one organization; hence not all supply chain practices were represented in the study sample. The customer, the contractor, the suppliers, and the consultant are only a few of the numerous actors involved in construction. This can be viewed as a limitation because it could be completed if the client, consultant, and other stakeholders' viewpoints were also taken into account. This work should be expanded by including new methodologies in the future. With the short amount of time available for this investigation, it is challenging to cover all supply chain actors.

Not all supply chain players were represented in the survey data, and several characteristics of the methodology employed in this study may have prevented conclusions from being generalized. This study, which took into account a non-probability sample of chosen projects, exposed the inherent limits of the methodological decisions made. The sample size, however, was chosen to reflect effect, reliability, and power. It's challenging to communicate and gather all the data in person because of the pandemic caused by COVID-19, and the network is also unreliable for social media like Telegram. Other restrictions include the study's focus being restricted to significant Infrastructure construction projects out of the many projects being undertaken in Federal Prison Commission, FPC.

1.8. Definitions of Terms

Terms are defined using both operational and conceptual meanings. Conceptual definitions of terms are those that come from theoretical viewpoints and necessitate citation descriptions. Operational definitions, on the other hand, are definitions that the researcher has provided in the context of the text. As a result, both operational and conceptual meanings of words are utilized in this thesis, and they are detailed below:

Construction industry -is an industry that uses numerous resources to create the built-in social, economic, and physical infrastructure required for socioeconomic development. It includes the procedure used to plan, design, obtain, erect, produce, alter, maintain, and destroy the aforementioned physical infrastructure.

Constructed infrastructures- include: Buildings; Transportation systems and facilities (airports, harbors, highways, subways, bridges, railroads, transit systems, pipelines and transmission and power lines); Structures for fluid containment, control and distribution (water treatment and distribution, sewage collection and treatment distribution systems, sedimentation lagoons, dams, and irrigation and canal systems); and Underground structures, such as tunnels and mines.

Supply chain management: - is the methodical, strategic coordination of the conventional business operations and the business supply chain inside a specific organization and between businesses (Mentzezer et al, 2004).

SCM practices are defined also as approaches applied in managing integration and coordination of supply, demand and relationships in order to satisfy consumers in effective and profitable manners Krause, D.R. and T.V. Scannell (2002).

Information Sharing - in the supply chain is defined as the scope, frequency, and intensity to which the critical and proprietary information is communicated to participating entities

Project life cycle-is all the collective phases the project progresses through in concert.

Supply chain responsiveness (SCR): - it is the act of supply chain to respond the market change rapidly. For this study operation system responsiveness, logistics process responsiveness, and supplier system responsiveness are used to measure Supply chain responsiveness, Thatte, (2007).

Competitive advantage of the firm (Operational performance): - is the system of producing great value product differently than the competitors. Cost, quality, flexibility, and delivery are used to measure operational performance, Thatte, (2007).

1.9. Organization of the Thesis

There are five chapters in this work. The introductory section of the paper is covered in the first chapter. It includes background information about the study and the company that is being evaluated, a statement of the problem, study objectives, and other pertinent topics. The focus of the second chapter is a review of pertinent literature. This chapter reviewed the pertinent literature in regard to the subject at hand. The third chapter discusses study methodology, including the methodologies utilized for data collecting and analysis as well as the research design. The study's main conclusions about the variables influencing supply chain management performance in construction projects, with a focus on infrastructure projects for the Ethiopia Federal Prison Commission, are presented in the fourth chapter. The summary of the study's key findings, conclusion, and recommendations are included in chapter five.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. General

This section summarizes earlier research on the topic under investigation. A review of the literature that aids in answering the questions prompted by the analysis of the study is given. It is vital to describe the elements that are included in this section before moving on to the major part of the study. "A useful methodology to get in-depth information of a research issue" is a literature review. Researchers can identify the present body of knowledge and find inspiration for new research by conducting a systematic review of the literature (Mok et al., 2015, p.447). Infrastructure and industrial development of a nation depend heavily on construction activity. It includes buildings such as hospitals, schools, townships, offices, homes, and other structures, as well as urban infrastructure (such as water supply, sewerage, and drainage), as well as highways, roads, ports, railways, and airports, as well as power systems, irrigation and agriculture systems, and telecommunications, among other things. Construction, which spans such a broad spectrum, becomes the fundamental component for socioeconomic development. Additionally, the building industry creates a significant amount of jobs and stimulates the growth of other industries through backward and forward connections. Therefore, it is crucial that this important activity is designed for the economy's healthy growth. Leading businesses are starting to see supply chain excellence as more than just a way to save costs; rather, they see it as a way to gain a competitive edge that has the potential to boost customer satisfaction, revenue generation, asset utilization, and cost savings. The achievement of these objectives, both individually and collectively, depends on effective cross-functional and enterprise collaboration inside each organization and between chain units (Ashayeri, Gattorna, and Kampstra, 2008).

This section reviewed selected empirical studies by various authors related to supply chain management and included framework descriptions of the literature, SCM adoption concept, SCM revolutions and definitions, overview of Ethiopia's SCM policy, nature of SCM in Ethiopian Federal Prison Commission in case of infrastructure projects carried out in company, and reviews of these studies. Their findings were presented as follows:-

2.2. Revolution Supply Chain Management

SCM was initially used to define "the spectrum of actions co-ordinated by an organization to procure and manage" in the early 1980s. SCM is a theory that emerged from Toyota's supply system, which it used to coordinate its supplies and lower its inventory (Womack, et al., 1990). The idea of SCM emerged in the Japanese automotive industry as a production system and has since developed into an industrial management theory and a unique area of scientific study (Bechtel, et al., 1997; Cooper, et al., 1997).

It was revealed that swift changes in international business practice are what are driving the development of SCM theory (Harland, 1996). They claimed that the global crisis of the late 1980s and early 1990s compelled businesses to reconsider their strategic goals for cost-cutting and value-adding initiatives across the board. The phrase was originally used to describe an internal emphasis limited to a single business and how it sought and acquired supplies, controlled its internal inventory, and distributed goods to its clients. It was acknowledged that this knowledge was insufficient and that the reality of managing supplies required supply chains to extend past the purchasing organization and into its subsequent lower echelons, including suppliers and their suppliers' suppliers (Christopher, 2005).

Christopher (2005) asserts that despite being a relatively new occurrence, SCM is unmistakably tied to logistics. It is a prevalent misconception that logistics entails the transportation of tangible objects from one place to another. Man has been concerned with how to transport materials to a construction site from the time of the great pyramids. Another illustration of large logistical difficulties is the movement of people from Europe to the Americas. The military was where the term "logistics" was first used. The military paid close attention to the study of logistics during both World Wars. More troops and supplies had to be moved during the Second World War than at any other time in history, and logistics had a significant role in both the result of the war and the outcome of many later military conflicts. As shown in figure 2.1, logistical principles received increasing attention in the business world following the war.

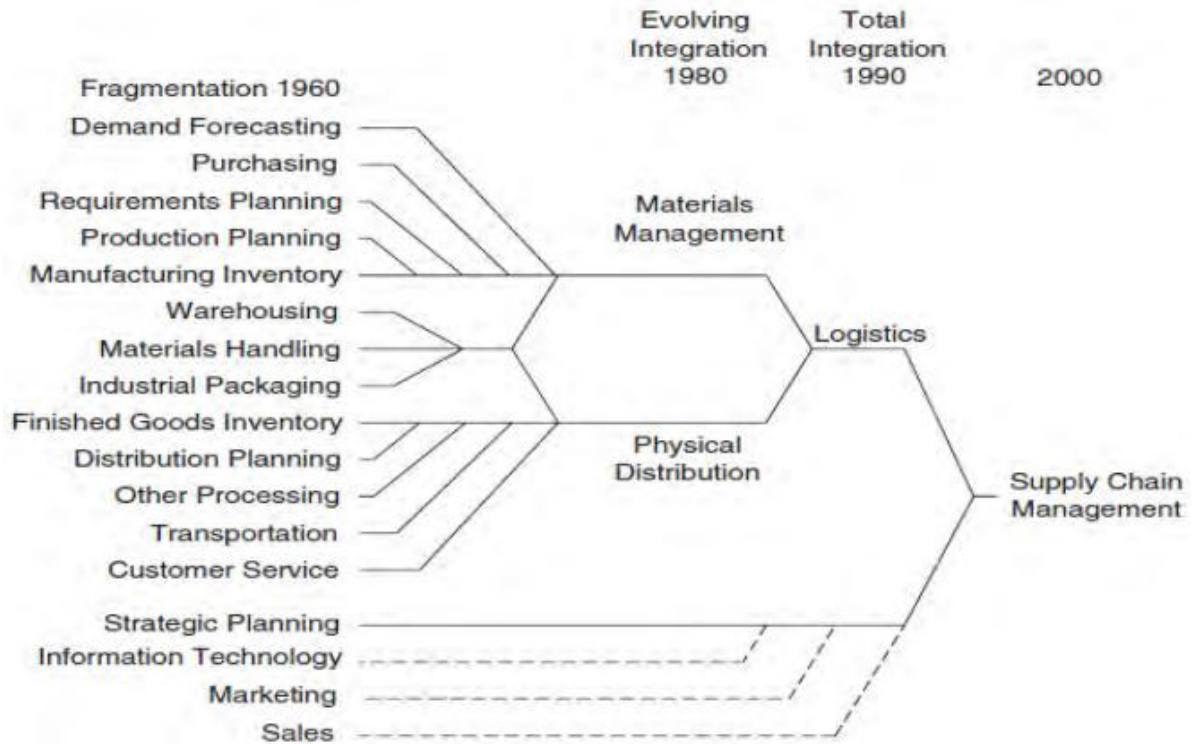


Figure 2.1: Logistics evolution to SCM (Christopher, 2005).

The terms ‘SCM’ and ‘logistics’ are often confused and viewed as overlapping, depending on the definition used by an organization. There is confusion and disagreement among general business practitioners and operations professionals regarding the terms logistics and SCM (Lummus, et al., 2001). Various formal definitions have been offered for both terms. With the increased interest in SCM, several authors have discussed the differences between this newer term (SCM) and logistics. It was stated that an understanding of SCM is not appreciably different from the understanding of integrated logistics management (Cooper, et al., 1997). However, logistics can be thought of as a planning orientation and framework that seeks to create a single plan for the flow of product and information through a business. SCM builds upon this framework and seeks to achieve linkage and co-ordination between the processes of other entities in the pipeline, that is suppliers and customers and client’s organization (Christopher, 2005).

2.3. Supply Chain Management Processes in construction

Increasingly, supply chain management is being recognized as the management of key business processes across the network of organizations that comprise the supply chain. While many have recognized the benefits of a process approach to managing the business and the supply chain, most are vague about what processes are to be considered, what sub-processes and activities are contained in each process, and how the processes interact with each other and with the traditional functional.

The Global Supply Chain Forum identified eight key processes that make up the core of supply chain management (Cooper, et al., 2007): these are: - Customer Relationship Management: the structure for how the relationship with the customer is developed and maintained, Customer Service Management: the single source of customer information, such as product availability, shipping dates and order status, Demand Management:- includes forecasting demand and synchronizing it with production, procurement, and distribution, Order Fulfillment:- integration of the firm's manufacturing, logistics and marketing plans, Manufacturing Flow Management:- deals with making the products and establishing the manufacturing flexibility needed to serve the target markets, Procurement (Supplier Relationship Management):- defines how a company interacts with its suppliers, Product Development and Commercialization;- developing new products quickly and getting them to the marketplace in an efficient manner is a major component of corporate success, Returns:- identifying productivity improvement opportunities and breakthrough projects.

The construction industry is defined generally as an economic activity directed to the creation, renovation, repair or extension of fixed assets in the form of buildings, land improvements of an engineering nature, and other engineering construction such as roads, bridges, dams etc. according to UN (1996) in (EEA, 2006-07). Construction Projects as any other projects have different phases. The famous Project management body of Knowledge (PMBOK) Guide identifies and categorizes project phases into five major categories: Initiating, Planning, Executing, Monitoring and Controlling, and Closing (Heldman, 2009). The phases may differ from project to project based on complexity of the project. These process groups or phases are inter-related and are known as the Project Life cycle. Other books on Project management (PM) may define these phases into more or lesser phases. For

instance Larson and Gray (2011) defined Project Life Cycle stages into four as; Defining, Planning, Executing and Closing. On the other hand Lock, (2007) states that many project management publications limit their account of the project life cycle or life history to Phases 6 through 13. According to Lock (2007) the reason for this is that these are the phases that most directly involve the control of the project manager, who might not actually come on to the scene until Phase 6 or 7. Construction also exhibits similar phases that could be described in different stages depending on the complexity of the project. Olsson (2000) asserts a simple housing project may be designated using the following process map. (Please refer Figure 2.2 below).

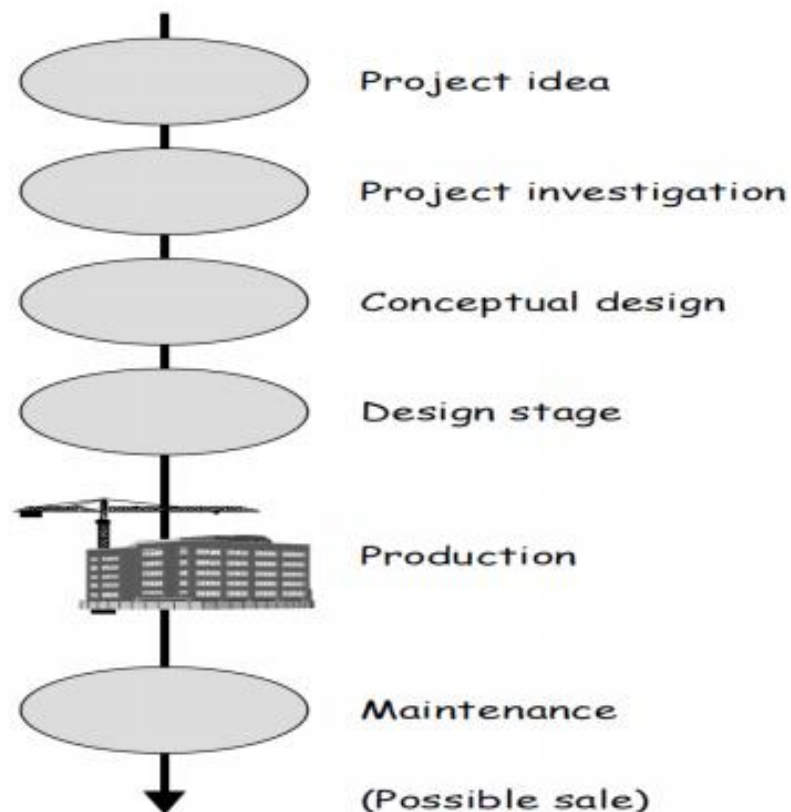


Figure 2.2: The Construction Process (Olsson, 2000)

The idea of construction SCM emerged as a result of the actual circumstance of the construction industry. Many researchers consider that the construction industry nowadays is highly fragmented and this could lead to significant negative impacts, low productivity, cost and time overruns conflicts and disputes, resulting in claims and time-consuming litigation (Latham, 1994; Egan, 1998). To overcome industry fragmentation, there has been a growing

recognition that it is important to integrate the various disciplines/participants in a construction project, and this includes aspects of integrating all the members of the supply chain (Anumba, et al., 2002).

2.4. Supply Chain Management Practice

Supply Chain Management practices is defined as a set of activities undertaken in an organization to promote effective management of its supply chain (Li, 2005). SCM practice is conceptualized to be a multi-dimensional concept whereby it is viewed toward more comprehensive concept that included supplier side, internal side and customer side approach. Chopra and Meindl (2001) mentioned that SCM practices can help on improving organizational long-term performance and supply chains performance with the practices of combining the cooperation in between manufacturers, distributors, suppliers and customers.

Li et al (2005); Thatte (2007) have developed a valid and reliable instrument to measure supply chain management practices. The similar instrument also adopted in this research. Three dimensions of supply chain management practices lead to supply chain responsiveness. These are strategic supplier partnership, customer relationship, and information sharing also identified. The purpose of this study to find out the effect of supply chain management practices such as strategic supplier partnership, customer relationship, information sharing and supply chain responsiveness. This study also investigates the effect of supply chain responsiveness in term of operation system responsiveness, logistic process responsiveness, supplier network responsiveness and competitive advantage of the firm. By improving competitive advantage of the firm, organization could improve its performance.

Supply chain integration is very important for construction performance; though there are problems in supply chain integration in Construction Industry. Related research by Briscoe and Dainty (2005) revealed that a large number of supply chain partners and the significant level of fragmentation limit the levels of integration that are achievable in UK construction. The interplay of environmental and procurement related factors renders the realization of truly integrated supply chains very problematic and difficult to achieve. There are many factors that should be considered in the selection of suppliers in construction. Material

quality, delivery dependability, and price are the most critical criteria for supplier selection in the construction industry (Benton(Jr.) and McHenry, 2010).

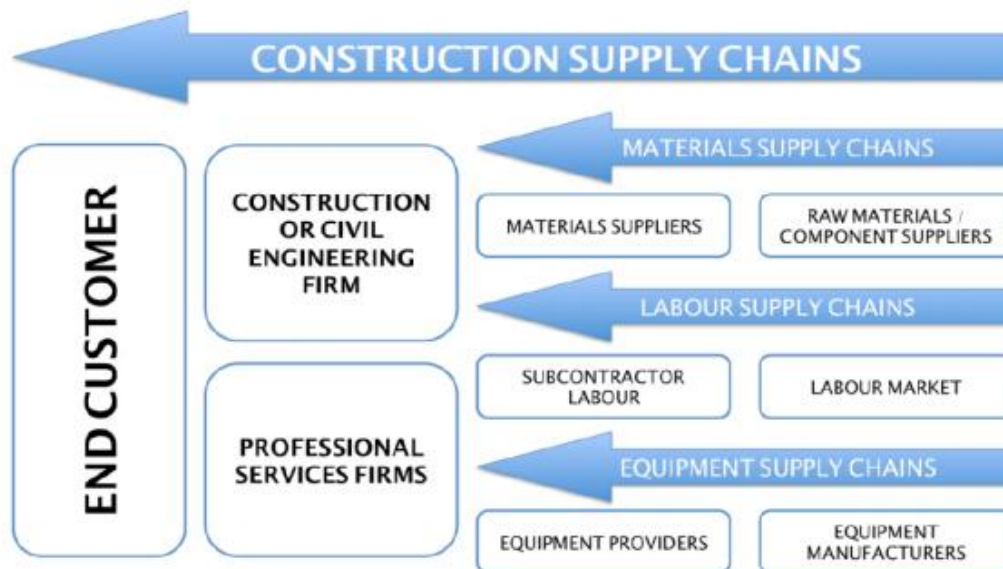


Figure 2.3: The Myriad of Construction supply Chains (Cox et. al. 2006) in Lovrencic, Grilec, and Mikulic (2016)

The construction supply chain is one of the complex supply chains where many stakeholders involve. The above figure 2.3 depicts a myriad of construction supply chains where material supply chains, labor supply chains, and equipment supply chains are linked to construction or engineering firms and professional services firms. The ultimate end customer is the source of the construction requirement that is also called the client.

According to Cox et al. (2006) in Lovrencic, Grilec, and Mikulic (2016), “The stage end customer includes all customers of construction projects. These clients typically source their construction requirements from highly competitive construction supply markets so the construction project provides the required functionality to support their business. Furthermore, construction or civil engineering firm includes all civil engineering and construction firms that deliver projects to the end customer. These firms play the 'integrating' role for all the constituent construction supply chains and typically operate within a highly competitive market place. Professional services firms include all professional services firms that provide engineering, design, planning etc...”

2.4.1. Strategic Supplier Partnership

Thatte (2007) stated that strategic supplier partnership as the long-term relationship between the organization and its supplier.

Strategic supplier partnerships including working closely with suppliers to design or redesign products and processes, solve problems, as well as prepare back-up plans is critical in attaining supply chain responsiveness (Storey et al., 2005; Liu and Kumar, 2003; Martin and Grbac, 2003; Gunasekaran and Yusuf, 2002; Sheth and Sharma, 1997; Tan et al, 1998; Araujo et al, 1999; Ghosh et al, 1997; Ellinger, 2000; Lambert and Cooper, 2000; Turner et al, 2000; Harris, 2005; Yusuf et al, 2004; Lee, 2004; Power et al, 2001; Narasimhan and Das, 2000; Martin and Grbac, 2003).

2.4.2. Customer Relationship Management

Customer relationship management (CRM) is not only focused on inbound customer relationships but also on outbound customer relationships in SCM. Customer relations related to the company's ability to communicate to the delivery of appropriate products and services to customers locally and globally in the right time, right place, and appropriate of quantity and quality.

The success of supply chain management encompasses customer integration at the downstream and supplier integration at the upstream, considering that each entity in a supply chain is a supplier as well as a customer (Thatte, 2007).

Customer relationship is essential for attaining supply chain wide responsiveness (Storey et al., 2005; Mitchell, 1997; Christine, 1997; Martin and Grbac, 2003; Sheth and Sharma, 1997; Tan et al., 1998; Araujo et al., 1999; Van Hoek, et al., 2001; Christopher, 2000; Harris, 2005).

2.4.3. Information sharing

Simatupang and Sridharan, (2002) defined information sharing as the access to private data between business partners thus enabling them to monitor the progress of products and orders as they pass through various processes in the supply chain. They identified some of element that comprise information sharing, consisting data acquisition, processing, storage, presentation, retrieval, and broadcasting of demand and forecast data, inventory status and location, order status, cost-related data, and performance status.

SCM application has particularly found obstacles in construction sector as a consequence of its particular context of temporary multiple organizationll (Cheng, et al., 2010) and because of the difficulties in managing networks of a large number of different companies, supplying materials, components and multiple services and with adversarial relationships (Briscoe, et al., 2001; Saad, et al., 2003). It was stated that the existing manufacturing research in SCM, although useful, cannot be directly applied to a construction environment; because of the transient nature of production in construction projects (O'Brien, 1995). Although effective SCM is a key element in reducing construction costs, it is noted that very few studies have defined what SCM means within the construction process (Davis, 2008; Atkin, et al., 1995; Crespin-Mazet, et al., 2007). For this reason, CSCM is defined as:

“It is the coordination and the integration of key construction business both processes and members involved in CSC, extending traditional intra-enterprise activities in a management philosophy by bringing together partners who have the common goals of optimization and efficiency so establishing long-term, win/win, and cooperative relationships between stakeholders in a systemic perspective.”

The CSC is not a real chain but a network of multiple organizations and relationships, which includes the flow of information, the flow of materials, services or products, and the flow of funds between client, designer, contractor and supplier (Xue, et al., 2007). Construction is a multi-organization process, which involves client/owner, designer, contractor, supplier, consultant, and so on. It is also a multi-stage process, which includes conceptual activities, design, construction, maintenance, replacement, and decommission. At first it was proposed

an alternative SCM networked structure, to substitute the traditional vertical one, in order to support partnering (Xue, et al., 2007; Karim, et al., 1995). This proposal seems to better fit the peculiarities of construction SC and align with the context of our discussion as presented in Figure 2.4.

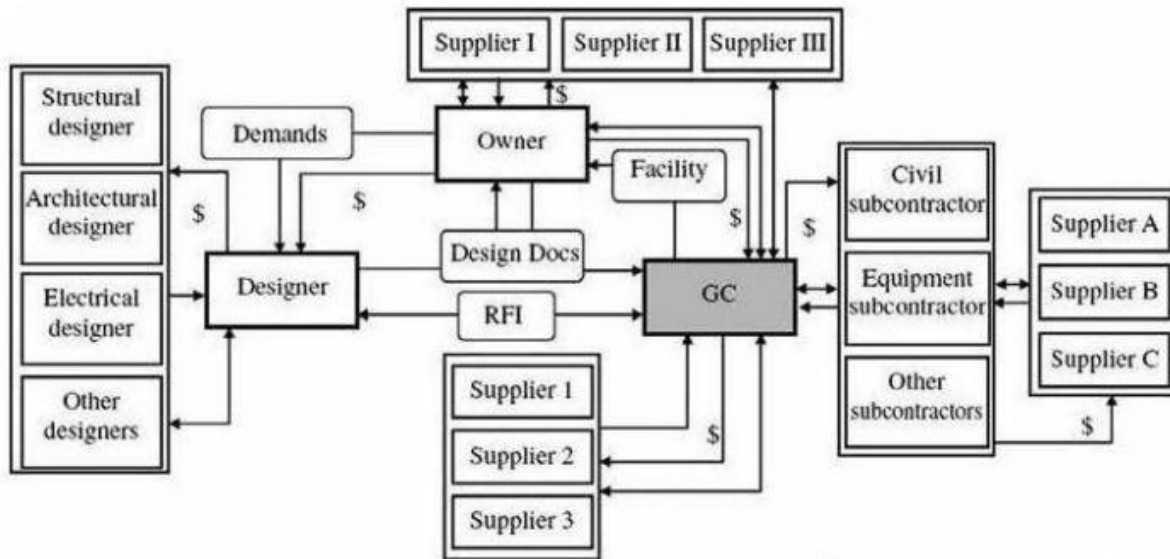


Figure 2.4 Construction supply network (Xue, et al., 2007)

2.5. Approaches of Supply Chain Management in Construction

Construction industry is characterized by its own distinctive features, which can heavily affect SCM application.

- Production systems: Construction is a typical project production industry operating within an environment of considerable complexity and uncertainty (Fearne, et al., 2006).
- Customer influence: Customers wield great influence on the final product in relation to its physical aspects and to the value of logistic parameters (Kornelius, et al., 1998; Pesa'maa, et al., 2009) of delay which in descending order of criticality were found to be: (1) necessary variations, (2) delayed payments, (3) scarcity of materials, (4) late material supply, (5) less emphasis to planning, (6) sub-surface condition, (7) changes in design, (8) material and labor price escalation, (9) unrealistic time schedule, and (10) failure to update schedules on time.

- Fragmentation: It refers to market fragmentation, as well process fragmentation (Baiden, et al., 2006)
- Number and type of stakeholders: The main subjects include: owners, designers, contractors and suppliers. However, a typical network involves multiple organizations and relationships, including the flow of information, the flow of materials, services and products, and the flow of funds between client, designer, contractor and supplier (Xue, et al., 2007).
- Buyer-supplier relationship: This is mostly of transactional nature, strained by conflict and mistrust (Lu, et al., 2007; Miller, et al., 2002). Moreover, it is widely known, especially among public sector clients, that in construction a tender price is the most significant parameter used for a bid evaluation. This focus on price is the main reason for project delivery problems (Hatush, et al., 1998; Hartmann, et al., 2010)
- Temporary configuration: Production at a temporary site by a temporary organization (Cheng, et al., 2010; Love, et al., 2002) leads to relationships focused on the short-term thinking, with actors attempting to leverage what they can out of the existing contract, resulting in an environment where opportunism reigns (Cox, et al., 1997; Kamann, et al., 2006).
- Change inertia: Construction organizations tend to be conservative referring to the need to change, because of the risks associated with the procurement of projects (Cheng, 2001; Love, et al., 2002; Kumaraswamy, 2005).

There is a basic pattern to the practice of supply chain management. Each supply chain has its own unique set of market demands and operating challenges and yet the issues remain essentially the same in every case. Companies in any supply chain must make decisions individually and collectively regarding their actions in five areas (Johnston, H.R., and Vitale, M.R. 1988):

- 1) **Production**—what products does the market want? How much of which products should be produced and by when? This activity includes the creation of master production schedules that take into account plant capacities, workload balancing, quality control, and equipment maintenance.

- 2) **Inventory**—what inventory should be stocked at each stage in a supply chain? How much inventory should be held as raw materials, semi-finished, or finished goods? The primary purpose of inventory is to act as a buffer against uncertainty in the supply chain. However, holding inventory can be expensive, so what are the optimal inventory levels and reorder points?
- 3) **Location**—where should facilities for production and inventory storage be located? Where are the most cost efficient locations for production and for storage of inventory? Should existing facilities be used or new ones built? Once these decisions are made they determine the possible paths available for product to flow through for delivery to the final consumer.
- 4) **Transportation**—how should inventory be moved from one supply chain location to another? Air freight and truck delivery are generally fast and reliable but they are expensive. Shipping by sea or rail is much less expensive but usually involves longer transit times and more uncertainty. This uncertainty must be compensated for by stocking higher levels of inventory. When is it better to use which mode of transportation?
- 5) **Information**—how much data should be collected and how much information should be shared? Timely and accurate information holds the promise of better coordination and better decision making. With good information, people can make effective decisions about what to produce and how much, about where to locate inventory and how best to transport it.

2.6. Construction Materials Management on Construction Projects

The management of materials should consider at all the phases of the construction process and throughout the construction and production periods. This is because poor materials management can often affect the overall construction time, quality and budget. The importance for planning and controlling of materials to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, obtained at a reasonable cost, and are available when needed. Many construction projects apply manual methods, not only for the tracking of materials, but also for materials

management as a whole and this involves paper based techniques and is problematic with many human errors (Narimah Kasim, 2013).

Managing and Minimizing Wastage of materials on construction projects Construction Material wastage has been recognized as a major problem in the construction industry that has important implications both for the efficiency industry and for the environmental impact of construction projects. Moreover, waste measurement plays an important role in the management of production systems since it is an effective way to assess their performance, allowing areas of potential improvement to be pointed out (Carlos Torres Formoso, 2002).

2.7. Challenges of the Construction Supply Chains

There are substantial difficulties in applying SCM in the construction industry (Saad, et al., 2002). Factors such as short-termism, lack of trust and adversarial relationships, the transient nature of construction projects and the considerable number of infrequent clients were highlighted as the main problems associated with the implementation of SCM in construction. This section will address the main challenges associated with adopting SCM in the construction industry.

Customer focus, SCM may well help improve the construction industry with its poor relationships, fragmented processes and lack of internal and external customer focus. However, there remain a number of critical issues within the construction industry that need to be considered and rectified. A long list of problems could be itemized, including lack of trust and commitment, co-ordination problems and training problems, all of which are already well documented by reports (Latham, 1994; Egan, 1998). Consequently, scope for implementing SCM within construction could be limited (Saad, et al., 2003).

Much research work and real test cases analyses have assessed that construction is ineffective and many problems can be observed. Analysis of these problems has shown that a major part of them are supply chain problems, originating at the interfaces of different parties or functions, among which the following are few of them (Vrijhoef R., et al., 2001):

- ⇒ Client/design interface: difficulties in finding out client's wishes, changes of client's wishes, long procedures to discuss changes,

- ⇒ Design/engineering interface: incorrect documents, design changes, extended wait for architect's approval or design changes
- ⇒ Engineering/purchasing & preparation interface: inaccurate data, engineering drawings not fitting the use,
- ⇒ Purchasing & preparation/suppliers interface and purchase & preparation/subcontractors interface: inaccurate data, information needs not met, adversarial bargaining and other changes,
- ⇒ Suppliers/subcontractors interface and suppliers/site interface: deliveries not in conformance with planning, wrong and defective deliveries, long storage period, awkward packing, large shipments,
- ⇒ Subcontractors/site interface: subcontracted work not delivered according to main design, contract and planning,
- ⇒ Site/completion of building interface: problematic completion due to quality problems,
- ⇒ Completion of building/occupation interface: unresolved quality problems, delayed occupation due to late completion,

It can be noticed from this list that communication problems (either described in terms of data, or more generally in terms of information handled during the exchanges) form an important part of the problems faced in construction supply chains.

The current practice of supply chain management rightly suggests controlling the supply chain as an integrated value-generating flow, rather than only as a series of individual activities. Here, the term "supply chain" refers to the stages through which construction materials factually proceed before having become a permanent part of the building or other facility. It covers thus both permanent supply chains, which exist independently of any particular project, and temporary supply chains, configured for a particular project.

2.8. Construction Supply Management in Different Countries of the World

2.8.1. Construction Supply Chain Management in Malaysia

Malaysian Construction Supply Chain management involves the management of activities in the chain to ensure best value for the customer and to achieve a sustainable competitive advantage. With the increment of competition and technology, it allows many firms transform to supply chain management, as a central part of strategic competence, which is believe would be able to create competitive advantage (Othman .A.A and Abd. Rahman, 2010).

In practice, SCM is applied to prevent issues about abandoned projects and delays. This issues will cause the customer lose the project and project management that are not consistent with plans made before the start of construction is called a real plan only after the contractor gets the Letter of Acceptance. Besides that, practicing the SCM in construction site can be achieved an integrated supply chain for building and facility standards.

2.8.2. Construction Supply Chain Management in Portugal

In Portugal, a framework was developed to automate the tendering, ordering, delivery, invoicing and payment processes of prefabricated house systems, equipment and services in its supply chain, whose members have different levels regarding information and communication technologies (Jardim-Gonclaves et al, 2000). This framework, together with an EDI communication infrastructure based on an inter-organizational workflow system, enables a better coordination between the supply chain partners, from the client, through to the contractor and suppliers. The developed tool coordinates the business and management information flows among participants in the various stages of the process of building prefabricated houses.

The construction industry is an important driving force behind many national economies. The present economic crisis has presented Portuguese construction companies with an opportunity to closely examine SCM practices and consider them as a means of becoming more competitive. Larger-sized companies, which normally take on the role of contractors

and are capable of influencing and structuring the CSC, are the target of the survey conducted in different researches.

- ⇒ Results show, with respect to construction SCM issues, that:
 - A high percentage of contractors have a SCM strategy and, interestingly, all internationalized contractors also have a SCM strategy in place;
- ⇒ The level of awareness of construction SCM is low;
- ⇒ The overall perception of the construction SCM integration level is positive and increases with the size of contractor; and
- ⇒ The performance assessment transparency increases with the size of contractor.

2.8.3. Supply Chain Management in the UK Construction Industry

Supply Chain Management in the UK Construction Industry is growing interest among major clients and contractors in the UK construction industry in developing collaborative relationships. So far these efforts have not been very successful, although, —the search for more collaborative relationships has become a contemporary theme in the industry (Cox, et al., 1997). SCM is considered as having replaced partnering as the latest buzzword of the UK construction industry (Pearson, 1999). He reports that a few major clients and contractors use SCM.

In a study, contractors' opinions were surveyed because of their pivotal role in the construction supply chain (Akintoye, et al., 2000). The study reveals that contractors are more oriented towards clients rather than their product suppliers in the supply chain. Contractors seem to have more arrangements with clients than with suppliers and a higher proportion of the relationships with clients are contractual. Due to the aggressive business mentality of the industry and the non-trusting climate, contractors have the tendencies to pay more attention to clients who provide their workload (Akintoye, et al., 2000). Finally, the survey highlights that problems in implementing successful SCM within the UK construction industry are at present associated with an inappropriate traditional business culture and the unique individual features of the organizational structure.

There are a number of problems within UK construction that might arguably be addressed through these of SCM (Mortledge, *et al.*, 2006). These are: fragmentation, adversarial

relationships, and project uniqueness, separation of design and production and competitive tendering.

2.8.4. Supply Chain Management in the North America Construction Industry

Supply Chain Management in the North America Construction Industry: - Since 1999, Virtual Construction Group, Arup Computing and Arup Project Management have been investigating, analyzing and developing new systems that can enhance quality, quantity and speed of project information needed to perform construction tasks (Hudgins and Chang, 2000).

Ove Arup and Partners developed a Web-based Project Extranet Site (a website that allows controlled access to partners, vendors and suppliers or an authorized set of customers - normally to a subset of the information accessible from an organization's intranet) to be used as a communication and document-handling tool for their global operations. The Site streamlines the movement of information between all organizations involved on the project, wherever they may be, enhancing productivity and achieving cost savings through increased access, organization and exchange of project information. Over 20 different project sites, within the Arup Partnership, have successfully adopted the Project Extranet Site (Hudgins and Chang, 2000).

2.8.5. Supply Chain Management in the Canada Construction Industry

In Canada, a Web-based communications framework was developed to operate as a document information center for project participants (Hammad and Alkass, 2000). This framework, entitled the Construction Project Document Information (CPDI) Center, offers a search facility as an integral part of other services such as document storage, retrieval, and general project information. It is also adaptable to any project organization or delivery method, and works for a single-site project as well as geographically dispersed projects.

Supply chain management in developing countries is a less researched area as compared to developed countries. However, some research findings reveal that the local end component

of the global supply chain in Tanzania faces many problems compared to developed countries. According to Tesha and Msimangira (2014)., key problems facing Tanzania are: the use of out-dated technology in the domestic market, lack of trust, documentation problems, procurement of counterfeit products (e.g., spare parts), and lack of integrated computerized systems to link with the overseas suppliers in the global supply chain, and so on. A research in Kenya revealed that there is a positive correlation between procurement and supply chain practices in construction companies in Nairobi and improved its organizational performance to large extent. Kiromo (2015) asserts that some of the ways in which procurement and supply chain improved organizational performance include; improved quality of products, improved ability to meet demand, improved organizational performance, leads to reduced costs improved ability to meet demand and helps in customer satisfaction and confidence.

2.9. Supply Chain Management in the Ethiopia Construction Industry

To use the term “Supply Chain Management” in the context of the current Ethiopia construction industry suggests that it is possible to adopt those practices, which have proved to be successful elsewhere, without significantly adapting them to reflect the particular nature of the industry and its culture (Mugher Cement Enterprise, 2010).

On the other hand, the numbers of construction companies are increasing at an alarming rate and some of the entrants are international companies having huge capital as well as long years of technical and managerial experiences in the industry. The supply chain management practices categorized under different issues shows that the level of the practices is at their lower level. The impacts of different variables on the competitive position of construction industry are highly significant.

It is important to see the Ethiopian industry competitive forces using the (Porter, 1985)‘s five competitive forces model (Mugher Cement Enterprise, 2010).

⇒ Rivalry between established firms – few years ago there were few firms and could sell easily what they could produce. This time the number of cement factories has

reached to about 11 and some others will resume operations very soon. Though rivalry is not now seemingly stiff as such, it is expected to come sooner at some other time.

- ⇒ New entrants - though the industry is capital intensive, there are major reasons that the industry may attract capable multinational companies. Government is promoting investors to enter into the construction industry due to the fact that it is becoming a bottleneck for its own infrastructural sector requirements. Economies of scale are very high as it is heterogeneous product that is produced in an integrated process. Due to this and high profit margin that the existing few companies are enjoying, it is a fertile ground to attract capable entrepreneurs.
- ⇒ Bargaining power of customers – there is a high demand and supply gap in the market. The former supersedes the latter by far.
- ⇒ Bargaining power of the suppliers – the main raw materials like lime stone, gypsum and pumice are found in the local market and most of the cement factories own the mining fields. However, spare parts, components, fuel, packing materials and main utilities are mostly owned by few or at times with sole suppliers where most of the time the suppliers do have a strong bargaining powers.
- ⇒ Threat for substitute products – Material such as cement does not have perfect substitute.

SCM practices and challenges in different industry of Ethiopia were studied in different dissertations such as:

Admaw (2010) studied the practice of SCM for Ethiopian textile firms. It was found that, SCM practices in Ethiopian textile firms are weak and not considering SCM as a strategic tool for competition. Business managers of the textile firms didn't give attention for SCM theories and practices.

Dereje, (2012) studied the impact of SCM practices on the organizational performances in metal and engineering industries. The result of the study shows that the implementation of

SCM in this industry is weak. Also the SCM practices don't have any relationship with organizational performances except internal lean practices.

Belay (2011) studied the practices of SCM in cement industries. The result of the thesis shows similar to other industries in the country i.e. the practice of SCM in cement industry is almost poor. There seems that since the demand outweighs the supply of the cement, which contributes for not using SCM as a competitive strategy.

Mesfin (2007) also studied the SCM and model development study as a case study of Mesfin Industrial Engineering plc. The result of this study shows that most of the employees of the company don't have awareness of SCM. The company also don't use supply chain cost analysis rather than using the traditional accounting system. Also there are problems in their warehouses. Besides to the above machine handling problem, ageing, poor preventive maintenance, lack of proper operation, and wear of spare parts are the main reasons for the breakage of machines in Mesfin Industrial Engineering.

Mogus (2015) studies Practice & Challenge of SCM on 11 Ethiopian Private G-1 Road Construction Companies. Major finding shows that; on the degree of relationship across supply chain characterized by less joint product planning with suppliers, but better relationship with customers; information sharing practice of SCM in the case companies is generally moderate, but poor information sharing on material forecast with suppliers; there is poor and absence of IT & information system within the case companies. Despite the increase of empirical research available on manufacturing sectors, only limited empirical studies undertaken on construction Industry, use of units of analysis, and approaches of performance measurement also varies.

Temesgen Tagesse (2017) study on supply chain management practice and impact on firm performance in the case of yotek construction plc. His study was focus on SCM practice and impact on firm performance that determined in terms of operational and organizational performance.

Mintesinot Abay (2018) test if there is a relationship between SCM practices, supply chain responsiveness, and operational performance in manufacturing industry in Bahir Dar, the

study indicate first there is a positive and significant relationship between supply chain management practices and supply chain responsiveness, second supply chain management practices i. e. strategic supplier partnership, customer relationship, and information sharing has a direct positive impact on operational performance and the last the study finds the relationship between supply chain responsiveness and operational performance. The result states that supply chain responsiveness has positive and significant impact on operational performance.

Mustefa (2014) also study on Supply Chain According to the overall challenges of supply chain management, one can say that the practices of supply chain management Ethiopian construction industry are almost poor. To use the term Supply Chain Management' in the context of the current Ethiopia construction industry suggests that it is possible to adopt those practices, which have proved to be successful elsewhere, without significantly adapting them to reflect the particular nature of the industry and its culture (Mugher Cement Enterprise, 2010).

In summary, this chapter presented the findings from a literature review on the concepts and application of SCM and logistics in the construction industry. A supply chain consists of a series of activities and organizations to help materials move from the initial suppliers to final customers. In contrast, logistics is about the time-related position of resources. Many individual logistics systems will form a complete supply chain management network when they act together. Based on the studies of previous research, it is found that the literature only covers a subset of issues in the construction supply chain. to the best of understanding of the researchers, few studies have been conducted to discover the whole supply chain.

Furthermore, although there are many problems during the construction logistics process, the benefits of an efficient supply chain process are identified by many researchers. An early and accurate scheduling of materials, planned to a time schedule and keyed to the master plan for site storage is highly desirable for the success of a construction project (Enshassi, 1996). It is also found that there is lack of methods to evaluate the benefits or efficiency of the supply chain network as many factors prevent the construction industry from effectively addressing supply chain problems. This led to the motivation for this research.

2.10. Conceptual framework

The purpose of the literature is to improve the competitive advantage of the firm and the responsiveness of the supply chain by presenting supply chain management strategies from many angles. The company could enhance its competitive advantage to boost performance. Supply chain responsiveness is influenced by three aspects of supply chain management methods. These include information sharing, customer relationships, and strategic supplier partnerships.

Thatte (2007) lists the operational system responsiveness, logistic process responsiveness, and supplier network responsiveness as the sub-constructs for supply chain responsiveness. The manufacturing system of a company's capacity to adapt to changes in client demand is known as operation system responsiveness. The capacity of a company's outward transformation, distribution, and warehousing system to adapt to variations in consumer demand is known as the logistic process responsiveness. According to Fawcett (2002), the supply of a responsive supply chain strategy depends heavily on the responsiveness of the logistical process. The ability of the company's primary suppliers to respond to changes in the firm's demand is known as supplier network responsiveness. The presence of flexible and responsive partners upstream and downstream of the firm is essential for responsiveness (Christopher & Peck, 2004). The five characteristics of competitive capacities listed by Koufteros et al. (2007) are competitive price, premium pricing, value-to-customer quality, dependable delivery, and product innovation. The five dimensions of competitive advantage—price, quality, dependability of delivery, time to market, and product innovation—were proposed by Thatte (2007). The author employed these dimensions in this study.

The following research framework can be derived from the aforementioned literature review: Source; (Thatte, et al 2013, Miguel, Ledur Brito, 2011)

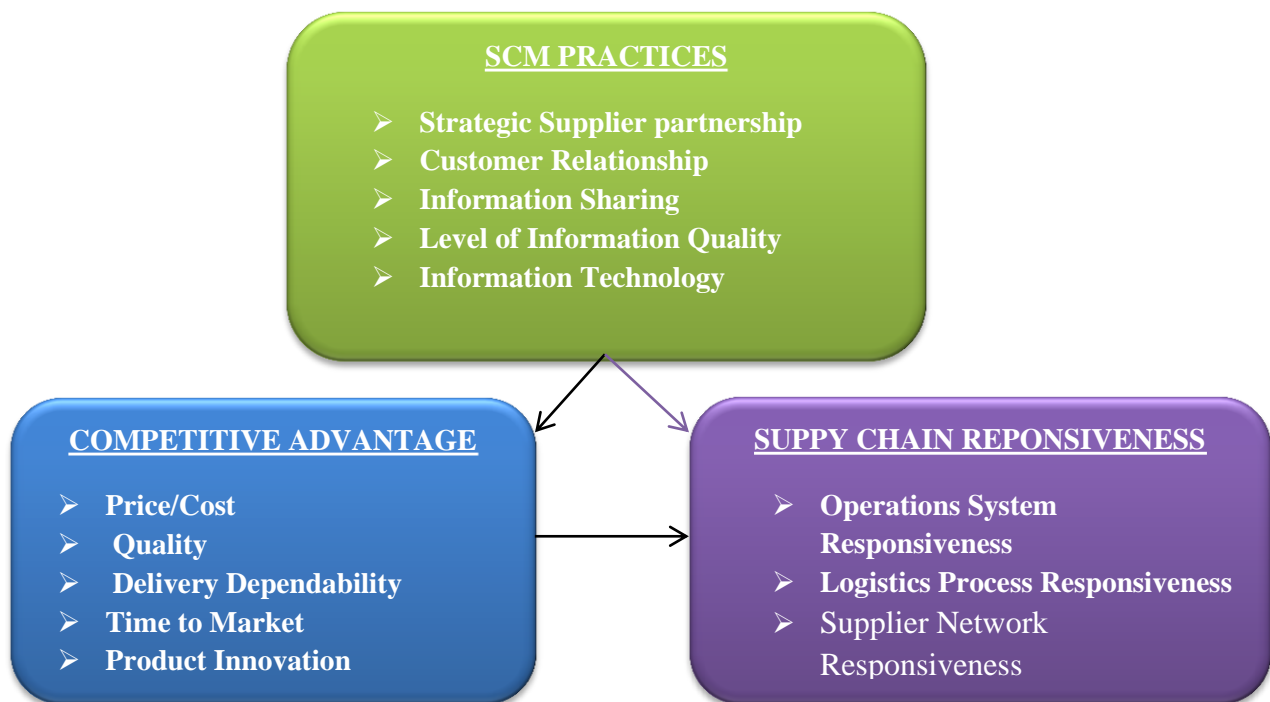


Figure 2.5 Conceptual Framework of the study [Source: adapted from Li et al. (2006) and Lenny et al. (2007)].

2.11. Research Gap

Most research on construction supply chain management has focused on particular elements of the chain, such as client-contractor relationships (Akintoye, McIntosh, and Fitzgerald, 2011), contractor, subcontractor, and supplier interface (Vrijhoef & Koskela, 2011), or rework (Love, Mandal and Li, 2009). Studies on topics including environmental performance (Ofori, 2011), design management (Khalfan et al., 2011), service quality (Hoxley, 2001), and purchasing behavior are also conducted in the construction industry (Dubios & Gadde, 2011). According to Barker, Hong-Minh, and Naim (2011), there is a glaring gap in the body of knowledge regarding SCM as it relates to construction projects. Initiatives related to SCM have been sparse in the construction sector up to this point, only addressing a select group of problems (such as transportation costs) in a small section of the supply chain (e.g., the construction site). According to Asplund and Danielson (2011), the difficulties are typically viewed from the perspective of the principal contractor.

Academic research on the process of supply chain improvement is lacking. [Beamon, (2011)] presented one of the earliest research pertaining to SCM measures. Later, a structure that connects the levels and processes of the supply chain (Gunasekaran, et al., 2004). By linking the formal supply chain procedures of plan, source, make/assemble, and deliver, the study added to our knowledge. The effectiveness of such processes is then assessed from operational, tactical, and strategic vantage points during various time periods. (Vachon, et al., 2009) developed another study by addressing the subject of competitive priorities and the application of metrics. The study received favorable feedback and was put to use in the business.

The majority of studies on SCM in the construction industry have been conducted in developed countries for particular SCM characteristics, as was discussed above. In the case of Federal Prison Commission Infrastructure projects, this research aims to investigate the application of SCM in the context of Ethiopia's (i.e., a developing country) construction industry. Additionally, this supply chain perspective study has attempted to take a comprehensive approach to government infrastructure projects from the viewpoints of the client, contractor, consultant, and supplier, with a focus on how to improve the supply chain process.

CHAPTER THREE

3. METHODOLOGY

3.1. Introduction

The basic research question is answered by the research design. Lewis and Thornhill's (2009) research, in the opinion of Saunders, demonstrated that the choice of research design is influenced by the study's goal, the accessibility of relevant data sources, the expense of getting those data, and the availability of time. This study aims to investigate supply chain management practices and their effects on business success. In order to demonstrate the relationship between the independent variables of SCM practice and firm performance, the research used a descriptive study to describe SCM practice and a causal study to demonstrate that association.

3.2. Research Design

Planning and carrying out a study in a way that would enable the researcher to get the desired results increases the likelihood of learning knowledge that could be relevant to the actual world (Burns & Grove, 2001). This study is a fundamental piece of research that was created to address a theoretical quandary and add to the body of knowledge. This study's research design utilized an interview and questionnaire to conduct both descriptive and explanatory research. In order to evaluate the relationship between SCM practices and supply chain responsiveness on the one hand and operational performance on the other, as well as the relationship between supply chain responsiveness and operational performance of infrastructure projects in the Federal Prison Commission, the researcher used a cross-sectional field survey method.

3.3. Data Type and Sources of Data

Primary and secondary data are the two categories of data that Saunders, Lewis, and Thornhill (2007) define. According to them, depending on the research kind and the data the researcher obtained, a study may employ both or just one of the forms of data. A focused group discussion and semi-structured questionnaires were employed to gather primary data for this study. A researcher creates primary data with the express intent of addressing the

current issue (Malhotra and Birks, 2006). There are both quantitative and qualitative sorts of primary data in this study. Because correlation analysis and tests of significance for the impact of supply chain components on supply chain performance required numerical data statistical analysis, quantitative data were employed in the study.

The Federal Prison Commission's construction and management staffs, as well as some of its main suppliers, were the primary sources of data for the study's primary data gathering method, which also included interviews and focused group discussions. The firm profile, a particular research paper, articles, and reports are where secondary data is gathered.

3.4. Data collection method

There are many methods that can be used to gather data. The three main types are surveys, interviews, and observations (Greener & Martelli, 2015). Through questionnaires and a literature analysis, both primary and secondary sources of data were used in this study. The survey questionnaire was specifically used to collect the primary data. The measuring tool for this study was a close-ended questionnaire that was used in a quantitative technique. A group of people can be administered the closed-ended surveys at once. The common questionnaire that was used to gather the data for the study was adapted from works by Thatte et al. (2013) to assess supply chain management practices and responsiveness, and by Miguel Ledur Brito (2011) to assess operational performance. The sample respondents' responses were gathered using the Likert-type scale approach, which offers the following options: strongly agree, strongly disagree, neutral, agree, and disagree.

Survey questions, site visits, and focused group discussions were used to address the study's objectives. Since it would be delivered to the professionals located among the stakeholders involved in Ethiopia Federal Prison Commission Infrastructure projects, the questionnaires will be developed in English.

3.5. Target population

The population of the study consists of contracting firms (Clients), firms with expertise working on infrastructure projects, consultants, and other individuals involved in the construction sector.

The information will be gathered from various organizations involved in infrastructure projects and from official government regulations of the building industry. The researchers will concentrate on professionals, including management staffs, involved in infrastructure projects being built or completed by the Ethiopia Federal Prison Commission in the study area in order to get the needed data.

3.6. Data Analysis Method

The three goals of data analysis getting a sense of the data, determining the accuracy of the data, and addressing the research question are emphasized by Sekaram (2003) in Kiage (2013). He points out that by measuring the validity and reliability of the measures employed in the study, proving the goodness of the data lends credence to all future analysis and findings.

The responses in numerical form were analyzed using the descriptive statistics method. Since percentages are simpler to understand, they are used in this analysis to express the findings as a share of the total. To make the results easier to grasp, they are provided in tables and charts.

The study's sample size is not very large. In order to get meaningful results, the analysis has integrated all responder groups (clients, consultants, and contractors). According to relevance and agreement, the study employed the relative importance index (RII) method to ordinally organize variables (Aibinu and Jagboro, 2002).

The sampling design for the research will include a thorough plan for the sample size, sample location, and sampling procedures. Themes will be found and categorized in accordance with the goals of the thesis in order to appropriately and more easily decipher the meanings of peoples' responses. It will be done using the following themes: Part I provides general information, Part II examines how players in the construction industry view the advantages of SCM, and Part III discusses current SCM practices and obstacles (Part IV) - Method for managing a supply chain, and (Part V) - Solutions to problems in the network of a supply chain. Following receipt of responses from the public bodies, consultants, contractors, and other interested bodies, the possible study suppliers will be

determined. To understand respondents' emotions or preferences, the Likert scale. On a rating scale, the respondents must state how closely their emotions align with the question or statement. The study will use ordinal measures from a five-point Likert scale (from 1 to 5). Each issue will be correlated using the following scales: (1- Unimportant/ Negligible/ Not at all), (2- Less Important/ Low/ little), (3- Somewhat Important/ Moderate/ average), (4- Important/ High/ considerably), and (5- Very Important/ Very High/ A Lot).

Similar research used the Relative Important Index (RII) approach to evaluate the relative relevance of various parameters (Sambasivan, et al, 2007). According to relevance and agreement, the study employed the relative importance index (RII) method to ordinally organize variables (Aibinu and Jagboro, 2002).

$$RII = \frac{\sum(w)}{A * N}$$

where:- w = the weight given to each factor by the respondents

A = the highest weight = 5

N = the total number of respondents.

By computing the average relative importance index of all the criteria in a group, the relative importance index (RII) was used to rank the groups of the questionnaire.

Using MS Excel 2007 and IBM SPSS Statistics Version 23, the data from Seventy-One (71) surveys is analyzed, and the findings were presented in Chapter 4. The data is provided to show sample size, response rate, and characteristics of contracting companies in Ethiopia, particularly in FPC infrastructural Projects. In addition to the various SCM methods and solutions for the difficulties in the supply chain network, it also includes the ranking of factors influencing how construction stakeholders perceive the advantages of SCM as well as the current SCM practices and challenges based on their relative mean rankings.

In accordance with this, the researcher evaluated the data's completeness after collecting it via questionnaire schedules in order to ensure its accuracy and clarity. Quantitative approaches were used to examine the data, and the results are shown as frequency

distribution tables and other charts. The study makes use of qualitative methodologies to make it easier to describe and explain the findings. The researcher has attempted to produce a clear grasp of the study findings by doing this. The collected information was entered into a computer, coded, and examined with the help of SPSS Version 23.

3.7. Sampling Technique

Using the characteristics of the sample, sampling is used to understand some characteristics or aspects of the entire population. The list of all the things from which a representative sample is taken for research purposes is known as a sampling frame. Sampling is the method or process of choosing a representative sample in order to ascertain the parameters or characteristics of the entire population (Adams et al., 2007).

The study first identified the major sections that have direct and indirect relationship with supply chain performance as well as the major suppliers of construction materials. And then define target population using judgmental sampling technique. Purposive sampling technique is used to select the respondents working with the contractor and Suppliers. According to Walliman (2005), Saunders et al. (2007), purposive sampling is a useful sampling method which allows a researcher to get information from a sample of the population that one thinks knows most about the subject matter. Therefore, the study has applied the later approach as it is convenient and also the targeted respondents are the ones who have knowledge of the area under research.

The study argues that the respondents have sufficient understanding of how the effectiveness of the supply chain function may affect the supply chain process because all of them were chosen based on prior knowledge of the FPC construction structure. Purposive and convenience sampling techniques were employed in the study to ensure that the research's goals were satisfied.

3.8. Sample Size

Determining sample size is very complex as it depends on other factors such as margins for errors, the degree of certainty and statistical technique (Corbetta, 2003). A general rule, one can say that the sample must be of an optimum size i.e., it should neither be excessively large nor too small (Kothari, 2004).

According to Saunders, Lewis, and Thornhill (2012), a 50% or relatively high response rate is considered to be a reasonable expectation. Depending on the sample fraction and the results of past survey research, the sampling technique may or may not be successful (Zikmund and Babin, 2010). With this, the study predicted to successfully collect or return the questionnaires at a rate of 60% because the respondents are not in the precise location and somewhat difficult to collect surveys, so the remaining 40% may deviate or nonresponse. The research has a 95% degree of confidence. The population sample size for the study was determined using the confidence formula for sample size determination below developed by Kothari (2004).

Sample size calculation formula for defined population:

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2 (N - 1) + z^2 \cdot p \cdot q}$$

Where:

- N = Size of Population
- Z = z score level of confidence (95% confidence level = 1.96);
- P = Sample successfully collected (0.6)
- q = Failure of sample (0.40)

- e = marginal error (5%)

$$n = \frac{(1.96)^2 * 0.6 * 0.4 * 87}{(0.05)^2 (87 - 1) + (1.96)^2 * 0.6 * 0.4}$$

$$n = 70.54 = 71 \text{ respondents}$$

3.9. Questionnaire Respondent

The research then categorized the respondents after determining the sample size. The research used a quota/ratio technique to initially distribute respondents to each group. The study used probability sampling approach, namely simple random sampling technique, to choose employees who were included in this research study as questionnaire respondents from each group. The determined sample size is 71 because the study also utilized a judgmental sampling strategy to include all Supply Chain Management Department employees.

3.10. Ethical Considerations

The company, Federal Prison Commission, was asked for authorization to collect data for the study through an official letter. From the prepared information on the first part of the questionnaire, data collectors provided respondents with the essential information. Individual identities and all provided information are kept private and are only used for academic study.

3.11. Validity and Reliability

In order to have comprehensive data on the research issues, the study initially attempted to address relevant and substantial literature. This thorough technique aids in ensuring the survey instrument's face and content validity. The survey's questions were developed after a thorough examination of the literature. In order to ensure that the survey instrument (questionnaire) is accurate, impartial, and clear to a small number of respondents, a pilot test was also carried out. Before beginning data collecting, the study tool and methodology were also revised and commented upon by a professional adviser and expertise.

The Cronbach's coefficient alpha, the most widely used test of inter-item consistency reliability, was utilized in this study to determine the validity of the survey items. Because it is simpler to use than another estimate when numerous items are used to quantify a concept or construct, calculating Cronbach's alpha (α) has become a frequent practice (Willson, 2003).

According to Sekaran (2000), a Cronbach's alpha value of less than 0.6 is considered to be poor; a value of more than 0.7 is deemed acceptable; and a value of more than 0.8 is thought to be good.

Table 3.1 Rule of Thumb of Cronbach's Alpha (Source: Zikmund, *et al*, 2010.)

Cronbach's Alpha	Description
≥ 0.9	Excellent
≥ 0.8 but < 0.9	Good
≥ 0.7 but < 0.8	Acceptable
≥ 0.6 but < 0.7	Questionable
≥ 0.5 but < 0.6	Poor
< 0.5	Unacceptable

Table 3.2 below shows that the Cronbach's alpha value for each dimension of independent variables (factors affecting supply chain performance) and the dependent variable (Supply chain performance) is greater than 0.8, indicating that all items are reliable, the data has internal consistency, and the data can be accepted for further analysis. [For all details please see the Annex-Ia and Ib of this study]

Table 3.2 Reliability statistics Result (Source: Researcher, 2022.)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.841	.841	76

The scale's internal consistency is shown by the Cronbach's alpha coefficient. A high Cronbach's alpha score indicates that the scale's components "hang together" and measure the same underlying construct. Scale reliability can be evaluated reasonably using a Cronbach's alpha value above 0.7 (Gaur A. and Gaur S., 2009).

Table 3.3 Case Processing Summary Result (Source: Researcher, 2022.)

Case Processing Summary			
		N	%
Cases	Valid	71	100.0
	Excluded ^a	0	.0
	Total	71	100.0
a. List wise deletion based on all variables in the procedure.			

On the 71 – item perceived task values scale, a reliability study was done. The questionnaire achieved acceptable reliability, according to Cronbach's alpha, which was 0.841. The Total Correlation column displays the correlation between each item and the overall questionnaire score. The table's final column includes Cronbach's Alpha if Deleted. This column, as its name implies, provides the Cronbach's alpha score you would obtain if you eliminated each item from the survey. Keep in mind that our current score is =0.841. If deleting an item lowers the score, we want to maintain it. However, if this score improves after the item is removed, we might wish to keep it because doing so would increase the validity of our survey. However, all of the items' Cronbach's alpha ratings are greater than 0.7, hence it is preferable to look into the supply chain management strategy.

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Introduction

This chapter presents the discussion and interpretation of data collected through questionnaires and interview. The discussion focuses respondent profile, SCM practices, and supply chain collaboration/ integration and about the relationship of SCM practices and Company performance.

A total of 87 questionnaires were given out to targeted corporate employees, and 76 (87.36%) of them were returned; of those, 71 (81.61%) were legitimate and used for analysis. Additionally, a structured interview with questions was conducted via email and other social media with the firm's procurement and supply manager, supplier, and client/consultant sides. With the aid of the statistical program IBM SPSS (version 23), the gathered data were displayed and examined.

The level of SCM practice was evaluated using descriptive statistics by computing mean and standard deviation. In order to measure the degree of association between SCM practices, supply chain responsiveness, and the competitive advantage of the firm as well as to investigate the impact of supply chain responsiveness on the competitive advantage, correlation analysis, specifically Pearson correlation, was also used. On the basis of the research objectives, regression analysis was also employed to examine the impact of an independent variable on a dependent variable. The factor affecting the firm's SCM practice was last measured using frequency and a relative index. As a result, the following data presentation and analysis were prepared based on the responses acquired from the survey data and interviews with the respondents:

4.2. Descriptive Statistics

Using variables including strategic supplier relationships, customer relationships, and information exchange, mean and standard deviation statistical analysis was carried out to investigate the supply chain management practices of FPC infrastructure projects. Mean value is a crucial indicator of the Federal Prison Commission's (FPC) level of construction practice on each variable among these statistical analysis tools. The mean and group mean

statistical values are close to 2.00, which indicates low performance, 3.00, which suggests average/moderate performance, and 4.00 and 5.00, which, respectively, indicate higher and very high/excellent performance.

4.2.1. Demographic Profile of the Respondents

The researcher analyzed and spoke about in this section the table below provides an overview of the demographic data of the respondents that are pertinent to the study, together with calculated and described frequencies and percentages. Many of these elements have no bearing on the study's criteria and exist merely to offer background data on the respondents. The interviewees' ages, jobs, levels of education, and relevant work experience are discussed. Table 4.1 shows a summary of these variables.

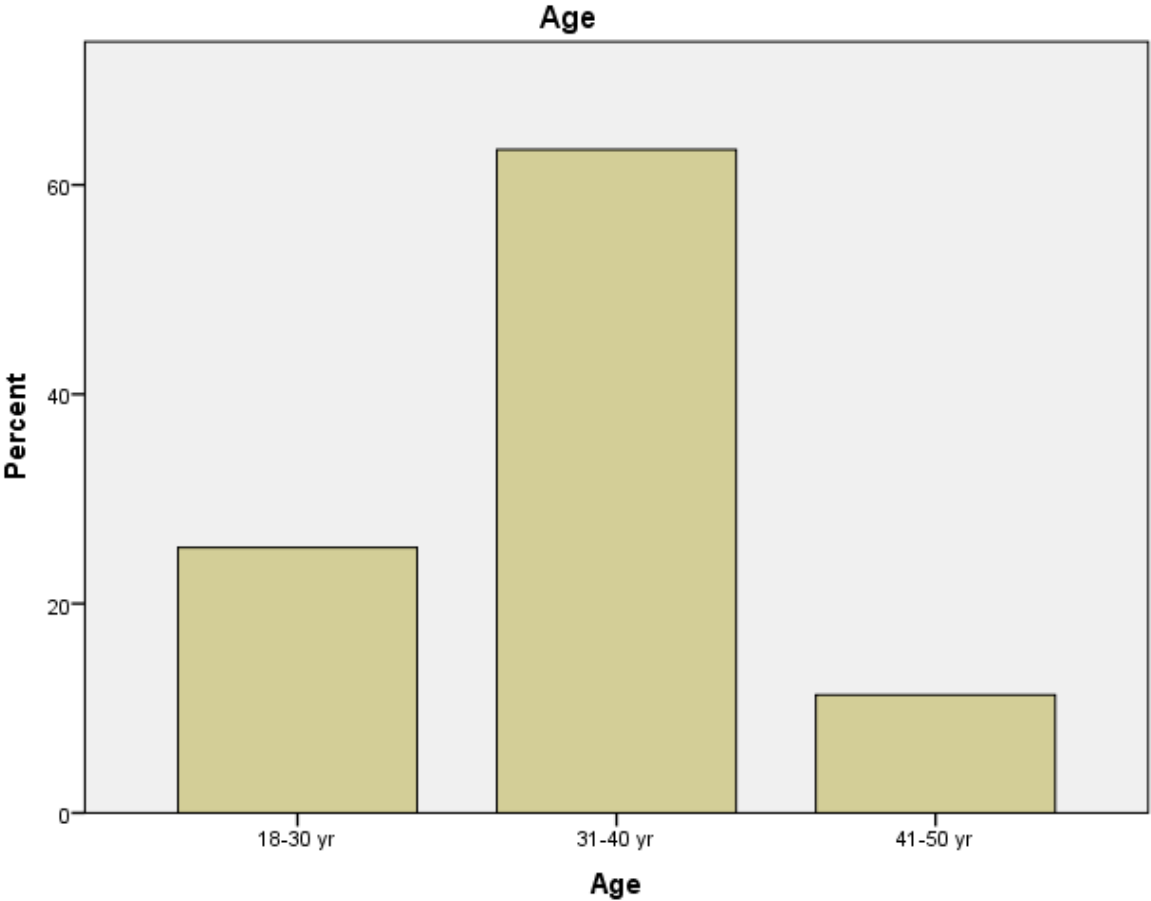


Chart 4.1: Age Frequency (source: Researcher’s Survey Result on SPSS 23, 2022)

According to the age frequencies of the 71 respondents, 25.4% of them are between the ages of 18 and 30; 63.4 % are between the ages of 31 and 40; and 11.3 % are between the ages of 41 and 50. The majority of responders (63.4%) are between the ages of 31 and 40.

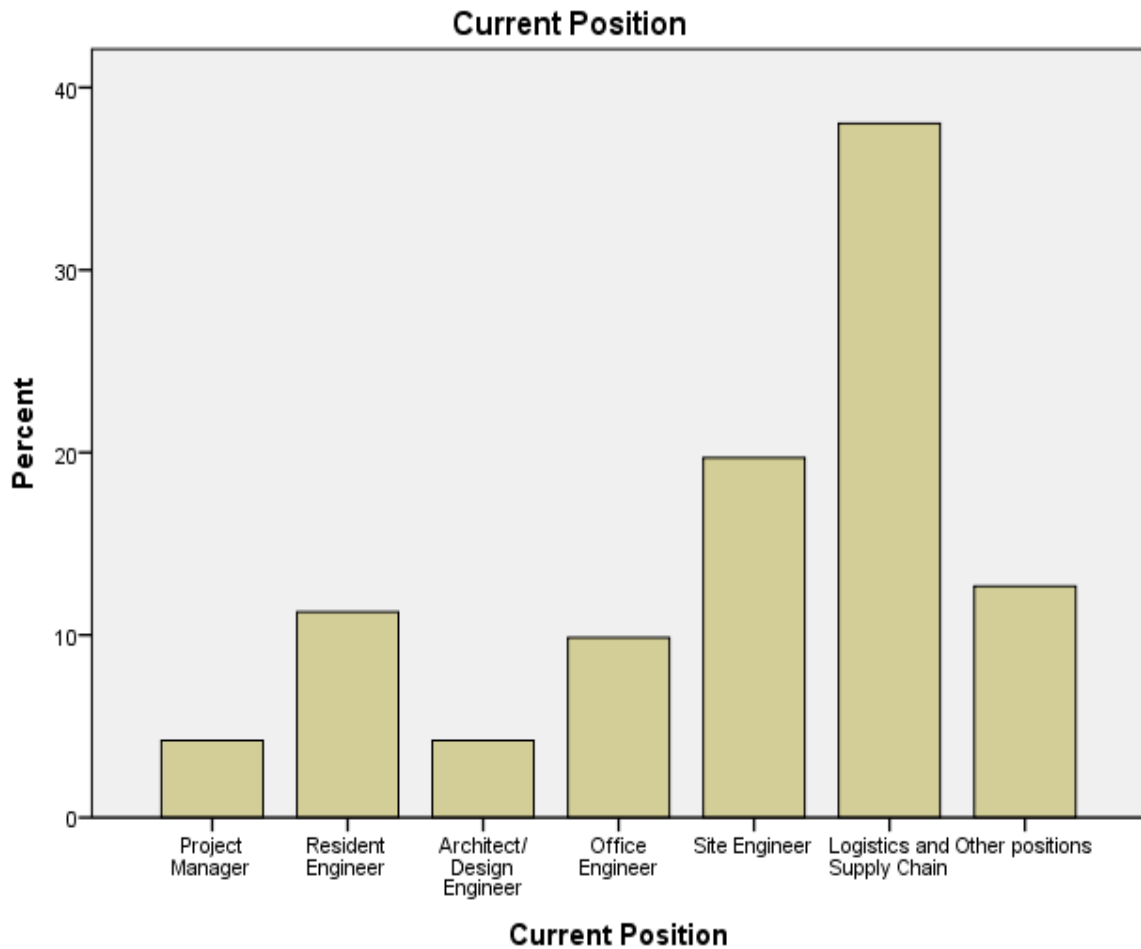


Chart 4.2: Positions of respondent (source: Researcher’s Survey Result on SPSS 23, 2022)

Project managers and design engineers responded to 4.2 percent of the questionnaires distributed, supervisors/resident engineers to 11.3 percent, office engineers to 9.9 percent, site engineers to 19.7 percent, logistics and supply chain experts to 38.0 percent, and other respondents (like directors and commissionaires) to 12.7 percent. These respondents' groupings are directly related to how supply chains are managed in building projects. So, all of the functions are represented, we may claim.

According to the respondents' level of education, 16.9% of them had a diploma or an advanced diploma, while the majority, 60.6 percent, had a first degree and 22.5 percent had a second degree or above. This demonstrates that the respondents were well-educated and able to comprehend the questions and provide a response. They were also qualified for their current jobs. See chart 4.3 below.

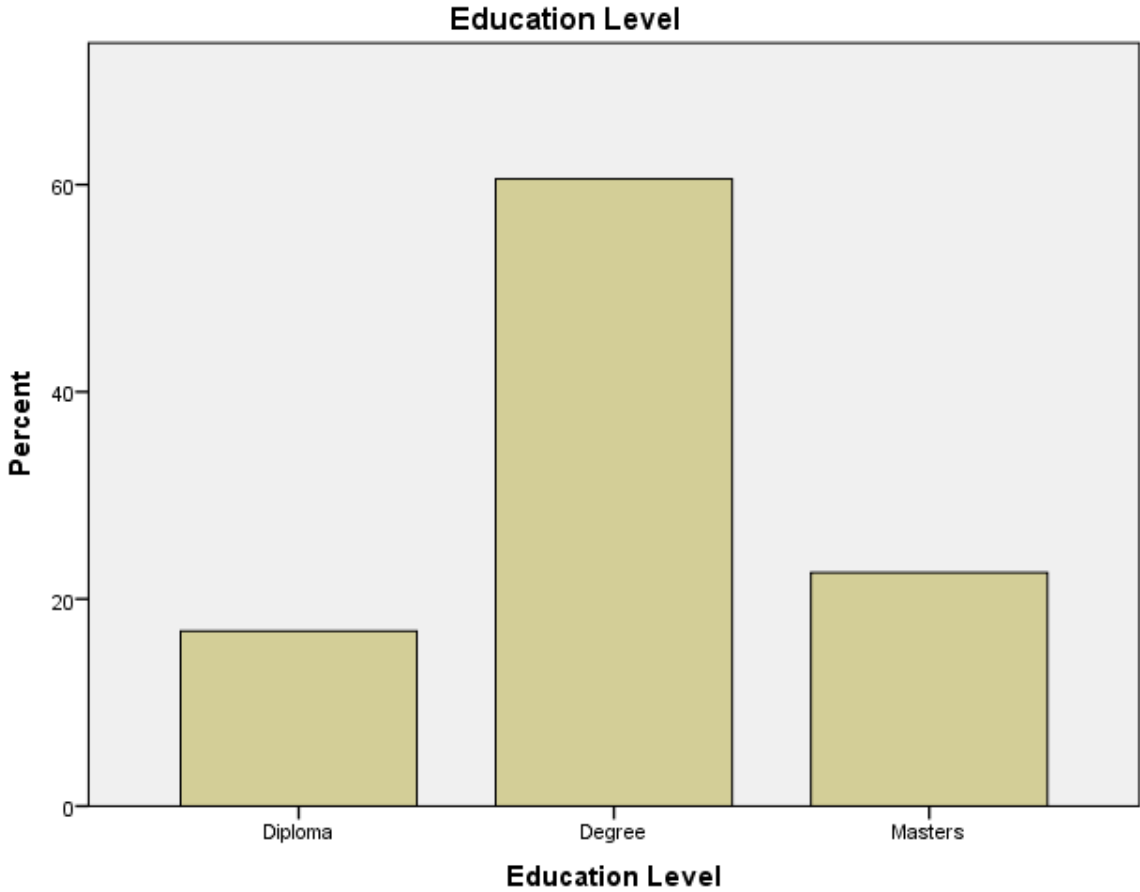


Chart 4.3: Education level of respondent (source: Researcher's Survey Result on SPSS 23, 2022)

Table 4.1: Demographic background of Respondents (source: Researcher’s Survey Result on SPSS 23, 2022)

	Variables	Frequency	Percent	Observation
Age Range	18-30yrs	18	25.4	71
	31-40yrs	45	63.4	
	41-50yrs	8	11.3	
	51-60yrs	0	0.00	
Position	Project Manager	3	4.2	71
	Resident Engineer	8	11.3	
	Architect /design engineer	3	4.2	
	Office Engineer	7	9.9	
	Site Engineer	14	19.7	
	logistics and supply chain	27	38.0	
	Other	9	12.7	
Educational level	Vocational Training	0	0.00	71
	Diploma	12	16.9	
	Degree	43	60.6	
	Masters	16	22.5	
Relevant Work Experience [in years]	1-5	0.	0.00	71
	6-10	36	50.7	
	11-15	21	29.6	
	16-20	14	19.7	
	21 above	0	0.00	

As can be seen in table 4.1 above, of the total valid respondents, 36 respondents, or 50.7 percent, have 6–10 years of work experience, 21 respondents, or 29.6 percent, have 11–15 years, and 14 respondents, or 19.7 percent, have 16–20 years.

With an average of 50.7 percent of respondents having more than six years' experience, it is clear that the data collected from them is trustworthy or dependable because they have extensive knowledge and experience regarding the supply chain concept and how it affects business performance.

4.2.2. Analysis of Supply Chain Management Practices

The level of supply chain management practice of the organization under inquiry was evaluated using descriptive statistical analysis based on the five elements of the conceptual framework created for this study. Strategic supplier relationships, customer relationships, information technology, information sharing at various levels, and information quality are the most prevalent supply chain management techniques.

According to (Frederico, Guilherme Francisco, 2015), SCM techniques include a range of actions made by organizations to support efficient supply chain management. By integrating internal processes and connecting them with the exterior operations of suppliers, consumers, and other supply chain players, SCM also leads to changes in the organizational structure.

4.2.2.1. Strategic Suppliers Relationship

According to Sadikoglu and Zehir (2010), suppliers have a more direct impact on the quality performance of a company, necessitating a strategic engagement with them. Cooperation, joint goal-setting and product planning, long-term connections, supplier performance assessment, and supplier motivation are among the most well-known traits of strategic supplier relationships that have been cited by various authors.

The mean and group mean statistical values of approaching to 2.00 and less indicates poor performance, 3.00 indicates average/moderate, while 4.00, and 5.00, indicate higher and very high/excellent performance respectively. Table 4.2 below indicates the level of relationship that exists between suppliers and the case company. Accordingly, the group means of supplier's relationship was 3.16 and it indicated average/ moderate performance level with respect to the overall measures taken into consideration. Specifically, Motivation and rewards for satisfactory suppliers, Suppliers performance measurement systems, Long-term relationship with suppliers, Key suppliers participation in planning and goal setting activities, Quality considered as number one criterion in selecting suppliers & The level of cooperativeness with suppliers indicates average/moderate performance 3.26761, 3.1831, 3.1831, 3.1690, 3.1268, & 3.0423 mean values respectively. These mean values imply that

Federal Prison Commission had moderate practice on supplier performance measurement, motivation of satisfactory suppliers and on cooperativeness with suppliers.

Table 4.2: Descriptive Statistics of Strategic Suppliers Relationship

Descriptive Statistics			
	N	Mean	Std. Deviation
Motivation and rewards for satisfactory suppliers	71	3.26761	1.330497
Suppliers performance measurement systems	71	3.1831	1.34494
Long-term relationship with suppliers	71	3.1831	1.22253
Key suppliers participation in planning and goal setting activities	71	3.1690	1.32002
Quality considered as number one criterion in selecting suppliers	71	3.1268	1.27537
The level of cooperativeness with suppliers	71	3.0423	1.26983
		Ave. mean	3.16

(Source: Researcher's Survey Result, 2022)

4.2.2.2. Customer Relationship

According to Li et al., (2006), all the practice for managing customer relationships could be source of competitive advantage. For example, managing customer complaints, building long term relationships, and improving customer satisfaction are effective methods of managing customer relationship. In addition, integration with chosen customers will build permanent uniqueness for the companies in the supply chains.

Table 4.3: Descriptive Statistics of Customer Relationship

Descriptive Statistics			
	N	Mean	Std. Deviation
Compliance with customer's delivery on time requirements	71	3.3239	1.39155
Compliance with customer's delivery in- full requirements	71	3.2958	1.19993
Regularly monitoring and evaluation of customer satisfaction	71	3.2817	1.27820
Strives and launches new products and services to the customers	71	3.2113	1.26396
Joint product planning with major customers	71	3.1549	1.45059
The level of cooperativeness with customers	71	3.1408	1.25693
		Ave. Mean	3.23

(Source: Researcher's Survey Result, 2022)

In general, as indicated in the above tables 4:3, average mean value of 3.23 showed that the company's performance with regard to customer's relationship was moderate/average level. On the item of Compliance with customer's delivery on time requirements, it had mean value of 3.32 and this was high level performance as compared to the other. And also Compliance with customer's delivery in- full requirements, Regularly monitoring and evaluation of customer satisfaction, Strives and launches new products and services to the customers, Joint product planning with major customers, and The level of cooperativeness with customers had mean values of 3.2958, 3.2817, 3.2113, 3.1549 and 3.1408, respectively. This result indicated about of average/moderate of the company related to addressing customer's desires of full requirements and time compliance.

4.2.2.3. Level of Information Sharing

In the supply chain, information flow is the component that allows the various actors to organize their activities, according to Alireza et al. (2011). Fundamentally, the foundation of every successful connection is information and trust. Additionally, information exchange can effectively provide integration and coordination across the supply chain.

Based on the seven factors indicated in Table 4.4 below, this study attempted to explore the practices of information sharing among the case company's supply chain participants with its upstream and downstream supply chain partners.

Table 4.4: Descriptive Statistics of Level of Information Sharing

Descriptive Statistics			
	N	Mean	Std. Deviation
Adequacy and quality of information sharing throughout the supply chain partners	71	3.3521	1.40508
Material required related Information sharing with suppliers	71	3.1972	1.45032
Material supply forecast Information sharing with Project sites	71	3.1549	1.48947
Material supply forecast Information sharing with suppliers	71	3.1127	1.31529
Overall efforts of Inter-organizational information coordination and sharing	71	3.0986	1.50385
Sense of trust, problem sharing & solving mechanism and skills transfer with partners	71	3.0704	1.37658
Material requirement related Information sharing by project sites	71	2.9859	1.48798
Ave. Mean		3.14	

On the other hand, Adequacy and quality of information sharing throughout the supply chain partners, Material required related Information sharing with suppliers, Material supply forecast Information sharing with Project sites, Material supply forecast Information sharing with suppliers, Overall efforts of Inter-organizational information coordination and sharing, Sense of trust, problem sharing & solving mechanism and skills transfer with partners had mean value 3.3521, 3.1972, 3.1549, 3.1127, 3.0986 and 3.0704 respectively. Whereas Material requirement related Information sharing by project sites has mean values of 2.9859 and which approach to average level of performance. Information sharing with company's project sites and inter organizational information coordination practice though approach to moderate level, it was below expected level and affect company's compliance for full requirement of product and time. In general, the above individual means value and group mean value of 3.14 revealed that the company's information sharing practice within SC members had moderate performance.

4.2.2.4. Level of Information Quality

The correctness, timeliness, sufficiency, and credibility of the information exchanged are all examples of factors that contribute to the quality of information sharing in the context of supply chain management. The goal of supply chain management is to gather real-time information fast, reduce costs, raise service levels, enhance communication between supply chain components, and boost responsiveness and delivery flexibility. According to the empirical study by Lazarevic et al. (2007), the degree and caliber of information sharing among SC partners considerably differentiates efficiency in satisfying client requirements.

Many literature shows that, level of information quality can be explained in terms of timeliness, accuracy, completeness, adequacy and reliability of information sharing among SC members. As indicated in table 4.5 below, Adequacy of Information exchange between supply chain partners had lowest mean value of 2.9155.

Table 4.5: Descriptive Statistics of Level of Information Quality

Descriptive Statistics			
	N	Mean	Std. Deviation
Timely Information exchange between supply chain partners	71	3.2254	1.32231
Completeness of Information exchange between supply chain partners	71	3.1831	1.51478
Reliability of Information exchange between supply chain partners	71	3.0704	1.41748
Accuracy of Information exchange between supply chain partners	71	3.0141	1.47835
Adequacy of Information exchange between supply chain partners	71	2.9155	1.58336
Ave. mean		3.08	

(Source: Researcher’s Survey Result, 2022)

On the other hand, Timely Information exchange between supply chain partners, Completeness of Information exchange between supply chain partners, Reliability of Information exchange between supply chain partners, and Accuracy of Information exchange between supply chain partners had mean values 3.2254, 3.1831, 3.0704 and 3.0141. In general, both customers agree during the interview on poor application of information technology in construction industry as compared with other industry affect information quality and integration between SC members in general.

4.2.2.5. Information Technology

The use of information technology is a major indicator of SCM best practice, particularly if employed to connect customers, suppliers and value adding services. According to Chopra and Meindl (2007), “Information is potentially the biggest driver of performance in the supply chain because it directly affects ... the other drivers”.

Table 4.6: Descriptive Statistics of Information Technology

Descriptive Statistics			
	N	Mean	Std. Deviation
Up-to-datedness of IT technologies throughout the supply chain	71	3.1549	1.45059
Level of IT-based automated ordering from major customers	71	3.0563	1.45295
Adequacy of IT systems throughout the supply chain	71	3.0141	1.53523
Level of IT-based automated ordering to major suppliers	71	3.0141	1.43918
Use of online system to achieve operating efficiency within and across supply chain members	71	2.9577	1.44851
Ave. Mean		3.04	

(Source: Researcher’s Survey Result, 2022)

As table 4.6 above revealed that, five items were used to measure IT application of the case company, Up-to-datedness of IT technologies throughout the supply chain, Level of IT-based automated ordering from major customers, Adequacy of IT systems throughout the supply chain, and Level of IT-based automated ordering to major suppliers had mean values 3.1549, 3.0563, 3.0141, and 3.0141 respectively in descending order. But Use of online system to achieve operating efficiency within and across supply chain members has lowest mean value 2.9577. In general, the groups mean value was 3.04 and this indicates about the practice of average IT application within and across the Federal Prison Commission supply chain members.

4.2.2.6. Supply Chain Collaboration / Integration

As companies migrate toward more extended supply chains, collaboration is becoming their most strategic activity. Collaboration may be with customers, suppliers and even with in organization’s functional units. Some of the features which many participants anticipate when entering in to collaboration are: joint planning, management and measurement, sharing goals, objectives, resources, information, risks and benefits with partners (Sunil, 2004).

When the level of collaboration is becoming more and more strong it leads to integrated and efficient SCM. Based on this, the researcher has tried to see the extent of integration of the case company with suppliers, customers and cross functional units within the company.

Table 4.7: Descriptive Statics of Company Integration with Suppliers

Descriptive Statistics			
	N	Mean	Std. Deviation
Availability of stable procurement through network	71	3.2254	1.41620
Frequency of contacts with major customers	71	3.1972	1.46989
Teamwork and intra-organizational coordination	71	3.1268	1.49217
Monitoring and measuring customer service level	71	3.0845	1.46137
Data integration among internal functions through network	71	3.0704	1.54295
Information system integration among internal functional units	71	3.0704	1.60645
The establishment of quick ordering system	71	3.0563	1.52959
Periodic inter-departmental meetings	71	3.0423	1.39833
The level of strategic partnership with suppliers	71	3.0282	1.53038
The level of market information sharing with major customers	71	2.9859	1.58108
Extent of interaction between main office supply and project warehouse	71	2.9718	1.44392
Follow-up customers for feedback	71	2.7606	1.37804
Ave. mean		3.05	

(Source: Researcher’s Survey Result, 2022)

As illustrated in table 4.7 above, there are twelve items used to determine the extent of integration of the case company with its suppliers. Accordingly, Availability of stable procurement through network, Frequency of contacts with major customers, Teamwork and intra-organizational coordination, Monitoring and measuring customer service level Data integration among internal functions through network Information system integration among internal functional units, The establishment of quick ordering system, Periodic inter-departmental meetings, The level of strategic partnership with suppliers, The level of market information sharing with major customers, Extent of interaction between main office supply and project warehouse, & Follow-up customers for feedback had mean value of 3.2254, 3.1972, 3.1268, 3.0845, 3.0704,3.0704,3.0563,3.0423,3.0282,2.9859,2.9718 , and 2.7606 respectively.

4.3. Inferential Statistics for SCM Practices

4.3.1. Correlation Analysis

Correlations are the measure of the linear relationship between two variables. A correlation coefficient has a value ranging from -1 to 1. Values that are closer to the absolute value of 1 indicate that there is a strong positive relationship, closer to -1 strong negative correlation between the variables being correlated whereas values closer to 0 indicates that there is little or no linear relationship.

As described by Andy (2006), the correlation is a commonly used measure of the size of an effect: values of ± 0.1 represent a small effect, ± 0.3 is a medium effect and ± 0.5 is a large effect.

Table 4.8: Correlation matrix between constructs of SCM practices and Strategic supplier partnership (N=71)

Correlations							
		The level of cooperativeness with suppliers	Quality considered as number one criterion in selecting suppliers	Long-term relationship with suppliers	Suppliers performance measurement systems	Motivation and rewards for satisfactory suppliers	Key suppliers participation in planning and goal setting activities
The level of cooperativeness with suppliers	Pearson Correlation	1	.129	.023	.305**	.103	-.073
	Sig. (2-tailed)		.284	.852	.010	.392	.548
	N	71	71	71	71	71	71
Quality considered as number one criterion in selecting suppliers	Pearson Correlation	.129	1	.186	-.139	.106	-.072
	Sig. (2-tailed)	.284		.119	.249	.379	.549
	N	71	71	71	71	71	71
Long-term relationship with suppliers	Pearson Correlation	.023	.186	1	.066	-.039	.034
	Sig. (2-tailed)	.852	.119		.583	.745	.780
	N	71	71	71	71	71	71
Suppliers performance measurement systems	Pearson Correlation	.305**	-.139	.066	1	.012	.087
	Sig. (2-t)	.010	.249	.583		.920	.471
	N	71	71	71	71	71	71
Motivation and rewards for satisfactory suppliers	Pearson Correlation	.103	.106	-.039	.012	1	.177
	Sig. (2-t)	.392	.379	.745	.920		.139
	N	71	71	71	71	71	71
Key suppliers participation in planning and goal setting activities	Pearson Correlation	-.073	-.072	.034	.087	.177	1
	Sig. (2-t)	.548	.549	.780	.471	.139	
	N	71	71	71	71	71	71

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

The correlation between each constructs of SCM practices with operational performance was seen in the above table. Thus, the result of correlation matrix between each constructs and operational performance were analyzed as follow:

As it is indicated in the table above, there was significant positive correlation between the level of cooperativeness with suppliers and Suppliers performance measurement systems by Pearson correlation of 0.305 ($r=0.305$) at the significant level 0.010. Therefore, the level of cooperativeness with suppliers and Suppliers performance measurement systems were positively correlated and had strong correlation between them. Similarly, there was positive relationship between customer relation (CR) and operational performance with a Pearson correlation coefficient of .129 ($r=0.129$).

Table 4.9: Correlation matrix between constructs of SCM practices and Strategic supplier partnership (N=71)

Correlations							
		Strives and launches new products and services to the customers	Regularly monitoring and evaluation of customer satisfaction	Compliance with customer's delivery in-full requirements	Compliance with customer's delivery on time requirements	Joint product planning with major customers	The level of cooperativeness with customers
Strives and launches new products and services to the customers	Pearson Correlation	1	-.090	-.032	.164	.512	.179
	Sig. (2-tailed)		.453	.789	.173	.000	.136
	N	71	71	71	71	71	71
Regularly monitoring and evaluation of customer satisfaction	Pearson Correlation	-.090	1	-.055	-.213	.030	-.212
	Sig. (2-tailed)	.453		.648	.075	.803	.076
	Pearson Correlation	-.032	-.055	1	-.161	.014	.285
Compliance with customer's delivery	Sig. (2-tailed)	.789	.648		.180	.906	.016

in-requirements full	N	71	71	71	71	71	71
	Pearson Correlation	.164	-.213	-.161	1	.201	.235
Compliance with customer's delivery on time requirements	Sig. (2-tailed)	.173	.075	.180		.092	.049
	N	71	71	71	71	71	71
	Pearson Correlation	.512	.030	.014	.201	1	.215
Joint product planning with major customers	Sig. (2-tailed)	.000	.803	.906	.092		.072
	N	71	71	71	71	71	71
	Pearson Correlation	.179	-.212	.285	.235	.215	1
The level of cooperativeness with customers	Sig. (2-tailed)	.136	.076	.016	.049	.072	
	N	71	71	71	71	71	71

As it is indicated in the table above, there was significant positive correlation between Joint product planning with major customers and Strives and launches new products and services to the customers by Pearson correlation of 0.512 ($r=0.512$) at the significant level 0.000. Therefore, the level of cooperativeness with suppliers and Suppliers performance measurement systems were positively correlated and had strong correlation between them. Similarly, there was positive relationship between customer relation (CR) and operational performance with a Pearson correlation coefficient of .285($r=0.285$). See annex of this study.

Table 4.10: Descriptive Statistics of Supply Chain Management in case company

Descriptive Statistics			
	N	Mean	Std. Deviation
Lack of attention paid to standard sizes available on the market	71	3.3239	1.34986
Increasing quality	71	3.2958	1.40808
Incorrect collaboration with supplier increase the production cost	71	3.2113	1.44336
Inaccurate data from project site	71	3.2113	1.45323
Checking materials supplied quantities and volumes	71	3.1972	1.51770
Difficult client relationship cause not to compete based on quality.	71	3.1972	1.36925
Access to latest information about types of materials on the market	71	3.1408	1.45696
Decreasing price and cost lost	71	3.1408	1.53340
Good coordination between store and construction personnel to avoid over	71	3.1268	1.43357
Design change	71	3.1268	1.49217
Late and incorrect payment to suppliers	71	3.1127	1.52643
Increasing market system	71	3.1127	1.43974
Enhancing delivery dependability	71	3.1127	1.43974
Extended time wait for architects/consultant approval	71	3.0986	1.54138
Incorrect packing and large shipment	71	3.0986	1.36439
Incorrect deal with the supplier affect our prices during construction	71	3.0986	1.42583
Improper supplier selection cause offering a low durable products to our client	71	3.0845	1.51890
Designer's unfamiliarity with alternative products	71	3.0423	1.39833
incorrect price during bidding process	71	3.0423	1.56238
Deliveries not in conformance with planning	71	3.0141	1.43918
Incorrect document	71	3.0141	1.46865
Lack of information sharing cause not to deliver customer order on time	71	3.0141	1.47835
Wrong and defective deliveries, Long storage period	71	3.0141	1.35744
Lack of good suppliers partnership cause difficult to provide dependable/faithful delivery	71	3.0000	1.57661
Accurate and good specifications of materials to avoid wrong ordering	71	2.9718	1.45378
Late payment from client	71	2.9718	1.44392
Incorrect information sharing cause not to deliver the kind of products needed to the site	71	2.9718	1.58540
ordering	71	2.9577	1.37775
Purchasing raw materials that are just sufficient	71	2.9577	1.51598
Incorrect price based supplier selection affect our prices offer to the client during tendering process.	71	2.9577	1.48744
Delays in passing of information to the contractor on types and sizes of products to be used	71	2.9577	1.54399
Unresolved quality problem	71	2.9155	1.42173
Improper supplier selection cause low quality products to the client.	71	2.8873	1.40965
In accurate data & information needed for site	71	2.7887	1.40322
Difficult for substitute product	71	2.7324	1.39343
Average Mean		3.054	

In general, SCM practices the above individual means value and group means value of 3.054 revealed that the company's SCM had moderate performance. On the other hand, in accurate data & information needed for site and difficulty for substitute product had a least mean value of 2.7887 and 2.7324, respectively. Whereas Lack of attention paid to standard sizes available on the market, Increasing quality, Incorrect collaboration with supplier increase the production cost, Inaccurate data from project site, Checking materials supplied quantities and volumes were top five ranked mean value as per the case company with mean value of 3.3239, 3.2958, 3.2113, 3.2113, and 3.1972 respectively.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

This study focuses on the SCM practice and its impact on firm performance assessment that is defined in terms of supply chain responsiveness and the business's competitive advantage, in an effort to fill in the gaps of the prior study based on the setting of the Ethiopian construction sector (operational performance). By gathering information from the fundamental participants in construction firms—client side, contractor side, consultant side, and supplier side—the study focuses on Ethiopia Federal Prison Commission Infrastructure construction SCM practice and how this affects at SCM responsiveness on their operational performance. The Federal Prison Commission's infrastructure projects in Shewa Robit, Ziway, Dire Dawa, New Addis Ababa Prison Facilities (Hospital), and Akaki Kality Prison House are affected by a number of factors, including those that are difficult to identify for the construction industry's SCM practices. As a result, this research try to identified the major factors that have an impact on those practices

5.2. CONCLUSIONS

The study's objectives were to evaluate the Federal Prison Commission's Infrastructure Projects, supply chain management practices, the degree of cooperation or integration among SC partners, and to empirically investigate the link between SCM practice constructs and business operational and organizational performance. The practice of supply chain management was examined in the study in terms of strategic supplier relationships, customer relationships, the degree of information exchange, the degree of information quality, and the usage of information technology.

This study has given empirical support for a framework that identifies five constructs of supply chain performance (i.e., strategic supplier partnerships, customer relationships, level of information sharing, level of information quality, information technology, and supply chain collaborations) and describes the relationship between these constructs and supply chain performance within the context of building in FPC infrastructure Projects. The study concludes that there is a connection between supply chain factors (independent variables)

and supply chain performance (dependent variable); the correlation relationship reveals a high and positive association with all supply network factors. The independent variables studied significantly and positively affect the supply chain performance of FPC infrastructure Projects. If the company invests in improving these factors, it can increase overall supply chain performance.

5.3. RECOMMENDATION

The following recommendations are made by the study to enhance FPC's supply chain performance in light of the study's findings:

In order to enhance both the performance of the organization as a whole and the performance of its supply chain in particular, the corporation, Federal Prison Commission, must concentrate on the six supply chain variables. Based on the result, priorities should be given **Customer Relationship** (average mean value of 3.23), **Strategic Supplier Partnership** (Accordingly, the group means of supplier's relationship was 3.16 and it indicated average/ moderate performance level with respect to the overall measures taken into consideration), **Level of Information Sharing** (group mean value of 3.14 revealed that the company's information sharing practice within SC members had moderate performance), **Level of Information Quality** (average mean value of 3.08), **Supply Chain Collaborations** (average mean value 3.05) and **Information Technology** (the groups mean value was 3.04 and this indicates about the practice of average IT application within and across the Federal Prison Commission supply chain members) in descending order.

Strategic supplier relationships and customer relationships are the two main areas that companies should give importance to in order to improve supply chain management practices, according to a number of academic studies. Instead of the conventional buy-sale relationship with suppliers and customers, this calls for a shift in mindset toward strategic thinking and the acquisition of knowledge in such a field.

The business should choose potential suppliers who are open to a long-term partnership and cooperation in order to strengthen its strategic relationship with them. They also need to regularly communicate information with vendors and measure performance, rewarding

excellent efforts. In addition, while obtaining materials from suppliers, quality should take precedence over a low-cost strategy.

Another crucial factor in improving the efficacy and efficiency of the decision-making process and the relationships between suppliers and customers among supply chain participants was the information exchange and its quality. The results of the research showed that there were greater gaps in the information's sufficiency, timeliness, dependability, and completeness as well as in the development of trust and problem-sharing or shared risk-taking behavior.

The instance company's existing information technology practices are poor, which has an impact on internal communication and data integration. Additionally, these subpar IT applications have a significant impact on the degree of integration between functional units as well as with suppliers and clients. The case company must, as a result, increase its investment in IT infrastructure and enhance the expertise of its current IT specialists and other key personnel in the SCM process.

In general, SCM practices group means value of 3.054 revealed that the company's SCM had average/moderate performance due this management and other stakeholders must place adequate attention on SCM methods in a contemporary manner in order to boost operational and organizational performance.

5.4. IMPLICATION FOR FUTURE RESEARCH

The idea of supply chain management (SCM) is complicated and entails a network of businesses working together, planning jointly, cooperating, and engaging in strategic thinking and mind-shifting for the mutual benefit of supply chain members as opposed to focusing on each one individually as is the conventional approach. SCM's roots are in the manufacturing sector, hence there is a dearth of research and empirical data for the construction sector in general and the Ethiopian construction sector in particular. As a result, the majority of SCM practice variables and measurements that were taken from industrial literature have limitations when used to assess and gauge SCM practices in the construction sector. The fragmentation of the many actors, including suppliers, customers, contractors, consultants, and other actors, is also a difficulty for the industries to successfully implement SCM. This is supported by a lot of literature. Additionally, there are restrictions on the appropriate IT applications that may be used for the construction industry generally, and more critically, a significant problem for the cases of the Ethiopian construction industry.

A few of these circumstances, together with other issues, call for greater research on SCM practice in the construction industry generally, with an emphasis on Ethiopian construction. Future studies can expand the scope of SCM practice by taking into account additional factors like logistical integration and consensus supply chain leadership, which were not taken into account in this study. Although this study attempted to examine the association between the six SCM practice aspects and operational and organizational performance, future research must take into account other significant dimensions that can impact performance.

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APPENDIX A: - SURVEY QUESTIONNAIRES
ADDIS COLLEGE
DEPARTMENT OF PROJECT MANAGEMENT
QUESTIONNAIRE

Dear participant, my name is Mismak Yosef and I am a student undertaking a Degree of Master of Science in project Management at Addis College. To fulfill the completion of this course, I am carrying out a study on the Supply Chain Management in the construction industry; Case study on Infrastructures projects in Ethiopia Federal Prison Commission. I am inviting you to participate in this research study by completing the attached questionnaire. If you choose to participate in this research, please answer all questions as honestly as possible.

I solemnly assure you that the information you provide in this questionnaire will remain confidential, you do not have to include your name. Appreciating your kindness to participate in this survey, I kindly ask you to fill the attached questionnaire completely and responsibly. The responses provided will be confidential and is only for research purpose except as a component of aggregated statistics.

If you have any question, please don't hesitate to ask:

Mismak Yosef

Cell Phone: +251-946348033/-911186218,

E-mail:- miyo.arc07@gmail.com

Thanks in advance for your cooperation

Part I- Demographic profile of respondents

Direction: Please answer the following general questions by filling the blanks and marking

“√” on the spaces provided as appropriate.

1. Gender: Male [] Female []
2. Age: 18-30yrs [] 31-40yrs [] 41-50yrs [] 51-60yrs [] Over 61yrs []
3. Level of education: Secondary [] Vocational Training [] Diploma []
Degree [] Masters [] PhD []
4. Years of service at the organization: (In Years)
1-5 [] 6-10 [] 11-15 [] 16-20 [] 21 above []
5. What is your title/position?
(1) Project Manager [] (4) Office Engineer []
(2) Resident Engineer [] (5) Site Engineer []
(3) Architect /design engineer [] (6) logistics and supply chain []
(Other)_____

Part II: Instruments for supply chain management practices, operational performance and organizational performance

Section One: Supply Chain Management Practices

With regard to SCM practices of your firm use the following Rating Scales under the columns and please tick (√) only one box from the given box after reading the variable.

1= Very Low, 2= Low, 3= Average, 4= High, 5= Very High

A	Strategic supplier partnership:	Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
1	The level of cooperativeness with suppliers					
2	Quality considered as number one criterion in selecting suppliers					
3	Long-term relationship with suppliers					
4	Suppliers performance measurement systems					
5	Motivation and rewards for satisfactory suppliers					
6	Key suppliers participation in planning and goal setting activities					

B	Customer Relationship:	Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
1	Strives and launches new products and services to the customers					
2	Regularly monitoring and evaluation of customer satisfaction					
3	Compliance with customer's delivery in- full requirements					
4	Compliance with customer's delivery on time requirements					
5	Joint product planning with major customers					
6	The level of cooperativeness with customers					
7	Long-term relationship with Customers					

C	Level of Information Sharing	Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
1	Adequacy and quality of information sharing throughout the supply chain partners					
2	Sense of trust, problem sharing & solving mechanism and skills transfer with partners					
3	Overall efforts of Inter-organizational information coordination and sharing					
4	Material requirement related Information sharing by project sites					
5	Material required related Information sharing with suppliers					
6	Material supply forecast Information sharing with suppliers					
7	Material supply forecast Information sharing with Project sites					

D	Level of Information Quality	Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
1	Accuracy of Information exchange between supply chain partners					
2	Timely Information exchange between supply chain partners					
3	Completeness of Information exchange between supply chain partners					
4	Reliability of Information exchange between supply chain partners					
5	Adequacy of Information exchange between supply chain partners					

E	Information Technology	Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
1	Use of online system to achieve operating efficiency within and across supply chain members					
2	Adequacy of IT systems throughout the supply chain					
3	Up-to-datedness of IT technologies throughout the supply chain					
4	Level of IT-based automated ordering to major suppliers					
5	Level of IT-based automated ordering from major customers					

F	Supply Chain Collaboration	Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
	Company's integration with suppliers					
1	The level of strategic partnership with suppliers					
2	The establishment of quick ordering system					
3	Availability of stable procurement through network					
	Company's Integration with Customers					
1	Follow-up customers for feedback					
2	Monitoring and measuring customer service level					
3	The level of market information sharing with major customers					
4	Frequency of contacts with major customers					
	Cross functional integration within a company					
1	Data integration among internal functions through network					
2	Information system integration among internal functional units					
3	Teamwork and intra-organizational coordination					
4	Extent of interaction between main office supply and project warehouse					
5	Periodic inter-departmental meetings					

Section Two: Effects of supply chain practice on competitive advantage of the firm (operational performance)

Below are list of Competitive advantage of the firm (operational performance). From your experience, please express your opinion by connecting the effects of SCM practices on the Competitive advantage of the firm (operational performance) in terms of price/cost, quality and delivery dependability. With regard to operational performance of your firm, use the following Rating Scales under the columns and please, tick (√) only one box from the given box after reading the variable.

1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

Measures of dependent Variables		Rating Scale				
A. Price/Cost		Strongly Disagree(1)	Disagree(2)	Neutral(3)	Agree(4)	Strongly Agree(5)
1	Incorrect price based supplier selection affect our prices offer to the client during tendering process.					
2	Incorrect collaboration with supplier increase the production cost to run the operation.					

3	Incorrect deal with the supplier affect our prices during construction					
B. Quality: an organization is capable of offering product quality and performance that creates higher value for customers.						
1	Difficult client relationship cause not to compete based on quality.					
2	Improper supplier selection cause low quality products to the client.					
3	Improper supplier selection cause offering a low durable products to our client					
C. Delivery dependability: an organization is capable of providing on time the type and volume of product required by customer(s).						
1	Incorrect information sharing cause not to deliver the kind of products needed to the site					
2	Lack of information sharing cause not to deliver customer order on time					
3	Lack of good suppliers partnership cause difficult to provide dependable/faithful delivery					

Section Three: Effects of supply chain responsiveness on competitive advantage of the firm.

The effect of supply chain responsiveness in term of operation system responsiveness, logistic process responsiveness, supplier network responsiveness on competitive advantage of the firm.

With regard to operational performance of your firm, use the following Rating Scales under the columns and please, tick (√) only one box from the given box after reading the variable.

1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

Measures of dependent Variables		Rating Scale				
A	Supply chain responsiveness of Federal Prison Commission of infrastructure projects have effect on the firm competitive advantage in terms of:	Strongly Disagree(1)	Disagree(2)	Neutral(3)	Agree(4)	Strongly Agree(5)
1	Decreasing price and cost lost					
2	Increasing quality					
3	Enhancing delivery dependability					
4	Increasing market system					

Section Four: The factor affecting the SCM practice of Federal Prison Commission.

Below are list of the factor affect the affect SCM practices. From your experience, please express your opinion by on how much those factor affect SCM practices in Federal Prison Commission Infrastructure Projects. With regard to operational performance of your firm, use the following Rating Scales under the columns and please, tick (√) only one box from the given box after reading the variable.

1= Very Low, 2= Low, 3= Average, 4= High, 5= Very High

Major factors		Very Low (1)	Low (2)	Average (3)	High (4)	Very High (5)
Client side						
1	Design change					
2	Late payment from client					
3	Designer’s unfamiliarity with alternative products					
4	Difficult for substitute product					
5	Incorrect document					
6	Delays in passing of information to the contractor on types and sizes of products to be used					
Contractor side						
7	Late and incorrect payment to suppliers					
8	Inaccurate data from project site					
9	incorrect price during bidding process					
10	Extended time wait for architects/consultant approval					
11	Checking materials supplied quantities and volumes					
12	Wrong and defective deliveries, Long storage period					
13	Incorrect packing and large shipment					
14	In accurate data & information needed for site					
15	Purchasing raw materials that are just sufficient					
16	Good coordination between store and construction personnel to avoid over ordering					
17	Accurate and good specifications of materials to avoid wrong ordering					
18	Checking materials supplied quantities and volumes					
Supplier side						
19	Deliveries not in conformance with planning					
20	Unresolved quality problem					
21	Access to latest information about types of materials on the market					
22	Lack of attention paid to standard sizes available on the market					

**Part III: Open ended questions on Supply Chain Practice
For Federal Prison Commission (FPC) Infrastructure Construction Customers
/client/consultants**

How do you see FPC company relationship management with their major suppliers in terms of quality, cost and durability of the material?

How do you see information sharing practice between your company and FPC? (With trust, risk and gain sharing practice, timely, accurate, reliable & adequate information sharing).

Does FPC can introduce new design or system on supply chain management and equipment than competitor?

Do you have any further comment, suggestion or contribution relative to Supply Chain Management in the construction industry?

----- *Thanks a lot for your valuable time*-----

Annex-Ia

Annex Table 1- Cronbach's Alpha

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
The level of cooperativeness with suppliers	231.43662	902.107	.286	.	.838
Quality considered as number one criterion in selecting suppliers	231.35211	905.917	.234	.	.839
Long-term relationship with suppliers	231.29577	919.926	.055	.	.842
Suppliers performance measurement systems	231.29577	929.554	-.071	.	.844
Motivation and rewards for satisfactory suppliers	231.21127	903.826	.249	.	.839
Key suppliers participation in planning and goal setting activities	231.30986	911.760	.151	.	.840
Strives and launches new products and services to the customers	231.26761	898.056	.341	.	.838
Regularly monitoring and evaluation of customer satisfaction	231.19718	917.589	.081	.	.841
Compliance with customer's delivery in- full requirements	231.18310	915.209	.122	.	.841
Compliance with customer's delivery on time requirements	231.15493	910.819	.152	.	.841
Joint product planning with major customers	231.32394	898.108	.291	.	.838
The level of cooperativeness with customers	231.33803	903.513	.270	.	.839
Adequacy and quality of information sharing throughout the supply chain partners	231.12676	921.969	.018	.	.843
Sense of trust, problem sharing & solving mechanism and skills transfer with partners	231.40845	914.159	.114	.	.841
Overall efforts of Inter-organizational information coordination and sharing	231.38028	889.268	.379	.	.837
Material requirement related Information sharing by project sites	231.49296	913.654	.107	.	.841
Material required related Information sharing with suppliers	231.28169	921.062	.027	.	.843
Material supply forecast Information sharing with suppliers	231.36620	913.693	.127	.	.841
Material supply forecast Information sharing with Project sites	231.32394	890.194	.372	.	.837
Accuracy of Information exchange between supply chain partners	231.46479	932.024	-.096	.	.845
Timely Information exchange between supply chain partners	231.25352	912.421	.142	.	.841
Completeness of Information exchange between supply chain partners	231.29577	930.154	-.075	.	.845

Reliability of Information exchange between supply chain partners	231.40845	900.845	.266	.	.839
Adequacy of Information exchange between supply chain partners	231.56338	894.249	.304	.	.838
Use of online system to achieve operating efficiency within and across supply chain members	231.52113	914.796	.098	.	.841
Adequacy of IT systems throughout the supply chain	231.46479	915.938	.078	.	.842
Up-to-datedness of IT technologies throughout the supply chain	231.32394	903.194	.232	.	.839
Level of IT-based automated ordering to major suppliers	231.46479	909.252	.163	.	.840
Level of IT-based automated ordering from major customers	231.42254	916.105	.083	.	.842
The level of strategic partnership with suppliers	231.45070	923.251	-.001	.	.843
The establishment of quick ordering system	231.42254	897.619	.279	.	.838
Availability of stable procurement through network	231.25352	907.363	.189	.	.840
Data integration among internal functions through network	231.40845	888.588	.376	.	.837
Information system integration among internal functional units	231.40845	901.016	.227	.	.839
Teamwork and intra-organizational coordination	231.35211	906.660	.185	.	.840
Extent of interaction between main office supply and project warehouse	231.50704	894.111	.339	.	.837
Periodic inter-departmental meetings	231.43662	881.821	.503	.	.835
Follow-up customers for feedback	231.71831	909.062	.175	.	.840
Monitoring and measuring customer service level	231.39437	896.842	.303	.	.838
The level of market information sharing with major customers	231.49296	900.082	.242	.	.839
Frequency of contacts with major customers	231.28169	892.977	.346	.	.837
Incorrect price based supplier selection affect our prices offer to the client during tendering process.	231.52113	907.825	.173	.	.840
Incorrect collaboration with supplier increase the production cost to run the operation.	231.26761	896.427	.312	.	.838
Incorrect deal with the supplier affect our prices during construction	231.38028	902.096	.250	.	.839
Difficult client relationship cause not to compete based on quality.	231.28169	904.005	.238	.	.839
Improper supplier selection cause low quality products to the client.	231.59155	899.874	.280	.	.838
Improper supplier selection cause offering a low durable products to our client	231.39437	879.842	.481	.	.835
Incorrect information sharing cause not to deliver the kind of products needed to the site	231.50704	889.511	.354	.	.837

Lack of information sharing cause not to deliver customer order on time	231.46479	911.224	.136	.	.841
Lack of good suppliers partnership cause difficult to provide dependable/faithful delivery	231.47887	883.425	.423	.	.836
Decreasing price and cost lost	231.33803	913.598	.103	.	.842
Increasing quality	231.18310	902.266	.251	.	.839
Enhancing delivery dependability	231.36620	898.950	.284	.	.838
Increasing market system	231.36620	876.921	.546	.	.834
Design change	231.35211	906.660	.185	.	.840
Late payment from client	231.50704	894.111	.339	.	.837
Designer's unfamiliarity with alternative products	231.43662	881.821	.503	.	.835
Difficult for substitute product	231.74648	906.221	.207	.	.840
Incorrect document	231.46479	892.224	.355	.	.837
Delays in passing of information to the contractor on types and sizes of products to be used	231.52113	899.196	.258	.	.839
Late and incorrect payment to suppliers	231.36620	898.435	.270	.	.839
Inaccurate data from project site	231.26761	908.027	.176	.	.840
incorrect price during bidding process	231.43662	902.278	.222	.	.839
Extended time wait for architects/consultant approval	231.38028	923.382	-.003	.	.843
Checking materials supplied quantities and volumes	231.28169	898.062	.276	.	.838
Wrong and defective deliveries, Long storage period	231.46479	901.595	.271	.	.839
Incorrect packing and large shipment	231.38028	882.239	.511	.	.835
In accurate data & information needed for site	231.69014	900.331	.276	.	.839
Purchasing raw materials that are just sufficient	231.52113	892.367	.341	.	.837
Good coordination between store and construction personnel to avoid over ordering	231.35211	916.317	.082	.	.842
Accurate and good specifications of materials to avoid wrong ordering	231.52113	893.567	.365	.	.837
Deliveries not in conformance with planning	231.50704	889.054	.396	.	.836
Unresolved quality problem	231.46479	888.167	.411	.	.836
Unresolved quality problem	231.56338	903.392	.235	.	.839
Access to latest information about types of materials on the market	231.33803	886.198	.429	.	.836
Lack of attention paid to standard sizes available on the market	231.15493	906.790	.208	.	.840

Annex -Ib

Table 2(Annex)- mean value statics

Descriptive Statistics					
	N	Mean		Std. Deviation	Variance
	Statistic	Statistic	Std. Error	Statistic	Statistic
Adequacy and quality of information sharing throughout the supply chain partners	71	3.352	.1668	1.405	1.974
Compliance with customer's delivery on time requirements	71	3.324	.1651	1.392	1.936
Compliance with customer's delivery in- full requirements	71	3.296	.1424	1.200	1.440
Increasing quality	71	3.296	.1671	1.408	1.983
Regularly monitoring and evaluation of customer satisfaction	71	3.282	.1517	1.278	1.634
Motivation and rewards for satisfactory suppliers	71	3.268	.1579	1.330	1.770
Availability of stable procurement through network	71	3.225	.1681	1.416	2.006
Timely Information exchange between supply chain partners	71	3.225	.1569	1.322	1.748
Incorrect collaboration with supplier increase the production cost to run the operation.	71	3.211	.1713	1.443	2.083
Inaccurate data from project site	71	3.211	.1725	1.453	2.112
Strives and launches new products and services to the customers	71	3.211	.1500	1.264	1.598
Checking materials supplied quantities and volumes	71	3.197	.1801	1.518	2.303
Frequency of contacts with major customers	71	3.197	.1744	1.470	2.161
Material required related Information sharing with suppliers	71	3.197	.1721	1.450	2.103
Difficult client relationship cause not to compete based on quality.	71	3.197	.1625	1.369	1.875
Completeness of Information exchange between supply chain partners	71	3.183	.1798	1.515	2.295
Suppliers performance measurement systems	71	3.183	.1596	1.345	1.809
Long-term relationship with suppliers	71	3.183	.1451	1.223	1.495
Key suppliers participation in planning	71	3.169	.1567	1.320	1.742

and goal setting activities					
Up-to-datedness of IT technologies throughout the supply chain	71	3.155	.1722	1.451	2.104
Joint product planning with major customers	71	3.155	.1722	1.451	2.104
Material supply forecast Information sharing with Project sites	71	3.155	.1768	1.489	2.219
Access to latest information about types of materials on the market	71	3.141	.1729	1.457	2.123
Decreasing price and cost lost	71	3.141	.1820	1.533	2.351
The level of cooperativeness with customers	71	3.141	.1492	1.257	1.580
Quality considered as number one criterion in selecting suppliers	71	3.127	.1514	1.275	1.627
Good coordination between store and construction personnel to avoid over	71	3.127	.1701	1.434	2.055
Teamwork and intra-organizational coordination	71	3.127	.1771	1.492	2.227
Design change	71	3.127	.1771	1.492	2.227
Material supply forecast Information sharing with suppliers	71	3.113	.1561	1.315	1.730
Late and incorrect payment to suppliers	71	3.113	.1812	1.526	2.330
Increasing market system	71	3.113	.1709	1.440	2.073
Enhancing delivery dependability	71	3.113	.1709	1.440	2.073
Extended time wait for architects/consultant approval	71	3.099	.1829	1.541	2.376
Overall efforts of Inter-organizational information coordination and sharing	71	3.099	.1785	1.504	2.262
Incorrect deal with the supplier affect our prices during construction	71	3.099	.1692	1.426	2.033
Incorrect packing and large shipment	71	3.099	.1619	1.364	1.862
Monitoring and measuring customer service level	71	3.085	.1734	1.461	2.136
Improper supplier selection cause offering a low durable products to our client	71	3.085	.1803	1.519	2.307
Data integration among internal functions through network	71	3.070	.1831	1.543	2.381
Reliability of Information exchange between supply chain partners	71	3.070	.1682	1.417	2.009
Sense of trust, problem sharing & solving mechanism and skills transfer with partners	71	3.070	.1634	1.377	1.895
Information system integration among internal functional units	71	3.070	.1907	1.606	2.581

Level of IT-based automated ordering from major customers	71	3.056	.1724	1.453	2.111
The establishment of quick ordering system	71	3.056	.1815	1.530	2.340
Periodic inter-departmental meetings	71	3.042	.1660	1.398	1.955
Designer's unfamiliarity with alternative products	71	3.042	.1660	1.398	1.955
The level of cooperativeness with suppliers	71	3.042	.1507	1.270	1.612
incorrect price during bidding process	71	3.042	.1854	1.562	2.441
The level of strategic partnership with suppliers	71	3.028	.1816	1.530	2.342
Adequacy of IT systems throughout the supply chain	71	3.014	.1822	1.535	2.357
Accuracy of Information exchange between supply chain partners	71	3.014	.1754	1.478	2.186
Level of IT-based automated ordering to major suppliers	71	3.014	.1708	1.439	2.071
Lack of information sharing cause not to deliver customer order on time	71	3.014	.1754	1.478	2.186
Incorrect document	71	3.014	.1743	1.469	2.157
Deliveries not in conformance with planning	71	3.014	.1708	1.439	2.071
Wrong and defective deliveries, Long storage period	71	3.014	.1611	1.357	1.843
Lack of good suppliers partnership cause difficult to provide dependable/faithful delivery	71	3.000	.1871	1.577	2.486
Material requirement related Information sharing by project sites	71	2.986	.1766	1.488	2.214
The level of market information sharing with major customers	71	2.986	.1876	1.581	2.500
Extent of interaction between main office supply and project warehouse	71	2.972	.1714	1.444	2.085
Late payment from client	71	2.972	.1714	1.444	2.085
Accurate and good specifications of materials to avoid wrong ordering	71	2.972	.1725	1.454	2.113
Incorrect information sharing cause not to deliver the kind of products needed to the site	71	2.972	.1882	1.585	2.513
ordering	71	2.958	.1635	1.378	1.898
Use of online system to achieve operating efficiency within and across supply chain members	71	2.958	.1719	1.449	2.098
Incorrect price based supplier selection affect our prices offer to the	71	2.958	.1765	1.487	2.212

client during tendering process.					
Purchasing raw materials that are just sufficient	71	2.958	.1799	1.516	2.298
Delays in passing of information to the contractor on types and sizes of products to be used	71	2.958	.1832	1.544	2.384
Lack of attention paid to standard sizes available on the market	36	2.917	.2500	1.500	2.250
Adequacy of Information exchange between supply chain partners	71	2.915	.1879	1.583	2.507
Unresolved quality problem	71	2.915	.1687	1.422	2.021
Improper supplier selection cause low quality products to the client.	71	2.887	.1673	1.410	1.987
In accurate data & information needed for site	71	2.789	.1665	1.403	1.969
Follow-up customers for feedback	71	2.761	.1635	1.378	1.899
Difficult for substitute product	71	2.732	.1654	1.393	1.942

Table (Annex) 3. :-ANOVA

	Sum of Squares	df	Mean Square	F	Sig
Between People	852.444	70	12.178		
Within People					
Between Items	83.490	75	1.113	.575	.999
Residual	10164.852	5250	1.936		
Total	10248.342	5325	1.925		
Total	11100.786	5395	2.058		

Grand Mean = 3.08525

Table 4 (Annex):- Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.085	2.732	3.352	.620	1.227	.016	76
Item Variances	2.071	1.440	2.581	1.141	1.792	.065	76
Inter-Item Covariances	.135	-.945	2.357	3.302	-2.492	.123	76
Inter-Item Correlations	.065	-.458	1.000	1.458	-2.184	.028	76