DYNAMICS OF SUPPLY CHAIN MANAGEMENT IN THE KENYAN CONSTRUCTION INDUSTRY A CASE STUDY OF NATIONAL IRRIGATION BOARD

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Dynamics of supply chain management in the Kenyan construction industry: A case study of national irrigation board

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DECLARATION

This project is my original work and has not been presented for a degree in any other university.

Signed………………………………. Date…………………….

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This project has been submitted for examination with my approval as university supervisors

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DEDICATION

To my beloved wife Beatrice Njambi and children Pauline, Derrick, Leon and Allan for their unqualified support every day.

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ACRONYMS AND ABBREVIATIONS

SCM: Supply chain management

SCMS: Supply chain management system

NIB: National Irrigation board

ANOVA: Analysis of variance

ODA: Official development assistance

EEC: European Economic Community

UNDP: United Nations development programme

SPM3: strategic project management maturity model

ABSTRACT

Many construction projects in Kenya fail by not meeting their cost projections, time schedules and/or quality demands leading to negative economic and social impacts. If the issue of construction project failures in Kenya is not treated with the seriousness it deserves and its continuance halted, it will be difficult for Kenya to achieve any meaningful growth and development and achievement anticipated in vision 2030 may not be realized. But the benefits offered by supply chain management (SCM) practices could be used to reduce construction project failures in Kenya. SCM best practices have been used successfully in the manufacturing industry and have particularly been recognized as having made Japanese manufacturing companies successful. But so far, there had not been any studies in Kenya showing the importance and relevance of SCM practices in construction projects or assessment of the degree of entrenchment of SCM practices or the impacts of SCM best practices on Construction projects performance in Kenya.Without assessing the degree of entrenchment or analyzing the impacts of SCM best practices on Construction projects performance, it is difficulty to implement solutions offered by SCM studies. This study sought to establish the effects of SCM best practices and supply chain system (SCS) integration on construction project performance in Kenya. To achieve this, various SCM practices together with performance metrics that have played key roles in the global evolution of supply chain management and their current contribution and relevance were reviewed. A qualitative descriptive survey questionnaire was then developed and served on a population of 65 National Irrigation Board (NIB) listed construction firm's management. A response rate of 83.1% was achieved. The relationships proposed in the study were analysed using descriptive statistics, multiple regression and correlation analysis by use of Statistical Package for Social Sciences (SPSS) while relationships were tested using Analysis of variance (ANOVA). The study established that NIB projects implement SCM practices to some extent with 1.54% of the respondents indicating that they implemented the SCM best practices frequently, 81.54% of respondents indicating that they implemented the SCM best practices sometimes while 16.92% of respondents indicated that they never implemented the SCM practices. The study further established that interaction between SCM practices and SCS integration influenced NIB construction project performance. The study concluded that SCM best practices have a positive impact on construction project performance and that improved implementation of SCM best practices by Kenyan construction firms can lead to improved construction project performance and reduce construction project failures in the industry. The study recommended that construction firms should focus significantly on improving their degree of SCM best practices implementation to boost project success. The study further recommended further research should to be carried out on construction firms from more than one organization. A further study should also be carried out using simulation method to determine the extent of construction project performance that can be possibly achieved through SCM practices and SCS integration.This study provides the stakeholders with a reference point in establishing a value sequenced transformational roadmap for mitigating actions against construction project failures in Kenya.

Key words: Supply chain management practices, multiple regression analysis, ANOVA.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

There is no doubt about the importance of the construction industry in today's world economy and in our daily lives (Mast, 2005). Delays, cost overruns, and bad quality construction projects have significant implications to the people and to the country economy. This is because the people get frustrated by these failures when they wait for the provision of services longer than it is necessary while the country suffers when reduction of the available resources limit the growth potential of the economy.

In Kenya, some notable failed projects identified were under National Irrigation Board (NIB) with the most glaring being Bura Irrigation and Settlement Project (BISP) that was funded by the World Bank, ODA, EEC, UNDP, Finnish Government, the Netherlands and the Government of Kenya. This project started in 1978 and was to be completed in 5 years. In this project, 6700 hectares was to be opened up in phase I and another 5000 hectares in Phase II. Only a part of the project was completed at the intended time in 1982. According to National Irrigation Board website at *http://www.nib.or.ke/schemes-stations/burascheme.html*, cost overruns, escalating costs and cash flow problems that faced the project at the start of implementation forced the Government to scale down the project to 3900 hectares in Phase I, with the project remaining in the list of priorities to date.This trend could be reversed through improved implementation of SCM practices and SCM system integration. Effective implementation of SCM practices has been proved to improve performance in the manufacturing industry. SCM best practices improve the flow of materials in one direction, the flow of money in the other direction and the flow of information in both directions. Forrester (1996) asserts that interaction between variables in a corporate and social system determines the “dynamics” of a system. In a dynamic SCM system the entire SCM system is visualized and SCM best practices applied to maximize strengths and efficiency at every level of the Supply chain process (Close, 2014). This leads to cost reduction, quality and prompt delivery of products. These are the same benefits aspired for in the construction industry. Benefits offered by SCM practices are therefore capable of improving construction project performance and has the potential of reducing construction project failures in Kenya. But the extent to which SCM practices had been embraced in the Kenyan construction industry was not known or understood and therefore the effects of SCM practices on project performance in Kenya needed to be explored and understood. This study sought to establish the extent of SCM practice entrenchment, SCM system integration and their relationship to construction project performance in Kenya.

NIB is a statutory non- profit making parastatal established under Irrigation Act Cap 347. It is mandated with Construction, rehabilitation, operation and maintenance of major irrigation and drainage infrastructure among other functions. In 2013/14, NIB budget allocation was Ksh. 11.8 billion for scaling up of irrigable land and other irrigation infrastructure projects. This is over 5% of the $ 2.1 billion national budget (Cecilia & Maria, 2011). Failures of its projects therefore involve significant and vital resources needed for growth and development of the Kenyan economy.

1.2 Problem Statement

In addition to frustration caused to the people, the Kenyan economy continue to incur huge financial losses as a result of underperformance of construction projects (Choge & Muturi, 2014). If the issue of construction project failures is not treated with the seriousness it deserves and its continuance halted, it will be difficult for Kenya to achieve any meaningful growth and development and achievement anticipated in vision 2030 may not be realized. Empirical studies (Lawson et. al. 2007) that show the relevance and contribution of SCM best practices in the manufacturing industry has enabled the industry to utilize solutions offered by SCM studies to spur success (Li, Ragu-Nathan, Ragu-Nathan & Rao, 2006) SCM best practices improve the flow of materials in one direction, the flow of money in the other direction and the flow of information in both directions. The interaction between SCM practices implementation and SCS integration determines the "dynamics" of SCM system (Forrester, 1996). In a dynamic SCM system the entire supply chain is visualized and SCM best practices applied to maximize strengths and efficiency at every level of the Supply chain process (Close 2014). This leads to cost reduction, quality and prompt delivery of products (Malik, Niemeyer, & Ruwadi, 2011). These are the same benefits aspired for in the construction industry. Achievements offered by SCM practices are therefore capable of improving construction project performance and has the potential of educing construction project failures in Kenya. The supply chain management practices includes effective communication, supply network coordination, Strategic purchasing, Logistics integration, external integration, trust and commitment with partners, Internal integration, good interaction, few supplier policy, supplier involvement in product development, prudent supplier selection, working with certified suppliers and finally long-term relationships.

Without assessing the degree of entrenchment and analyzing the effects of SCM best practices in the Construction industry, it will be difficulty to implement solutions offered by SCM studies. By highlighting the importance and relevance of SCM best practices and SCM system integration on construction project performance, all the stakeholders will be in a position to take remedial action.

1.3 Objectives of the Study

1.3.1 Main objective

To assess the extent of SCM practices entrenchment in the Kenyan construction industry and the impacts on their project performance

1.3.2 Specific objectives

i. To determine the degree of implementation of supply chain management practices implementation by National Irrigation Board listed contractors.

ii. To determine the effect of the implementation of supply chain management practices on National Irrigation Board construction project performance.

iii. To determine the effect of supply chain system integration on National Irrigation Board construction projects.

1.4 Research Hypothesis

The following hypotheses were tested in the study.

H_0. There was no significant implementation of supply chain management practices at National Irrigation Board construction projects.

H_A. There was a significant implementation of supply chain management practices at National Irrigation Board construction projects.

H_0. There existed no significant influence of supply chain management practices on project performance at National Irrigation Board construction projects.

H_A. There existed a significant influence of supply chain management practices on project performance at National Irrigation Board construction projects

H_0. There was no significant effect of physical flow integration, financial flow integration, information flow integration and trust at National Irrigation Board construction projects.

H_A. There was a significant effect of physical flow integration, financial flow integration, information flow integration and trust at National Irrigation Board construction projects.

1.5 Justification and Significance of the Study

The trend of failure of Construction projects in Kenya need to be reversed since it hurts the economy through wastage of resources and frustration of the stakeholders and furthermore, construction industry is one of the principal sectors that revitalize economic growth of many nations including Kenya. When the entire SCS is visualized and SCM best practices applied to maximize strengths and efficiency at every level of the Supply chain process (Close 2014), cost reduction, quality and prompt delivery of products (Malik et al. 2011) is achieved.

It is hoped that the findings of this study will enable contractors, developers and other industry players to understand the importance of SCM practices in ensuring construction project success and take appropriate remedial action. If applied, the findings can lead to increase in efficiency and profitability and reduction in the rate of project failures in the construction industry in Kenya. The research also adds to the body of knowledge in the area of SCM and will assist those doing research in the area as a point of reference.

1.6 Scope and Limitation

Previous studies on project success reveal that cost, time, quality, safety, functionality and satisfaction are all performance indicators of success (Atkinson et al. 1997). But the cost, time and quality remain the three basic and most important performance indicators of performance in construction projects. This study focused on the three basic elements of performance to measure success in the construction projects. This is because Atkinson et al. 1999 avers that cost, time and quality are the three basic and the only critical performance indicators. Construction firms considered in the study were selected from contractors retained by NIB and this study is therefore based on the assumption that the contractors retained by NIB formed a fair representation of construction firms in Kenya.

1.7 Organization Structure of the Thesis

This thesis comprises six chapters. Chapter one presents the background on the study, research problem, research objectives and value of the study. Chapter two provides the literature review pertaining to supply chain management practices, supply chain management systems and construction project performance including supporting theories. It also discusses empirical research relevant to supply chain management practices and construction project performance, outlines the research's conceptual model and the research hypotheses. Chapter three presents the research methodology, including the research philosophy, population, data collection instrument, and data analysis techniques. Chapter four presents the research findings, results and analysis, firm demographics, measurement model and structural model analysis results and testing for research hypotheses. Chapter five presents a summary of the findings, research conclusions, contributions and implications and recommendations for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the available literature on the genesis, definitions and theories underlying SCM practices, discusses the concepts of project failure based on Quality, Cost and time variations and how entrenchment and implementation of supply chain management practices affects the performance of firms. In this chapter, each of the variables will be linked to the theories and objectives of the study, the conceptual framework developed and empirical review to cover each variable undertaken. The review of the literature is aimed at identifying research gaps on factors affecting performance of construction projects and developing the hypothesized relationships.

2.2 The Concept of Supply Chain Management

Last two decades witnessed rapid growth in the concept of SCM being adopted by organizations in all types of industries and has been defined in a number of different ways. Petrovic et al. (2007), defines supply chain management as an integrated collection of organizations that manage information, product, and cash flows in order to maximize consumption satisfaction with minimal total costs. This study adopted the definition by Akintoye et al. (2000) and Tucker et al. (2001) who defines Construction SCM as managing the process of financial flow, materials flow, information flow and any other processes involved within various networks and linkages both upstream and downstream of organizations in order to develop high quality products and services. SCM in construction involves principal contractors, sub-contractors, suppliers, and distributors. The network of suppliers in the construction sector can be extremely complex where on large projects the number of suppliers can go to hundreds. The main role of SCM in projects is directing operations to link successive operating stages through product flow; information and funds and transforming these operating stages into a single cohesive unit by coordinating and controlling internal actions within these stages. The upstream of construction SCM is in relation to the position of a main contractor consisting of the activities and tasks leading to preparation of the production on site involving construction clients and design team. Akintoye et al. (2000) consider downstream of project that consists of activities and tasks in the delivery of construction product involving construction suppliers, subcontractors, and specialist contractors in relation to the main contractor, to be the weaker link that needs to be improved if the full potential of SCM is to be realized. A case study in Small and medium enterprises (SMEs) in the construction industry, carried out by Dainty, Briscoe and Millett (2001) revealed that there has been tremendous integration in the upstream of construction and it is the downstream that now has significant supply chain problems that need to be solved. The downstream involves actual construction activities on site that includes sourcing of materials, scheduling and quality controls of construction works. In order to achieve a competitive advantage, supply chains need this downstream of construction project to be managed appropriately (Bode & Isack, 2011).

2.3 Supply Chain Management Characteristics

Supply chain as opposed to supply chain management is a set of organizations directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer. Managing a supply chain is 'supply chain management'. The chain must have efficient linkages that will create customers satisfaction at the delivery of the project. This regards lowering of costs, adding value, and increasing efficiency, removal of bottlenecks and reward of enhanced performance. This is made possible by employing SCM that encompasses the planning, logistics management, coordination and collaboration with supply chain partners of suppliers, third party service providers and customers. SCM recognizes that supply chain is vulnerable to both internal and external risks. External risks are those attributed to the environment, social, economic and political activities (Keneth & Brian 2006). This study is particularly focused on the Internal risks that stem from interactions between organizations in the supply chain, e.g. blurred boundaries between the buyer and the supplying organizations, mistrust and distorted information in the supply chain, decision risks, lack of stock to take care of disruptions and inertia risks that are viewed as lack of responsiveness by suppliers.

Christopher (2002) identifies basic components of supply chain management as;

i. ‘Plan’-This is the strategic portion of supply chain management. There is need for a strategy for managing all the resources that go toward meeting customer demand for a product or service. A big piece of planning is developing a set of metrics to monitor the supply chain so that it is efficient, costs less and delivers high quality and value to customers.

ii. ‘Source’-Choose the suppliers that will deliver the goods and services needed to create a product or service. Develop a set of pricing, delivery and payment processes with suppliers and create metrics for monitoring and improving the relationships. Put together processes for managing the inventory of goods and services you receive from suppliers, including receiving shipments, verifying them, transferring them to your manufacturing facilities and authorizing supplier payments.

iii. ‘Make’-This is the manufacturing step. Schedule the activities necessary for production, testing, packaging and preparation for delivery. As the most metric-intensive portion of the supply chain, measure quality levels, production output and worker productivity.

iv. ‘Deliver’-This is the part that many insiders refer to as logistics. Coordinate the receipt of orders from customers, develop a network of warehouses, pick carriers to get products to customers and set up an invoicing system to receive payments.

v. ‘Return’-The problem part of the supply chain. Create a network for receiving defective and excess products back from customers and supporting customers who have problems with delivered products.

In construction projects, the first four elements of plan, source and deliver are particularly imperative in construction projects as they seamlessly connect planning, sourcing and supply of resources, site construction activities and delivery operations. They provide near real-time visibility across the supply network, thereby enabling rapid decision-making and optimal execution of construction projects. These elements makes possible the optimized flow and positioning of goods, materials, information and all resources required in a construction project.

2.4 Effectiveness

Organizational effectiveness is an external standard of how well an organization is meeting the demands of the various groups and organizations that are concerned with its activities (Pfeffer & Salancik, 2003). It is a construct for doing the right things or having validity of outcomes (Hines et al 2000). Effectiveness is assessed when deliveries are in line with what was agreed upon in the contractual or verbal agreements (Benedicte & Borgstrom, 2006). In construction projects therefore, when projects are delivered on time, within the original cost estimates and within acceptable quality, the project SCM can be said to have been effective.

2.5 Competitive Advantage

Competitive advantage is the extent to which an organization is able to create a defensible position over its competitors. The empirical literature has been quite consistent in identifying SCM best practices as important competitive capabilities (Suhong et al. (2004). SCM best practices are expected to increase an organization's competitive position. The increased competitiveness of a firm enables the firm to implement higher levels of SCM practices due to the need to outperform its competitors and keep its competitive position.

2.6 Supply Chain Management System

The supply chain management system (SCMS) involves the flow of materials in one direction, the flow of money in the other direction and the flow of information in both directions. The philosophy behind supply chain management is that by visualizing the entire SCMS and applying SCM practices, those involved can maximize strengths and efficiencies at each level of the process to create a highly competitive, customer-driven SCM system that is able to respond immediately to changes in supply and demand (Close, 2014). Lee et al. (1997) highlights the importance of SCMS visibility by stating that any, “distorted information from one end of a supply chain to the other can lead to tremendous inefficiencies: excessive inventory investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation, and missed production schedules”. This study assessed the System dynamics of SCM relative to SCM practices and project performance. Forrester (1996) perceives system dynamics as modelling interactions between SCM practices, capacity, price, quality and delivery delays in corporate and social systems

2.7 SCM Practices

This study adopted Suhong et al. (2004) definition of SCM practices as a set of activities undertaken by an organization to promote effective management of its supply chain with Voss et al (1994) emphasizes that there exist no general best practice database. Donlon (1996) describes what he perceives as the latest evolution of SCM practices, to include supplier partnership, outsourcing, cycle time compression, continuous process flow, and information technology sharing. Tan et al. (1998) uses purchasing, quality, and customer relations to represent SCM practices, in their empirical study.

Alvarado and Kotzab (2001) include in their list of SCM practices concentration on core competencies, use of inter-organizational systems, and elimination of excess inventory levels by postponing customization toward the end of the supply chain. Tan et al. [2002] identify six aspects of SCM practice through factor analysis: supply chain integration, information sharing, supply chain characteristics, customer service management, geographical proximity and just in time (JIT) capability.

Chen and Paulraj (2004) use supplier base reduction, long-term relationship, communication, cross-functional teams and supplier involvement to measure SCM Maturity.Ragatz et al. (1997) points that various components of SCM practices have an impact on various aspects of competitive advantage (such as price/cost) stating that strategic supplier partnership can improve supplier performance and reduce time to market while maintaining a level of customer responsiveness and satisfaction.

The set of practices that developed organizations implement to effectively manage the functioning of their supply chain and help them succeed are known as supply chain management best practices. Effective implementation of SCM practices in any industry achieves expected benefits and leads to success. Suhong et al. (2004) views SCM practices as a set of activities undertaken by an organization to promote effective management of its supply chain. Laugen et al. (2005) points to SCM practices as having made the Japanese companies successful. Effective implementation of (SCM) best practices has therefore the potential of reducing failures and improving organizational performance. It is clear from the literature that SCM practices are instrumental in the control of material flow, information flow and financial flow; these factors lead to improved delivery of products while maximizing quality of the products and services and minimizing costs. Voss (1995) emphasize that there exists no general best practice database. The researcher found the following 13 best practices to be consistent with views of many scholars and were used in this study.

2.7.1 Strategic purchasing

Historically, purchasing had been considered to have a passive role in the business organization. In the 1980s, purchasing was seen to be involved in the corporate strategic planning process. By the 1990s, both academics and managers were giving much more attention to strategic purchasing (Coban 2012). The conceptual re-description of purchasing as the integration of internal and external exchange functions is affiliated with many neo-classical tasks of industrial purchasing such as measuring internal customer's perception of purchasing service quality (Corina and Sitar, 2001), making entrepreneurial ventures through innovation, risk-taking, pro-activeness and establishing cooperative supplier relationships to match a firm's competitive stance. The perspective of strategic purchasing is also consistent with general strategy literature. According to Pearson, Ellram and Carter (1996), strategic purchasing has a proactive long-term focus. The ability of purchasing to influence strategic planning has also increased due to the rapidly changing competitive environment (Coban, 2012). A number of studies have addressed the imperative role of strategic purchasing in SCM (e.g. Coban, 2012 and Suhong et al, 2004). In particular, Suhong et al, (2004) studied the relationships of strategic purchasing, buyer–supplier relationships, supplier evaluation system, and tested the impact of supply management orientation on suppliers' and buyers' performance. Increasing evidence reveals that purchasing is increasingly assuming a strategic role in SCM. For example, more purchasing professionals are now trained in cross-functional areas and strategic elements of the competitive strategy where purchasing selects the right type of relationship with its suppliers; supplier relationships are strategically managed and purchasing performance is being measured in terms of contributions to the firm's success (Chen and Paulaj, 2004).

2.7.2 Supply management

Supply management is different from SCM in that SCM emphasizes all aspects of delivering products and services to customers, whereas supply management emphasizes primarily the buyer–supplier relationship (Leenders, et al. 2002). Fueled by the strategic recognition and extended role of purchasing, buyer–supplier relationship or supply management has drawn unprecedented interest in SCM literature. Noting that since suppliers have a profound and direct impact on cost, quality, time and responsiveness of the buying firms, the management of business and relationships with other members of the supply chain (i.e. buyer–suppler relationship) is increasingly being referred to as SCM. While some researchers argue that the conceptualization of SCM should be broader than defining it in terms of a firm's involvement in managing relationships with its suppliers (e.g. Ho, et al, 2002), this perspective has been the predominant approach to SCM research. The prevalence of this approach appears to have benefited drastically from the increasing globalization of markets and the trendy practice of strategic purchasing making it one of the important best practices in SCM.

2.7.3 Communication

In order to jointly find solutions to material problems and design issues, buyers and suppliers must commit a greater amount of information and be willing to share sensitive design information (Lawson et al, 2007). This is often achieved through engineer-to-engineer communication on design issues, in order to improve process capability, manufacturability, and performance without affecting profit margins. Communication is said to occur among design, engineering, quality control and other functions between the buyer and supplier firm's. In addition to the purchasing–sales interface, the supplier's quality performance is superior to that experienced when only the buying firm's purchasing department and supplier's sales department act as the inter firm's information conduit (Lawson et. al, 2007). Furthermore, many supplier product problems are due to poor communication (Newman and Rhee, 1990). Poor communication was often a fundamental weakness in the interface between a buying firm and its supplier, which undermined the buying firm's efforts to achieve increased levels of supplier performance. In their ten case studies of buying firms in the UK, Galt and Dale (1991) revealed the importance of two-way communication with suppliers and its potential positive effects on the buying firm's competitiveness. Effective inter-organizational communication could be characterized as frequent, genuine, and involving personal contacts between buying and selling personnel. Effective two-way communication is demonstrated throughout the literature as essential to successful project implementation.

2.7.4 Supplier base reduction

The traditional practice of firm's contracting with multiple suppliers, even for the same material or component, was based on the premises that competition is the basis of the economic system, purchasing must not become source dependent and multiple sourcing is a risk-reducing technique (Shinm et al, 2000). Reduction of the supplier base, however, is a unique characteristic of contemporary buyer–supplier relationships because the administrative or transaction costs associated with managing a large number of vendors often outweigh the benefits (Dyer, 2000). Many firm's are reducing the number of primary suppliers and allocating a majority of the purchased material requirements to a single source. Shinm et al, (2000) lists multiple benefits provided by the process of supplier base reduction which includes:

i. fewer suppliers to contact in the case of orders given on short notice,
ii. reduced inventory management costs
iii. volume consolidation and quantity discounts,
iv. increased economies of scale based on order volume and the learning curve effect
v. reduced lead times due to dedicated capacity and work-in-process inventory from the suppliers,
vi. Reduced logistical costs
vii. Coordinated replenishment
viii. improved buyer–supplier product design relationship
ix. Improved trust due to communication
x. Improved performance
xi. Better customer service and market penetration

The benefits attributed to this practice often exceed those achieved through traditional bidding from multiple sources, which often emphasizes low price at the expense of performance (Mohr and Spekman, 1994). Moreover, supply base consolidation sets the stage for future development of the chosen suppliers. In practice, a significant shift has occurred from traditional multiple sourcing, characterized by adversarial buyer–seller relationships, to the use of a limited number of qualified suppliers. This appears to be consistent with the notion of parallel sourcing, which involves the use of multiple sole sources for each type of component that provides incentives for supplier performance associated with multiple sourcing while preserving claimed benefits of sole sourcing (Shinm et al, 2000)

2.7.5 Long-term relationships

Though longer planning horizon have become a crucial characteristic of modern supply chain relationship (Shin et al, 2000), long-term relationships do not refer to any specific period of time, but rather, to the intention that the arrangement is not going to be temporary. Through close relationships, supply chain partners are willing to share risks, reward and maintain the relationship over a longer period of time. Cooper and Ellram, (1993) compared the potential costs associated with different sourcing strategies and suggested that companies would gain benefits by placing a larger volume of business with fewer suppliers using long-term contracts. De Toni and Nassimbeni (1999) found that a long-term perspective between the buyer and supplier increases the intensity of buyer–supplier coordination. Carr and Pearson (1999) discovered that strategically managed long-term relationships with key suppliers have a positive impact on a firm's supplier performance. Through a long-term relationship, the supplier will become part of a well-managed chain and will have a lasting effect on the competitiveness of the entire supply chain. Supplier contracts have increasingly become long-term, and more and more suppliers must provide customers with information about their processes, quality performance, and even cost structure (Helper and Sako, 1995). Closer and long-term relationships with suppliers are evident in several industries which cause increasing dependence on suppliers (Tuten and Urban, 2001). The terms 'partnership' and 'partnership sourcing' have been used to refer to these closer, longer relationships with suppliers. These long-term orientations support most recent findings, which discover that once the transacting teams have made the upfront investment to develop self-enforcing safeguards such as relational trust, the transaction costs decline in the long term because self-enforcing safeguards can control opportunism over an indefinite time horizon. Specifically, the transaction costs and inventory holding costs associated with arm's-length bidding practices, characterized by short-term relationships with a large number of short-term suppliers, can actually outweigh the costs of the parts themselves (Dyer, 2000).

2.7.6 Supplier selection

Selecting suppliers for specific goods and services is a critical decision for most organizations, since supply performance can have a direct financial and operational impact on the business. Croom, (1992) argues that by engaging in supplier selection organizations are buying the supplier's capabilities; the formal sourcing protocol being relying heavily on the supplier's ability to meet cost targets. In practice, however, a much wider set of concerns are involved. The abilities to meet quality standards and deliver products on time as well as performance history are the most critical determinants in choosing suppliers. Many conceptual studies also emphasize that supply management must have a quality focus (Helper 1991; Choi and Hartley 1996) when selecting supplier. Quality has been mentioned as one of the most important performance criteria even with the conventional purchasing strategy. Helper (1991) contends that the importance of quality criteria has increased the most while the importance of price increased the least. Choi and Hartley (1996) also found that companies place more importance on consistency (quality and delivery) and the least importance on price. On the whole, quality, on-time delivery, and uninterrupted supply has become critical selection criteria because supplier failures on these dimensions have more serious adverse effect on the buyer's operations. Trustworthiness, integrity, commitment, and characteristics that imply 'fair dealing' are also considered with importance in selecting the supplier (Lewis, 1995). Specifically, suppliers who are unwilling to share information on cost, quality and production can be screened out, because willingness to share information is viewed as a signal of the trustworthiness of the supplier (Dyer, 1997),

2.7.7 Supplier certification

Chen and Pualraj (2004) described a certified supplier as a vendor who, after extensive investigation of its manufacturing operations, production capabilities, personnel and technology, is certified to provide materials and components without routine testing of each receipt. According to Murphy (1992), supplier quality begins with supplier certification. Supplier certification involves the thorough examination of all aspects of a vendor's performance and is expected to enhance buyer–supplier trust and communication, to improve supplier product quality, to reduce communication errors, and to reduce inspection and inventory costs for the buyer. Suhong et al (2004) depicted supplier certification as a buyer-supplier partnership, involving higher levels of trust and communication, leading to improved quality and lower costs. American Quality Foundation et al (1993), in their international quality study of over 500 organizations, reported that formal programs for certifying suppliers showed an across-the-board beneficial impact on performance, especially in quality and productivity. Supplier certification therefore supports greater joint action between buyer and supplier by providing a mechanism for screening a supplier's motivation and capabilities.

2.7.8 Supplier involvement

Ragatz et al, (1997) and Chen and Pualraj (2004) have observed that effective integration of suppliers into new product development can yield such benefits as reduced cost and improved quality of purchased materials, reduced product development time, and improved access to and application of technology. The involvement may range from giving minor design suggestions to being responsible for the complete development, design and engineering of a specific part of assembly. Chen and Pualraj, (2004) discussed Kodak's early supplier involvement program that involved suppliers in its new research and development (R&D) efforts and states that Motorola's strategy included suppliers in the early developmental stages of new products to benefit from their technical expertise. A considerable amount has been written documenting the integration of suppliers in the new product development process as a fundamental element in the optimization of the SCM system.

2.7.9 Cross-functional teams

The breadth of corporate objectives pursued through teamwork indicates that it is central to many attempts at wide-ranging organizational transformation. Organizations achieving transformation through increased customer focus anticipate quite dramatic increases in team-based efforts. Firms changing their value chain and supplier relations also anticipate major contributions through team efforts. The greatest changes are those areas of the firm that interact with outsiders: customers, suppliers and international partners (Hastings, 1993). Cross-functional teams have been identified as important contributors to the success of such efforts as supplier selection, product design, just-in-time manufacturing, cost reduction, total quality initiatives (Burt and Doyle, 1993) and, most of all, improved communication. Because of the wide range of supplier problems, potentially addressed by better buyer–supplier relationships, expertise is required from various functions (Krause and Ellram, 1997). Research has revealed that managing long-term relationships with customers using cross-functional teams is becoming a common practice in supply chains.

2.7.10 Trust and commitment

Cooperation, whereby firm's exchange bits of essential information and engage some suppliers–customers in longer-term contracts, has become the threshold level of supply chain interaction. According to Kumar (1996), SCM is built on a foundation of trust and commitment. The consensus is that trust can contribute significantly to the long-term stability of an organization (Handfield and Bechtel, 2002). Trust is conveyed through faith, reliance, belief or confidence in the supply partner and is viewed as willingness to forego opportunistic behavior. Trust is one's belief that one's supply chain partner will act in a consistent manner and do what he/she promises. It is the sense of performance in accordance with intentions and expectations that hold in check one's fear of self-serving behavior on the part of the other members of the supply. Commitment implies that the trading partners are willing to devote energy to sustaining this relationship (Dion et al. 1992). That is, committed partners dedicate resources to sustaining and furthering the goals of the supply chain. To a large degree, commitment makes it more difficult for partners to act in ways that might adversely affect overall supply chain performance. With commitment, supply chain partners become integrated into their major customers' processes and more tied to their goals. While trust comes in various forms such as 'cognitive trust' and 'calculative trust', it is the calculative trust that can have a significant impact on buyer–supplier relationships and, consequently, supply chain performance. For example, Hill (1990) argues that contrary to the theory of transaction cost economics (TCE) that opportunism generally characterizes exchange, relationships based on cooperation and trust are more likely to survive in the marketplace. Therefore, it is argued that the assumption that opportunism characterizes exchange should be reconsidered in favour of one that suggests that trust characterizes exchange (Zaheer and Venkatraman, 1995.) Specifically, although legal contracts are viewed as the primary means for safeguarding transactions in Western economies, alternative means such as relational trust has proven to be an efficient governance mechanism that reduces transaction costs by minimizing search, contracting, monitoring and enforcement costs over the long term (Dyer, 1997). Further, a high level of inter organizational trust is found to be related to enhanced supplier performance, lowered costs of negotiation and reduced conflict (Zaheer et al, 1998).

2.7.11 Logistics integration

Logistics provides industrial firms with time and space utilities. It has traditionally been defined as the process of planning, implementing and controlling the efficient flow and storage of goods, services and related information as they travel from the point of origin to the point of consumption. Some of the activities included in the logistics domain include transportation, warehousing, purchasing and distribution. Within this model, the locus of logistics control has been the individual firm. A more recent interpretation calls for logistics to guarantee that the necessary quantity of goods is in the right place and at the right time (La Londe 1993). The reduction of organizational slack, of which inventory is a typical example, needs close coordination of and an intensive information exchange between the supply chain partners (Vollman et al, 1997). This current trend in using strategic partnerships and cooperative agreements among firm's forces the logistics integration to extend outside the boundaries of the individual firm (Langley and Holcomb 1992). It can be characterized by integration of logistics activities across functional departments within the firm, as well as integration of the firms logistics activities with the logistics activities of other supply chain members. Logistics integration, reflects it's growing importance of logistics as a coordinating mechanism among multiple units of the enterprise and ultimately as a source of customer value in project performance.

2.7.12 Internal integration

According to Chen and Poulraj (2004), internal integration is the degree to which firms are able to integrate and collaborate across traditional functional boundaries to provide better customer service. Managing internal activity involves other functions within the firm, namely marketing, finance, purchasing, and production.

Coordination is required within the firm's internal supply chain departments to realize the desired benefits for the firm. It is widely agreed that task interdependence is the catalyst for inter-departmental customer satisfaction and is dependent on the output of more than one worker or one functional area. This brings benefits to companies that operate their logistics processes as an integrated system rather than by optimizing functional subsystems. Numerous empirical studies suggest that collaborative cross-functional integration is positively associated with performance. Collaborative interdepartmental integration involves a predominantly informal process based on trust, mutual respect and information sharing, the joint ownership of decision, and collective responsibility for outcomes. Thus, collaboration between departments is often needed to ensure delivery of high quality services to customers, and involves the ability to work seamlessly across the silos that have characterized organizational structures. Collaborative behavior is based on cooperation (willingness), rather than on compliance (requirement). Its success is contingent upon the ability of individuals from interdependent departments to build meaningful relationships. Higher levels of internal integration are characterized by increased coordination of logistics activities with other departments in the firm, increased importance of logistics in the overall business strategy, and a blurring of the formal distinction between logistics and other areas of the firm (Chen and Paulraj, 2004).

2.7.13 External integration

External integration is the integration of activities across firm boundaries. This is an extension of manufacturing enterprise to encompass the entire supply chain, not just an individual company, as the competitive unit. Managers are coordinating with companies beyond their own, seeking new ways to lower costs or improve service through mechanisms such as vendor managed inventory and just-in-time scheduling (Chen and Poulraj, 2004). Collaboration is needed across enterprise boundaries interfacing with external suppliers, carrier partners and customers. Morash et al, (1997) identify customer service, quality, channel distribution, and total cost minimization as major boundary-spanning interface external integration capabilities.

2.8 Dynamics of SCM System

The concept of Supply Chain Management is based on the core idea that practically every product that reaches an end user represents the cumulative effort of multiple organizations connected through the flow of materials in one direction, the flow of money in the other direction and the flow of information in both directions. SCM practices create waves of influence in these organizations and these waves of influence are reflected in cost, quality and prompt delivery of construction projects. How these influences propagate through the SCM system determines the "dynamics" of the SCM system (Wang and Ingham, 2008).

2.8.1 Information flow

Information flow has been defined as the extent to which information is shared between a firm and its supply chain partners (Rai et al. 2006). According to Lee et al. (1997), information sharing within business units, across supply chain partners such as suppliers and other strategic alliances is essential to perform three major linkages: supplier linkage, internal linkage and customer linkage. In particular, this integration through effective and efficient information flow will eventually lead the firm and total supply chain to better performance (Palsson and Johansson, 2009). Past studies

(Gunasekaran and Ngai, 2004) reported positive relationships between the level of information flow integration and performance. Coyle et al. (1996) states that today's business competition has changed the characteristic of supply chain management, where information sharing becomes the most important characteristic to achieve supply chain success. Instead of suffering from scarcity of data, the challenge for companies is to achieve good quality information (Wagner, 2002) and to decide which data can be utilized in decision making to improve supply chain performance and which data can be ignored. Lee et al. (1997) declares that information flow paths can impose delays, limitations, and constraints that may reduce the effectiveness of the supply chain. To measure information flow over the supply chain therefore give a valuable information on what to improve. Beamon (1999) states that performance measures of information flow is output that includes production and delivery schedules, performance metrics, collaboration with supply chain members, sharing sales data with partners, visible inventory data, order fulfillment and shipment tracking. High levels of information sharing within the supply chain management improve supply chain success and contribute to firm's project performance. Increasing the level of integration and information sharing among the members of a construction supply chain is therefore a necessary component for a successful project delivery.

2.8.2 Financial flow

According to Rai et al. (2006), financial flow integration is defined as the extent to which exchange of financial resources between a firm and its supply chain partners is driven by workflow events. This includes all activities required to facilitate the flow of funds across the supply chain, including invoicing customers, paying suppliers and internal transfers (Johnson and Mena, 2008).This implies that effective flow of funds across the supply chain improves cash conversion cycle or cash-to-cash cycle through reduced days-in-inventory, shortened days-in-receivables and prolonged days-in-payables (Tsai, 2008). Eventually, the financial flow optimization (Comellia et al. 2008) will make possible shareholders satisfaction and the supply chain working improvement. Effective and efficient management of financial flow integration is therefore essential to improve the supply chain performance.

2.8.3 Physical flow

Rai et al. (2006) defines physical flow integration as the extent to which a firm uses global optimization with its supply chain partners to manage the flow of materials and finished goods from the point of origin (ultimate supplier), to the point of destination (ultimate customer). This implies that suppliers can be integrated with the internal processes of their customers in an effort to improve quality and reduce costs (Koufteros, 2005). Quesada et al. (2008) augments that in the long run this enables companies to gain order winning capabilities and better customer services. As such physical flow integration makes a significant contribution to the firms performance (Zailani and Rajagopal, 2005) and finally to the total supply chain members (Zelbst et al, 2009). Various studies show a cost reduction potential varying from 10% to 17% of the material costs (i.e. purchasing price) by means of improved logistics (Wegelius-Lehtonen, 1995). Physical flow integration therefore improves the productivity of firms through reduction in production cost, effective just-in-time inventory management and improved supplier management.

2.8.4 Trust

Khalfan et al. (2007) declares that trust is a major requirement for successful SCM in construction supply chains but is however, negatively affected by many factors in construction projects such as lack of honest communications and reliability and the problems in the delivery of the project. Most studies point to ways of measuring trust in a dynamic supply chain as: shared goals; having experience of working together; solving problems together; rewarding culture on trusted behaviors; fair working and reasonable behaviors in work environment.

2.9 SCM Practice Benchmarking

Benchmarking a firm relative to industry best practice with the aid of a maturity model enhances performance. According to McCormack (2001) the SCM journey is a difficult one, and “without a map and a compass, it is impossible” and points out that a maturity test paints a map and gives a hint in which direction to proceed. According to Fraser et al (2002), “the principal idea of the maturity grid is that it describes in a few phrases, the typical behavior exhibited by a firm at a number of levels of ‘maturity’, for each of several aspects of the area under study”. Therefore the maturity of a company’s operations relative to industry best practices may be benchmarked with the aid of a maturity model. This is because maturity models have the advantage that they are simple and easy to understand (Klimko, 2003). Fraser et al (2002) list six typical attributes of a maturity model: It has a number of maturity levels, a descriptive name for each level, a generic description of each level as a whole, a number of dimensions or process areas, a number of elements or activities for each process area, and a description of each activity as it might be performed at each maturity level. Most scholars agree that the extent to which a firm uses a stated best practice may be evaluated on a scale of five by identifying the firm maturity level, according to a qualitative answer to the question: "To which extent does your supply chain use best practice stated?" Level 1 = "Never or does not exist", Level 2 = "Sometimes or to some extent", Level 3 = "Frequently or partly exist", Level 4 = "Mostly or often exist", and Level 5 = "Always or definitely exist". According to this scale, the highest average maturity level corresponds to the best performer but according to Blanchard (2007) the best performing firm need not have best practices implemented in all its business areas. Lockamy and McCormack, (2004) presupposes that higher levels of maturity in business processes will result in better control of results; improved forecasting of goals, costs, and performance; greater effectiveness in reaching defined goals; and improved ability to propose new and higher targets for performance. This study adopts maturity levels developed by Marcos et al. (2011), where companies with maturity average mean of between 1 and 2.26 points are positioned at maturity level 1; between 2.26 and 2.86 points at level 2; ranging between 2.86 and 3.36 at level 3; between 3.36 and 3.93 at level 4; and above 3.93 points at maturity level 5 (Figure 2.1). Such classification was based on a previous definition of the maturity levels as discussed by McCormack et al (2003).

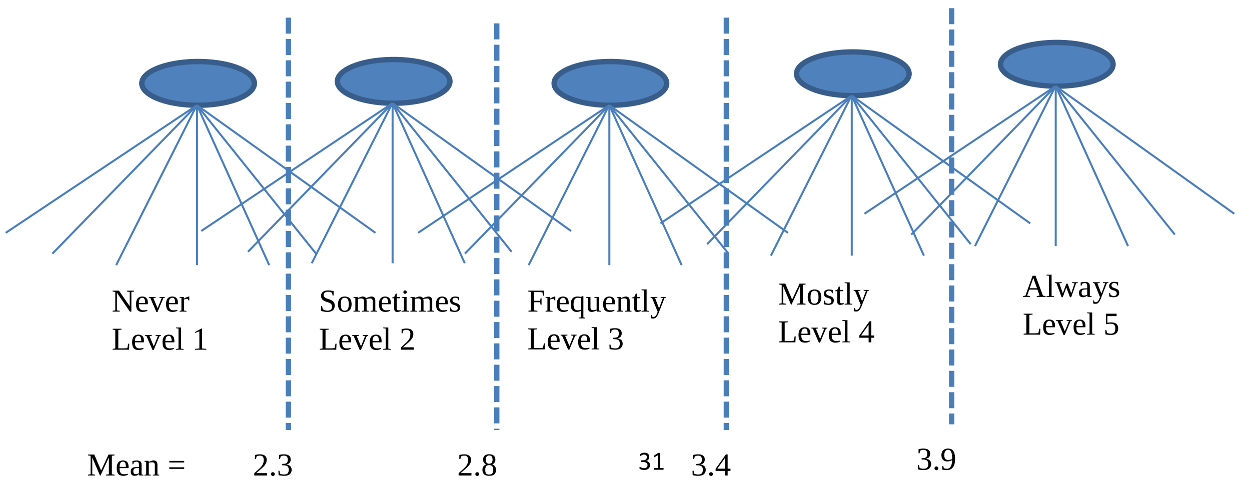

Figure 2.1: Maturity key turning points

Adopted from SPM3 by Marcos et al. (2011)

Lockamy and McCormack (2004) states that the five stages of maturity show the progression of activities toward effective supply chain management and process maturity stressing that each level contains characteristics associated with process maturity such as predictability, capability, control, effectiveness and efficiency and further gives the following brief description of each SCM maturity level.

Level 1 (Ad Hoc) - The supply chain and the SCM practices are unstructured and ill defined. Process measures are not in place and the jobs and organizational structures are based upon the traditional functions, not horizontal supply chain processes. Process performance is unpredictable and targets, if defined, are often missed. SCM costs are high both in dollars and emotional costs.

Level 2 (Defined) - The basic SCM processes are defined and documented. Jobs and organizational structures include an SCM aspect, but remain basically traditional. Process performance is more predictable and targets are defined but still missed more often than not. Overcoming the functional silos takes considerable effort due to turf concerns and competing goals. SCM costs remain high, frustration is still present and customer satisfaction, although better defined, is still low.

Level 3 (Linked) - This represents the breakthrough level. Managers employ SCM with strategic intent and results. Broad SCM jobs and structures are put in place outside and on top of traditional functions. Cooperation between intra-firm functions, vendors and customers takes the form of teams that share common SCM measures and goals that reach horizontally across the supply chain. Process performance becomes more predictable and targets are often achieved. Continuous improvement efforts take shape focused on root cause elimination and performance improvements. SCM costs begin decreasing and feelings of esprit de corps take the place of frustration. Customers are included in process improvement efforts and customer satisfaction begins to show marked improvement.

Level 4 (Integrated) - The firm, its vendors and suppliers, take cooperation to the process level. Organizational structures and jobs are based on SCM procedures, and traditional functions, as they relate to the supply chain, begin to disappear altogether. SCM measures and management systems are deeply imbedded in the organization. Advanced SCM practices, such as collaborative forecasting and planning with customers and suppliers, take shape. Process performance becomes very predictable and targets are reliably achieved. Process improvement goals are set by the teams and achieved with confidence. SCM costs are dramatically reduced and customer satisfaction and esprit de corps become a competitive advantage.

Level 5 (Extended) - Competition is based upon multi-firm supply chains. Collaboration between legal entities is routine to the point where advanced SCM practices that allow transfer of responsibility without legal ownership are in place. Multi-firm SCM teams with common processes, goals and broad authority take shape. Trust, mutual dependency and esprit de corps are the glue holding the extended supply chain together. A horizontal, customer-focused, collaborative culture is firmly in place. Process performance and reliability of the extended system are measured and joint investments in improving the system are shared, as are the returns. This is the beginning of a functioning supply chain network.

2.10 SCM Implementation (Maturity) Model

Maturity modelling, more specifically, process maturity modelling, has its genesis in the software manufacturing industry (Finnemore & Sarshar, (2000) and is based on an adaptation of Deming‘s concept of process improvement. Paulk et al. (1995) upholds that the underlying premise of process maturity modelling is that the quality of a product is directly related to the quality of the process used to develop that product. According to McCormack et al. (2008), companies with higher SCM maturity are more profitable or have better SCM performance than firms with lower SCM maturity. Other studies indicate connections between supply chain performance and financial success (Christensen et al. 2007).

Kalyan et al (2007) interprets maturity to happen along three dimensions:

(i) **Functional integration** – is across board and requires very little business process change - information sharing achieve the desired results.

(ii) **Multi-project integration -** process and organizational alignment to work across projects required.

(iii)**Multi-firm integration** - seamless communication across firms.

his study employed SCM maturity at multi-project level.

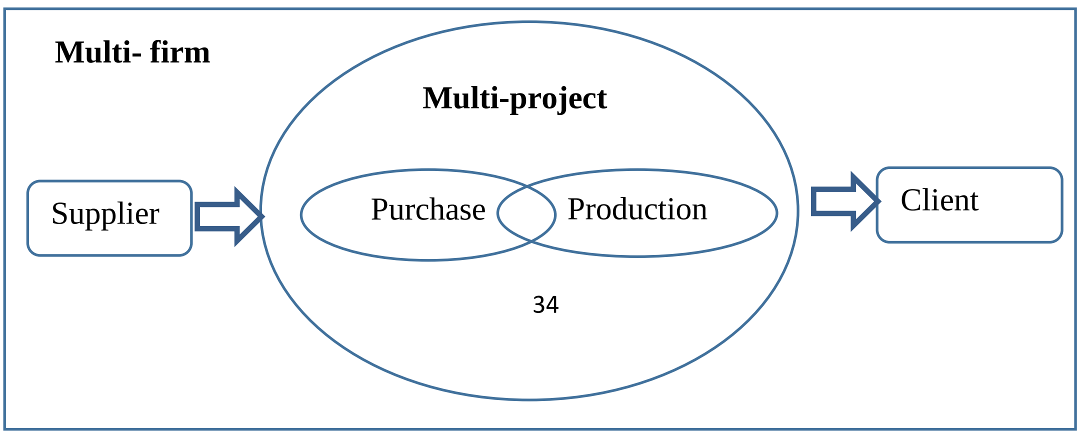

Figure 2.2: Typical construction project supply chain
Source: Kalyan et al (2007)

2.11 Construction Project Performance Measurements

Time, cost and quality are the basic criteria to project success; nearly every related article mentions these three and point out their importance in a construction project and in the views of project participants, such as Hatush and Skitmore (1997). Atkinson (1999) identified these three criteria as the 'Iron Triangle'. While some different definitions about project management have been made, the criteria for success, namely cost, time and quality remain and are included in the actual description. This study focuses on the three elements of cost, time and quality to measure the success of construction projects under review.

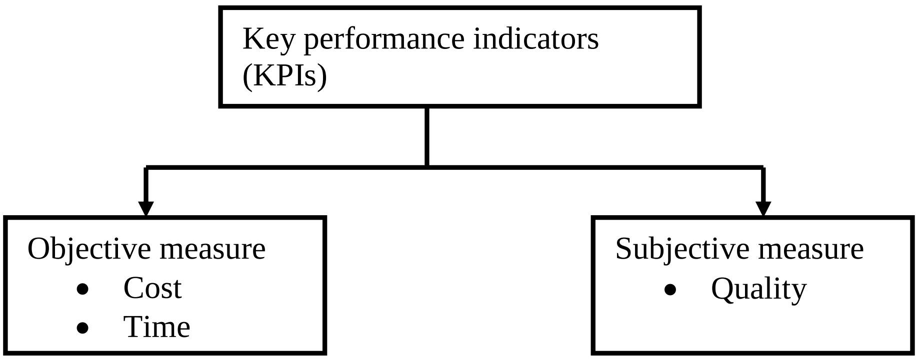

Figure 2.3: Key Performance Indicators (KPIs)
Adopted from Chan (2001)

2.12 Construction Project Performance Metrics

2.12.1 Cost

According to Bubashait and Almohawis, (1994), Cost is the degree to which the general conditions promote the completion of a project within the estimated budget. Cost is not confined to the tender sum only but it is the overall cost that a project incurs from inception to completion; so it includes any costs that arise from variations and modification during construction period and the cost created by the legal claims, such as litigation and arbitration. The measure of cost can be in form of unit cost or percentage of net variation over final cost. Percentage net variation over final cost (%NETVAR) is the ratio of net variations to final contract sum expressed in percentage term. It gives an indication of cost overrun or underrun. Yeong's (1994) approach in measuring cost is used where

$$: \%NETVAR = \frac{\text{Net Value of Variations}}{\text{Final Contract Sum}} \times 100\%$$

Where

Net Value of Variations = Final Contract Sum –Base

Base = Original Contract Sum + Final Rise and fall –Contingency Allowance

This study used Percentage net variation over final cost to gauge cost overrun/ underrun of NIB construction projects.

2.12.2 Time

Time is another important measure. Time is the duration for completing the project. It is scheduled to enable the building to be used by a date determined by the client's future plans (Hatush and Skitmore, 1997). From Naoum (1994) and Chan (1997), time can be measured in terms of construction time, speed of construction and time overrun. Construction Time is the absolute time that is calculated as the number of days/weeks from start on site to practical completion of the project. Construction time = Practical Completion Date –Project Commencement Date. Time variation is measured by the percentage of increase or decrease in the estimated project in days/weeks, discounting the effect of Extension of Time (EOT) granted by the client.

$$\text{Time overrun/underrun} = \frac{\text{Construction Time} - \text{Revised Contract Period}}{\text{Revised Contract Period}} \times 100\%$$

Where;

Revised Contract Period = Original Contract Period + EOT

2.12.3 Quality

Quality is another basic criterion that is heavily referred to by previous researchers. However, the assessment of quality is rather subjective. In the construction industry, quality is defined as the totality of features required by a product or services to satisfy a given need; fitness for purpose (Parfitt and Sanvido, 1993). Nowadays, quality is the guarantee of the products that convince the customers or the end-users to purchase or use. Specification is one of the criteria that were advocated by Songer et al. (1996). They defined it as the workmanship guidelines provided to contractors by clients or client's representative at the commencement of project execution. The measure of technical specification is to what extent the technical requirements specified can be achieved. Actually, technical specification is provided to ensure that construction projects are built to good standard and by proper procedure. Freeman and Beale (1992) extended the definition of technical performance with scope and quality. So, meeting technical specification is grouped under the ‘quality’ category. The measurement of quality will be measured subjectively.

In other words, in order to conduct a research, suitable methodologies defining how the research shall be conducted and specific research approach and methods fitting the methodology should be employed (Silverman, 2001).

2.13 Theoretical Framework

The research embraced Kombo and Tromp (2006) view of a theoretical framework as an idea that accounts for or explains a phenomena and attempts to clarify why things are the way they are based on theories.

Optimization theory

This study adopted optimization theory described by Joydeep (1968) as the art, science or mathematics of choosing the best among a given set of finite or infinite alternatives in any subject cutting through the boundaries of mathematics, economics, engineering, or natural sciences. Joydeep (1968) traced the beginning of the modern methods of optimization to the growth of the Calculus of Variations in 1696 when Johann Bernoulli proposed the famous Brachistochrone problem (Figure 2.4) which seek to measure the curve along which a particle moving from one point to another in a vertical plane does so in minimum time.

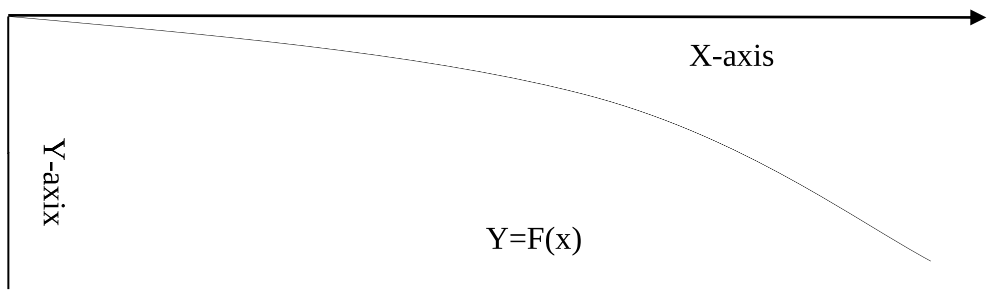

Figure 2.4: Brachistochrone curve
Source: Joydeep (1968)

2.14 Empirical Literature

Project Management Institute (2004) while citing Project Management Book of Knowledge suggests that the success or failure of a project is measured by the difference between what is expected of a project both during and after its completion and the actual observed performance of the project. In other words, when the expectations of the client and other stakeholders in terms of cost, completion time and quality are not matched by the actual construction by contractors and other project teams, the project is judged to be a failure (Ikediashi et al 2014). Kaming et al. (1997) investigated factors responsible for failure of 31 high-rise projects in Indonesia and discovered cost, time overruns and quality are the most critical. Kaming et al. (1997) however discovered that cost overruns were more severe than time overruns.

The search for factors that contribute to the success or failure construction projects has caught the attention of many scholars and construction practitioners over the years. This is because identifying project failure factors could aid prevention, management or control of these failures by the project team and contractors alike through systematically and objectively evaluating their projects.

The construction industry reforms in the UK sought to transform the unenviable adversarial track record of the sector into one that is more relational and achieve success in construction projects by emblazing a contractor-centric focus of SCM practices and dynamic in inter-organizational trust development that has contributed towards long-term construction project performance improvements (Green *et al.*, 2005). Failure to integrate suppliers and consultants into collaborative framework agreements has been a major shortcoming of these recent collaborative efforts Kumaraswamy *et al.* (2010) and limited research has discussed issues related to integration of SCs and suppliers into collaborative arrangements.

In Malaysia, a survey amongst SCs also revealed contractors poor performance resulting from bad practices such as late payments, charging fees to tender for work, award of contracts based on cheapest price rather than best value, demand of retrospective discounts and demand of cash rebates from suppliers (Hurley, 2012).

In South African the government insisted on a SCM that focus on eliminating health and safety (H&S) failures and cost overruns (CIDB, 2009). The South African government therefore recognize the crucial role that SCM can play in performance of the sector.

In Nigeria, Saka and Mudi, (2007) observed that supply chain management practices in building constructing firms in the Lagos metropolitan area could influence successful construction project delivery.

In Kenya most construction projects failed to meet their cost projections, time schedules and quality demands (Gwaya et al, 2014). This trend was undermining the Kenyan growth and development and achievement of the Kenyan vision 2030 was at risk. Previous studies had tried to address construction project failures in Kenya through improved project planning (Muchungu 2012), resource management (Masu 2006) and variations control (Gichunge 2000) but construction project failures were still high.

It is apparent from these studies particularly in in the Kenyan context that there is relatively little coverage on SCM factors as contributors of construction project failures. It is clear that majority of these studies argue that most failures are closely aligned to construction risks and project management.

Ragatz et al. (1997) has also pointed out that various SCM practices have an impact on various aspects of competitive advantage (such as price/cost) stating that strategic supplier partnership can improve supplier performance and reduce time to market while maintaining a level of customer responsiveness and satisfaction. Suhong et al (2004) discovered that SCM practices impacts positively on competitive advantage and to organization performance. It is evident that effective implementation of SCM practices improves manufacturing projects performance.

Donlon (1996) describes what he perceives as the latest evolution of SCM practices, to include supplier partnership, outsourcing, cycle time compression, continuous process flow, and information technology sharing. Alvarado and Kotzab (2001) include in their list of SCM practices concentration on core competencies, use of inter-organizational systems, and elimination of excess inventory levels by postponing customization toward the end of the supply chain. In their empirical study, Tan et al. (2002) identify six aspects of SCM practice through factor analysis: supply chain integration, information sharing, supply chain characteristics, customer service management, and geographical proximity and just in time (JIT) capability.

Chen and Paulraj (2004) used SCM factors such as supplier base reduction, long-term relationship, communication, cross-functional teams and supplier involvement to measure SCM maturity and discovered that companies with more maturity performed better than their counterparts.

The extent to which SCM practices had been embraced in the Kenyan construction industry was not known or understood. Furthermore the impacts of SCM practices on project performance in Kenya have never been verified. This study intended to assess the degree of SCM practices entrenchment and determine the effects of SCM best practices on the project performance of construction projects in Kenya.

2.15 Conceptual Framework

Kombo and Tromp (2006) view a concept as a word or phrase that symbolizes several interrelated ideas which does not need to be discussed to be understood (Smyth, 2004).The study adopted Donald and Delno (2006) view of a conceptual framework as a general idea inferred or derived from specific instances that explains the possible connection between variables. Previous studies have related better performance of projects to effective implementation of SCM practices with Womack et al., (1990) affirming that enterprises implementing best practices usually perform better than those that do not and (Voss, 1995) lamenting that enterprises seek best practice as the basis of their operations strategy while Roth & Martin, (2000) affirm that firms achieve the expected benefits with effective implementation of SCM practices.

Figure 2.5 below presents the SCM framework developed in this study. The researcher conceptualized in the study that improved implementation of SCM practices can improve construction project performance either directly or indirectly through Supply chain system integration.

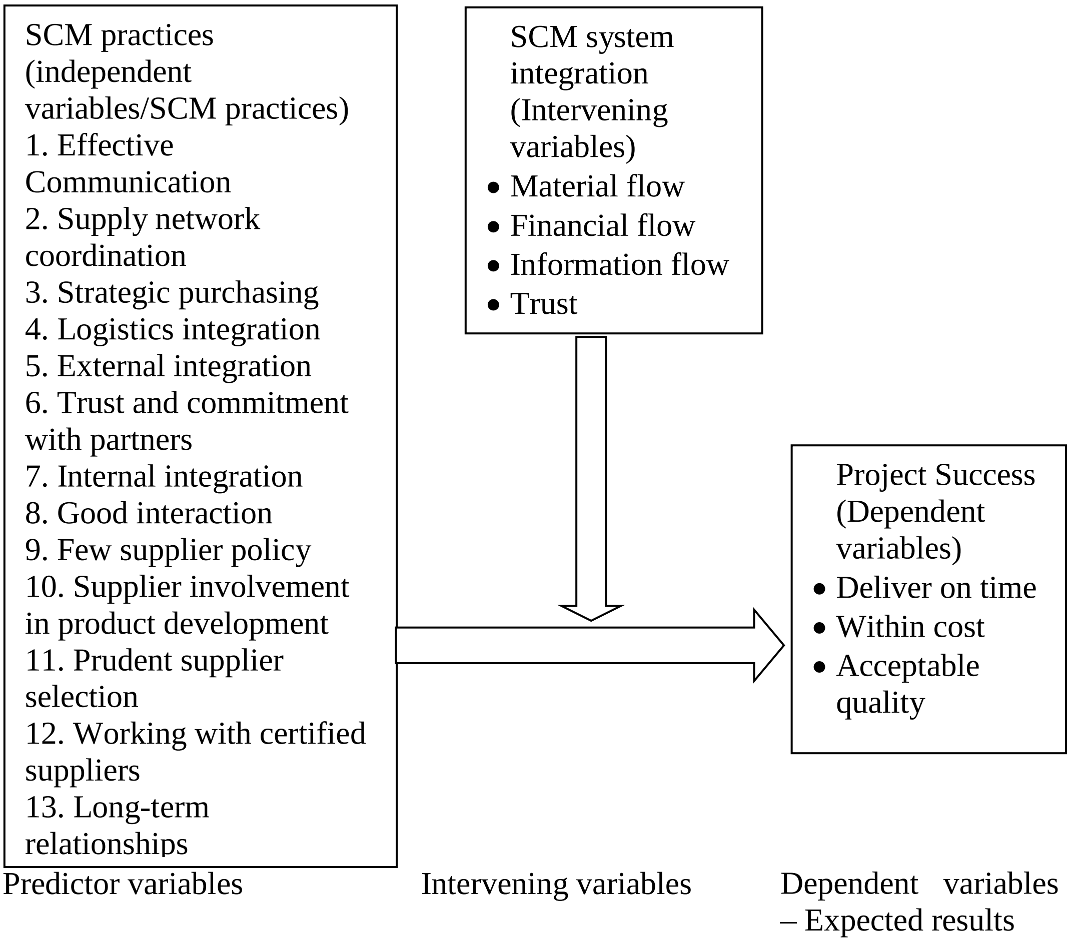

Figure 2.5: Conceptual framework
Source: Chen and Paulraj (2004)

2.16 Research Gaps

Although prior research has been done that show SCM practices as a principal factor in overall organizational performance (Suhong Lia et al. 2004), little has been done to relate SCM practices to construction project performance in Kenya. Research with regard to entrenchment and implementation of supply chain management practices in construction firms has not been done in Kenya. Previous studies have focused on the general causes of delays in construction firms (Muchungu 2012; Masu 2006; Gichunge 2000) and this has contributed to limited knowledge on the factors determining the success or failure of construction firms. There is therefore limited understanding and knowledge on the extent to which supply chain management practices are adopted by construction firms in Kenya and how this affects their performance. This research will, therefore, seek a deeper understanding on how these supply chain management practices are entrenched and also implemented in various construction firms in Kenya and whether this has any effect on the performance of the studied construction firms. The performance of the construction firms will be determined through the level of quality, cost of production and also time variation.

CHAPTER THREE

3. RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter deals with the description of the methods applied in carrying out the study. It is organized under the following sections: research design, research site, population, sampling techniques, research instruments, and data collection procedures and data analysis.

3.2 Research Design

The purposes of research can be categorized as exploratory, descriptive and explanatory (Saunders et al., 2007). An exploratory study is described as finding out what is happening, and asking questions and assessing phenomena in a new light; a descriptive study described as portraying an accurate profile of persons, events or situations; and an explanatory study described as establishing causal relationships between variables. This research study adopts cross-sectional survey research design. According to Saunders et al. (2007) cross-sectional survey research design study establishes causal relationships between variables. This study sought to establish the causal relationship between Supply Chain management practices and project performance. According to Cooper and Schindler (2003), descriptive survey research focuses on finding out who, what, where, when and how much. Mugenda and Mugenda (2009) contend that a descriptive survey enables researchers to summarize and organize data in an effective and meaningful way. This study sought to establish 'how' the various aspects of supply chain management practices influence the performance of construction projects. Descriptive statistics involves organization, summarization, and display of data. A cross-sectional study, according to Saunders et al. (2009), seeks to measure the relationship of variables at a specified time so as to describe the incidence of a phenomenon and how the variables are related. Furthermore, descriptive statistics was used to prepare the data for further statistical analysis and therefore provide for generalization from the study sample to the study population. Statistical analysis provided the basis for establishing the probabilistic causation between the research variables, testing of the research hypothesis, and making of conclusions.

3.3 Research Site

The study was carried out in Kenya. Purposive sampling was used to select NIB. This was because of their large 2012/2013 budget allocation of 11.8 billion as compared to the Kenyan overall infrastructure budget of 220 billion per year (Cecilia M. and Maria S. 2011). NIB also had diverse representation of contractors from the highest class to the lowest class. This formed a fair representation of the contractors working in Kenya. National irrigation Board is a statutory non- profit making parastatal established under Irrigation Act Cap 347 mandated with Construction, rehabilitation, operation & maintenance of major irrigation & drainage infrastructure among other functions. In 2013/14, NIB budget allocation was Ksh. 11.8 billion for scaling up of irrigable land and other irrigation infrastructure projects.

3.4 Study Population

There were 199 construction firms listed in the NIB register of contractors in the year 2013 (Table 3.1). The sample of the study was drawn from all the 199 contractors.

The respondents included construction managers, senior to middle level supply chain managers and NIB project engineers supervising them.Their hands on experience made them the most suitable targets for the study.

3.5 Sampling Technique

The following formulae were used:

To calculate the infinite population (Cochran formula)

$$n_0 = \frac{z^2 pq}{e^2} \quad \text{.. (i)}$$

Where n_o = the sample size

Z^2 = is the abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level, e.g., 95%). Z is found in statistical tables which contain the area under the normal curve

p = the estimated confidence level, e.g., 95%), z^2pq

e = the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and

q = 1-p noting that the value for.

(i) To calculate the sample size of the finite population (Cochran formula) was used:

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \quad \text{.. (ii)}$$

Where N = total population

n = the sample size

n_o = infinite population.

(ii) To calculate the stratified sample size, (Cochran formula) was used.

$n_c=(N_c/ N) \times n$………………………………………………….. (iii)

Where n_c = the sample size for stratum

N_c = the population size of stratum

N = the total population and

n = the total sample size

Table 3.1: Sampling table

Category (strata)	Value limits (ksh.)	Strata	Strata size (n)	Sample Size $n_c= (N_c / N) \times n$
A	Unlimited	Large	16	5
B	Up to Ksh 250,000,000			
C	Up to Ksh 150,000,000	Medium	130	42
D	Up to Ksh 100,000,000			
E	Up to Ksh 50,000,000			
F	Up to Ksh 20,000,000	Small	53	18
G	Up to Ksh 10,000,000			
H	Up to Ksh 5,000,000			
TOTAL (N)			199	65

Source: Ministry of Roads categorization (2013)

3.6 Research Instruments

The survey instruments developed in this study consisted of a structured questionnaire with three main sections. The study collected both primary and secondary data using questionnaires divided in three sections. The first section consisted of 13 questions that were intended to measure the degree of utilization of SCM practices and determine the SCM practice maturity of the sampled firms; section 2 sought to find out from the respective firms and NIB project engineers the project performance of undertaken projects based on cost and time and quality elements, while section 3 was meant to capture the extent to which the integration of the supply chain system consisting of the flow of material, information and capital impacts on project performance. According to Mugenda and Mugenda (2009) questionnaires are the most appropriate tools in survey research and also when there are a relatively large number of sampled respondents and the foregoing argument is in line with this study.

Both primary and primary and secondary data was being collected. Primary data is the data directly from the source. Secondary data is information collected from someone or organization other than the source to resolve a research problem.

3.7 Data Collection Methods

The researcher used both primary Questionnaires and secondary data comprising published documents and government publications. The questionnaire contained closed ended questions. The questionnaire was used because it helped in collecting a large volume of data, easy to be administered, save time and enabled collection of quantitative data for the study. The questionnaires were self-administered to the respondents.

3.8 Validity and Reliability of Research Instrument

3.8.1 Validity

The most important criterion of research is validity. Validity is concerned with the integrity of the conclusions that are generated from a piece of research. It is the degree to which an instrument measures what it purports to measure. It estimates how accurately the data in the study represents a given variable or construct in the study (Mugenda & Mugenda, 2009). Validity suggests fruitfulness and refers to the match between a construct, or the way a study conceptualizes the idea in a conceptual definition, and the data. There are various types of validity but in the context of this study, content validity was determined. To establish the content validity of the research instrument the study sought the opinions of experts in the field of study especially the study's supervisors and lecturers in the school. This facilitated the necessary revision and modification of the research instrument thereby enhancing its validity. Mugenda and Mugenda (2009) contend that the usual procedure in assessing content validity of a measure was to use a professional or expert in a particular field

3.8.2 Reliability

Reliability is the tendency towards consistency (Shanghverzy, 2003) and therefore, different measures of the same concept or the same measurements repeated over time should produce the same results. Reliability is synonymous with the consistency of a test, survey, observation, or other measuring device. The index alpha of 0.7 is the most important index of internal consistency and is attributed as the mean of correlations of all the variables, and it does not depend on their arrangement (Anastasiadou, 2006). Reliability is increased by including many similar items on a measure, by testing a diverse sample of individuals and by using uniform testing procedures. It is commonly used in relation to the question of whether the measures that are devised for concepts in business are consistent. A Cronbach's alpha (Cronbach coefficient alpha), which is based on internal consistency was calculated using SPSS to establish the reliability of the survey instrument. This methodology measured the average of measurable items and its correlation. Petzer and Mackay quoted from Pallant (2010) that Cronbach's alpha value that is at least 0.70 suffices for a reliable research instrument. In this study a threshold of 0.70 was used to establish the reliability of the data collection instrument. Cronbach's alpha value was used because it has the highest threshold and most stable measure of reliability outcome in research compared with split half reliability method which has a threshold of 60% of 0.6 and test -retest method which has a threshold of 0.5 (Copper and Schilder, 2009). According to Eisinga et al. (2013), a commonly accepted rule of thumb for describing internal consistency is as follows:

Table 3.2: Acceptance Cronbach's alpha Value rule of thumb

Cronbach's alpha	**Internal consistency**
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Source: Eisinga et al (2013)

3.9 Data Analysis

Before processing the responses, the collected data will be prepared for statistical analysis. Validation and checking is done after the questionnaires is received from the field. Responses are checked for clarity, legibility, relevance and appropriateness.

Moreover, the questionnaires is edited for completeness and consistency. Coding is done on the basis of the locale of the respondents. Quantitative data will be analyzed using descriptive and inferential statistics. Descriptive statistics includes percentages, frequencies, means, and standard deviations while inferential statistics included factors analysis and regression analysis.

The mean will be calculated using the following formula:

M = (f x m)/ R

Where f = frequency or number of companies using a particular variable

M = Mean

f = number of respondents.

m = level of maturity.

R = number of total respondents.

Table 3.3: Example of calculated means

Description of variable	Maturity(M)						Standard deviation
	Always - 5	Mostly - 4	Frequently - 3	Sometimes - 2	Never - 1	Mean	

Supply chain wide inventory is jointly managed with suppliers and logistics partners	0	13	34	7	0	3.11	0.60
Distribution networks are configured to minimize total supply chain-wide inventory costs.	0	14	33	7	0	3.12	0.62
Inventory holdings are minimized across the supply chain.	1	23	23	7	0	3.33	0.73
Suppliers and logistics partners deliver products and materials just in time.	24	13	12	5	0	4.03	1.27

Source: Own survey (2013)

Based on the objectives, this study will use multiple regression analysis which help to generate a weighted estimation equation used to predict values (Cooper & Schindler, 2003) for dependent variable from the values from several independent variables. The study will seek to predict performance of construction project due to a dynamic supply chain management practices. It will also seek to predict the moderating effect of supply chain management system integration on the relationship between supply chain management practices and construction project performance for the National Irrigation Board construction projects. Inferential analysis will be used to examine the relationship between supply chain management practices and project performance in National Irrigation Board projects through the use of multiple analysis. Furthermore, the researcher will use confirmatory factor analysis, testing for correlations and selection of supply chain management practices through communality loading to ascertain model fitness and significance of the variables. The research will test hypothesis at 95% level of confidence in order to provide for drawing conclusions. According to Mugenda and Mugenda (2003) a lower confidence level than 95% is too low while a higher one would introduce financial constraints. Results of quantitative data analysis will be presented using charts and tables. The study will use multiple regression models that involve analyzing moderation and mediation effects of SCM practices and supply chain management system integration on construction project performance in NIB construction projects. The use of multiple regression models is best suited to test the strength of the effect of the variables determined by use of sobel test approaches (Henseler et al., 2009). To establish the effect of SCM practices on NIB construction Project performance, the model below (Mugenda and Mugenda 2003), denoting the relationship between SCM practices and construction project performance will be used;

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$……........................Equation (i)

Where Y= Construction Project Performance

$X_{1=}$ Strategic supplier partnership,

X_2= Customer relationship

$X_{3=}$ Information Sharing

$X_{4=}$ Sourcing

β_1, β_2, β_3, $\beta_{4,}$ β_5 and β_6 = Beta coefficients and

ε = Error term

To establish the effect of SCM system integration on NIB construction Project performance, the model below, (equation ii) (Mugenda and Mugenda 2003) denoting the relationship between supply chain management integration and construction project performance will be used.

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$ ………………… Equation (ii)

Where;

Y = Construction Project Performance

X_1= Physical Flow

X_2= Information Flow

X_3= Financial Flow

X_4= Trust Development

β_1, β_2, β_3, β_4, β_5 and β_6 = Beta coefficients and

ε = Error term

3.9.1 Moderating test

Moderation occurs when the variable, say M, alters the relationship between the variables, say X and Y, by enhancing, strengthening or weakening the relationship (Sauer & Dick, 1993). Moderating will be tested using equation iii. In this equation, the test coefficient on XM (i.e., β_5) is used to moderate.

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5M + \varepsilon$ …………… Equation (iii)

Where;

Y = Construction Project Performance

X_1= Strategic supplier partnership,

X_2= Customer relationship

X_3= Information Sharing

X_4= Sourcing

M = Integrations (X_1= Physical Flow, X_2= Information Flow, X_3= Financial Flow and X_4= Trust Development)

β_1, β_2, β_3, β_4, β_5 and β_6 = Beta coefficients and

ε = Error term

3.9.2 Extraction method employing principal component analysis

Principal components analysis is a method of data reduction to only those that contribute significantly to the attributes under consideration. Table 3.4 below show an example of the values and variables to be used in the analysis.

Table 3.4: Descriptive statistics

Independent variables	Mean	Standard deviation	Analysis N
Effective Communication	2.48	.58	54
Supply network coordination	3.11	.69	54
Strategic purchasing	3.14	.68	54
Logistics integration	2.91	.51	54
External integration	3.09	.55	54
Trust and commitment with partners	3.15	.59	54
Internal integration	3.43	.81	54
Good interaction	3.44	.72	54
Few supplier policy	3.74	.97	54
Supplier involvement in product development	3.65	.91	54
Prudent supplier selection	3.74	.97	54
Working with certified suppliers	3.76	.95	54
Long-term relationships	3.80	1.01	54

Source: Own survey (2013)

Mean – these are the means of the variables used in the factor analysis

Std. Deviation – these are the standard deviations to be used in the factor analysis

Analysis N – this is the number of cases to be used in the factor analysis.

The communalities Table (3.4) below are computations of the extent to which a variable is explained by the components. Variables with low communalities indicate that they are less well explained than any other variables.

Table 3.5: Communalities

Independent variables	Initial	Extraction
Effective Communication	1.000	0.945
Supply network coordination	1.000	0.916
Strategic purchasing	1.000	0.994
Logistics integration	1.000	0.921
External integration	1.000	0.922
Trust and commitment with partners	1.000	0.883
Internal integration	1.000	0.838
Good interaction	1.000	0.804
Few supplier policy	1.000	0.660
Supplier involvement in product development	1.000	0.878
Prudent supplier selection	1.000	0.939
Working with certified suppliers	1.000	0. 572
Long-term relationships	1.000	0.891

Source: Own survey (2013)

Initial value of the communality in a principal components analysis is 1. The values in the extraction column indicate the proportion of each variable's variance that can be explained by the principal components.

Table 3.6 below indicate the variances of the principal components.

Table 3.6: Total Variance Explained

SCMP	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var	Cum %	Total	% of Var	Cum %	Total	% of Var	Cum %
1	4.578	26.930	26.930	4.578	26.930	26.930	3.111	18.302	18.302
2	3.659	21.525	48.455	3.659	21.525	48.455	2.699	15.877	34.179

3	2.178	12.814	61.270	2.178	12.814	61.270	2.440	14.356	48.535
4	1.567	9.216	70.486	1.567	9.216	70.486	2.179	12.815	61.350
5	.854	7.809	78.295						
6	.810	6.586	84.881						
7	.788	4.636	89.518						
8	.703	4.135	93.652						
9	.472	2.778	96.430						
10	.327	1.921	98.351						
11	.135	.791	99.143						
12	.087	.511	99.653						
13	-6.508E-16	-3.828E-15	100.000						

Source: Own survey (2013)

Eigenvalues are the variances of the principal components. When the principal components analysis is conducted on a correlation matrix, the variables are standardized which means that each variable has a variance of 1, and the total variance is equal to the number of variables used in the analysis, in this case 13. The total column contains the eigenvalues. The first component will always have the highest eigenvalue and the next will account as much of the left over variance as it can and so on. The percent variance column contains the percent of variance accounted for by each principal component while the cumulative variance contains the cumulative variance accounted for by the current and all preceding principal components. The three right most columns of Total Variance Explained contain the most important information on this table. In this table, 4 factors have been saved. The analysis assumes that the 13 original values can be reduced to 4 underlying factors. These are the factors that explain most of the variance in the data.

Table 3.7 below contain components loadings which are the correlations between the variable and the components extracted in Table 3.6.

Table 3.7: Component matrix

Independent variables	1	2	3	4
Effective Communication	.842			
Supply network coordination	.711			
Strategic purchasing	.696			.598
Logistics integration	.650		.619	
External integration	.599	.322		.405
Trust and commitment with partners	.599			.311
Internal integration	.586	.459	.338	.358
Good interaction	.582	.553		.471
Few supplier policy	.564	.468		
Supplier involvement in product development	.477	.459		.475
Prudent supplier selection	.372		.779	
Working with certified suppliers	.337	.736	.472	
Long-term relationships	.354		.346	.516

Source: Own survey (2013)

The column under the components heading contain components that have been extracted in Table 3.6.

The rotated component matrix (Table 3.8) sometimes referred to as the loadings is the key output of principal component analysis. It contains estimates of the correlations between each of the variables and the estimated components. Typically, correlations of less than 0.4 are regarded as trivial.

Table 3.8: Rotated component Matrix

Independent variables	1	2	3	4
Effective Communication			.915	

Supply network coordination	.945			
Strategic purchasing	.967	.740		
Logistics integration	.668	701	.417	
External integration	.762			
Trust and commitment with partners		.822		
Internal integration	708			
Good interaction	.481	.529		
Few supplier policy			.913	
Supplier involvement in product development	.563			
Prudent supplier selection	.438		.683	.788
Working with certified suppliers				812
Long-term relationships		.898		

Source: Own survey (2013)

3.9.3 Test of Significance

Analysis of variance will be used to test whether the overall models were statistically significant by indicating whether or not R^2 could have occurred by chance alone. The F-ratio generated in the ANOVA table measures the probability of chance departure from a straight line. The p value of the F-ratio generated is supposed to be less than 0.05 for the equation to be statistically significant at 95% confidence level. The outcome of multiple regression models could be accepted at 90%, 95% and 99% (Kothari, 2004). The study used the common confidence level of P-value at 95 % confidence level of 0.05 significant values due to quantitative nature of the study where P Value less that 0.05 would be acceptable. Where the study had has precision and confidence level of a question with finite population then the equation would accept results at 99% at 0.01 significant level (Bland & Peacock, 2002). Use of 90% confidence level was not used in the study due to high level of standard error within the sample. For the individual variables, p values of their coefficients generated in the regression analysis must be less than .05 for their relationship to be concluded significant at 95% confidence level. Principal Components Analysis regression method that cut the number of predictors to a smaller set of uncorrelated components was used to control multi-collinearity and autocorrelation.

CHAPTER FOUR

4. RESULTS, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents results of data collected, analysis, interpretation and discussion. The chapter is organized into sections beginning with questionnaire responses followed by implementation of SCM practices then Firms project performances followed by material, financial, information (flows) and trust integration and finally the impacts of SCM practices and project performance of the firms. Findings on the degree of entrenchment of SCM practices were presented on a 5-point Likert scale form where 5 points indicated the highest level with 1 point indicated the lowest level. Project quality, cost and time performances were presented on their percentage variations. Standard deviations were also used to indicate the degree of unanimity on responses or the extent of dispersal of responses from the mean.

4.2 Response Rate

Out of the 65 targeted respondents 54 respondents responded to the questionnaires (Table 4.1).

Table 4.1: Questionnaire response rate

Category of the respondent's firm	Sample Size	Responses	Response rate
Big companies	5	4	70.0
Medium companies	42	35	83.3
Small companies	18	15	83.3
Total	**65**	**54**	**83.1**

Source: Own survey (2013)

This represented a 83.1% response rate which was considered sufficient for analysis and reporting basing on a recommendation by Mugenda and Mugenda (2003) who advocates a response rate of 50%, 60% of 70% as sufficient for research purposes using questionnaire in data collection approach.

Figure 4.1 on the other hand reveals that 4 out of 5 of the sampled big companies responded, 35 out of the sampled 42 Medium companies responded while 15 out of the sampled 18 Small companies responded translating to 7 percent, 65 percent and 28 percent of the total respondents respectively. Further analysis indicates that Medium companies registered better response than the rest while big companies registered the least. This was attributed to their tall structure that hindered direct access to the intended respondents. Small companies had also some challenges since some of them had no permanent addresses while others had moved to other areas. The good response rate for Medium companies was attributed to their ease of access.

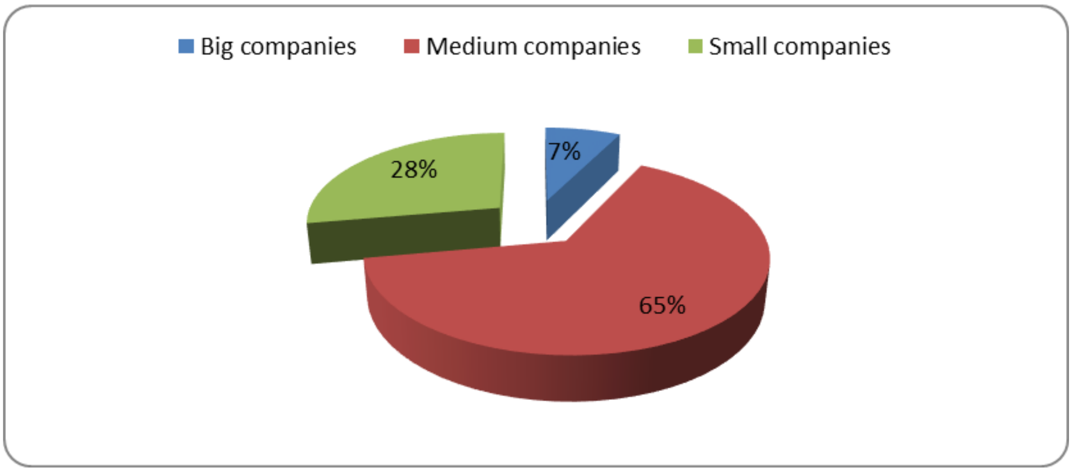

Figure 4.1: Questionnaire response rate

Source: Own survey (2013)

4.3 Reliability Results

Table 4.1 illustrates the findings of the study concerning the reliability analysis. In this study, reliability was ensured through a piloted questionnaire that was subjected to a sample of 5 respondents, who were not included in the study. The 5 respondents were selected from National Irrigation Board contractors. According to Mugenda and Mugenda (2003), The reliability results for physical flow and supply chain management maturity had 0.8158 and 0.8385 cronbach value which was $0.9 > \alpha \geq 0.8$ hence internal consistency was good while financial flow integration, information flow integration and trust integration had Cronbach values 0.7194, 0.7614 and 0.7785 meeting the criterion $0.8 > \alpha \geq 0.7$ making the internal consistency of the instrument acceptable. This implied that the instrument used to collect data was reliable.

Table 4.2 illustrates the findings of the study concerning the reliability analysis. In this study, reliability was ensured through a piloted questionnaire that was subjected to a sample of 5 staff which constituted 10% of the study sample (Mugenda and Mugenda , 1999) that was selected through simple random to avoid biasness, who were not included in the study. The 5 staffs were selected from National Irrigation Board. The reliability results for physical flow and supply chain management maturity had 0.8158 and 0.8385 Cronbach value which was $0.9 > \alpha \geq 0.8$ hence internal consistency was good while financial flow integration, information flow integration and trust integration had Cronbach values 0.7194, 0.7614 and 0.7785 meeting the criterion $0.8 > \alpha \geq 0.7$ making the internal consistency of the instrument acceptable. This implied that the instrument used to collect data was reliable.

Table 4.2: Reliability Results

Variable	Cronbach's… alpha value	No of items
Physical Flow	0.8158	5
Financial Flow integration	0.7194	5
Information flow integration	0.7614	4
Trust integration	0.7785	6
SCM maturity	0.8385	5

Source: Own Survey (2013)

4.4 Validity Outcomes

Validity is the accuracy or meaningfulness and technical soundness of the research. It was the degree to which a test measures what it purports to measure. Mugenda and Mugenda (1999), stated that to enhance validity of a questionnaire, data should be collected from reliable sources, the language used on the questionnaire was kept simple to avoid any ambiguity and misunderstanding. The validity of data collected was made through collecting data from the relevant respondents having been permitted by the management of the National Irrigation Board. The validity of the instrument was established by being given to experts with experience in the supervisor who approved the instrument for data collection.

4.5 NIB Construction Projects Performance

To determine the effect of the implementation of supply chain management practices in NIB construction project performance, the study sought to determine the NIB construction project performances in the sampled firms.

4.5.1 Cost overruns

The objective of measuring cost overruns was to finally enable the determination of the overall performance of the NIB construction projects.

In Table 4.3 below, results show that 74% of respondents exceeded the projected cost with few respondents (26%) saying they completed their projects within the estimated cost. 46% of respondents indicated that they exceeded the budgeted cost by 1-5% while 26% and 2% of respondents had experienced 5-10% and over 10% of cost overruns respectively. Tolerance for cost overruns was +/- 5%.

Table 4.3: Cost performance of NIB construction projects

Percentage of Cost overrun	Frequency	Percent %	Cumulative %
<1%	14	26	26
>1-5%	25	46	72
>5-10%	14	26	98
>10-15%	1	2	2
More than 15%			
Total	54		

Source: Own survey (2013)

4.5.2 Time performance

The objective of measuring project delivery performance was to finally enable the establishment of the overall performance of the NIB construction projects. Figure 4.2 reveals that most projects faced the problem of time overruns with only 2% of respondents completing their projects within the stipulated time. Majority of respondents (44%) exceeded their projected time by 5-10%, 15% of respondents exceeded their time by 1-5%, while 31% and 7% experienced 10-15% and 7% of time overruns respectively. This shows that time overruns is a common phenomenon in the construction industry.

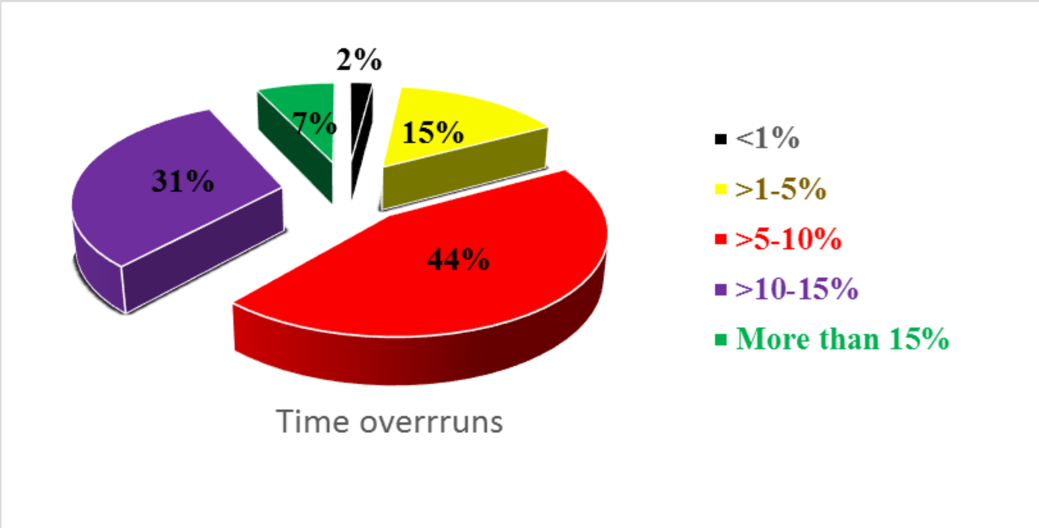

Figure 4.2: Time underperformance of NIB construction projects
Source: Own survey (2013)

4.5.3 Quality performance

The objective of measuring quality performance was to finally enable the establishment of the overall performance of the NIB construction projects. Table 4.4 and figure 4.3 shows that 37 % of respondents indicated that the quality performance of their NIB projects ranged between 80-85%, 29.6% indicated that the quality performance of their NIB projects ranged between 85-90%, 18.5 indicated that the quality performance of their NIB projects ranged between 90-95%, 13% of respondents indicated that the quality performance of their NIB projects ranged between 95-95% while only 2% of respondents indicated that the quality performance of their NIB projects was over 99%. This was an underperformance of 15-20%, 10-15%, 5-10%, 1-5% and 1% respectively.

Table 4.4: Quality of NIB construction projects

Below 80%	Frequency	Percent (%) of respondents	underperformance
<80%			
80-85%	20	37.0	15-20%
85-90%	16	29.6	10-15%
90-95%	10	18.5	5-10%
95-99%	7	13.0	1-5%
Over 99%	1	1.9	<1
	54	100	

Source: Own survey (2013)

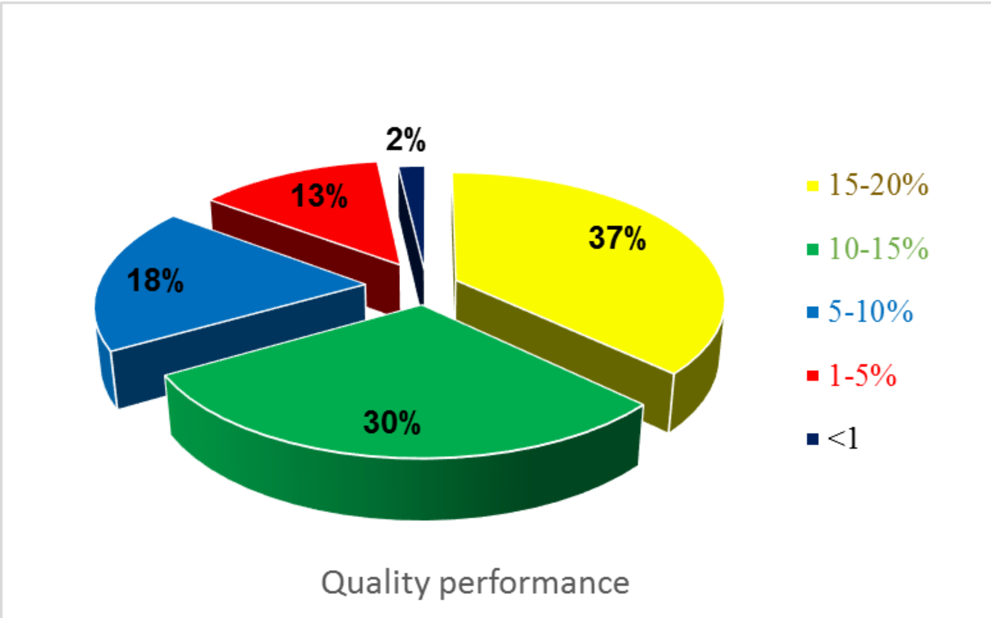

Figure 4.3: Quality of NIB construction projects

Source: Own survey (2013)

4.6 Extent of Implementation of SCM Practices

To determine the degree of implementation of SCM practices in NIB construction projects, the respondents were requested to indicate the extent to which they implemented the stated SCM Practices on a scale of 1 (never) to 5 (always). As revealed in Table 4.5, majority of the respondents indicated that long-term relationships, working with certified suppliers, prudent supplier selection and few supplier policies were the most utilized in that order as indicated by a mean of 3.80, 3.76, 3.74 and 3.74 respectively and as supported by standard deviation of 1.01, 0.95, 0.97 and 0.97. This was followed by supplier involvement in product development; good interaction and internal integration in that order as indicated by a mean of 3.65, 3.44 and 3.43 with standard deviation of 0.91, 0.72 and 0.81 respectively. The respondents indicated that trust and commitment with partners, strategic purchasing, supply network coordination, external integration, logistics integration and effective communication as the least implemented in that order as indicated by a mean of 3.15, 3.14, 3.11, 3.09, 2.91, 2.48 and a standard deviation of 0.59, 0.68, 0.69, 0.55, 0.51 and 0.58 respectively.

Table 4.5: Degree of implementation of SCM Practices in NIB projects

Independent variables	Always	Mostly	Frequently	Sometimes	Never	Mean	Standard deviation
Effective Communication	1	7	18	19	9	2.48	.58
Supply network coordination	0	15	31	7	1	3.11	.69
Strategic purchasing	1	14	31	8	0	3.14	.68
Logistics integration	1	9	36	0	8	2.91	.51
External integration	0	13	34	6	1	3.09	.55
Trust and commitment with partners	0	14	34	6	0	3.15	.59
Internal integration	1	30	15	7	1	3.43	.81
Good interaction	6	23	18	3	4	3.44	.72
Few supplier policy	8	33	7	3	3	3.74	.97
Supplier involvement in product development	13	22	6	13	0	3.65	.91
Prudent supplier selection	12	24	10	8	0	3.74	.97
Working with certified suppliers	12	24	11	7	0	3.76	.95
Long-term relationships	14	23	10	6	1	3.80	1.01

Source: Own survey (2013)

As revealed in Figure 4.4, 1.54% of the respondents indicated that they implemented the SCM best practices frequently, 81.54% of respondents indicated that they implemented the SCM best practices sometimes while 16.92% of respondents indicated that they never implemented the SCM practices.

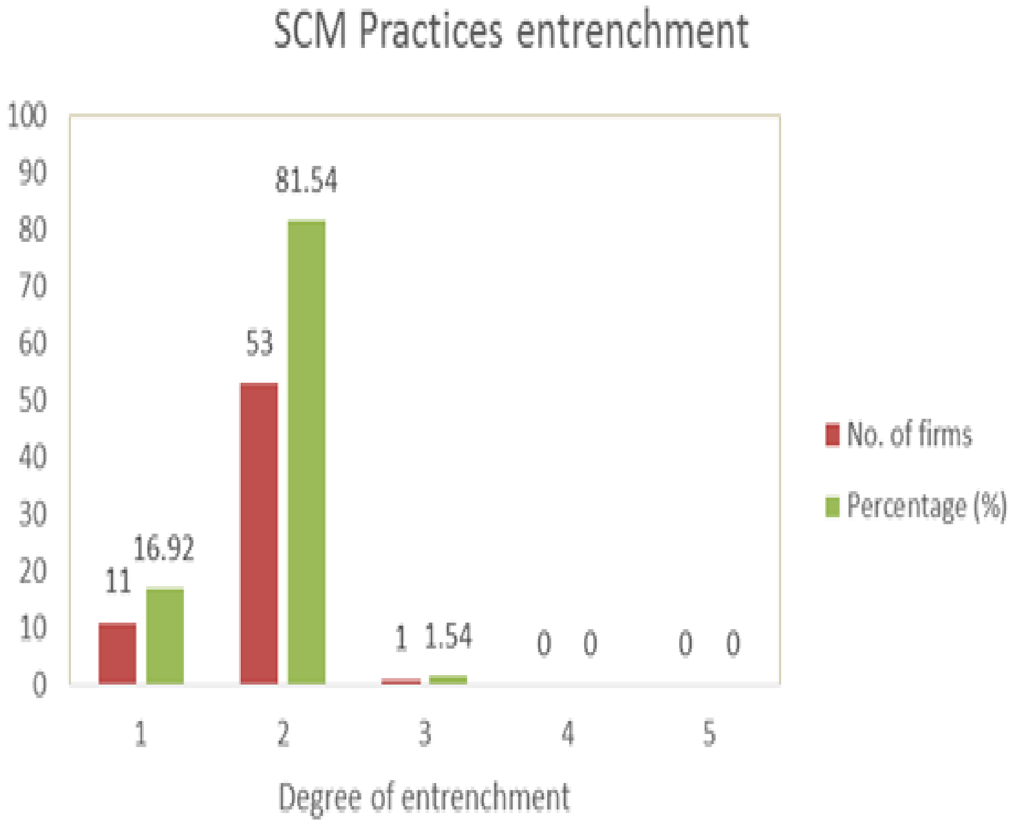

Figure 4.4: SCM practices entrenchment in Kenya.
Source: Own survey (2013)

4.7 Effect of the Implementation of SCM Practices on NIB Construction Project Performance

To establish the effect of SCM practices on project performance in construction projects, the following Mugenda and Mugenda (2003) multiple regression model was used.

$Y = a + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + e$

Where:

Y= Construction project Performance

a =Constant Term,

β_1= Beta coefficients,

X_1= Strategic supplier partnership,

X_2= Customer relationship,

$X_{3=}$ information sharing,

$X_{4=}$ Sourcing

e= Error Term

4.7.1 Factor analysis

To help the study to reduce the number of SCM practices (Factors) to only those SCM practices (Factors) that had significant variance between variables, the study undertook confirmatory factor analysis to reduce the number of SCM practices based on correlation strength of factor loading between variables. First it is important in the extraction phase to examine the communality. This is the proportion of variance that each item has in common with other factors. The communality is represented by the sum of the squared loadings for a variable across factors. The Table 4.6 below shows the estimated communality for each SCM practice. The communalities can range from 0 to 1. A communality of 1 means that all of the variance in the model is explained by the factors (variables). This is shown in the "Initial" column of Table 4.5. Although there are no 0 values; if there were, it would mean that variable (factor) contributed nothing to explaining the common variance of the model.

Table 4.6: Determination of the proportion of variance that each item has in common with other factors - Communalities (Extraction Method: Principal Component Analysis)**.**

Independent variables	Initial	Extraction
Effective Communication	1.000	0.945
Supply network coordination	1.000	0.916
Strategic purchasing	1.000	0.994
Logistics integration	1.000	0.921
External integration	1.000	0.922
Trust and commitment with partners	1.000	0.883
Internal integration	1.000	0.838
Good interaction	1.000	0.804
Few supplier policy	1.000	0.660
Supplier involvement in product development	1.000	0.878
Prudent supplier selection	1.000	0.939
Working with certified suppliers	1.000	0. 572
Long-term relationships	1.000	0.891

Source: Own survey (2013)

From the finding for example, use of strategic purchasing influence performance of the construction performance as indicated by 99.4% communality or shared relationship with other supply chain management practices that influencing project performance in National Irrigation Board construction projects. While 'strategic purchasing leads with the greatest impact on construction project performance, working with certified suppliers has the least communality or relationship with others of 57.3%.

In Table 4.7, the researcher used Kaiser Normalization Criterion, which allows for the extraction of components that have an Eigen value greater than 1. Factor 1 had Eigenvalue 4.578, factor 2 had Eigenvalue 3.659, factor 3 had Eigenvalue 2.178 while factor 4 had Eigenvalue of 1.567.

Table 4.7: Determination of SCM practices variables with most contribution - Total Variance Explained

SCMP	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var	Cum %	Total	% of Var	Cum %	Total	% of Var	Cum %
1	4.578	26.930	26.930	4.578	26.930	26.930	3.111	18.302	18.302
2	3.659	21.525	48.455	3.659	21.525	48.455	2.699	15.877	34.179
3	2.178	12.814	61.270	2.178	12.814	61.270	2.440	14.356	48.535
4	1.567	9.216	70.486	1.567	9.216	70.486	2.179	12.815	61.350
5	.854	7.809	78.295						
6	.810	6.586	84.881						
7	.788	4.636	89.518						
8	.703	4.135	93.652						
9	.472	2.778	96.430						
10	.327	1.921	98.351						
11	.135	.791	99.143						
12	.087	.511	99.653						
13	-6.508 E-16	-3.828E -15	100.000						

Source: Own survey (2013)

The contributions decrease as one moves from one factor to the other up to factor 4. The factors in the principal component analysis show individual relationships, much like the beta values in regression. In fact, the factor loadings here are the correlations between the factors and their related variables. The Eigenvalue used to establish a cutoff of factors is a value like R in regression. As with regression, the Eigenvalue represents the strength of a factor. The Eigenvalue of the first factor is such that the sum of the squared factor loadings is the most for the model. The reason the Eigenvalue is used as a cutoff is because it is the sum of the squared factor loadings of all variables (the sum divided by the number of variables in a factor equals the average percentage of variance explained by that factor). Since the squared factor loadings are divided by the number of variables, an Eigenvalue of 1 simply means that the variables explain at least an average amount of the variance. A factor with an Eigenvalue of less than 1 means the variable is not even contributing an average amount to explaining the variance.

The principal component analysis was used and four factors were extracted. As the table shows, these four factors explain 61.35% of the total variation. Factor 1 contributed the highest variation of 18. 30%. The contributions decrease as one move from one factor to the other up to factor 4. Since the first four factors were the only ones that had eigenvalues > 1, the final factor solution will only represent 61.8% of the variance in the data. The loadings listed under the "Factor" headings represent a correlation between that item and the overall factor. Like Pearson correlations, they range from -1 to 1.

4.7.2 Component matrix

Further confirmatory factors analysis, component Matrix was carried out (Table 4.8) to examine the factor matrix (Component matrix) and determine which variables could be combined (those that load together) and if any variables should be dropped.

Table 4.8: Component Matrix

Independent variables	1	2	3	4
Effective Communication	.842			
Supply network coordination	.711			
Strategic purchasing	.696			.598
Logistics integration	.650		.619	
External integration	.599	.322		.405
Trust and commitment with partners	.599			.311
Internal integration	.586	.459	.338	.358
Good interaction	.582	.553		.471
Few supplier policy	.564	.468		
Supplier involvement in product development	.477	.459		.475
Prudent supplier selection	.372		.779	
Working with certified suppliers	.337	.736	.472	
Long-term relationships	.354		.346	.516

Source: Own survey (2013)

4.7.3 Rotation of components matrix

To identify what variables fall under each of the 4 major extracted factors, the initial component matrix was rotated using Varimax (Variance Maximization) with Kaiser Normalization. Table 4.9 results allowed the study to identify what variables fall under each of the 4 major extracted factors. Each of the 13 variables was looked at and placed to one of the 4 factors depending on the percentage of variability; it explained the total variability of each factor. A variable is said to belong to a factor to which it explains more variation than any other factor. From the findings (Table 4.8), the study group the SCM practices influencing Construction project performance in NIB projects based on the factors that loads heavily to try and identify common SCM practices influencing project performance in NIB construction projects.

Table 4.9: Variables that fall under the four major extracted variables - Rotated Component Matrix

Independent variables	1	2	3	4
Effective Communication			.915	
Supply network coordination	.945			
Strategic purchasing	.967	.740		
Logistics integration	.668	701	.417	
External integration	.762			
Trust and commitment with partners		.822		
Internal integration	708			
Good interaction	.481	.529		
Few supplier policy			.913	
Supplier involvement in product development	.563			
Prudent supplier selection	.438		.683	.788
Working with certified suppliers				812
Long-term relationships		.898		

Source: Own survey (2013)

Rotation converged in 13 iterations.

The variables that loads highly on Factor 1 were labeled as Strategic supplier partnership. The variables that relate highly on factor 2 all relates on Customer relationship and so Factor 2 was labeled Factor Customer relationship. The factors that relate to communication influencing project performance for the National Irrigation Board in Factor 3 were labeled Information Sharing. The factor relating to making and delivering of goods at later date influencing project performance, Factor

4 was labeled as sourcing. From Table 4.9, the individual variables constituting the four factors extracted are summarized and identified below.

Factor1: Strategic supplier partnership

Factor 1 included Supply network coordination, strategic purchasing, supplier involvement in product development, internal integration and external integration

Factor 2 Customer relationship

Under Factor 2, the following **factors** were extracted; trust and commitment with partners, good interaction, long-term relationships, good interaction and logistics integration.

Factor 3: Information Sharing

Under Factor 3, the factor loading or correlating related to information sharing which included effective communication and little supplier policy influence performance of the construction projects.

Factor 4: Sourcing

Under Factor 4, the factor loading or correlating was sourcing of materials and goods prudent supplier selection and working with certified suppliers to influence project performance. From the factor analysis, the study reduced the supply chain management practices into four which included Strategic supplier partnership, customer relationship, information sharing and sourcing.

These were then used in the regression analysis to establish whether SCM practices had a significant effect in the NIB construction projects performance.

4.7.4 Model summary

Using the four main factors as predictors, the model column of multiple models was reduced to a single regression by SPSS command with one linear model being used to determine the influence of SCMP on project performance in NIB construction projects. R is the square root of R-Squared. R is the correlation between the observed and predicted values of dependent variable. This implies that there was association of 0.54 between Supply chain management practices and Construction project performance (Table 4.10). R-Squared is the proportion of the variance in the dependent variable of construction project performance that was explained by variations in the Strategic supplier partnership, Customer relationship, information sharing and Sourcing**.** This implied that there was a variance of 29.2% between variables in general.

Adjusted R^2=0.253, is the coefficient of determination which indicates how construction project performance varies with variation in strategic supplier partnership, customer relationship, and information sharing and sourcing**.**

Table 4.10: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics R Square Change	F Change	df1	df2	Sig. F Change
1	.54(a)	.292	.253	0.29	1.615	5	.215	5.751	.002(a)

Source: Own survey (2013)

(a) Predictors: (Constant) Strategic supplier partnership, X2= Customer relationship, X3= information sharing, X4= Sourcing, e = Error Term

(b) Dependent: Construction Project Performance

The study established that there existed a significance positive variation between SCM practices and NIB construction projects performance as r= 0. 253, P=0.01 < 0.05.

4.7.5 ANOVA

Table 4.11 shows the regression, residual and total variance. The study established that there existed a significant goodness of fit between variable as F=4.871, P=0.001< 0.05. The strength of variation of the predictor values of strategic supplier partnership, customer relationship, and information sharing and sourcing had a significant construction project performance as 95% confidence level.

Table 4.11: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.642	1	.537	4.871	0.001(a)
	Residual	18.497	53	.349		
	Total	19.034	54			

Source: Own survey (2013)

(a) Predictors: (Constant) Strategic supplier partnership, X_2= Customer relationship, $X_{3=}$ information sharing, $X_{4=}$ Sourcing, e = Error Term
Dependent: Construction Project Performance

4.7.6 Coefficients

Table 4.12 shows the Coefficients the study obtained.

Table 4.12: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.000	.467		4.120	0.01
	Strategic supplier partnership	0.838	.635	0.615	2.034	0.02
	Customer relationship	0.449	426	0.012	2.313	0.01
	Information Sharing	0. 278	.322	.145	2.906	0.03
	Sourcing	0.167	.231	.159	2.769	0.002

Source: Own survey (2013)

(a) Predictors: (Constant) Strategic supplier partnership, X_2= Customer relationship, $X_{3=}$ Information Sharing, $X_{4=}$ Sourcing, e = Error Term
Dependent: Construction Project Performance

$Y = 3.000 + 0.838X_1 + 0.449X_2 + 0.278X_3 + 0.167X_4$

From the regression model, it was found that construction project performance would be at 3.000 holding, strategic supplier partnership, customer relationship, information sharing, and sourcing constant at zero (0). The study established that there existed a significant positive relationship between strategic supplier partnership and construction project performance as r=0.838, t=2.034, P= 0.02<0.05.

The study established that a unit increase in customer relationship would significantly result into increase in Construction project performance as r=0.449, t=2.313, P=0.03<0.05. The study found that information sharing had significant positive impact on Construction project performance as r= 0.168, t=2.906, P= 0.03<0.05.

The study found that increased in Sourcing had a significant positive impact of construction project performance as r=0.167, t=2.769, P= 0.002<0.05.

4.8 The effect of SCM System Integration on NIB Construction Project Performance

To establish the effect of supply chain system integration on NIB construction projects performance, the extent to which material flow integration, financial flow integration, information flow integration and trust were implemented in NIB construction projects was first established.

Then the following Mugenda and Mugenda (2003) multiple regression model was used to show the relationship.

$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \mu$

Where;

Y= Dependent variable- Construction Project Performance (%)

α = Constant

μ= Error

β= Coefficient of the supply chain Integrations

X_1= Physical Flow Integration. (Maturity level)

X_2= Financial Flow Integration. (Maturity level)

X_3= Information Flow Integration. (Maturity level)

X_4= Trust. (Maturity level)

4.8.1 Material flow integration

Results presented in Table 4.13 shows that, majority of the respondents indicated that suppliers and logistics partners deliver products and materials just in time as indicated by a mean of 4.03 with standard deviation of 1.27. This was followed by respondents who indicated that inventory holdings are minimized across the supply chain, distribution networks are configured to minimize total supply chain-wide inventory costs and supply chain wide inventory is jointly managed with suppliers and logistics with a mean of 3.33, 3.12 and 3.11 with standard deviation of 0.73, 0.62 and 0.60 respectively. This is in line with Wegelius-Lehtonen (1995), who stated that material flow integration improves the productivity of firms through reduction in production cost, effective just-in-time inventory management and improved supplier management.

Table 4.13: Material flow integration

Description of variable	Always	Mostly	Frequently	Sometimes	Never	Mean	Standard deviation
Supply chain wide inventory is jointly managed with suppliers and logistics partners	0	13	34	7	0	3.11	0.60
Distribution networks are configured to minimize total supply chain-wide inventory costs.	0	14	33	7	0	3.12	0.62
Inventory holdings are minimized across the supply chain.	1	23	23	7	0	3.33	0.73
Suppliers and logistics partners deliver products and materials just in time.	24	13	12	5	0	4.03	1.27

Source: Own survey (2013)

4.8.2 Financial Flow integration

Table 4.14 shows respondents' response on the extent of financial flow integration. From the findings, most of the respondents indicated that having account payable processes that are automatically triggered when supplies are received from suppliers was the most integrated with a mean of 4.44 followed by capital efficiency with a mean of 4.00, then activity based costing for key supply Chain processes followed with a mean of 3.48 and finally, account receivables processes being automatically triggered when customers are invoiced was the least integrated with a mean of 3.00. Their standard deviations were 0.90, 0.89, 0.66 and 0.58 respectively.

Table 4.14. Financial Flow integration

Description of variable	Always	Mostly	Frequently	Sometimes	Never	Mean	Standard deviation
Account receivables processes are automatically triggered when invoice the customers	0	10	34	20	1	3.00	0.58
use activity based costing for key supply Chain processes (e.g. inventory, storage, transportation)	1	32	22	9	1	3.48	0.66
Capital efficiency, working and fixed, is maximized across the supply chain.	23	22	13	6	1	4.00	0.89
Account payable processes are automatically triggered when receive supplies from suppliers.	36	23	0	6	0	4.44	0.90

Source: Own survey (2013)

This implies that effective and efficient management of financial flow integration is therefore essential to improve the supply chain performance. This is in line with Johnson and Mena (2008), who stated that effective flow of funds across the supply chain improves cash conversion cycle or cash-to-cash cycle through reduced days-in-inventory, shortened days-in-receivables and prolonged days-in-payables

4.8.3 Information flow integration

The other objective of the study was to determine influence of financial flow integration on construction project performance at National Irrigation Board. From the findings (Table 4.15), majority of the respondents indicated that sharing of performance metrics across the supply chain was the most integrated with a mean of 4.57 and with a standard deviation of 0.60. This was followed by order fulfillment and shipment status being tracked at each step across the supply chain, inventory data being visible and the downstream partners sharing their actual sales data with a mean of 4.37, 4.35 and 4.31 respectively with standard deviation of 0.89, 0.70 and 0.86 respectively. Supply chain members collaborating in arriving at demand forecasts and delivery schedules being shared across the supply chain were the least integrated at a mean of 3.85 and 4.11 respectively supported by standard deviation of 0.53 and 0.88 respectively.

Table 4.15. Information flow integration

Description of variable	Always	Mostly	Frequently	Sometimes	Never	Mean	Standard deviation
Supply chain members collaborate in arriving at demand forecasts.	22	21	6	15	1	3.85	0.53
Production and delivery schedules are shared across the supply chain.	30	15	10	10	0	4.11	0.88
Inventory data are visible at all steps across the supply chain.	35	15	10	5	0	4.35	0.70
Our downstream partners (e.g. distributors, wholesalers, retailers) share their actual sales data with us.	38	16	9	2	0	4.31	0.86
Order fulfillment and shipment status are tracked at each step across the supply chain	40	17	3	5	0	4.37	0.89
Performance metrics are shared across the supply chain	43	18	4	0	0	4.57	0.60

Source: Own survey (2013)

4.8.4 Trust integration

From the findings (Table 4.16), majority of the respondents indicated that trust and good will had the same or greater significance as formal contracts as indicated by a mean of 4.19 with standard deviation of 0.77. Sharing of information a bout procedures and cost structures was second with a mean of 3.80, followed by Lo ng-term relationships with Strategic partners with a mean of 3.35 with standard deviation of 0.68. The least integrated was not making any demands that can hurt their relationship with a mean of 3.19 and a standard deviation of 0.68. This is in line with Khalfan (2007),who declares that trust is a major requirement for successful SCM in construction supply chains but is however, negatively affected by many factors in construction projects such as lack of honest communications.

Table 4.16. Trust integration

Description of variable	Always	Mostly	Frequently	Sometimes	Never	Mean	Standard deviation
Information about procedures and cost structures are shared.	1	14	21	18	11	3.80	0.63
not make any demands that can hurt the relationship.	0	19	33	12	1	3.19	.68
Long-term relationships with Strategic partners.	1	15	40	8	1	3.35	.68
Trust and good will have the same, or greater, Significance as formal contracts.	23	26	13	2	1	4.19	.77

Source: Own survey (2013)

4.8.5 Model summary of regression analysis

Table 4.17: Model Summary of Regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.78(a)	.6084	.587	0.12	1.741	6	.207	8.191	.001(a)

Source: Own survey (2013)

Predictors: (Constant) physical flow integration, financial flow integration, information flow integration and trust.
Dependent: Construction Project Performance

Adjusted R^2 is called the coefficient of determination which indicates how Construction Project Performance varied with variation in physical flow integration, financial flow integration, information flow integration and trust. From the Table 4.16, the value of adjusted R^2 was 0.6084.

This implied that, there was a variation of 60.8. % of Construction Project Performance varied with variation in supply chain system and which was statistically significant as r=0.6084, P= 0.001 < 0.05.

4.8.6 ANOVA

As revealed in Table 4.18, the Total variance (10.516) was the difference into the variance which can be explained by the independent variables (Model) and the variance which was not explained by the independent variables (Error). The study established that there existed a significant goodness of fit between variables as F-test (F=1.6569, P=0.01< 0.05). The calculated F=1.6569 far exceeds the F-critical of 1.307. This implied there the level of variation between independence and dependent variable was significant at 95% confidence level. This indicated that the model formed between Supply chain systems material flow integration, financial flow integration, information flow integration and trust and Construction Project Performance was a good fit for the data. The strength of variation of the predictor values contruction project performance was significant at P= 0.02<0.05.

Table 4.18: ANOVA

Model			Sum of Squares	Df	Mean Square	F	Sig.
1		Regression	5.364	18	.298	1.307	0.02(a)
		Residual	10.152	47	.216		
		Total	10.516	65			

Source: Own survey (2013)

Predictors: (Constant) physical flow integration, financial flow integration, information flow integration and trust
Dependent: Construction Project Performance

4.8.7 Coefficient

The findings in Table 4.19 show that SC system integration improved performance at NIB construction projects.

Table 4.19: Coefficients

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	5.768	.275		3.640	0.01
	Physical flow integration	0.883	.205	0.857	2.931	0.03
	Financial flow integration	0.717	.146	0.629	2.803	0.01
	Information flow integration	0.868	.120	0.751	1.906	0.02
	Trust Integration	0.791	.390	0.729	1.672	0.01

Source: Own survey (2013)

(a). Predictors: (Constant): Physical flow integration, financial flow integration, information flow integration and trust
(b). Dependent: Construction Project Performance

A unit increase in Physical flow integration would lead to a significance positive increase in construction project performance as r=0.883, P= 0.003<0.05. Thus increase in physical flow integration would lead to increase in project cost effective, quality, completion timeliness. The study also found that a unit increase in financial flow integration would lead to increase in Construction Project Performance as r =0.717, P< 0.02. This implied that there exist a positive relationship between financial flow integration and construction Project Performance. The study also indicated that a unit increase in information flow integration would lead to a unit increase in increase in construction project performance as r =0.868, P< 0.02). This clearly indicated that information flow integration plays a critical role in improving performance of Construction project performance.

The regression results further indicated that increase in trust among the stakeholders would lead to increase in construction project performance as $r = 0.791$, $P < 0.01$.Thus increase in trust would improve construction Project Performance.

$Y = 5.768 + 0.883X_1 + 0.717X_2 + 0.868X_3 + 0.791X_4 + e$

From the regression model, it was found that Construction failure would be 5.768% if the following are held at zero; physical flow integration, financial flow integration, information flow integration and trust.

This clearly indicated that there existed a positive relationship between physical flow integration, financial flow integration, information flow integration, trust and Project Performance in NIB construction projects.

4.9 The Moderating Effect of SCM System Integration on NIB Construction Projects

Supply chain management system was added to the regression model $Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$ which resulted to an increase in change of construction project performance. With supply chain systems introduced, the predictor variables explained 34.3% of change in construction Project Performance

Table 4.20 Model Summary - Supply chain management Practices and SC system integration.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.586[a]	.343	.328	.55881

Source: Own survey (2013)

Predictors: (Constant) Strategic supplier partnership, X_1= Customer relationship, $X_{2=}$ information sharing, $X_{3=}$ Sourcing, $X_{4=}$ Supply chain management system, integration,
e= Error Term
Dependent: Construction Project Performance

Table 4.21: ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.415	5	.483	14.356	.000[b]
	Residual	15.288	49	.312		
	Total	17.294	54			

Source: Own survey (2013)

Predictors: (Constant) Strategic supplier partnership, X2= Customer relationship, X3= information sharing, X4= Sourcing, X5= Supply chain management system, e = Error Term

The coefficients Table 4.22 below shows that four predictor variables were statistically significant contributors to 34.3% change in SC system integration. Strategic supplier partnership (β=.424, *P*=.002<0.05), customer relationship (β=.336, *P*=.0033<0.05), Information Sharing (β=.245, *P*=.002<0.05), and Supply chain management system (β=.5.16, *P*=.002<0.05) were the statistically significant predictors.

Table 4.22: Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.844	.314		5.869	.000
	Strategic supplier partnership	.424	.096	.309	3.364	.002
	Customer relationship	.336	.104	.032	.342	.0033
	Information Sharing	.245	.073	.043	.627	.002
	Sourcing	.102	.093	.002	.018	.986
	Supply chain management system	.516	.102	.285	3.098	.002

Source: Own survey (2013)

Predictors: (Constant) Strategic supplier partnership, X_1= Customer relationship, $X_{2=}$ information sharing, $X_{3=}$ Sourcing, X_4
Dependent: supply chain integration

Table 4.23: Model Summary of Moderating Relationship

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.57[a]	.325	.302	.37865

Source: Own survey (2013)

Predictors: (Constant), MX4, Zscore(Strategic supplier partnership), Zscore(Customer relationship), MX3, Zscore(information sharing), Zscore(Sourcing), MX1, MX2
Dependent: Construction Project Performance

To establish the moderated relationship, regression analysis model $Y_2 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 (X_1 M) + \beta_6 (X_2 M) + \beta_7 (X_3 M) + \beta_8 (X_4 M) + \varepsilon$ was used. The results show that predictor variables explain 32.5% of change in construction project performance.

In the moderated relationship, the overall equation was statistically significant (F=12.297, *p*<.000) (Table 4.24).

Table 4.24: ANOVA of Moderating Relationship

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	74.769	8	9.346	12.297	.000[b]
	Residual	194.561	46	.760		
	Total	269.330	54			

Source: Own survey (2013)

a. Predictors: (Constant), MX4, Zscore(Strategic supplier partnership), Zscore(Customer relationship), MX3, Zscore(information sharing), Zscore(Sourcing), MX1, MX2
b. Dependent Variable: Zscore (Construction Project Performance)

Table 4.25: Coefficients Model of Moderating Relationship

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.005	.060		.085	.000
	Zscore(Strategic supplier partnership)	.301	.092	.289	2.166	.031
	Zscore(Customer relationship)	.227	.090	.160	.302	.002
	Zscore(Information Sharing)	.189	.068	.089	1.313	.012
	Zscore (Sourcing)	.101	.076	.272	3.550	.064
	MX1	.226	.068	.396	3.301	.001
	MX2	-.130	.098	.050	.303	.011
	MX3	.153	.063	.097	.834	.004
	MX4	-.183	.053	-.398	3.473	.101

Source: Own survey (2013)

Dependent Variable: Zscore (Construction Project Performance)

In the moderated relationship, strategic supplier partnership (β=.301, P=.031), customer relationship (β=.227, P=.002<0.05) and Information Sharing (β=.189, P=.012<0.05) were statistically significant.

Table 4.26: Summarized multiple regression analysis results

Models	Control	Model 1 Standardized Coefficients Beta	Model 1 Sig.	Model 2 Standardized Coefficients Beta	Model 2 Sig.
	(Constant)	3.000	.000	1.005	.000
	Strategic supplier partnership	0.838	.001	.301	.031
	Customer relationship	0.449	.908	.227	.002
	Information Sharing	0. 278	.772	.189	.012
	Sourcing	0.167	.003	.101	.064
	MX1			.226	.001
	MX2			-.130	.011
	MX3			.153	.004
	MX4			-.183	.101
	R	. 54[a]		.57[a]	
	R Square	. 292		.325	
	Adjusted R Square	. 253		.301	
	Std. Error of the Estimate	0.29		.37865	
	F	4.871		12.297	
	Sig.	.001[a]		.000[b]	

Source: Own survey (2013)

Summarized results of multiple regression analysis are presented in Table 4.26. From the multiple regression analysis, the study established that there was a significant change of 3.3% from 29.2% to 32.5% in the relationship between supply chain management practices and construction project performance when supply chain management system integration was introduced. This implied that supply chain management system integration plays a significance role in enhancing the effectiveness of supply chain management practices in achieving better project performance.

From the findings, the study established that there existed a significance positive moderating effects of supply chain management system in the relationship between supplier partnership and construction project performance. The study established that there existed a significance positive moderating effects of supply chain management system in the relationship between Customer relationship and construction project performance. The study also established that there existed a significance positive moderating effects of supply chain management system in the relationship between Information Sharing and construction project performance. However, the study revealed that there existed an insignificance positive moderating effects of supply chain management system in the relationship between Sourcing and construction project performance.

CHAPTER FIVE

5. SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of findings, conclusions and recommendations of the study based on the objective which was to assess the degree of SCM practices entrenchment in the Kenyan construction industry and the impacts on their project performance. The chapter also gives suggestions for further studies.

5.2 Summary of Findings

(i) In regard to specific objective 1.3.2(i), the study revealed that long-term relationships, working with certified suppliers, prudent supplier selection and few supplier policies, supplier involvement in product development, good interaction and internal, trust and commitment with partners, strategic purchasing, supply network coordination, external integration, logistics integration and effective communication were implemented to some extent at National Irrigation Board. On average, 1.54% of the respondents indicated that they implemented the SCM best practices frequently, 81.54% of respondents indicated that they implemented the SCM best practices sometimes while 16.92% of respondents indicated that they never implemented the SCM practices. The null hypothesis that there was no significant implementation of supply chain management practices at National Irrigation Board construction projects was therefore rejected. The alternative hypothesis was accepted since there was implementation of SCM practices to some extent at National Irrigation Board construction projects.

(ii) In regard to specific objective no 1.3.2 (ii), the study established that a unit increase for a combined supply network coordination, strategic purchasing, supplier involvement in product development, internal integration and external integration improved performance at National Irrigation Board construction projects by 0.828%, a unit increase to a combined trust and commitment with partners, good interaction, long-term relationships, good interaction and logistics integration improved performance at National Irrigation Board construction projects by 0.449%, a unit increase to a combined information sharing which included effective communication, and few supplier policy improved performance at National Irrigation Board construction projects by 0.278% while a unit increase to a combined sourcing of materials, goods prudent supplier selection and working with certified suppliers improved performance at National Irrigation Board construction projects by 0.167%. This was a significant influence of supply chain management practices on project performance at National Irrigation Board construction projects. The null hypothesis that there existed no significant influence of supply chain management practices on project performance at National Irrigation Board construction projects was rejected.

(iii) In regard to specific objective no 1.3.2 (ii), the study established that a unit increase in jointly managing supply chain wide inventory with suppliers and logistics partners, configuring distribution networks to minimize total supply chain-wide inventory costs, minimizing inventory holdings across the supply chain and suppliers and logistics partners delivering products and materials just in time affected project performance at National Irrigation Board construction projects by 0.883%, a unit increase in having account receivable processes being automatically triggered when customers are invoiced, using activity based costing for key supply Chain processes (e.g. inventory, storage, transportation), maximizing capital efficiency(working and fixed) across the supply chain, and account payable processes being automatically triggered when supplies are received from suppliers improved performance by 0.717%, Having supply chain members collaborating in arriving at demand forecasts, sharing production and delivery schedules across the supply chain, inventory data being visible at all steps across the supply chain, downstream partners (e.g. distributors, wholesalers, retailers) sharing their actual sales data, tracking order fulfillment and shipment status at each step across the supply chain and sharing performance metrics across the supply chain increased time affected project performance at National Irrigation Board construction projects by 0.868% while a unit change in the combined sharing of information about procedures and cost structures, not making any demands that can hurt their relationship, long-term relationships with strategic partners, and trust and goodwill having the same or greater significance as formal contracts affected project performance at National Irrigation Board construction projects by 0.791%.

The null hypothesis that there was no significant integration of physical flow, financial flow, information flow and trust at National Irrigation Board construction projects was rejected. There was a significant effect of physical flow integration, financial flow integration, information flow integration and trust at National Irrigation Board construction projects.

5.3 Conclusions

The study concluded that:

(i) SCM best practices have a positive impact on construction project performance

(ii) Improved implementation of SCM best practices by Kenyan construction firms can lead to improved construction project performance and reduce construction project failures in the industry.

(iii) Physical flow integration improves the productivity of firms through reduction in production cost, effective just-in-time inventory management and improved supplier management.

(iv) The study concludes that effective and efficient management of financial flow integration is essential to improve the supply chain performance. Effective flow of funds across the supply chain improves cash conversion cycle or cash-to-cash cycle through reduced days-in-inventory, shortened days-in-receivables and prolonged days-in-payables.

(v) The study concluded that information sharing within business units, across supply chain partners such as suppliers and other strategic alliances is essential to construction project performance. Integration through effective and efficient information flow eventually lead a firm and total supply chain to better project performance

(vi) Trust is a major requirement for successful SCM in construction supply chains but is however, negatively affected by some factors in construction projects such as lack of honest communication.

(vii) Improved implementation of SCM practices improves SC system integration leading to improvements to construction project performance.

5.4 Recommendations

(i) The study recommends that companies focusing on improving their project performance should focus significantly on improving their degree of SCM best practices implementation and SCM system integration to boost project success given the significant positive relationship between SCM practices and project performance.

(ii) This study had a narrow focus on the contractors working for NIB which represent a small sample size of respondents as compared to entire contractor's population in Kenya. To increase the scientific validity of the research and reflect on a more holistic approaches in identifying the true relationship between SCM best practices and performance, research should be carried out on construction firms from more than one organization.

(iii) The study focused on the static interaction between supply chain management practices, SCS integration and performance in the Kenyan construction industry; a case study of national irrigation board. More studies showing the relationship between SCM practices and construction project performance should be carried out in the Kenyan construction industry to enable dynamics of SCM practices in the construction industry in Kenya to be fully established.

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APPENDICES

Appendix 1: Survey Instruments

Section 1: Implementation of SCM best practices

To what extent do you use the SCM practice stated?
Level 1 = “Never or does not exist”, Level 2 = “Sometimes or to some extent”, Level 3 = “Frequently or partly exist”, Level 4 = “Mostly or often exist”, and Level 5 = “Always or definitely exist”.

Table A1: Implementation of SCM best practices

Item	Supply Chain Management practice	Never	Sometimes	Frequently	Mostly	Always
		1	2	3	4	5
1	Effective Communication					
2	Supply network coordination					
3	Strategic purchasing					
4	Logistics integration					
5	External integration					
6	Trust and commitment with partners					
7	Internal integration					
8	Good interaction					
9	Few supplier policy					
10	Supplier involvement in product development					
11	Prudent supplier selection					
12	Working with certified suppliers					
13	Long-term relationships					

SECTION 2: Project performance

In your opinion what was the average time delay in the projects you have carried out for National Irrigation Board?

☐	☐	☐	☐	☐	☐
<1%	1<5%	5<10%	10<15%	Over 15<20%	Please specify

In your opinion what was the average cost increase in the projects you have carried out for National Irrigation Board?

☐	☐	☐	☐	☐	☐
<1%	1<5%	5<10%	10<15%	Over 15<20%	Please specify

In your opinion what was the average quality of works in the projects you have carried out for National Irrigation Board?

☐	☐	☐	☐	☐	☐
Please specify	80<85%	85<90%	90<95%	95<99%	>99%

Section 3: SCM system integration
To what extent do you observe the following events in your firm?
Answer with tick on:
1 = "Never or does not exist", 2 = "Sometimes or to some extent", 3 = "Frequently or partly exist", 4 = "Mostly or often exist", and 5 = "Always or definitely exist".

Table A2: Physical flow integration

Item	Event	Never	Sometimes	Frequently	Mostly	Always
		1	2	3	4	5
14	Supply chain wide inventory is jointly managed with suppliers and logistics partners					
15	Distribution networks are configured to minimize total supply chain-wide inventory costs.					
16	Inventory holdings are minimized across the supply chain.					
17	Suppliers and logistics partners deliver products and materials just in time.					

To what extent do you observe the following events in your firm?

Answer with tick on:
1 = “Never or does not exist”, 2 = “Sometimes or to some extent”, 3 = “Frequently or partly exist”, 4 = “Mostly or often exist”, and 5 = “Always or definitely exist”.

Table A3: Financial flow integration

		Never	Sometimes	Frequently	Mostly	Always
Item	Events	1	2	3	4	5
18	Account receivables processes are automatically triggered when we invoice our customers.					
19	We use activity based costing for key supply Chain processes (e.g. inventory, storage, transportation)					
20	Capital efficiency, working and fixed, is maximized across the supply chain.					
21	Account payable processes are automatically triggered when we receive supplies from our suppliers.					

To what extent do you observe the following events in your firm?
Answer with tick on 1 = “Never or does not exist”, 2 = “Sometimes or to some extent”, 3 = “Frequently or partly exist”, 4 = “Mostly or often exist”, and 5 = “Always or definitely exist”.

Table A4: Information flow integration

Item	Events	Never	Sometimes	Frequently	Mostly	Always
		1	2	3	4	5
22	Supply chain members collaborate in arriving at demand forecasts.					
23	Production and delivery schedules are shared across the supply chain.					
24	Inventory data are visible at all steps across the supply chain.					
25	Our downstream partners (e.g. distributors, wholesalers, retailers) share their actual sales data with us.					
26	Order fulfillment and shipment status are tracked at each step across the supply chain					
27	Performance metrics are shared across the supply chain					

To what extent do you observe the following events in your firm?
Answer with tick on 1 = “Never or does not exist”, 2 = “Sometimes or to some extent”, 3 = “Frequently or partly exist”, 4 = “Mostly or often exist”, and 5 = “Always or definitely exist”.

Table A5: Trust integration

Item	Description of the component	Never	Sometimes	Frequently	Mostly	Always
	Events	1	2	3	4	5
28	Information about procedures and cost structures are shared.					
29	We do not make any demands that can hurt the relationship.					
30	We have long-term relationships with Strategic partners.					
31	Trust and good-will have the same, or greater, Significance as formal contracts.					

Appendix 2: SCM System Integration in NIB Construction Projects

	Supply chain system integration																	
Company	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	3	4	4	5	3	5	5	5	5	5	5	5	5	5	4	2	4	5
2	4	3	3	5	2	3	5	4	4	4	4	4	4	4	3	2	3	5
3	3	3	4	5	4	4	5	4	5	4	5	5	5	5	5	3	4	4
4	4	3	3	5	3	3	5	5	3	4	5	5	5	4	4	4	4	5
5	2	4	3	5	3	3	5	4	2	3	3	3	3	5	3	3	3	4
6	3	2	5	5	4	4	5	5	5	3	2	2	2	5	5	3	3	5
7	3	3	3	5	3	3	5	4	5	3	5	5	5	5	4	3	4	5
8	3	3	4	5	2	3	5	5	4	2	4	4	4	4	3	3	3	5
9	4	3	4	5	3	5	5	4	3	3	5	5	5	5	3	3	4	4
10	3	3	3	5	4	2	5	5	5	3	3	3	3	4	5	3	3	5
11	3	3	4	5	3	1	5	4	4	3	5	5	5	5	4	4	4	5
12	3	3	3	5	3	4	5	5	5	3	4	4	4	5	3	3	3	5
13	4	3	4	5	3	1	5	4	3	5A	5	5	5	5	2	3	5	5
14	2	4	3	5	2	5	5	5	4	5	3	3	3	4	5	3	3	4
15	3	2	3	5	3	1	5	4	4	5	5	5	5	5	4	4	3	2
16	2	2	2	5	4	4	5	5	3	5	4	4	4	4	2	3	4	5
17	4	3	3	5	3	4	5	4	5	5	5	5	5	5	4	3	4	3
18	3	3	3	5	3	3	5	5	4	5	3	3	3	5	5	3	2	5
19	3	2	2	5	3	4	5	3	4	5	5	5	5	5	4	4	4	4
20	3	4	4	5	4	3	5	5	4	5	5	5	5	4	2	3	3	5
21	3	2	2	5	2	4	5	5	5	5	3	3	3	5	4	3	4	4
22	4	3	3	5	3	4	5	5	3	5	5	5	5	4	3	3	2	3
23	3	4	4	5	3	5	5	4	4	5	5	5	5	5	5	4	3	5
24	3	3	3	5	4	3	5	5	2	5	3	3	3	5	4	3	4	4
25	3	3	3	4	3	4	4	4	3	4	5	5	5	5	2	3	2	5
26	4	4	4	4	2	3	4	5	5	4	5	5	5	4	5	3	4	3
27	3	3	3	4	4	4	4	3	2	4	5	5	5	5	4	3	3	5
28	3	3	3	4	3	4	4	5	4	4	5	5	5	3	2	4	4	5
29	3	3	3	4	3	2	4	5	4	4	4	4	4	5	4	4	4	4
30	4	4	3	4	2	1	4	5	3	5	5	5	5	4	5	3	2	5
31	2	2	4	4	4	4	4	4	5	5	3	3	3	5	3	3	4	3
32	3	3	2	4	3		4	5	2	5	5	5	5	4	3	3	3	5
33	3	3	3	4	2	4	4	3	4	4	5	5	5	5	5	2	5	4
34	3	3	3	4	3	4	4	5	2	4	5	5	5	3	2	4	3	4
35	4	4	4	4	3	4	4	4	5	4	4	4	4	5	4	5	4	5
36	2	2	3	4	2	5	4	5	2	4	5	5	5	4	1	3	3	4
37	3	3	3	4	4	3	4	4	4	4	4	4	4	5	5	3	2	5
38	4	4	3	2	3	4	2	5	3	3	5	5	5	4	4	4	4	1
39	3	3	4	3	2	4	3	3	5	3	4	4	4	5	4	3	4	5
40	4	4	3	3	4	4	3	5	3	3	5	5	5	4	4	3	2	5
41	3	3	4	3	3	4	3	4	5	5	3	3	4	5	5	3	4	4
42	3	3	2	3	3	3	3	5	4	5	5	5	5	5	4	4	3	3
43	2	3	2	3	3	3	3	4	5	5	4	4	4	5	4	3	4	2
44	4	4	4	2	4	4	2	5	3	5	5	5	5	3	4	3	2	4
45	3	3	2	3	2	3	3	4	4	5	3	3	4	4	5	4	4	4
46	3	3	4	3	3	3	3	5	5	5	5	5	5	5	3	3	3	4
47	3	3	4	3	3	4	3	5	3	5	4	4	4	5	4	3	4	4
48	2	4	4	3	4	3	3	4	5	5	5	5	5	5	5	4	3	2
49	3	3	4	3	2	5	3	5	5	3	5	5	5	5	4	3	4	4
50	3	3	4	2	3	3	2	4	3	3	5	5	5	5	3	3	3	5
51	4	4	4	2	2	4	2	5	4	3	4	4	4	5	4	4	4	4
52	3	3	4	2	3	3	2	4	5	3	5	3	4	3	5	1	1	4
53	3	3	4	2	3	4	2	5	2	3	4	4	4	5	4	3	3	4
54	3	4	4	2	3	3	2	3	4	3	3	3	3	5	4	3	3	4

Appendix 3: Implementation of SCM Practices by NIB Construction Projects

Company	SCM practices												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1	2	4	2	1	4	2	4	1	1	2	4	4	5
2	3	3	5	3	1	3	1	5	4	4	4	5	3
3	2	3	3	3	3	4	4	4	4	3	3	3	5
4	2	4	4	4	4	3	4	3	3	4	2	3	4
5	3	3	3	3	3	3	4	3	4	2	5	5	3
6	3	3	3	3	4	3	3	4	3	3	3	4	5
7	2	3	3	3	3	3	4	3	4	5	4	3	4
8	4	4	3	3	3	3	4	3	3	2	5	4	3
9	1	3	4	3	4	3	4	5	5	4	3	2	3
10	3	3	3	3	3	4	4	4	4	2	3	3	5
11	3	4	3	3	3	3	4	3	4	3	4	3	4
12	2	3	2	4	3	3	4	2	4	2	2	2	3
13	3	3	3	4	4	3	3	1	4	5	4	5	2
14	4	4	3	3	3	4	4	3	4	3	3	2	4
15	1	3	3	3	3	3	4	5	4	2	4	4	5
16	1	3	3	3	3	3	2	1	1	4	5	5	2
17	3	4	4	3	4	3	3	4	5	5	5	4	4
18	4	3	3	3	3	4	4	3	4	2	4	2	5
19	2	4	4	4	3	3	2	4	4	4	2	4	4
20	2	1	3	3	3	3	4	3	3	2	2	5	2
21	2	3	4	3	3	3	3	4	5	4	2	4	4
22	3	3	3	3	3	4	4	4	3	4	4	2	4
23	1	3	3	3	3	3	3	5	4	5	2	4	5
24	2	4	3	4	4	3	2	4	2	4	4	4	4
25	1	3	3	3	2	3	3	4	4	4	5	5	2
26	3	3	4	3	3	3	3	4	3	4	3	3	5
27	2	3	2	3	4	4	4	4	5	2	4	3	4
28	4	4	3	3	3	4	4	4	4	5	2	2	2
29	2	2	3	4	3	3	4	2	4	4	5	4	4
30	3	3	4	3	4	2	4	1	4	4	3	4	5
31	1	2	3	1	3	3	3	3	2	4	3	5	3
32	3	3	2	3	2	2	2	2	4	2	5	3	3
33	1	4	4	3	4	4	4	4	5	5	4	5	4
34	5	2	4	3	3	3	4	4	4	2	4	4	2
35	1	3	4	3	4	3	3	4	4	4	4	3	4
36	2	2	3	3	2	3	4	5	1	4	2	4	1
37	3	4	3	3	3	4	4	3	4	3	4	4	5
38	3	3	3	1	3	3	2	4	4	5	5	4	4
39	2	3	2	3	4	3	4	4	4	4	4	5	3
40	4	2	2	4	2	3	4	4	4	4	3	4	4
41	2	4	3	1	3	4	2	4	5	5	4	4	5
42	3	2	3	1	3	3	3	4	4	5	5	4	4
43	4	3	4	3	3	3	4	3	4	4	4	3	4
44	1	3	3	1	2	3	3	3	4	3	3	3	4
45	3	3	4	1	3	2	4	3	5	4	5	4	5
46	2	4	2	4	3	3	4	3	5	5	4	4	4
47	2	2	3	1	2	2	2	4	3	4	4	5	3
48	4	3	2	3	3	4	3	3	4	4	4	2	5
49	2	3	3	5	3	2	4	5	4	5	4	4	4
50	2	4	4	3	3	4	5	3	4	5	5	5	3
51	3	3	3	4	4	4	3	4	2	2	4	4	4
52	3	3	3	3	3	3	4	3	4	4	4	4	5
53	2	4	4	3	3	3	3	4	4	2	4	5	4
54	3	3	3	3	3	4	3	3	4	5	5	4	4