ASSESSMENT OF THE APPLICATION OF INTEGRATED CONSTRUCTION SUPPLY CHAIN PRACTICE IN BUILDING PROJECTS IN TANZANIA

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By

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A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Science (Construction Economics and Management) of Ardhi University

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CERTIFICATION

The undersigned certify that she has read and hereby recommend for examination by Ardhi University a dissertation entitled '**Assessment of the application of integrated construction supply chain practice in building projects in Tanzania'** in fulfillment of the requirements for the degree of Master of Science in Construction Economics and Management of Ardhi University.

……..

Dr.Nyamagere, Gladys Sospeter

(Supervisor)

Date……

DECLARATION AND COPYRIGHT

I Matiku, Jocelline Paul declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

……

Matiku, Jocelline Paul

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DEDICATION

This work is dedicated to almighty God, my parents Mr. Paul M. Matiku and Mrs. Josephine Matiku, my young brothers and sisters for their encouragement and support towards fulfillment of this work.

ABSTRACT

Integrated construction supply chain is an approach in which the supply chain participants (client, consultants, main contractor, subcontractors and suppliers) work in highly collaborative relationships during construction and throughout the project life cycle to achieve added value for construction clients and other stakeholders. The main objective of the study was to assess application of integrated construction supply chain in building projects in Tanzania. The specific objectives were to assess the extent of application of integrated construction supply chain in building projects in Tanzania, to determine challenges which hinder the application of ICSC, to suggest what should be done to enhance awareness and application of ICSC.

The study used a mixed approach where by quantitative method (Questionnaire survey) was used at the first stage and qualitative method (case study method) were later used to supplement the questionnaire response. Sixty five respondents from client, consultant, main contractor, sub-contractor and supplier were obtained from questionnaire survey in the ten building projects selected through snowball sampling by the researcher. Also, an interview was conducted to supplement the information gathered from the questionnaire.

Findings shows that extent of application of integrated construction supply chain is minimal applied as the integrating practices were not practiced fully according to the principles of integration. Inefficient organization structure, inadequate information flow, lack of staff training, Lack of mutual objectives were the critical challenges faced in the application of integrated construction supply chain practice.

Finally, the study revealed that application of integrated construction supply chain is minimal applied in building projects in Tanzania. Eventually, the study recommends that construction companies should encourage crucial investment in modern IT technologies, training and workshops that would be conducted regularly by the responsible authorities with familiar knowledge of both the benefits of an application of ICSC and other necessary duties to be performed by the supply chain participants in general.

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ABREVIATIONS

CSC	Construction supply chain
ICSC	Integrated construction supply chain
SCM	Supply chain management
SPSS	Statistical package for social science
HVAC	High Ventilation Air Condition
SAP	System Application Product
ERP	Enterprise Resource Planning
BIM	Building Information Model
ICT	Information Communication Technology
IT	Information Technology
R & D	Research and Development
ERB	Engineers Registration Board

CHAPTER ONE

INTRODUCTION

1.1.1 Background of the Study

Integrated construction supply chain is becoming increasingly important because business organizations need to unite as a team in working collaboratively in planning, designing and procuring in construction so as to add value to the client. ICSC is a management approach in which the key supply chain participants comprising of client, consultants, main contractor, subcontractors and suppliers work in highly collaborative environment i.e. having a joint risk management, use of collaborative tools in information sharing and transparency during construction and throughout the project life cycle to achieve value for construction clients. (Office of Government Commerce, 2006) illustrated that an integrated construction supply chain arrangement enable supply chain participants to work in collaboration over a longer period in order to develop a relationship based on trust that results into value for money in the construction projects.

The integrated supply chain in construction has a goal of understanding and working wholly in the interest of client's project (construction excellence, 2004).Its function is to synchronize the client requirements with materials, money and information flows along the supply chain until reaching a balance between client satisfaction and the cost. It involves a set of activities from the demand for construction by client, design, procurement of works and materials, execution and coordination up to the delivery of a project through information flow, logistics and cash flow to forming a

constructing network with suppliers, sub-contractors, architects and owners to enhance value of the end product (Khalfan et al. 2001)

Olaniyi et al. (2015) addresses construction supply chain management and integration issues mainly from organizations and procurement perspectives where collectively argued that procurement methods and organizational structure are insufficient in a way that does not support supply chain management application. Nevertheless, supply chain integration is not only in procurement perspectives but also the study incorporates ideas from various scholars who arguably spoke on the theme of construction industry, some of them being the following ideas from;

Cox&Ireland (2002) and Vrijhoef et al.(2001) have mentioned efforts in the development of technology for integrated construction environments and the implementations are among the main contributors to the construction supply chain integration.

The concept of integrated construction supply chain has well succeeded in other continents through the effective application of integrated construction supply chain in the construction industry. In Japanese experiences, the Japanese construction industry is well known for the integrated approach to the project it adopts in establishing long-term contractor- subcontractor relationships (Ireland, 2004).In 2003 they developed a web technology to assist contractors and suppliers in working collaboratively in distant locations.

In European experience contractors and clients use supply chain management(Cox and Ireland, 2002).These contractors have managed this through establishing consistent relationship with suppliers that they may have a willingness to work with

difficulties and disagreements, organizing a program in discussing a cooperative approach of solving various problems(Vrijhoef and Voordijk,2003).Therefore these contractors hope to receive large discounts from a small number of firms each with a large workload questionnaire and also they involve suppliers at the early stage of the project to reduce contractor's contingency fees. In Europe, the Bam group which is the one of the largest contracting active in construction has succeeded in various construction projects due to their ability to integrate their construction supply chain in various components of procurement, logistics and quality control.

In UK, Alshawi and Ingiringe (2003) reports a Collaborative Construction information network being a web based facility that helps in collaboration between users for the benefit of improved shared project information in searching and retrieval in a project, therefore, enabling better and faster information access leading to a more informed decision making.

In Portugal, Tucker et al. (2001) reports a framework was developed to ease tendering, ordering, delivering, invoicing and payment process of prefabricated house systems, equipment, and services where by member have a different position regarding information communication technologies. This tool helped in coordinating technical and management information flow among project participants, therefore, reducing planning, production, logistics and storage leading to a more integrated supply chain.

In north America construction companies have been investigated on new systems of information integration to enhance quality, quantity and speed of project information thus developing a document management software called Web based Project extranet

site aiming at unifying conflicting contractor and consultant allowing a controlled access to project files without accessing individual company's document systems, over 20 different projects have successfully adopted the Project extranet site(Tucker et al. 2001).

In the state of Pennsylvania is reported that bidding process is one that necessitates a high degree of communication and interaction among organizations. In bidding a 940,000 square feet building each organization was required to submit a secured building software.170 contractors participated on bidding at the internet at the date and time set and after one and half hours the lowest bidder with US$2.6 million was awarded the project. The bidding required that any new submission could bid at $2500 less than the previous which this termed as reverse auctioning (Tucker et al. 2001)

In Nigeria, it is reported that the perceptions of professional quantity surveyors in Ondo state on the supply chain management practices in construction procurement is that the main supply chain activities known to quantity surveyors are information dissemination, management leadership and relationship development also quantity surveyors are involved in varying degrees(Olaniyi et al.2015).

In Kenya, there is a great influence in the use of supply chain management system in construction projects due to its success irrigation projects by national irrigation board in Kenya. This is due to its ability to establish long term relationships with suppliers, good financial flow integration, and information flow integration and trust integration (Price et al. 2004)

Due to the success in other continents integrated construction supply chain is the fitting path for construction industry in attaining competitive strategy. However a number of literatures in other continents have discussed integrated supply chain, its role in construction projects, its benefits, its challenges and strategies; a few of them are such as those done by(McDermott and Khalfan,2012) and (Vrijhoef and Voordijk,2003) while the concept of integrated construction supply chain in Tanzania little is known by many stakeholders of the construction industry. Nevertheless, in Tanzania, there are few studies on the supply chain integration in other industries such as agriculture industry (Hasenklever, 2016) and Timber production (Ochieng and Price, 2009). While in the construction industry little is known about integrated supply chain in the industry. With regard to this, the researcher intends to conduct an assessment of application of integrated construction supply chain in building projects in order to bring influence in its application in Tanzania.

1.1.2 Statement of the problem

The construction industry is very large and it includes buildings such as the low rise and high rise building which contribute greatly to the economy of the country. However, there have been observed failures/problems of incomplete project time schedules, cost overruns, perceived low productivity, cost and time overruns, conflicts and disputes, and resulting claims and time-consuming litigation in most building projects. These have been acknowledged as the major causes of performance-related problems facing the building projects in Tanzania (Vrijhoef and Voordijk, 2003).

Construction is a business where a number of fragmented organizations such as the main contractor, consultant, subcontractor and suppliers are given supply contracts of goods and services in order to provide the customer (construction client) a designated product. Integrated construction supply chain gives an opportunity to key supply chain participants in working cooperative and collaborative in order to increase productivity and add value to the client.

Construction supply chain management is based on the coordination of materials, information and financial flows between various construction project teams in a project. Currently, in Tanzania construction supply chain management is employed using old ways of managing construction supply chains using traditional procurement system which is characterized by fragmentation nature of the key supply chain participants namely client, consultant, main contractor, sub-contractor and suppliers. With the increasing global competition, construction firms' in Tanzania need to focus on the new ways of influencing productivity through integration of key supply chain participants and use of modern procurement method i.e. design and build and management contracting methods so as to achieve global standards.

The integration of these flows will increase the probability of a successful project. (Handfield and Nichols, 2003) argue that integrated supply chain management is becoming recognized as a core competitive strategy. As organizations continuously seek to provide their products and services to customers faster, cheaper and better than the competition, it is of this viable significances managers have come to realize that they cannot do it alone, rather they should collaborate with their supply chains in order to succeed and therefore the researcher intends to asses on the application of

integrated construction supply chain practice as applied by other continents, so as to be aware of the possible remedies to be acquainted with ICSC phenomenon especially in Tanzanian construction industry.

1.3 Objectives of the study

The researcher introduces both main and specific objectives in pursuance of the study.

1.3.1 Main Objective

The main objective of this study is to assess the application of integrated construction supply chain practices in the construction industry in Tanzania.

1.3.2 Specific Objectives

1. To assess the extent by which the integrated construction supply chain practices are applied in management of building projects in Tanzania
2. To determine challenges faced in the application of integrated construction supply chain practices in the management of building projects in Tanzania.
3. To suggest what should be done to improve the application of construction supply chain integration in Tanzania building projects.

1.4 Research Questions

1. To what extents are the integrated construction supply chain practices used in the management of building projects in Tanzania?
2. What challenges are faced by building actors in the application of integrated construction supply chain practices in the management of building projects in Tanzania?

3. What could be done to improve the application of integrated construction supply chain practices in Tanzania building projects?

1.5 Significance of the study

The research provides various construction stakeholders to understand the extent of application of integrated construction supply chain, the challenges and ways to promote the application of ICSC. Additionally, it will also benefit various organizations in managing the key construction supply chain partners. The study will assist other construction boards, researchers, academicians, policy makers and any other individuals who wish to conduct research in this field.

1.6 Originality

This research study has added another dimension to the large body of knowledge that already exists on supply chain integration. It focuses on construction, a large and important sector of the economy but it’s the one that has little research written as much as research written on manufacturing industry.

1.7 Scope and limitation

This research study was carried out in Dar es Salaam in Tanzania. This is because there are a large number of ongoing building projects in Dar es Salaam. Due to limited resources information was obtained from five key supply chain participants in building projects namely; Client, consultant, main contractor, sub-contractor and supplier.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Based on the fact that integrated construction supply chain relies on well-established supply chain integration principles, this section reviews the literature regarding supply chain integration definitions, characteristics, key indicators, dimensions, benefits, challenges and strategies for successful supply chain integration in the construction industry.

2.1 Construction process in Tanzania

The construction process in Tanzania is project based constituting of fragmented parties which undertake various unique activities throughout the lifecycle of a project (Kamala, 2000).These parties comprise of client, consultant, the main contractor, subcontractors and suppliers. The construction processes in Tanzania are influenced by the standard forms of contract, procurement methods and the complex nature of the project. The standard forms of a contract include of Design & build and traditional contract. In Tanzania traditional contract is widely used except the growing trend of design and build form of contract. The traditional contract comprises the following construction project process.

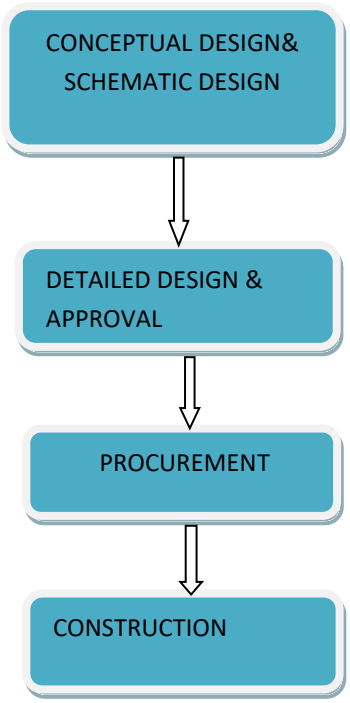

Figure 2.1: Typical Construction Stages In Traditional Contract

Figure 2.1shows the four different stages of construction process which is dependent on each other, the conceptual and schematic design stage is an early stage of design in which broad outlines of client wishes, wants are then made into functions, and then rough sketches (models) are then produced by an architect. Detailed design is done by the architect and engineer is given approved architectural drawings to produce structural design drawings. Procurement stage is the one that the bill of quantities are done by the quantity surveyor and is when main contractor and subcontractor are procured through tendering proceedings by the procuring entity. Also in this stage, the suppliers are determined. At the construction stage, the contractor is called upon to build the structure according to the approved design and at an agreed cost.

2.2.1 Construction supply chain team (Key participants)

Construction supply chains involve stakeholders who are individual service providers such as subcontractors, designers, engineering consultants, main contractors and owner (O'Brien et al. 2004). Typically, construction supply chains only exist for the duration of the project. Where maintenance is a part of the contract, construction supply chains exist theoretically throughout the life of a building(Briscoe et al.2001).

Akintoye et al. (2000) found evidence of a growing trend towards partnering arrangements, but these were mainly focused on clients and main contractors rather than extending down the chain to subcontractors and suppliers. Hence complete integration is not achieved throughout the duration of the project. Supply chain management is a management of a network of organizations which are involved in carrying out the business process. In the construction industry, this network may be complex due to the size of the project and number of organizations involved (Asad et al.2005).

2.2.2 Integrated construction supply team

Integrated supply team is a term used to describe the integration of the key supply chain team involved in the project delivery. This team comprises the designers, main contractor, sub-contractors, suppliers and facility managers (Cooper et al.2000). The integrated supply team in construction is particularly relevant on public projects which employ procurement routes such as design and build, prime contracting and private financing initiative whereby under these routes the entire supply chain team is appointed after project brief has been prepared, often under one contract.

2.3 Construction supply chain systems

Construction supply chain consist of stakeholders who are directly involved in the construction during the execution of onsite operations of the project such as the main contractor, sub-contractor, engineering consultant, client and suppliers (Pryke, 2009).On average material, cost contributes 50% to the project cost and hundreds of material and equipment suppliers take part in the supply chain. Apart from these suppliers, activities of the construction projects are subcontracted to specialty contractors such as designers, electrical, engineering, plumbing etc.

Supply chains in construction could be divided into two major groups such as materials chain and construction chain, which help to separate the procurement and management operations. However, both chains are linked through a supply chain management database, which is further linked with central project database. This would ensure the smooth flow of information within the different chains and results in an increase in the supply chain collaboration within the supply chain partners (Desai et al. 2015).

Different procurement systems categorize various construction supply chain systems for instance in traditional procurement system the design consultants are the tier one supplier working for the client and the contractor has a supply chain of specialist sub-contractors and suppliers while in design & build procurement system the main contractor is the tier one supplier working for the client and will have a supply chain of design consultants, specialist sub-contractors, and suppliers. Figure 2.2 illustrates an example of a construction supply chain procured under design and build procurement.

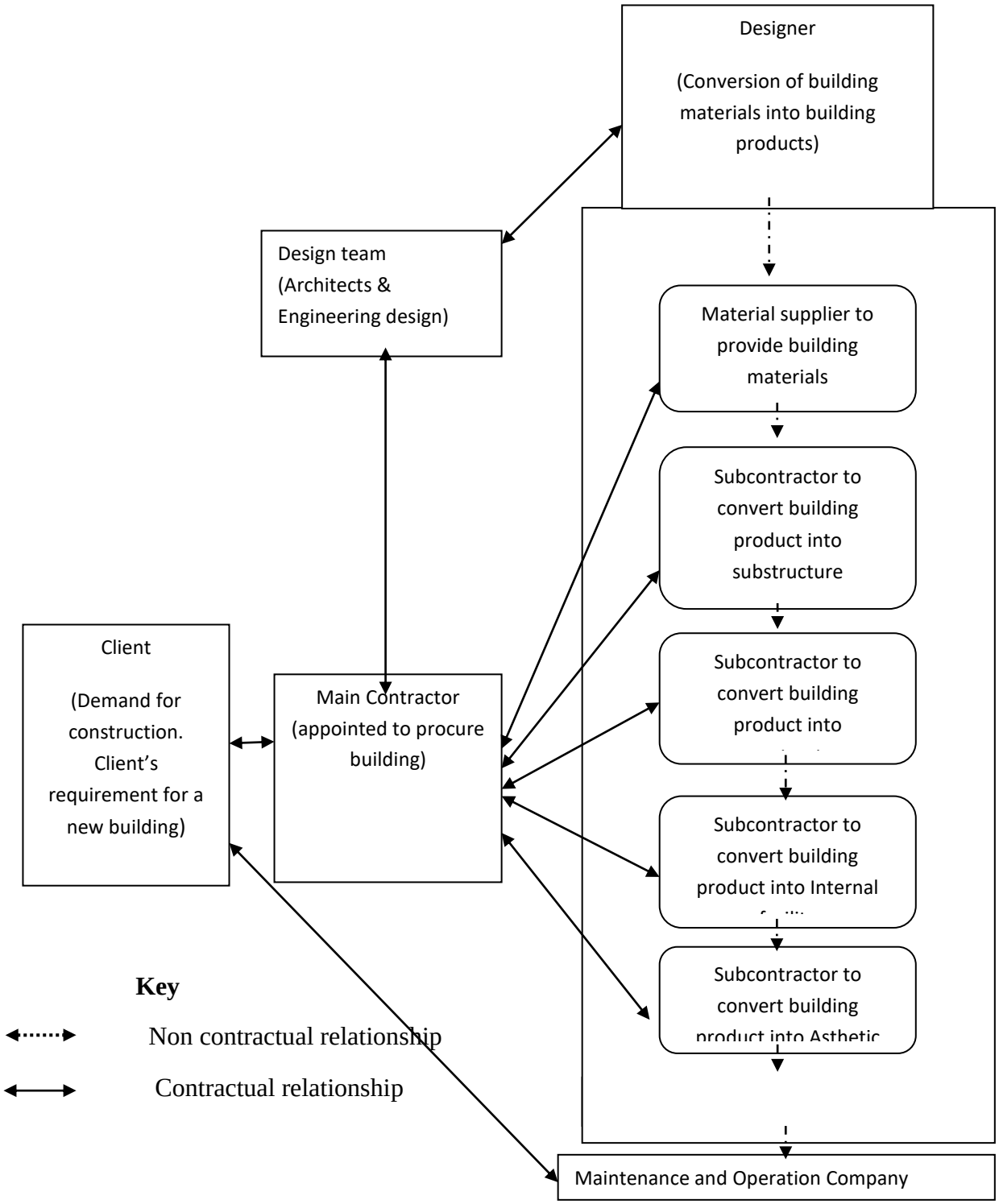

Figure 2.2:Typical construction supply chain relationships in Design and Build Procurement route.

2.3.1 Traditional VS integrated construction supply chain

Koskela and Vrjihoef, (2000) in her study said that supply chain management checks on the interdependency among partners of the supply chain in the coordination of the activities in order of increasing transparency by integrating various activities and hence improved coordination and resulting to efficient project performance. The traditional way of managing construction supply chain differs from integrating ways construction supply chain as illustrated in Table 2.1

Table 2.1: Difference between traditional and integrated construction supply chain, (Vrijhoef et al 2001)

S/N	Traditional	Integrated
1	Presence of short term plans and goals	Presence of long-term plans
2	Improper planning leading into no harmonization between channel partners	High speed of operations due to interconnecting flows, just in time delivery and quick response across the channel
3	Multiple organizations with different objectives involved in production process	One organization responsible for the production process
4	Lack of joint planning	Joint efforts and planning
5	Lack of information sharing and monitoring	Constantly planning, controlling and monitoring process
6	Uncertain demand forecast and inadequate tools make forecasting/planning huge challenge	Reliable demand forecast and planning can be done
7	High degree of standardization repeatability	Project-unique design and material specifications with little or no repeatability
8	Wider and less specific product	Specific and defined end product
9	Build to stock is commonly used	Build to order is the widely used model
10	Project-specific suppliers and distribution networks	Pre-defined supplier and distribution network
11	Many suppliers supplying to a wide range of end users	Many suppliers supplying to a specific end user i.e. converging supply chain

2.4 Characteristics of construction supply chain

Construction supply chain can be defined as a series of functional activities, taking owners perspective and requirements as objectives which begin with project requirements, then defining the project, obtaining project finance, designing the project, constructing the project, maintaining the project until reconstruction or

demolish session. The construction project is set up around the single product, unlike manufacturing industry systems where multiple products pass through the factory. It is a converging supply chain directing all materials to the construction site where the object is assembled form incoming materials (Papadopoulos et al. 2016)

The construction project produces to satisfy a client. Unlike manufacturing industry where multiple products pass through the factory and are distributed to many customers. Construction project apart from rare exceptions are temporary supply chain producing one product through repeated reconfiguration of project organizations (Briscoe and Dainty, 2005).It is typical make-to-order supply chain, with every project creating a new product except little repetition. As a result, the construction supply chain is typified by instability, fragmentation and especially by the separation between the design and construction of a built project. There are two primary schools of thoughts within supply chain management theory within the construction industry.

First is the logistics theory and it reduces waste through efficient management of the flow of supply of materials to construction site. In this logistics are done by viewing suppliers as clusters of subcontractor around main contractor (Asad et al.2005). (Bertel et al.2008) also looked at the logistic theory in construction and concluded that a fast increase in productivity is due to just-in-time delivery of building materials required at the site. The second is the lean thinking that involves the promoting the coordinating the supply chain parties in a project (O’Brien et al.2002).

The following are the characteristics of construction supply chain as discussed by (Venecius and koskela, 2015); project based nature, network design, fragmentation and demand forecast.

2.4.1 Project based nature

Koskela and Vrijhoef,(2000) said that project based construction supply chain is constituted by temporary multi-organizations forms and site based operations. They are temporary due to the fact that different parties focus on completing their small and often unique parts in a project (Cheng et al.2010). (Gosling et al.2014) said that there should be established flexible chains to deal with subcontractor and suppliers in order to reduce cost of penalties to a minimum cost. He added that also construction supply chains are managed on a temporary basis.

2.4.2 Network design

Aziz and Hafez, (2013) in his study said that the design of a construction supply chain is typically characterized by various links which affect day to day activities and processes. These links include the main contractor linked to a various subcontractor, suppliers, client and consultants. The complexity of moving labor, equipment and materials from suppliers to project site is increased as the number of parties increase. (Vrijhoef and Voordijk, 2003) mentioned impact of variability on works on site and gave a solution of considering buffer times in order to reduce variability in the management of construction supply chains.

2.4.3 Demand forecast

In construction supply chain demand is the factor that drives this chain i.e. client demand. Often clients don’t know their wants and hence they are subjected to the

opportunistic behavior of construction companies (Ireland, 2004). He added that most of construction companies are integrators of different supply chains that have unpredictable, volatile and customer driven demand patterns. There is a limited demand forecast in Engineer-to-order supply chain structures as that of make-to-stock sectors **(**Gosling et al. 2013).This engineer-to-order supply chain its produced uncertainty is increased due to its high level of customization, project specific designs and inadequate information.

These difficulties are addressed as they are derived from the principle of construction that work starts after the order is placed (Olhager, 2003). However, these difficulties are further pointed at the design stage which is the earliest stage of production activities which specifies the demand forecast which is later to be used in preparation of production schedules. For the purpose of decreased uncertainties in demand forecast (Gosling et al.2014) suggested the adoption of a tactic he named as "Sharing demand information" which entails in the principle of "information transparency". This means accurate and non-biased information regarding demand such inventories, work in progress, correspondence, specifications and flow rates should be available to all relevant parties involved in a project.

2.5 Integrated construction supply chain concept

Khalfanet al.(2010), in their study noted that integration of construction supply chain means knowing the supply chain. They also added that it is important for each member in the supply chain to know the construction processes and the business of other members of the supply chain. The culture of people working as a team in the project and thereafter disperse after the project completion is out of trend due to the new procurement methods like design and build, contract management and the

project management which are practiced in the construction industry. It is necessary for people. It is now necessary to know people and their business because the construction project team is slowly transforming from virtually temporally to permanent with benefits that are enjoyable to everybody in the supply chain. Figure 2.3 shows a conceptual view of a construction project supply chain with main supply chain parties.

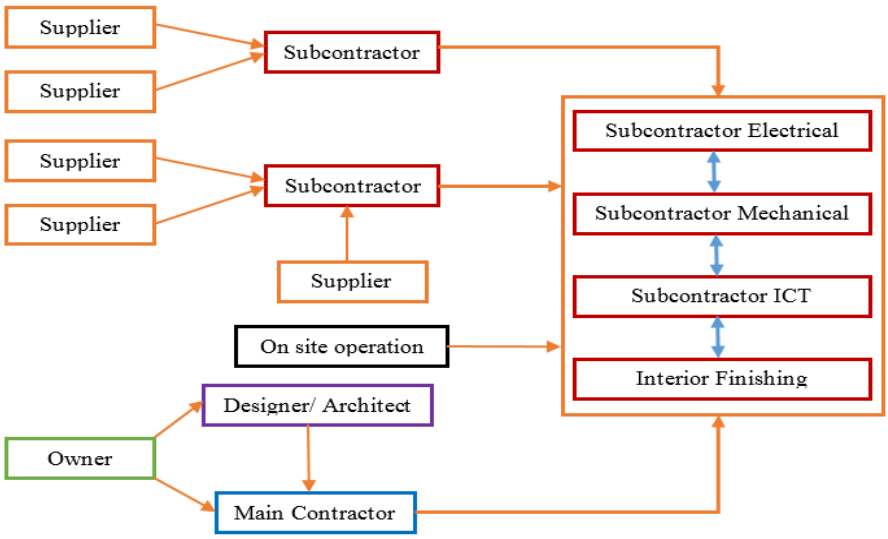

Figure 2.3: A conceptual view of construction project supply chain O'Brien et al. (2002)

2.6 Levels of integrated construction supply chain

Internal and external integration in the system of supply chain management is becoming crucial for the increased individual company and for other companies involved in the supply chain in a project.

2.6.1 Internal supply chain integration

Internal integration is achieved through internal communication between departments. It is the relationship between these insiders that is going to be portrayed to the outsiders. This shows how internal integration is linked to external integration.

This is seen in the building project that in establishing collaboration with other companies in the project it is necessary to first establish collaboration within one's company.

Toivo, (2010) stated that trust and relationships are obtained through the cross-functional activities and inter-functional activities and therefore making it necessary for the need of cross-functional integration. (Kocoglu et al.2011) in his study found that the degree of interaction, communication, information sharing and coordination across functions is the measure of internal integration. He added that internal integration can be enabled through internal collaboration to overcome functional myopia.

2.6.2 External supply chain integration

This involves the integration of supply chain members comprising of client, consultants, main contractor, sub-contractors and suppliers. This aims at establishing a strategic partner relationship between members. A strategic supply chain partnership is a relationship formed between two independent entities in supply channels to achieve specific objectives and benefits (Segerstedt and Olofsson,2010). This means that it requires of the main contractors should establish a strong relationship with strategic subcontractors and suppliers in achieving the highest level of information flow and accurate (free of error) planning and scheduling of demand and supply forecast. Also through strategic supply chain partnership partners shares goals as well as inherent risks through joint planning, control. With client and consultants it will assist in the monitoring process. Thus all members in the construction supply chain will get advantage of decreased uncertainty, easy control

of cost, time of the activities, material, and project quality and ensure client satisfaction.

2.7 Dimensions of integrated construction supply chain

Generally, there are three dimensions of Integrated constructed supply chain namely; Information integration, Process integration, and trust integration. Information Integration is the sharing of information and transparency. It enhances direct and real time accessibility. Process integration is the collaborative planning, forecasting and enhancement of joint design. Trust integration assist in coordinating mechanism of planning and operations.

2.7.1.1 Information integration

2.7.1.1 Free flow communication

Baiden and Price, (2010) identified communication as one of the indicators of the practice of integrated supply chain in construction projects. Communication has lead to the rise in team effectiveness across organization levels leading to organization effectiveness. Communications encourage face to face relationships and interactions to be achieved. Communication has lead to the rise in team effectiveness across organization levels leading to organization effectiveness. It is through communication flows that any professional and cultural interfaces can be established (Moore et al.2015).

Ochieng and Price, (2009) stated that for the purpose of reducing complexity of the design implementation process, high quality communication between main project offices and on site production staff must be established. (Baiden and Price, 2010) added that communication barriers between project teams have created boundaries to

their participation in design development, despite the importance of managing the implementation of design changes. Good leadership and facilitators plays a vital role in improving effective communication.

2.7.1.2 Sharing information

Information is a collection of facts or data that has been given meaning by ways of relational connection. It provides human beings basics in developing decisions, (Kocoglu et al.2011). Construction information often exists in the form of documentation such as brief, logistics, financial status, drawings, specifications, contracts and conditions, explanations and clarification which are shared among project teams identified two types of information in construction namely production information and process or supply chain information(McDermott et al.2004).

Production information is further divided into two types of geometry information and property information. Geometry information is characterized by defining a building object by using geometric features and space relation features between these objects for instance, 3D model, space interactions, horizontal map, and elevation. Property information is characterized by describing properties of objects through function, material and criteria information for instance materials, appearance, strong character, and design standard and construction regulation (Khalfan and Maqsood, 2012).

Process/supply chain information is also divided into two types of process information and supply & demand information. Process information is characterized by defining the work package according to the construction practice and resources for instance who, what time, how and when to finish a specific work package. Supply and demand information is characterized by providing supply and demand

information depending on the construction schedule plan or market for instance suppliers of materials, machinery and human capital and requirements of demand. Many researchers have chain integration (Kocoglu et al. 2011).

To a great extent, it measures the application or performance of the construction supply chain integration since it allows, direct and forbid the material and financial flow. Also assist in providing proof and audit trails in transactions. Lack of information sharing and integration is a major barrier to effective construction supply chain integration. Identified information integration and sharing information as a major role in the construction supply (Kumar et al.2012).

2.7.1.3 Integrated Information communication system

Khalfan et al. (2001) stated that one of the indicators of integrated CSC is the ability of the project teams to use the ICT systems in the delivery process. According to (O'Brien et al.2004) integration between project teams would be successful if there was a compatible information system. (Titus and Bronchner, 2005) said that in this day generation of modern technology it is possible to overcome the lack of communication and information flow that is due to distant locations.

Information can be transmitted to all project parties by the centralized system via a centrally accessible location established to store the electronic information or a network for transferring the electronic information to all parties. (Alshawi and Faraj,2002) added that this system will ensure all the information about the project is consistent with each project team to have access to the same information. (Saurin, 2012) noted that the use of the internet can help in creating one medium of exchanging information such as holding online conferences. He added that through

ICT system many time wasted on works of manual information storage can be saved by being more innovative and creative.

2.7.1.4 Creation of single team location

Mcdermott and Khalfan, (2012) viewed creating a single location for all internal stakeholders on one site as one of indicators of construction supply chain integration. They added that the whole project team needs to be confined in the same area from the beginning of the project in order to maintain close physical contact and remove information and communication barriers. (Bresnen and Marshall, 2002)stated that having a joint project office provides a face to face communication between project teams rather than a distant project office and it speed up collaboration through shared information.

Rita et al. (2015) added that assembling the project teams from different geographical and cultural context in the same location will enhance them to understand the collaborative culture, to build a relationship that helps in joint problem realization and creating a joint solution. However some procurement approaches do not call for a joint project location although it is best fit for collaborative working.

2.7.2 Process integration

2.7.2.1 Client Care Team

Riddalls et al. (2000) suggested that there is a need to form a client care team that will be at the centre between end-users and project teams in order to ensure the needs of the end-user are met in the completion of the project.

However (Baiden et al.2006) added that developing and tracking these requirements is a task to supply chain teams because most end-users have no awareness of project delivery and fail to address their needs and wants. (Bakker et al.2012) in his study said that this task can be done by various forms of interactions, for instance, having schedule of briefing the public after 3 months for long duration projects and 1 month for short duration projects. This will increase motivation, integration and team work can succeed and hence success of the project.

2.7.2.2 Commitment of top management

Baiden et al.(2006) identified that commitment from top management as an indicator for the measure of integrated construction supply chain. He added that for complex organizational and technical systems of construction projects being committed to doing it well is the most important aspect and measures level of integration. (Briscoe et al.2001) said that commitment of senior management in the process of coordination and determines the transparent and mutual perspective among supply chain members.

Ochieng and Price, (2009)added that it is the senior management that supports and train team members on collaborative working, cooperation, good practice and behavior throughout the project. (Smith, 2006) suggested that senior top management from each organization requires early training on high level commitment in leading and maintaining cooperation in order of increased efficiency in the delivery of the construction projects.

2.7.2.3 Mutual Objective

The mutual objective is another important indicator of ICSC. (Ibrahim et al.2013) stated that team integration in the formulation of mutual or collective goals at an early stage of the project contribute to the creative and innovative design that meets the client's demands. He added that collective responsibility, design quality, a speed of delivery, decision on cost of construction and operational efficiency of the project can be achieve through mutual understanding of the project goals.

Miller et al.(2001) added that through mutual understanding transparent and collective decision making can be achieved. (Akintan and Morledge, 2013) in their study identified that collaborative decision making with low tier suppliers for their specialist skills will contribute to the effective decision. They suggest that professionals' contributions at personal and organizational level can be seen if each member see themselves as a member of the project team and important player in the project team rather than as members of their individual disciplines.

2.7.2.4 Agile and flexible management

Kerzner, (2013) in his study said completing a project on time and within budget is the primary objective of the top management, however being rigid to the growth of the project could reduce the value of the client's final product. Managers who understand flexibility approach believe that the project will develop or change from initial brief and therefore keep constant tab in communication with all supply chain members to ensure changing requirements are incorporated in the project.

He also, identified that construction projects are characterized by numerous of uncertainties, personnel changes, design changes and management changes during

the construction of the projects delivery and therefore team flexibility to the adoption of the changes will speed up the parse of the project and increase integration with other team members of the supply chain.

The main focus is on how team members respond the changes. (Whyte et al.2016) in their study suggested that for large complex projects should depend on digital technologies and configuration management in maintaining integrity during the transformation of occurred changes. He added that savvy project managers embrace uncertainty and change rather than avoiding them.

2.7.2.5 Joint risk management

Osipova, (2013) in his study identified that the contractual relationship between client and contractor is faced by the adversarial nature and that diminishes the urge to participate in joint risk management. He added that joint risk management is achieved in the environment of strong collaboration between parties concerned, this means converting from different goals and attitudes to risk to joint goals and attitudes to risk.

Kumaraswamy et al. (2001) urged that unforeseen risks need to be handled by a joint risk management strategy that will work through dynamic efforts. He added that attitudes and cooperative relationships are important in the successful delivery of the project. He added that failure to adopt joint risk management the uncertainties will result in prolonged claims and disputes.

2.7.3 Trust Integration

2.7.3.1 Trust

Trust is a firm belief in the reliability, truth or ability of someone or something. (Koskela and Vrijhoef,2000) stated that lack of trust and respect of the old ways of doing things prevail, attitudes and suspicions perceived by the project participants can cause tensions and problems among team members.

Ochieng and Price, (2009) said that team members need to trust each other and believe that every individual is trying their best to achieve a common objective. He added that mutual understanding and respect is necessary for the successful completion of the project. (Briscoe and Dainty, 2005) suggested that early participation of the whole supply chain will create equal respect among team members. He added that sharing information within the project requires trust and coordination.

2.7.3.2 Long term relationship

Mueller, (2014) stated that a stable solution over a long term is the one that every partner of the supply chain from suppliers to end user benefits from the process.(Barrat,2004) said that personal relationships that evolve among collaborating partners are a positive factor for future business with each other. He added that for such relationship which takes time to develop it is necessary to maintain such a strong bond for individual benefits and supply chain as a whole.

2.7.3.3 Transparency

Transparency is defined as an ability of all stakeholders in an integrated team to have a clear understanding of different aspects of the current system, performance status

and feedback, letting them recognize interdependencies to enhance creates ways to develop value added in a project (Mueller, 2014). He added that transparency can help incorporate input from all key supply chain participants ie.building operators at an early stage of the design process. Operations input can provide insight to maintenance costs. Also, helps in transferring unfamiliar technologies from waterless urinals to the next generation of HVAC control systems are integral to achieving sustainable goals.

2.7.3.4 Team building activities

Toivo, (2010) stated that there is the need for key supply chain participants to get involved together in team building activities to enable effective interaction with others and generating new ideas. (Adetunji et al.2008) said that through activities that build the team, team members are empowered and encourage contributing their creativity to the project team. He further explained that team building activities are essential for transferring culture of having an integrated team.

2.8 Factors hindering the application of integrated construction supply chain

In the previous, we have seen the various benefits of the application of integrated construction supply chain. However, there various factors that hinder the application of integrated construction supply chain. They include the following;

2.8.1 Lack of good information flow

Information is a set of organized data. In construction project information is considered as processed data and it is necessary for the effective action. Project information exchange among the client, consultants, main contractor, sub contractors

and suppliers has mainly been based on paper document system traditionally (Xianguang et al.2010). Xianguangfound that two third of the construction problems are a result of an inadequate exchange of information and inefficient information. He added that information and communication technology is the key to successful project but recently it is difficult to transform the control and direct information flow electronically in construction projects. However (Shen et al.2010) said that the cost of the cost of paper documents produced during construction is three times their initial cost. The ineffective information flow is due to the inability to share electronic data between construction project participants.

2.8.2 Organization structure

Katunzi and Zheng, (2010) found that there is an absence of compatible organization structures in small and medium enterprises that support supply chain integration. However, in his findings found that small and medium enterprises give less attention to supply chain management strategies and are reluctant to employ transparent integrated system to link them with other actors. Failure to have a compatible organization structure is such a critical factor for achieving an integrated construction supply chain.

2.8.3 Lack of training on ICSC

Barrat, (2004) stated that there is an increasing shortage of skilled workforce on new technologies. With increased technology, integrating members of a supply chain in a fast way it requires the use of information and communication technology. Also there are few with technical and managerial skills enough to achieve value added in a project. (Briscoe and Dainty, 2005) found that no developed career structure to sustain supervisory and management skills.

2.8.4 Lack of top management support

Awasthi and Grzybowska, (2014) in his study identified the lack of support from top management as the critical barrier of the supply chain integration process. Lack of top management support was the root cause barrier to integration in within organizations and with other organizations in a project. He added that failure of misalignment and fragmentation of company strategy and supply chain strategy for the benefit of the company is a factor hindering the application of ICSC (Muller, 2014) stated that support of top management is crucial and a requirement in the successful application of ICSC.

2.8.5 Lack of staff training

Unger, (2003) stated that in developing countries most of the personnel fail are not trained on various platforms that facilitate integration. Also, he suggested that in order to facilitate integration the management staff should be trained on the use of soft skills necessary for the implementation of supply chain integration.

2.8.6 Lack of willingness to invest in supply chain integration

Awasthi and Grzybowska, (2014) said that there is a huge struggle with the management of construction companies to willingly invest in supply chain integration process as this is a financial factor. Without willing to invest in ICSC the organization or project will not see the benefits of ICSC. This factor is a hindrance towards the implementation of ICSC.

2.8.7 Multiple independent information systems

Many companies have various technologies in different aspects such as that of finance and procurement. (Seifert, 2003) found that most companies operate with

many independent systems and loosely coupled information systems. He added that these independent systems result to lack of integration among different departments and different colleagues in a company. For the construction project to successfully implement the application of ICSC there are required on integrated information communication system that links various department and brings integration among the key supply chain participants.

2.9 Benefits of application of integrated construction supply chain

Despite the many challenges of application of integrated construction supply chain, there are many benefits/rewards of effective application of integrated construction supply chain .The following are those obtained from the extensive literature.

2.9.1 Early design completion

Tucker et al. (2001) in his study found that through improved information flow and better collaboration enables more design to be completed before construction by considering the needs of the suppliers and users, issues of regulatory control, finance and insurance. Also, suggested that early engagement of supply chain in the design stage helps in speeding up the design through knowledge sharing and cooperative attitude.

Egan, (1998) said that early involvement of all main supply chain partners and thorough pre-planning is expected to yield additional benefits in terms of health and safety performance within the construction industry. He added that involvement of suppliers and subcontractors early in the design phase will not only improve efficiency and quality of the work but also will benefit them by learning from large

companies and helping them gains something through the adoption of integration strategies.

2.9.2 Innovation

Through developing new areas of knowledge around improved information flow and better collaboration in construction it makes innovation more visible, promoting the benefits of novel technologies or approaches (Kocoguli et al. 2011)

2.9.3 Expertise importation

Many experts from manufacturing and other sectors will join forces in collaboration to aid delivery and operation of buildings, roads and bridges and thus increase in expertise in the construction industry. Thus great continuity of work and a more stable working environment (Miller, 2001)

2.9.4 Integrated procurement system

Shen et al. (2010) in his study said that there will be a development of new practices for coordinating procurement and delivery based on shared problems solving, systems engineering and collaborative working.

2.9.5 Improved information management systems

In the struggle for improved flow of information from manufactures/ suppliers to client in the supply chain will result in the development of lifecycle information management technologies , products and services that will provide data to specifies and designers from commissioning, operation, post-occupancy evaluation and feedback, end users and building sensor system(Unger, 2003)

2.9.6 Accurate demand and supply of materials

Through improved information management systems, one can identify solutions for mapping and managing staffs and materials, to address peaks and troughs in demand or supply (Seifert, 2003)

2.10 Strategies to enhance the application of integrated construction supply chain

Many kinds of literature have identified the various ways to promote the efficient application of integrated construction supply chain. The following are the success factors have been revealed upon extensive literature review done;

2.10.1 Involve suppliers and subcontractors at an early stage of design phase

Egan, (1998) in his study suggested the concept of "*design for construction*" as he stressed on the involvement of suppliers and subcontractor in the design team for efficiency and quality by feeding the experience of the completed projects into the next one depending on each one's expertise. Also, defects and snagging need to be designed out on the computer before the work starts. Therefore designers should work in close collaboration with the other participants in the project process including clients that need to be advised on the need for the resources to be concentrated up-front on projects if greater efficiency and quality need to be achieved.

2.10.2 Repetitive supply chain team on new projects

Egan, (1998) in his study said that repetitive supply chain team on new projects can be achieved through long-term relationships throughout the supply chain. He argued,

“A team that doesn’t stay together has no learning capability and no chance of making incremental improvements that improve efficiency over a long term. Therefore, improved profitability through the increased reduction of costs from non value adding activities.

2.10.3 Training on collaborative culture

The application requires a transformation change of stakeholders in construction towards collaboration and mutual benefits. This can be achieved through organizing workshops on training regarding ICSC to the members of construction supply chain. Continuous improvement through close working relationships with the adjacent partners in the supply chain

2.10 Conceptual framework chart of the study

In figure 2.4 the researcher conceptualized in the study that the client, consultant, main contractor, sub-contractor and suppliers should apply the integrated construction supply chain practices in order to have an effectively integrated construction supply chain in building projects. The construction project performance depends on the effective application of integrated construction supply chain practice.

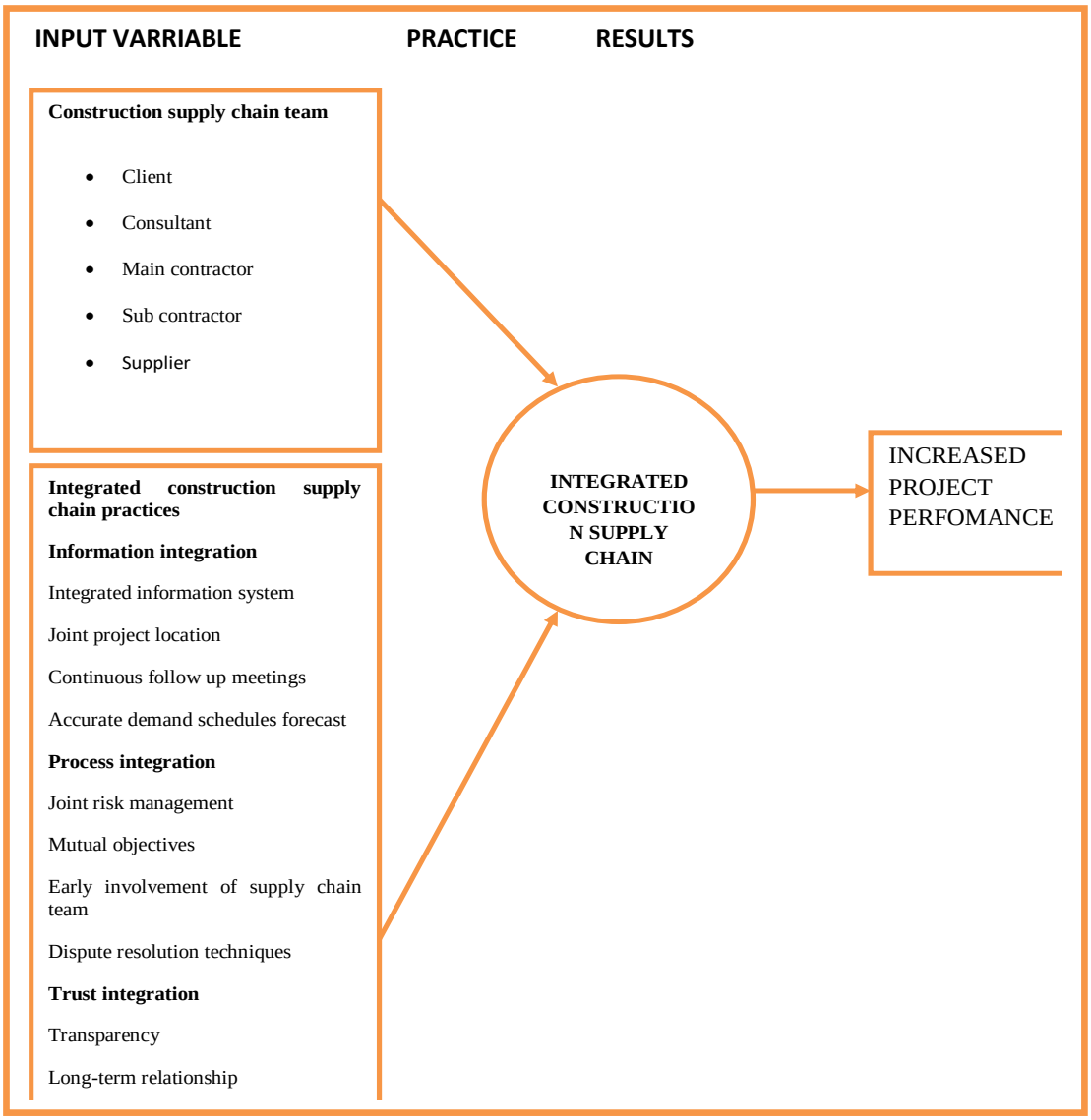

Figure 2.4: conceptual framework of the study

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research strategy used in this study. It describes the research approach employed in this research and its justification. The research design is illustrated followed by a discussion on the selection of cases and sampling technique used. Methods of data collection used in this study are then elaborated with their justifications and discussion on how the data shall be analyzed and presented in answering the research questions follows thereafter. The chapter lastly discusses on how validity and reliability of the methodology used in this research were considered.

3.2 Research Approach

Research approach refers to a systematic and logical procedure for solving a problem with the support of facts (Yin, 2003). In order to assess the application of integrated construction supply chain practice in building projects in Tanzania, this study used the mixed approach where it entails both quantitative and qualitative approaches. The quantitative approach (survey method) was first adopted in obtaining the extent of application, challenges and ways to promote the application of integrated construction supply chain practice in building projects in Tanzania, however information regarding how and why to such extents were insufficient and therefore a qualitative approach (case-study method) was then adopted to see how the ICSC is practiced, to what extent, (challenges) and recommendations. Data collection and

analysis were done by mixed approach which is quantitative (questionnaire) and exploratory (case-study).

Quantitative method approach is a deductive process of inquiry where by the variables in study are measured in numbers, analyzed using statistical procedures in order to describe or make generalizations, and reported in formal, impersonal language (Creswell,2013).Here the researcher aimed at obtaining the percentage and mean of respondents regarding the knowledge of building actors on supply chain integration practices, the extent of the application, challenges and ways to promote the application of ICSC.

A qualitative method was adopted in this study because of its significance in exploring in-depth information regarding the respondents/subjects under study. In this situation a researcher seeks to establish the meaning of a phenomenon from view of participants (Yin, 2010). It was used to gain an understanding of underlying reasons and opinions regarding supply chain integration practices.

3.3 Research design

3.3.1 Case study

A case study is a research method which explore in depth an event, activity, process or entity. It involves an extensive investigation of just one person, group or event, its focus is on a particular unit, and that is the case, (Collis and Hussey, 2009). This research method was selected because it allowed a researcher to conduct in-depth study of the research topic and more understanding on the subject matter after critical analysis of results from the selected cases. (Yin, 2010) informs that through case study approach large amount of information may be obtained as a result this design

was sought to be ideal for exploring information from an area where little information was known.

Also, due to the nature of the study case study methodology was selected so as to provide comprehensive empirical base which gave an opportunity to learn and illustrate the application of supply chain integration in building projects in Tanzania. This method intended to focus on how integration construction supply chain practices are applied, factors hindering its application and ways to promote its application.

3.3.2 Case study Area

The study was conducted in Dar es Salaam due to presence of a number of ongoing building projects which sought to be resulted from recent government plans to move to Dodoma and transforms Dar es Salaam into a business city, this welcomes the need to have as many as possible large buildings for both commercial and residential activities. In conducting the study, researcher highlighted various reasons for the selection of building projects during data collection as they include multiple numbers of key players in pursuance of the given project. (Christopher et al.2004) noted that building projects covers a wide range of materials, product, systems and specialists services, supplied by a variety of industrial sectors and currently organized on fragmented basis, therefore making it viable for the study of supply chain integration.

3.3.3 Selection of cases

Cases selected for this study were largely focused on envisions or offering of an opportunity to learn and gather new ideas and information regarding the application of integrated construction supply chain practice in building projects in Tanzania.

(Yin, 2010) said that multiple case studies are essential compared to single case study when the research is new and unique that give analytical generalization which requires numerous cases to compare results of the case study to a theory that may have much wider application than the particular case study. In this case a multiple projects were therefore involved by a researcher so as to explore the differences between cases on application of integrated construction supply chain practice.

To select the most crucial cases for detailed analysis, an initial survey was conducted to obtain potential large building projects based in Dar es Salaam. From the Contractor's Registration Board portal and through snowball sampling the researcher obtained a list often large building projects in Dar es Salaam.

Table 3.1 illustrate the list of ten cases that were selected relying on various factors/characteristics which include; they were ongoing building projects, they had in place the five key supply chain participants inclusive of client, consultant, main contractor, sub-contractors and suppliers, cases with elements of integrated construction supply chain and nature of works done were constructions, electrical and mechanical works.

However the researcher also considered the proposed project duration to be at minimum twelve months and current stage of the project to be minimum six months since commencement stage. Also, the selected cases considered large projects with an average project sum of not less than two million Euros which is equivalent to five billions Tanzanian shillings that sought to have enough information regarding topic under study.

Ten building projects selected in Dar es Salaam were namely; Residential Apartments for Magomeni-Quarter Ex-tenants-kinondoni municipality, Proposed construction of complex terminal building and its facilities-Ilala municipal, Proposed Construction of MwalimuNyerere Foundation Square building at Zanaki street and Mansfield street, Kinondoni- Dar es Salaam and new PPF head office building– kinondoni municipal, Proposed construction of NHC Victoria Plaza building, Kinondoni municipality-Dar es Salaam, Proposed construction of office building for ministry of water (Majihouse) at Ubungomaji-Dar es Salaam,

Proposed construction of Sky tower building in Makumbusho, Kinondoni municipality-Dar es Salaam, Proposed construction of Mzizima tower at Maktabastreet& India street, Ilala-Dar es Salaam, Proposed construction of NHC Morocco square office Tower building at Mwaikibaki road, Kinondoni municipality-Dar es Salaam and Proposed construction of Mlimani Plaza building, Kinondoni municipality-Dar es Salaam. At this stage questionnaire survey was used to determine the knowledge of application of integration practices by building actors and extent of application of integrated construction supply chain practice in the ten case projects. Thereafter the researcher had found to obtain insufficient information.

Due to inadequate information from the questionnaire survey, three cases which were sought to have rich information were then selected through purposive sampling from ten cases, in order to get an in-depth understanding of the study.Five interviews were then conducted in the three cases then analyzed by cross-case analysis. The three cases are namely; Proposed construction of complex terminal building and its facilities-Ilala municipal, Proposed construction of NHC Morocco square office

Tower building at Mwaikibaki road and Proposed Construction of MwalimuNyerere Foundation Square building at Zanaki street and Mansfield street.

Table 3.1: Projects characteristics

NO	Project Characteristics	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6	Project 7	Project 8	Project 9	Project 10
1	Client	Public	Public	Public	Public	Public	Public	Private	Public	Public	Private
2	Contractor	Local	Foreign	Local	Local	Local	Foreign	Foreign	Local	Local	Local
3	Contract sum	€4M	€250M	€20M	€25M	€12M	€16M	€10M	€43M	€208M	€10M
4	Contract form	Design & build	Design & build	Design & build	Design & build	Traditional contract	Traditional contract	Traditional contract;	Traditional contract;	Design & build	Traditional contract;
5	Nature of works	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical	Construction, Electrical & Mechanical
6	Current stage of the project(time)	30%; month 8	60%; month 48	40% ; month 27	75%; month 18	70%; month 24	60%; month 18	65%; month 22	40%; month 27	50%; month 27	30% ; month 16
7	Proposed project duration	24 months	36 months	30 months	36 months	24 months	30 months	30 months	36 months	30 months	24 months
8	Number of subcontractors	3	8	5	4	3	4	4	4	7	3
9	Mode of contractor selection	Pre-qualification	Pre-qualification	Competitive tendering	Competitive Tendering	Competitive Tendering	Competitive Tendering	Competitive Tendering	Competitive Tendering	Competitive Tendering	Competitive Tendering

3.3.4 Unit of Analysis

The study consisted of five (5) key supply chain participants in the building projects in Dar es Salaam. The targeted respondents were clients, consultants, main contractors, sub-contractors and suppliers. Their involvements were depended on their roles in the integration of supply chain practice as follows;

- The client is anyone for whom the construction project carried out. The client roles in ICSC are; making suitable arrangements for managing the project, assembling the project team, provide pre-construction plan and maintaining the management arrangements
- The consultant is an individual or organization that prepares or modifies a design for construction project. Consultant roles in ICSC include; prepare or modify design, providing clients with advice on the related works and cooperating with other duty stakeholders.
- Sub-contractor is an individual or an organization that performs all or part of the obligations of the contractors contract, his/her roles in ICSC are to work hand in hand with the contractor and other supply chain participants to complete the construction project
- Main contractor is an individual or organization that manages the construction by employing construction workers. His roles in the ICSC includes; making clients aware of their duties, planning, managing and monitoring construction work, providing information and instructions to others when required.
- Supplier is an individual organization that ensures materials and equipments are supplied and made available for the project work on time where by such

individual person performs a multiple of tasks this includes ensuring quality control adhered by manufacturer also advises the project on design and development strategy

3.4 Methods of data collection and analysis

3.4.1 Questionnaire

Questionnaire survey was first adopted with the aim of determining the perception of key project participants of their knowledge on the practices of integrated construction supply chain obtained from literature. This was important to find out if they had knowledge before finding out to what level they had applied that knowledge. Ten large construction projects based in Dar es Salaam were selected through purposive sampling.100 respondents from client, consultant, the main contractor, sub-contractor and supplier from ten construction sites were asked whether they had knowledge of the practices of ICSC and then asked to rank the extent to which they practiced that knowledge on a 1-5 Likert scale. Other parts of the questionnaire were designed to obtain the challenges faced in the application of integrated construction supply chain and ways to promote the application of ICSC. The data from questionnaire were analyzed using Statically Packages for Social Sciences (SPSS). From this stage, the researcher found that the data obtained was insufficient as they could not give the potential features of the projects. Thus it paved a way for case study approach in order to obtain a large amount of data.

3.4.2 Interview

Yin (2003) said that large volume of data can be obtained through interviews. Unstructured open ended questions were mainly adopted in order to obtain in-depth information. At this stage, five interviews were conducted with managers from three

cases selected as case study areas to answer the three specific objectives. Interview guide questions were prepared in accordance with specific objectives. Most of the interviews were tape-recorded, transcribed and translated into English.

3.5 Validity of research

Validity is the degree to which a study accurately reflects the specific concept that the researcher is attempting to measure.

Construct validity is concerned with exposing and reducing subjectivity, by linking data collection questions and measures to research questions and propositions. This study used multiple source of evidence such as interview and closed-ended questionnaire in order to minimize data collection and analysis constraints to construct validity (Yin, 2003).

The study used different approaches such as survey and case study on the same unit of analysis whereby the result of one approach paved way for the next approach. The researcher increased reliability by checking the result one against the other.

Reliability; the objective of this test is to ensure that the data collected can be redone by another researcher following the same procedure and produce the same results. This test was adopted by documenting all the procedure used in finding out the research data showing clearly the research questions and procedures for collecting the data, professionals to be faced for questionnaire and interview and data analysis methods which was aided by computer programme (Microsoft office excel & SPSS) to enhance reliability.

3.6 Chapter Summary

This chapter explains the methodology adopted in this study. It describes the research approach applied, case study design, data collection and analysis methods that were employed by the researcher. Efforts have been made to show the various reasons for the selection of approach, cases and data collection methods in relation to this research under study. The next chapter four will discuss the data collected from respondents, data analysis hence give out the findings of the study.

CHAPTER FOUR

DATA COLLECTION AND ANALYSIS

4.1 Introduction

This chapter presents analysis of data and discussion of findings on the assessment of the application of integrated construction supply chain in construction building projects in Tanzania. Analysis and discussion was based on the results from interviews and questionnaires from different respondents. The data collected were analyzed and results were produced in the form of figures and Tables with an aid of Microsoft excel, Statistical package for social sciences (SPSS) software.

4.2. Respondents Profile

Table 4. 1 Demographic characteristics of the respondents

Characteristics	Attribute	Frequency	Percentage
Age	18-28	4	6.15
	29-39	24	36.92
	40-50	30	46.15
	Above 50	7	10.77
Total		65	100
Education	Certificate	3	4.62
	Diploma	5	7.69
	Degree	32	49.23
	Masters	23	35.38
	Doctorate	2	3.08
Total		65	100
Gender	Male	50	76.92
	Female	15	23.07
Total		65	100
Position	Junior Management	15	23.07
	Senior Management	18	27.69
	Head of Department	24	36.92
	Top Management	8	12.30
Total		65	100

Experience	1-5 Years	8	12.30
	6-10 Years	21	32.30
	11-15 Years	17	26.15
	More than 15 Years	19	29.23
Total		65	100
Building Projects Experiences	1-5 Years	8	12.30
	6-10 Years	17	26.15
	11-15 Years	21	32.30
	More than 15 Years	19	29.23
Total		65	100
Project team	Client	10	15.38
	Contractor	10	15.38
	Sub-contractor	14	21.54
	Consultant	23	35.38
	Supplier	8	12.30
Total		65	100

From Table 4.1 the demographic characteristics of 65 respondents obtained from the field comprised of Age, education, gender, position, experience in construction industry, experience in building project and project team members.

Various age groups were involved. This included 18-28 (6.15%), 29-39 (36.92%), 40-50 (46.15%), and lastly above 50 (10.77%) with huge respondents aged between 40-45 years of age, this implies that according to the nature of the research topic large number of managers whose said to have enough experiences were involved so as to give out their views on integrating other supply chain team members in building projects, generally this granted an opportunity to people whose ages tend to be higher in the industry.

Education level amongst respondents were also involved during data collection where by 4.62% were certificate level, 7.69% diploma level, 49.23% degree level, 35.38% were masters and 3.08% were doctorate level , although most of the

respondents had a bachelor degree this indicated that large number of respondents whose involved in the study had an ability to understand the topic precisely. Moreover, the study included gender of the respondents whereby 76.92% of the respondents included were male and 23.07% were female, this shows that most of the building projects involve more male compared to female, since the activities requires much energy and in most cases construction activities in Tanzanian Projects involves large number of men compared to women.

During data collection of the study in the surveyed projects various positions were included in the study these were 23.07% junior management, 27.69% senior management, 36.92% head of departments, and 12.30% were the top management this implies that the large number of head of departments followed by senior management were purposively selected by the researcher due to their level of experiences from various projects.

Not only that but also the study focuses on the experiences of the respondents that were involved as 12.30% of them had 1-5 years of experience, 32.30% had 6-10 years of experience, 26.15% had 11-15 years of experience and lastly 29.23 of the respondents had more than 15 years of experiences.

The information provided during the study requires much people with enough experience from various projects as per level of experiences observed from the study, a number of respondents had an experience of 6-10 years followed by 15 and above years of experience in construction project handling. This implies that inclusion of

people with huge experience paves a way of gathering potential information on any matter under study.

Researcher went far by looking on the building projects experiences across all the visited projects where then found that experiences that range from 1-5 years had 12.30% of the total respondents included in the study, while 6-10 years of experiences had 26.15% number of respondents, 11-15 years of experiences had 32.30%, and lastly more than 15 years of experiences had 29.23% numbers of the total respondents.

The study also involved various members of the project team (key supply chain integrated team) such as clients who were 15.38% of the total respondents, 15.38% main contractors, 21.54% sub-contractors, 35.38% consultants and finally 12.30% suppliers of the total respondents.

4.3 Knowledge of integrated construction supply chain practices (ICSC)

Building actors were asked of whether they used various practices of ICSC in building projects. Where by Table 4.2 indicate the knowledge of building actors on ICSC practices.

Table 4.2: Knowledge of Integrated Construction supply chain practices

S/N	Concept of ICSC	Number of respondents	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
			YES		NO	
1	Creation of Joint project location	65	49	76%	16	24%
2	Integrated information communication system	65	30	54%	35	46%
3	use of ICT in the scheduling of activities	65	51	78%	14	22%
4	Joint risk management	65	22	66%	43	34%
5	Team building activities	65	57	87%	8	13%
6	Involvement of actors in design stage	65	57	88%	8	12%
7	Long- term relationship with other actors	65	32	49%	33	51%
8	Transparency in information sharing	65	52	80%	13	20%

Table 4.2 revealed that across all the surveyed projects various concepts of integration construction supply chain were introduced so as to know respondents knowledge on the application of Integration construction supply chain practices in construction projects. It is in this regard where by 76% of the respondents across all the projects visited agreed that there is practices of integrated construction supply chain based on joint project location for all participants of the ICSC in construction projects. While on the other side 24% of the respondents from the field denied on the availability of such practices on their projects.

Based on the data from field 54% of the respondents from the surveyed projects argued that integrated information communication system practices are incorporated into the construction projects by all participants of the project as to comprehend shared information concept in pursuance of the prior set goal of the project, this implies that to a moderate extent ICSC concept is somehow considered. However researcher found that 46% of the respondents across the surveyed building projects in

Dar es Salaam do not incorporate integrated information communication system practices into their project performances.

Also, use of ICT in the scheduling of activities, the surveyed projects was proven to be of great help in construction projects performances. Through scheduling it succeeded in reducing unnecessary delays of activities by scaling up the priorities of project activities in accordance with the planned schedule and their preferences. This started with the most preferred to the least preferred according to their rate of importance as witnessed by 78% of the respondents across the projects, this shows that ICSC concepts are given chances to prevail in the construction industry in Tanzania. Subsequent to the views posed out by a huge number of respondents on the same idea that 22% of the respondents revealed the use of ICT scheduling tools appeared to pose contradictions as it failed to observe the idea of privacy on one another. Also, Installation of the system requires an additional budget and technological specialists this gave rise of financial constraints to project handling.

In responding to the concept of ICSC elements, data from the field shows that 66% of the respondents agreed on the use of joint risk management in constructions project. While on the other hand, 34% of the respondents denied on the joint risk management for construction projects. This implies that through joint risk management health, safety issues are adhered and also quality of materials and services was achieved. For those who do not apply may lead to poor quality of the project.

4.3.1 Knowledge level of integrated construction supply chain practice

The knowledge level of the respondents involved in the study were measured variously due to the nature of the study topic, the extent to which one dimension of ICSC were to be measured involved a number of integration activities that used to measure knowledge level of the respondents towards the ICSC, in this regard knowledge level of ICSC varied from one respondent to another although most of the respondents had some idea relating to the topic under study.

Smith, (2006) "Construction Management procedures" "narrated that Knowledge is the necessary information that an individual person has towards something, with the undergoing tasks. Moreover, knowledge enables simple, speedy, easy and systematic performance of the duty that one has knowledge with".

In this regard Figure 4.1presents the findings as;

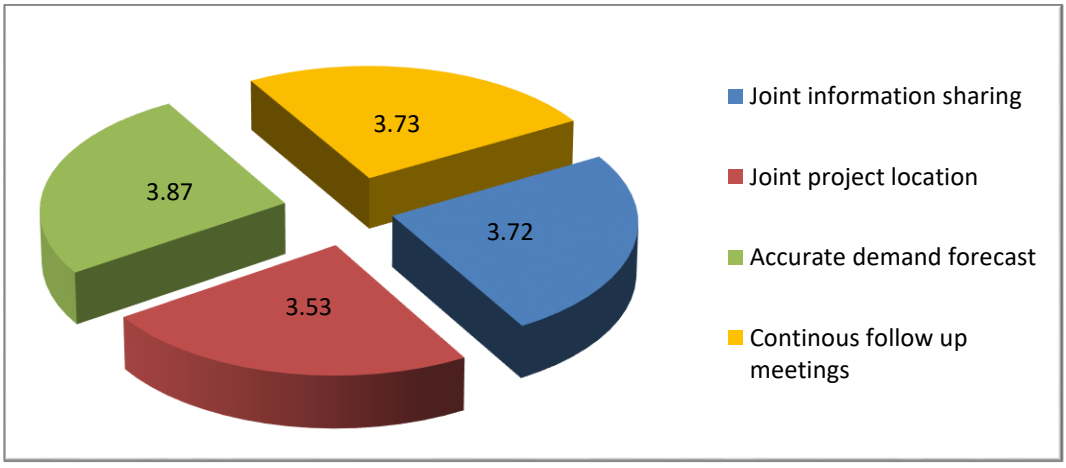

Figure 4.1 Information integration

From Figure 4.1, informs that information integration measured by four dimensions in which accurate demand schedules had a mean value of 3.87, this shows that many personnel are aware of ICSC. Absence of project stagnation implies that on the

material order scheduling is done continuously to avoid delays of the project. Accurate demand forecast has seen to be a necessity in pursuance of the project by many respondents of this study due to its implication as it ensures continuing the supply of the material and other necessary compliments before the shortage that may lead to project shut off occurs.

However continuous follow up, joint information sharing and joint project location with mean values of 3.73, 3.72 and 3.53 respectively. Were also measured to show the level of knowledge on ICSC by the respondents, with respect to respondents views each unit of the dimensions had different strengths that enabled them to judge the level of knowledge on ICSC variously on such units although to minimal extent joint project location had the lowest mean value other than various units of information integration in building projects, this implies that respondents had little knowledge regarding such parable.

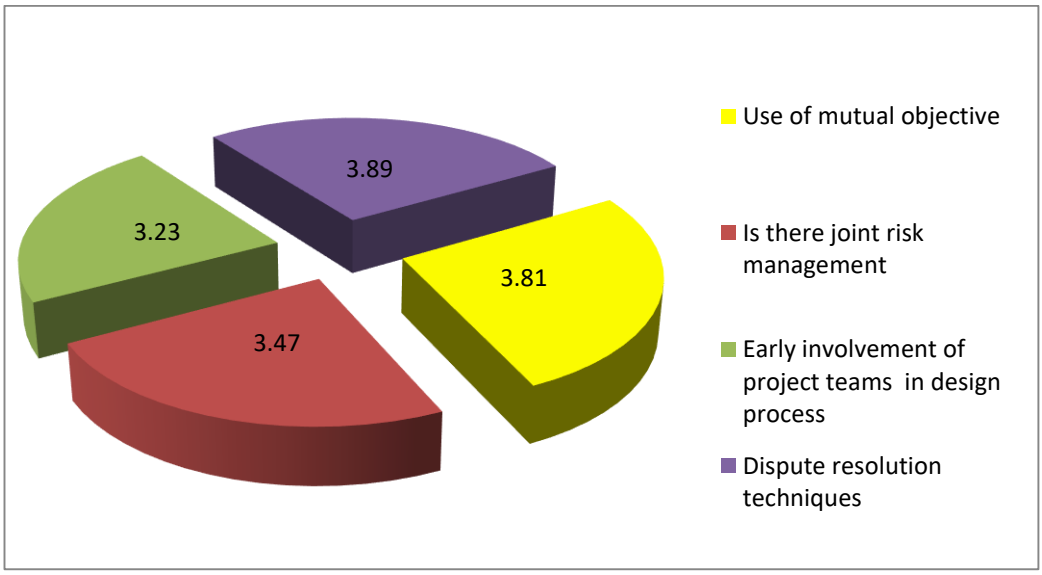

Figure 4.2: Process integration

From Figure 4.2, negotiation technique is largely applicable in dispute resolution techniques as it implies that 3.89 mean values of the respondents were positively argued so in building projects, knowledge on various dispute resolutions such as negotiation, arbitration and mediation has posted a smooth line of various disputes arises during project implementation although to a large extent negotiation and collaboration techniques were knowledgably applied in finding a mutual solutions to both parties. This has increased friendliness across members of the project.

Moreover, mutual objective, joint risk management and early involvement of the project team were also included in the study so as to determine the level of understanding by the respondents to such items regarding ICSC dimensions units. Each individual units of the dimension portrayed mean values score as response views by the study respondents as 3.81, 3.47and 3.23 respectively.Generally this implied that each respondents who was involved in the study gave out his/her views in relation to the importance's of each individual dimension unit in the place of his/her work and to general co-workers whose said to be satisfied with the availability of such dimensional unit in such area.

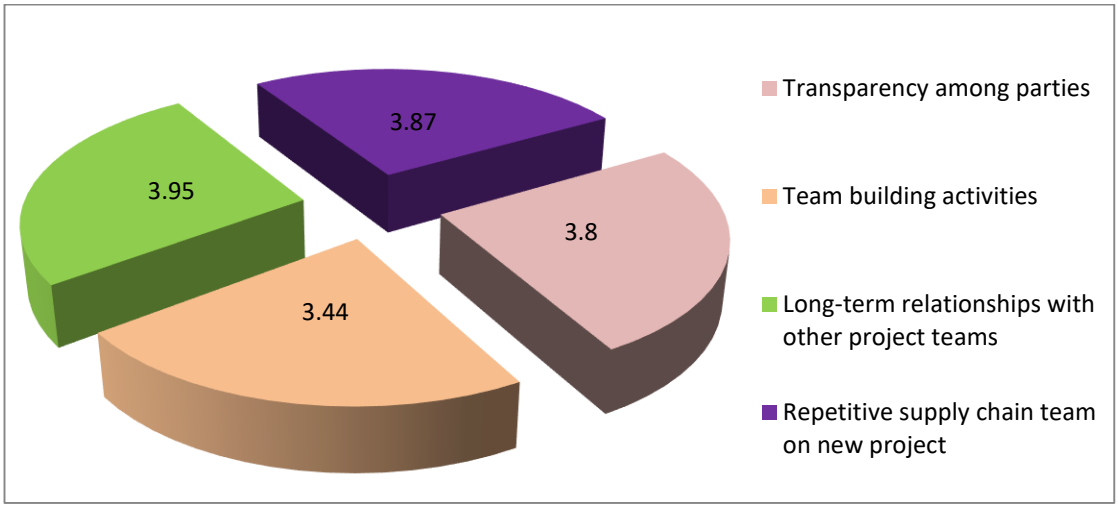

Figure 4.3: Trust integration

Figure 4.3, indicates that overwhelming relationships that exist between team members of the project is the results of valued long-term relationships with other project teams. This was found by the researcher during the gathering of the information that a total of 3.95 mean value of the whole respondents argued that knowledge on ICSC is the results of Long-term relationships with other project teams from the previous projects. However repetitive supply chain team on a new project had a significant value of the knowledge increase on ICSC dimension, this also was sought to be an important area of knowledge speed-up and transferring agent to other localities where it does not apply. In this regard 3.87 mean value was recorded to be responses from the respondents who believed so. Followed by 3.80 mean values that measured the knowledge on transparency among parties in sharing of the information, trusting against each other both within teams and between teams during implementation of the project whereby many of them appeared to assure the availability of transparency in the project team. Lastly is early involvement of project team in a design process with a mean value of 3.44 indicating rarely application of ICSC concept in building project.

4.4 Brief description of the case study projects A, B & C

4.4.1 Project A

This case study was based on the construction of complex airport terminal III building of 3 storey and its associated facilities in Dar es Salaam city. It is located along MwalimuNyerere road near the Julius Nyerere International Airport. In the case study A, the client is public, the form of contract was design and build with main contractor team (main contractor, subcontractors and suppliers) and client team (client & consultant) and the main contractor is a foreign contractor

4.4.2 Project B

Case study B comprised of a modern residential and commercial building, the Morocco Square Towers residing in Dar es Salaam city. It was located along Sam-nujoma road opposite Victoria fuel station. The client was public and the main contractor was local. The form of contract was design and build with main contractor team (consultant, subcontractors and suppliers) and the client team.

4.4.3 Project C

Case study C comprised of a new commercial, residential and office building in Dar es Salaam. It is located along Somora avenue road. The client was both public and private as it was under the form of Build Operate and Transfer (BOT). The form of contract was design and build with one team of client, main contractor, subcontractors and suppliers'

4.5 Application of integrated construction supply chain (ICSC) in building projects.

In this, questions were designed to answer the first objective which aimed at assessing the application of integrated construction supply chain practices in building projects in Tanzania.

Integrated construction supply chain application

Case study A

Integrated information system

The researcher found that the integrated information system used was Think project software. The software was used by all departments in sharing of the information such as drawings, correspondences, material approval status, and material delivery status. In which this was said to be used frequently due to its ability to facilitate information sharing between departments such as finance, procurement, quality and engineering departments within the organization.

"*The integrated information system was the main form of sharing information such as drawings, correspondence and other related information between the client, consultant, main contractor, sub-contractor and suppliers. This system was established since the commencement of the project and it has been used since then till present, as it is an information sharing machine in the project. We always have real-time up-to-date information available. This enables us to make the right decisions at the right time and deliver our services. This system has really assisted us in speeding up the project by sharing information with other stakeholders on time.*

We need this in all the building projects if we need to deliver services on time", (Informant, Project A).

Joint project location

According to the respondent interviewed in the visited project, the client, consultant, main contractor, sub-contractors and nominated suppliers were all located in the same project location. This was sought to ease communication sharing among project teams where by the information included Works Inspection Request (WIR), Material Inspection request (MIR), Material Approval Status (MAS) and Method statements.

"*Having the stakeholders located in the same project area has been effective in this project since they are all present at site with their staff throughout the day. It has been easy to reach them and convey any project information daily. It has also help us in conducting continuous follow up meetings once per week as all stakeholders are present at site daily*", (Informant, Project A).

Accurate Demand schedules forecast and delivery

The researcher found that many IT-tools were used in sharing information regarding the preparation of demand and delivery schedules such as Primavera, Microsoft project and 4D-Building information modeling(BIM), GPS-tracking, where by these information sharing tools fall under Enterprise Resource Planning (ERP) solutions. With these tools, easy information flow regarding material specification were attained and facilitated the accurate demand schedule forecast. However, systems of material approvals such as Material Approval Status (MAS) which consist of technical specifications to be approved by the client team were also found to be used in the project.

"With the established Enterprise resource planning (ERP) since the commencement of the project has been a major step for the progress of the company assigned duties. This has helped us to keep good track of the various construction logistics and suppliers/subcontractors after the project takeoff. This also has enabled us to make material order schedules on time and in right amount. Moreover, due to its often application, the ERP system easy tracking and timely ordering of the materials has minimized the time frame of the project" (Informant Management team, Project A).

Continuous follow up meetings

In this project the client, consultant, main contractor, sub contractor and nominated suppliers were located in the same project area. Availability of all the project stakeholders in one location ensured successful information sharing; discussion on the possible remedies for the problems rose during project implementation, eventually the monthly meetings conveyed by the contractors and his/her team either physically or web conference meetings ensured sustainable sharing's of the project progresses within the team that involved of main contractor, sub contractor and supplier of the project.

"*We conduct follow up meetings with representatives of the members of the project team every Monday of the week as informed to all. Eventually, these meetings are effectively conducted without any excuses in most cases. In which they have helped us to get various opinions from all members of the project team that enabled us easy problem solving at the exact time when it appears. This is a more efficient way of project management as it allows time management and quality deliverables of the duties under progress*" (Informant from Management team, Project A).

Joint risk management

Risk management is done through mainly health and safety. The main contractor had a role of ensuring health and safety of the employees and other people available in the workplaces and to respond to hazards before an incident occurs by ensuring safe work procedures are in place. During construction various health, safety and environmental (HSE) meetings are held on site for review of health and safety risk plan of any changes such as change in technology/equipment/process, legal changes, after accidents, passage of time and organization (safety officers in charge) changes hence monitoring the health, safety and environmental (HSE).The monthly meetings are held between the project manager, project safety manager from sub contractors, consultant and the client. Also, daily tool box talk meeting are done by the safety officer.

"Joint risk management is a collectively planning, controlling and monitoring various activities of health and safety. We have a toolbox meeting to train employees on health and safety wherever they are employed and during the project. Health and safety officers occasionally meet to discuss the matter arising in the safety department. Also we have method statements to assure quality and risk assessment control which is given to all members of the project for review. We use an online safety management system to track information relating training, safety performance statistics, safety inspections and incident reporting. So far risks within the project has minimized to the extreme"(Informant Project A).

Early involvement of project team in the design

Interviewer found that supply chain partner is integrated into the project team. The main contractor involves his team that includes the main contractor, specialist subcontractor and suppliers in the design process to participate in the planning, technical input, project management, design solutions, programming and innovation, healthy and safety monitoring, training and development, resource provision and performance measurement. Also, the client was integrated in the project team. The consultant was late selected and thus not involved early in the project but is integrated in the project team.

"In our project we have systematic procedures for assessment before engaging early with specialist partners. We always engage our supply chains in all our projects with fully integrated into our organization. Selection of our partners not only based on their technical expertise but also for their proven willingness and ability to work collaboratively with us. Our supply chain partner contributes to planning, technical input, design solutions, project management, environmental issues and resource division from the conceptual stage to the completion stage of the project"(Informant from project management team, Project A).

Mutual objective

The researcher found that the project team members focused on the goal of the project which is to deliver the built asset at designed cost, quality and time even despite their different roles each had in the project. In pursuance of their duties, some ensured quality conformance without considering time (consultant from client side).

"Working together on a common goal is the major goal of the project team. Our project manager to a much extent establishes an atmosphere of mutual trust and cooperation across our selected supply chain partners, underpinned by a common aim of successfully delivering the project. Timely and quality delivering of the assigned duties has become a cornerstone of our team members towards project progresses"(Informant Project spokesperson, Project A)

Dispute resolution techniques

The researcher found that a contract manager who would ensure project team members maintained their contractual relationship of good cooperation among them despite their misunderstandings. The main techniques in solving disputes were negotiation and mediation.

"*Our contract manager acts as a contract advisor to different members of the project team by ensuring that when we come into contrast with our supply chain partner he advises in order to reach to a point of negotiation in order to preserve our partnership. Rarely are disputes arising and even is the resolution of disputes"*(Informant, Project A).

Transparency

The researcher found transparency in sharing information is observed in this case study. The project personnel's of the project team are allowed to access information from the integrated information system. This shows that there is an open communication system in the project which is also stated by (Muller, 2014) that with open ways of sharing information makes it easy to increase production and efficiency in the project.

Long term relationship

The researcher found that the contractor had a system of measuring performance of his team of sub-contractors, suppliers and consultant. Long-term relationship is established with partners that has proven to have good experiences in previous projects, continuous improvement, proven design capability, team approach and financial status, eventually most of the involved supply chain participants in the study were said to be having a long relationships among themselves that proclaimed to be not less than 5 to 7 years of working relationships against each other.

Repetitive supply chain team on new project

During the study, the interviewer found that the contractor has established a good relationship with some consultants, sub-contractors and suppliers based on trust built among them in the provision of quality services with minimal cost. In pursuance of duties in different projects they worked together with the same project team.

Team building activities

These are the activities done by both parties in catching up of the parties trust for implementing and committing to a certain objectives, goal or something to apprehend. In case study A, they conducted a number of team building activities such as the Engineers day, women engineers day and the Five million safe man-hours without lost time injury. This is the social participation in the construction industry whereby in these activities all members of the project team participate effectively by uniting with others in exchange of opinions.

Case study B

Integrated information system

It was reported that sharing of the information was through emails, site meeting, and site visits and through face to face conversation. Also, it was reported that the channel of communication for drawings were paper based. Mainly the contractor design and submit the hard copy to the consultant for review and if approved, are then emailed to the client for the final approval and then filed ready for construction. The whole process does take a couple of days for one approval to be completed ready for project takeoff, it then depends to number of days for an approval to be taking place that decides the length of the project time. Due to this scenario, easier sharing of the information (Integrated information sharing) through systematic ways counter delays weaknesses of the project.

"Use of mails, Site meetings, and continuous site visits has improved good communication of the desired goals of the project by both management and subordinates/implementers of the project. During implementation of the project several meetings are conducted that involves both management and other co-workers within the compound, this involves early Monday briefing, Friday progress give outs and other preferred meetings whenever sought to be required. Generally this has strengthened good sharing of the intended objectives across members of the project. And to a large extent such sharing's has enabled us to smoothly implement our duties" (Informant Project, B).

Joint project location

According to the respondent interviewed in the visited project, it shown that all supply chain participants were located in the same project area where it sought to ease their sharing of information through every day site inspection and face to face conversation. However the reality was not viable as it were speculated to be since some members of the project contractor's team (sub contractor, supplier) was not physically involved in the project site despite their offices being located in the area. Due to low involvement by the contractor as they have no last say or power in practicing their professional practices, this results to poor project performance.

"There are offices located for various members of the project team such as consultants, client, sub-contractors and suppliers but they are never present at site. They come rarely during site meetings and on visiting the site otherwise there are present in their main offices outside the site. To a small extent are they all located on site due to their small number of staff to undertake many projects"(Informant, Project B).

Accurate Demand schedules forecast and delivery

It was revealed that there were delays in ordering of the materials are due to late approvals of materials on site by the client. This is due to the fact that information sharing in preparing material order schedules depends on the procurement method i.e. in design and build it takes lesser time due to accompanied process involved in ordering of materials unlike to traditional procurement which is characterized by a huge fragmentation as organization requires enough time to review and approve for the material order schedules. In general this involves a number of hierarchies in

material ordering that delays time for project completion. Also there was insufficient information by the client regarding specifications of materials this result to delays of material approvals in ordering of materials.

However, due to low involvement of experts on the client side that could review design and specification of tabled drawings and materials approvals by the main contractor these results to delays in approvals for drawings and materials as the client incur longer time to review it.

Continuous follow up meetings

For the project visited, the interviewer found that variously conducted follow up meetings with the client, main contractor, consultant, sub contractor and suppliers are conveyed after every two months. This is due to presence of few members and many sites to visit at a time and timetable is very fixed in such a way that they cannot convey meetings regularly. Also, they incur much longer time to have meetings so as to pose an opportunity for the implementation of last meetings agreements.

Joint risk management

Risk management is jointly controlled through method statements which are jointly prepared by the contractor team, despite the client not involved in this stage during construction. At contractor's team side top management prepares a risk assessment plan and often in their monthly meeting discusses on the risks associated where largely investigates on the progress of plan. However at site, risk management is through health and safety where by the contractor's team are briefed on the health and safety through toolbox. In which toolbox is knowledge on the various safety gears and precaution available in case of unhealthy/unsafe environment. Secondly

risk management is through quality and this is mainly done by the contractor's team as they ensure high quality of the various components of the building.

"Risk management at site is mainly through health and safety. Health and safety risk management is done by the contractor's team of consultant, sub-contractors and suppliers. The client mainly ensure that the contractor abide to the health and safety policy. To a large extent the health and safety policy is followed by many employees in the project after being trained on the risks of accidents associated with unsafe health activities"(Informant, Project B).

Early involvement of project team in the design

Interviewer found that main contractor involves his team that includes consultant, main contractor, subcontractor and suppliers in the design process. Although, the client was not involved in the design. This is due to the nature of the procurement method of design and build which has a weakness of not involving the client in the design as he only choose the main contractor to do the design and construction and only approves of the architectural drawings once design is complete.

Mutual objective

From the pilot study, the researcher found that the core objective that bind each side of the building construction project together (client's side & contractor's side) is the goal of that particular project. (Mueller, 2014), Informs that goal of the project on construction arena consolidates the positive relationships between the clients and contractors sides by bringing them together for collective attainments of the pre-determined goal.

Dispute resolution techniques

The researcher found that the most preferred technique in dispute resolution is negotiation this is due to the fact that the method offers partnering traits to both sides that intensify the nature of relationships between client and contractors side.

Transparency

The researcher found that there is transparency in sharing information on drawings and material specifications but little transparency is in the financial information. This shows lack of trust as the members do not trust each other. Due to different cultures, some people do not have the culture of sharing information with others (selfish individuality) and this resulting to lack of transparency in sharing information especially top management officials with such characters are more likely to hinder necessary progress of the project to be taking place as a result of in-absence of transparency which delays project completion.

Long term relationship

The interviewer found that the main contractor's team has established a long term relationship with consultants, sub contractors and suppliers. The contractor select his suppliers for instance based on trust built on them and may have worked with in several projects. This shows that trust integration through established long term relationships is often applied.

Repetitive supply chain team on new project

During the study interviewer found that performance measurements by the contractor to his team members based on trust in various aspects such that in some instances

supplier is ordered to supply material of certain quality by keeping a frame of his work do delivers the ordered materials with the same quality. Same applied to consultant and sub contractors. With such trust the contractor may further employ the same team in other new projects since they all have a common understanding in observing to one another objective. This has helped the contractor to have a repetitive supply chain team on new projects. This shows that often repetitive supply chain team is applied on new projects.

Team building activities

These are the activities done by both parties in catching up of the parties trust for implementing and committing to a certain objectives, goal or something to apprehend. From the project surveyed respondent revealed that activities such as integrated health and safety day's that involve both parties of the project (Client's part and Contractor's part) which is almost conveyed across projects and once a quarter in a project lifetime pose a significant improvements not just for mutual objectives under operations but also does improve one to one relationships among individuals, moreover having such commitments among teams propagates the partnerships and friendly lines between parties that smoothens easier project completion, for example the project visited both client's team and contractor's team values the importance's of team building activities as they convey such activities after every two months during project continuations, so far this has helped to promote good relationships and commitment to the on-going objective between the parties

Case study C

Integrated information system

The interviewee conveyed that they had collaborative software by which they used to communicate among members of the top management in sharing project information such drawings review, client requirements, correspondences and others of alike. Then later these information are passed down to the subordinates such site engineer, consultant, subcontractors and suppliers inspectors through emails and hardcopy printed sheets. Also the information with all members of the supply chain is shared through Microsoft office presentations and at contractor's conference hall. This line of communication was reported to delay information sharing because the top managers after receiving information they email few information and the rest of the information are revealed once they are asked about it. This means there is a selfish attitude of the top management to their sub ordinates.

Joint project location

It was reported that in the visited project the client, consultant, main contractor, subcontractor and nominated supplier had offices in the same block in the same project area. This was elaborated to ease information through face to face conversation, call for immediate action meetings and sharing printed documents such as RFI (Request for Inspection) approvals. They were all present at site throughout the day. However some of the members of the consultant and client were at a distant location such as in a far country and those are the ones who had a mandate to make decisions on approval of drawings and correspondences. This was proven to be difficult in the sharing of information due to distant location.

Accurate Demand schedules forecast and delivery

They had difficulties in meeting accurate demand schedules forecast due to changes done by the client as a result of the end-user demands being changed frequently. Material order such as paints, tiles, terrazzo and ceiling finishes highly depend on the demands of the end-user of the residential and commercial apartments under construction. Also the distant members of the client and consultant made delays as they took long time (months) to review a numerous material specifications and provide correspondence that showed approval or to incorporate and resubmit.

"It is difficult to obtain accurate demand schedules because of various changes of materials made by end-users on visiting the rental apartments that are still in construction. In most cases demand schedules are not accurate due to many changes" (Informant, Project C).

Continuous follow up meetings

They conducted meetings with client, consultant, main contractor, sub contractor and suppliers after every one month since they were all available at site and could set up meetings monthly. However they also had meetings after every two weeks which they were progress meetings to review the two weeks progress.

Joint risk management

Risk management is done through method statements and the contractor prepares this in cooperation with sub contractors. The method statements should have a risk assessment plan of the concerned activity and health and safety precautions

necessary. The method statement prepared is then sent to the client, architect and consultant for review

Early involvement of project team in the design

The interviewer found that there is low involvement of some members of the supply chain in the visited project such as client, subcontractor and suppliers. This removes their ability to give ideas on their specialist experience during design which results to many design changes during construction.

Mutual objective

From the interviewee perspective the members of the supply chain work together with a common objective. (Simon, 2008), Informs that goal of the project on construction arena consolidates the positive relationships between the clients and contractors sides by bringing them together for collective attainments of the pre-determined goal. In the case study the researcher found that the project team members worked through a common objective of the project.

Dispute resolution techniques

In the project visited there employed negotiation and arbitration in solving disputes which may arise. For instance if there is dispute items in the Bill of quantities are solved by negotiation between the contractor’s side and the client’s side. This technique has helped many contractual relationships to increase partnering and strengthen their business relationships.

Transparency

The researcher found that transparency in sharing information and this is because the project is a joint venture of the client and contractor meaning that some staff of the client is to the contractor's side. This means information from the client to the contractor is transferred without barriers because they are of the same team. Also the information from the contractor to the sub contractor and supplier is open and without bias hence transparent.

Long term relationship

The interviewee conveyed that the contractor select a team of sub contractor and supplier based on trust and good communication that is portrayed among them. This shows that the contractor has long term relationship with his team of sub contractor and supplier in the visited project. Also the client has worked with the same contractor's team in the new project.

Repetitive supply chain team on new project

During the study the interviewer found that the contractor has established a good relationship with some consultants, sub-contractors and suppliers based on trust built among them in the provision of quality services with minimum cost. This enabled them to work together in many different projects.

Team building activities

These are the activities done by both parties in catching up of the parties trust for implementing and committing to a certain objectives, goal or something to apprehend. In case study C the respondent conveyed on attending a team building

activity at Zanzibar as a team visiting various areas together and socializing . It is through such events that all key project teams participate and cooperate as a team.

Cross case analysis between Projects A-C

Based on the findings it reveals that in information integrated information system were applied to the maximum point in project A and to a minimal extent in project C but not applied in project B whose main form of communication is through emails and site meetings. Joint project location and continuous follow up meetings in information integration were revealed as common items in the three projects A, B and C. Accurate demand schedules forecast is only attained to a great extent in project A .Therefore information integration is still not sufficient as seen from the previous studies done by (Briscoe and Dainty, 2005) and (McDermott and Khalfan, 2014), whose argued that the main item that measures information integration is the presence of an integrated information communication system.

Involvement of all the key construction supply chain teams in the design stage were applied in all the three cases although involvement across the three cases varies amongst one another this is to say that others are involved during pre-tendering stage of the project example project A and project B while others are involved during post-tendering stage of the project. Mutual objective was common applied in all the three projects. In all the three cases negotiation were used in dispute resolution techniques. Joint risk management was applied across the three projects mainly health and safety risks management but left behind other necessary risks that may arise in the construction industry where this includes Technical risks, environmental risks and financial risks.

The concept of Trust integration was characterized by a number of similar applications of the activities across the three projects visited, these included transparency, team building activities, long-term relationships and repetitive supply chain team activities in conducting of the projects. However applications on such activities varied significantly against each other, this is to say that Transparency level in the visited projects were seen to be observed to some of them mostly at top managerial levels and minimal inclusive of both middle line and first line managers, for example in project B and C minimal involvement of middle and first line managers were greatly observed.

Nevertheless, observation of little information sharing as a part of transparency in conducting projects that were revealed, long-term relationships with client and consultant in project A were not present this led to difficult to integrate with other parties/teams of the project, while project B and C client and consultant had long-term relationships between themselves this led to easier integration of the project team.

Table 4.3: Cross case analysis between Projects A-C

Dimension	Project A	Project B	Project C
Information Integration	Project teams were located in the same project area.	Similar to Project A but were never present at site.	Similar to Project A but they had no authority to make decision.
	Many IT-tools were used in integrated information system such as Think project, SAP and ERP solutions	Employed collaborative software which mainly was used by top managers in sharing information.	Collaborative software was used in sharing information though not sufficient enough to those in distant location.
	Conducted follow up meetings with project teams through web conferencing and face to face after every three weeks	Conducted follow up meetings with project teams through face to face after two months.	Similar to project B but were conducted after one month

	Many IT-tools were used in scheduling demand and delivery of materials such as Primavera, Microsoft project, 4D-BIM and ERP solutions. Accurate demand schedule is attained to a great extent.	Microsoft project was used in scheduling demand and delivery of material. Accurate demand schedule is attained to a low extent	Similar to Project B but scheduling were affected by demands of end-users. Accurate demand schedule is attained to a low extent
	Information integration was very highly applied considering the activities being practiced fully.	Information integration was moderate applied considering the integrative activities not practiced fully.	Information integration was moderate applied considering the integrative activities not practiced fully.
Process Integration	The main contractor, subcontractor and suppliers were procured early in the feasibility stage. The consultant was procured shortly after the project commenced.	Similar to Project A but the consultant was procured together with sub-contractors and suppliers soon after the investment decision.	The consultant/architect and main contractor were procured early in the feasibility stage and performed design works. The subcontractors and suppliers were procured shortly after the investment decision. The end-users were not involved early in the project.
	The project teams were working towards a common goal in a collaborative manner.	The project teams were working towards a common goal but in a counterproductive manner	Similar to project A
	Negotiation was used in resolution of conflicts and to strengthen their partnership	Similar to Project A but also included meditation.	Similar to Project B
	Health & safety Risk management was conducted monthly with all the project teams.	Health & safety Risk management was conducted monthly with all the project teams.	Health & safety Risk management was conducted monthly with all the project teams.
	Process integration was highly applied	Process integration was moderate applied considering performance of the integrating practices.	Process integration was moderate applied considering performance of the integrating practices.
Trust Integration	Transparency is seen within firms(internal integration) and minimal across firms(external integration)	Transparency is seen with top management and minimal with middle line management and first line management.	Transparency is seen high within firms(internal integration) and across firms(external integration).
	Many team building activities were used in building trust	Team building activities i.e. Engineers day were used in building trust	Similar to project B but also included Award of good health and safety.

	among project teams.	and transparency.	
	Long-term relationship were with sub-contractors and suppliers	Similar to project A but also consultant and client.	Similar to project B
	Repetitive supply chain team included the sub-contractors and suppliers	Similar to project A but also consultant and client.	Similar to project B

Generally, the results show that joint project locations, continuous follow up meetings and mutual objective were commonly practiced across projects. Other practices such as integrated information system, joint risk management, early involvement of key supply chain team members and transparency are not yet sufficiently applied by the respondents. This implies that there is a low rate of application of ICSC in construction industry in Tanzania.

4.6 Challenges facing the application of integrated construction supply chain practice (ICSC)

Responses from the selected projects with some missing values, 65 respondents elicited their knowledge on the challenges hindering the application of integrated construction supply chain in building projects. Table 4.4 below shows the mean scores as ranked by responses, mean scores were used as a ranking benchmark indicating the average position the respondents voted for the five point likert scale i.e. ‘strongly disagree’, ‘disagree’, ‘neutral’, ‘agree’, ‘strongly agree

Table 4.4: Challenges facing the application of ICSC

S/N	Challenges	Rating Scale					Total	Mean Score	Rank
		1	2	3	4	5			
1	Inefficient organization structure	0	7	19	24	31	65	4.95	1
2	Poor knowledge on the management	0	5	20	32	8	65	3.66	16
3	Lack of staff training	0	0	4	40	21	65	4.26	3
4	Lack of production staff	0	3	13	39	10	65	3.86	15
5	Lack of top management support	0	5	10	31	19	65	3.88	14
6	Lack of willingness to invest in SC integration	0	4	12	29	20	65	3.96	13
7	Information system support accounting and finance only	0	1	7	39	18	65	4.13	9
8	Unable to invest in SC integration	0	4	6	37	18	65	4.06	10
9	Multiple independent departmental systems	0	2	8	34	21	65	4.13	8
10	Lack of reward system	0	3	6	33	23	65	4.16	7
11	The “us against them culture”	0	0	9	33	23	65	4.21	6
12	Inefficiency of traditional procurement method	0	4	5	40	16	65	3.98	12
13	Lack of trust	3	0	7	30	24	65	4.06	11
14	Lack of team spirit	0	0	5	41	19	65	4.21	5
15	Lack of mutual objectives	0	0	8	34	23	65	4.23	4
16	Inadequate information flow	0	0	5	25	35	65	4.46	2

Table 4.4 above shows that the most critical challenge facing the application of integrated construction supply chain in building projects in Tanzania are ; Inefficient organization structure, Inadequate information flow , lack of staff training with mean values of 4.95, 4.46 & 4.26 respectively.

Other factors such as inefficiency of traditional procurement, lack of willingness to invest in SC integration, lack of top management support, lack of production staff and poor knowledge on management had average potential with mean values of 3.98, 3.96, 3.88 & 3.86 respectively. Challenges discussed in literature review were organization structure, Lack of good information flow, lack of staff training, lack of morale and motivation, lack of top management support and ignorance of integrated construction supply chain (Xianguang et al.2008)of which these challenges are also ranked by the respondents in the field. It is imperative that challenges are identified and actions are to be taken to promote the application of integrated construction supply chain practice in Tanzania.

Discussion of the findings

i) **Inefficient organization structure**

Respondents have ranked this strategy as the first with a mean score of 4.95 which implies that they strongly agree that most of the construction companies have no supply chain management in their organization structure to support the integration of construction supply chain. With supply chain management the company is able to improve performance and productivity and this is evaluated through parameters of quality, cost and time.

ii) **Inadequate information flow**

Information includes facts provided or learned about something or someone. In construction sites most information transferred are drawings details, correspondence letters, project schedules, request for inspections and report on daily, weekly and monthly basis. In Table 4.4 it is ranked second by the respondents as the second most

critical challenge faced in the application of integrated construction supply chain, this means that there is information bias to some members of the project team. For example information from the designer first is received by senior management and later transferred to junior management with some or little information. This was said to be due to failure to establish one integrated information system whereby all the project information are available and are easily accessed.

iii) **Lack of staff training**

Failure to train staff regarding integrating supply chain team in working collaboratively throughout the project lifecycle is ranked as the third most critical challenge faced in the application of integrated construction supply chain with a mean score of 4.26. This entails that most of the employees in the construction sites are not prepared in knowing the need to work with other members of the project team in an integrated manner.

iv) **Lack of mutual objectives**

Mutual objectives of the teams bind together parties into one agreement of undertakings duties together so as to accomplish the assigned tasks and to large extent contribute to an application of ICSC in the project. However the study indicates that respondents with the mean value of 4.23 argued that mutual objectives is a challenge to many projects as selfishness among individuals who undertake project goals violates course of action towards mutual agreement between parties of the project (Client part and Contractor's part).

v) **Lack of team spirit**

Failure to train staff regarding integrated supply chain team in working collaboratively throughout the project lifecycle is ranked as the thid most crtical challenge faced in the application of ICSC with a mean of 4.21. This entails that most of the employees in the construction sites are not prepared in knowing the need to work with other members of the project team in an integrated manner.

vi) **Inefficiency of traditional procurement**

Mode of project procurement technique can pave a way to integrate the concept of supply chain during project implementation on the other side although to the other side too can lead to hinder the application of ICSC by the project implementers. Data from the field revealed that respondents with mean score of 3.98 said that ineffiencies resulted from traditional procurement hindered an integration of the ICSC since the one who decides on personnel's to be involved in the project is the client himself unlike to other mode like design and build where contractor decides the number of personnel to be involved in the project this give an opportunity to involve people whose can simply integrate with due to long-term relationships that might have been built earlier before commencement of the new project.

vii) **Lack of willingness to invest in supply chain**

Research and development on new inverted techniques that pose significant challenges to construction industry by the companies dealing with building projects is of little consideration, unlike to other industries where research and development are given enough space and huge investments so as to allow modern and

sophisticated techniques that can assure quality and quantity products are produced at minimal costs. Willingness to invest in supply chain requires enough knowledge about the supply chain by the project handlers across various projects that can finally invests on chain supply after having an idea of what it produces. Data from the field shows that 3.96 mean score of the respondents argued that lack of willingness to invest on supply chain hinders an application of ICSC on building projects since few construction companies are willing to invest in supply chain management this is due to little knowledge on construction supply chain and most of the construction companies have no idea on the integration of ICSC.

viii) **Lack of top management support**

Management support in pursuance of any activities does add strength, courage, readiness and confidences to subordinates who undertakes that particular duties. Also top management support by persuading alternative ways for integration of ICSC to projects by addressing the advantages of integrating the concept to their project among members of the team that implementing the project. While the absence of top management support in the project hinders the application of ICSC in the project easily. Data from the field shows that 3.88 mean scores of the total respondents involved in the study narrated that absence of top management support to their projects to a great extent disrupts the application of ICSC concepts in their projects.

Generally, respondents agree to varying degrees to all listed challenges facing the application of ICSC. However, challenges such as lack of top management support, lack of willingness to invest in ICSC and lack of staff training also mentioned by (koskela and Vrjihoef, 2000;Pryke,2009 and Mohammad, 2014) have led the concept

of ICSC management become ineffective by its application due to minimal extent of application of integrated information system, joint risk management and transparency.

4.7 Ways to promote the application of integrated construction supply chain practice and influence its application in the construction industry in Tanzania.

From the previous discussed challenges, lack of staff training, inadequate organization structure, lack of team spirit, lack of mutual objectives and lack of good information flow were top five challenges ranked low by respondents therefore the third objective of this research was aimed at suggesting ways that will promote the application of integrated construction supply chain practicebuilding projects in Tanzania. In here a list of potential strategies from literature were listed and respondents were asked to rank them in order of their importance.

Table 4. 5: Ways to promote the application of integrated construction supply chain

S/N	ICSC strategies	Rating scale							
		1	2	3	4	5	Total	Mean	Rank
1	Application of ICT in modern way to enhance supply chain integration	0	0	4	35	26	65	4.06	1
2	Training staff on supply chain integration	0	1	26	25	13	65	3.46	6
3	Identifying non-value adding activities and eliminate them	0	3	21	18	23	65	3.94	3
4	Setting bench marking prior to the process of ICSC	0	2	15	26	22	65	3.95	2
5	Involvement of all key supply chain participants at an early stage of design process	0	5	19	30	11	65	3.72	5
6	Repetitive supply chain on new projects	0	2	16	34	13	65	3.89	4
7	Research and Development	0	0	16	24	25	65	3.37	7

4.7.1 Discussion on the analysis of ways to promote the application of ICSC

i) Application of ICT in modern way to enhance supply chain integration

Respondents have ranked this strategy as the first implying that they strongly agreed that the usage of ICT tools will encourage the crucial application of ICSC in building projects since ICT systems in construction industry fasten easier applications of necessary software's that simplifies tasks in construction projects. This was witnessed by Zhenmin, (2010) that the use of internet can help in creating one medium of exchanging information such as holding online conferences and reduces both financial and time wastage on physical meetings. Table 4.5 illustrates the ranks across all potential parameters of the necessary ways and strategies to adopt so as to improve the application of ICSC in Tanzanian building projects.

ii) Setting goals or bench marking prior to the process

However, setting goals or benchmarking prior to the process is also seen to be key strategy for the application of ICSC in construction activities. In table 4.5 it is ranked second by the respondents. In line with what the respondents perceives to be an ideal solution to the application of ICSC in construction projects, a number of surveyed projects respondents argued that there shall be guidelines set by the responsible entity emanated/granted power by the law to ensure application of ICSC.

iii) Identifying non-value adding activities/wastes and eliminating them

An activity that does not add to the function of the project is considered as a non-value adding activity or wastes (Imec, 2017). These activities include overproduction of materials, machine defects, incorrect inspections, and extra copies of paperwork, idle time waiting for instructions and extra time looking for equipments. From the

surveyed projects, respondents agreed on the identification of non-value adding activities as a strategy necessary for the implementation of ICSC. In table 4.5 'Identifying non value adding activities/wastes and eliminating them' was ranked third with mean value of 3.94 and this means through elimination of non-value adding activities typical improvements include increased project quality and cost and hence successful project.

iv) Repetitive supply chain on new projects

Moving with the same supply team on new projects is necessary as it helps to reduce cost due to economies of scale, also having a team that entertain mutual/common objectives is necessary for the implementation of ICSC (Egan, 1998). Across the surveyed projects, respondents agreed that having a repetition of a supply team on new projects is necessary in promoting application of integrated construction supply chain in building projects in Tanzania. In table 4.5 'repetitive supply chain on new projects' is ranked fourth and this indicated that it is an important strategy in promoting the application of integrated construction supply chain

v) Involve all key supply chain participants at an early stage of design processes

Among all the essential parameters ranked in table 4.5, the fifth rank sought to be one among the fruitful benefit on the attainment of ICSC application on building projects. This came as the respondents across all the surveyed projects agreed that on successful communication and implementation of the building projects, an involvement of all the key supply chain participants such as clients, contractors, sub-contractors, consultants and suppliers is important for planning, budgeting and

designing processes of the building projects. This enables all the participants to be aware from the beginning of the project to an end. Also, ensure minimal usage of both time and financial resources in construction processes, application of this strategy enables an attainment of ICSC concepts in construction industry in Tanzania.

vi) Training staff on supply chain integration

Training is teaching or developing in oneself or others any skills and knowledge that relate to specific useful competencies (Business dictionary, 2017). As an organized activity aimed at imparting information and instruction to improve the recipients' performance, respondents across surveyed projects argued that responsible entities which are able in advocating on an application of ICSC shall train all necessary staffs of construction industry on supply chain integration so as to impart them with knowledge that relates to ICSC. This will strengthen skills that each employee of building project needs to improve and in further it assures success and development of either an organization or the industry at large. Table 4.5 ranked this strategy at sixth rank, this implies that despite all the prior ranked strategies importance's, training of the staff on supply chain is of crucial need for both project success and addressing weaknesses in the work places for such particular phenomenon

vii) Research and Development

This is the process by which a company works to obtain new knowledge that it might use to create new technology, products, services or systems that it will either use or sell (Business encyclopedia, 2017). Respondents from several projects surveyed suggested that conducting of the research and development on ICSC applications

must be considered so as to understand all necessary potentials it entails in constructions projects. This was sought so due to wide knowledge avails among individuals on the importance of research and development. R&D plays a critical role in the innovation process. This also plays a crucial role in both success and sustainability of the business. Table 4.5 reallocated both parameters and their ranks where R&D were ranked in the seventh rank, this shows that nevertheless all the mentioned strategies on application of ICSC, R&D were also given enough attention on emanating sustainable development and application of ICSC in Tanzanian building projects.

Finally, results shows that respondents agree in varying degrees to all the listed ways to promote the application of integrated construction supply chain. Identifying non-value adding activities, application of ICT in modern way and training staff were ranked high in promoting the application of ICSC. Such are also mentioned in the study of (Unger, 2013; Segerstedt and Olofsson, 2010). Awareness and implementation of these strategies could facilitate the application of integrated construction supply chain.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents conclusions made and recommendation of the study whose main objective is to assess the application of integrated construction supply chain in building projects in Tanzania. Specifically,assessing the extent of the application on integrated construction supply chain, determining the challenges facing the application of ICSC and promoting the application of ICSC. It makes conclusions from the findings and then followed by recommendations and lastly areas the further research.

5.2 Conclusion

5.2.1 To assess the extent of application of integrated construction supply chain.

Despite the high extent of application of joint project locations, continuous follow up meetings and dispute resolution techniques the minimal extent of application of construction supply chain integration were largely observed as witnessed by absence of modern IT-tools in the sharing information, preparing accurate demand schedules, low involvement of key project participants early in the design stage and absence of mutual objective. Whereby, such units had a significance role in ensuring high application of ICSC by easy information sharing, ensuring early design completion, timely project completion and increased project performance.

5.2.2 To determine the challenges facing the application of ICSC

The study encountered a number of challenges that hinder the application of ICSC in building projects where by inefficient organization structure, inadequate information flow and lack of staff training were top ranked challenges while inefficiency of traditional procurement, lack of willingness to invest in SC integration, lack of top management support, lack of production staff and poor knowledge on management were the least challenges facing the application of ICSC.

5.2.3 Ways to promote the application of ICSC

The use of ICT, training of staffs, setting benchmarks and involving all key supply chain participants in early stages of designing were sought to be an ideal solutions on successive application of ICSC in construction industry, the involvements of such groups and use of modern ICT technologies encourages more sophisticated tributes on application of the ICSC in various projects, use of collaborative communication system easy both communication network and other relevant duties of the project across team members of the supply chain, that finally results in timely project completion.

5.3.1 Recommendations

The followings are the recommendations put forward in the light of the study findings:

- Construction companies should be encouraged to invest in modern IT –tools in improving information sharing within departments and with other key project participants so as to minimize the problem of inadequate information flow.

- Due to low involvement of key project participants, various training and workshops on matters pertaining to integration and supply chain in construction projects has to be put in place so that actors of the Supply chain team allowed to engage on the importance of early involvement of key project participants in the design (pre-tendering) of any project so that they practice it during construction period that will finally results to successful timely and quality deliverance of a project to Clients.
- Stakeholders in construction projects should review the risk management and various risks assessment criteria's aspect so as to be familiar with other risks that may arise both before and during project take-off, this include financial and technical risks that may arise during project implementation due to weak or poor risks assessments on the project, the assessed risks can then be shared with key participants of the project to adopt an immediate course of action to prevent further damages during project implementation..

5.4 Areas for further research

This research has not covered integrated construction supply chain in other small building projects, therefore further researches should cover this scope, as it was done in this research .The following are the recommended topics for further research:

a) Assessment of the application of integrated construction supply chain Small and Medium Enterprises (SME'S).
b) An evaluation of Tanzania procurement system in the application of integrated construction supply chain concept in building construction projects in Tanzania.

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APPENDICES

Appendix I

Sample of questionnaires

I would like to enlist your help, I am a student at Ardhi University and for my final dissertation I am assessing the application of integrated construction supply chain practice in building projects in Tanzania.

As a stakeholder in construction industry, I am inviting you to participate in this research study by completing the questions below.

Please answer all questions as honestly as possible. The information you provide will be used for academic purposes only. While you may not experience any direct benefits from participation, information collected in this study may benefit the profession of construction management in the future by better understanding the influence of application of integrated construction supply chain on increased project performance in Tanzania and in other developing countries.

The following questionnaire will require approximately 15-20 minutes completing. Thank you for taking time to assist in my education endeavors.

If you have any question concerning the research study, please call me at 0717039299 or email at matikusenior@gmail.com

General Characteristics

Name of the project _____

Based on the project in which supply team are you in?

- ○ Consultant
- ○ Contractor
- ○ Client
- ○ Subcontractor
- ○ Supplier
- ○ Other

What is your current job title?

- ○ Architect
- ○ Construction manager
- ○ Procurement manager
- ○ Engineer
- ○ Quantity surveyor
- ○ Technician
- ○ Surveyor

What is your gender?

- ○ Male
- ○ Female

How old are you?

- ○ Above 50

- ○ 40 – 50
- ○ 29 – 39
- ○ 18 – 28

What level of education are you?

- ○ Certificate
- ○ Diploma
- ○ Bachelor degree
- ○ Masters degree
- ○ Doctorate
- ○ Other

In which department are you working?

- ○ Senior management
- ○ Head of department
- ○ Manager

How long have you been working with the construction industry?

- ○ 1 – 5 years
- ○ 6 -10 years
- ○ 11 – 15 years
- ○ More than 15 years

How long have you been working with building projects?

- ○ 1 – 5 years
- ○ 6 – 10 years
- ○ 11 – 15 years
- ○ More than 15 years
- ○ Other

Which class is your company?

- ○ Class 7
- ○ Class 6
- ○ Class 5
- ○ Class 4
- ○ Class 3
- ○ Class 2
- ○ Class 1

What is average project sum? _____

Do you have a joint project location?

- ○ Yes
- ○ No

Based on the project which of these shared information management system are you using?

- ○ Paper based system
- ○ Procedure
- ○ proEst
- ○ Geniebelt
- ○ Other

Based on the project which of these project scheduling tools do you use to and deliver forecast?

- ○ Microsoft project
- ○ BIM (Building Information Model) 4D
- ○ Primavera

What type of relationship your company has with other key project participants in the construction process of the project?

- ○ Competitive
- ○ Counter productive
- ○ Cooperative and collaborative
- ○ Other

Which of these are applicable in the project area?

- ○ Joint decision making
- ○ Supplier involvement in design phase
- ○ Team building activities
- ○ Long term relationship with other actors of the supply chain
- ○ Partnering enforcement
- ○ Other

Based on the project do you import material / pre – assemblies from different countries?

- ○ Yes
- ○ No

Do you track order and shipment of imported material / pre – assemblies from suppliers at each step?

- ○ Yes
- ○ No

If yes please mention it below _____

Do you conduct follow up meetings?

- ○ Yes
- ○ No

Which of these dispute resolution techniques are you using in the project?

- ○ Negotiation
- ○ Meditation
- ○ Arbitration
- ○ Litigation

Is there transparency in sharing information among project participants?

- ○ Yes
- ○ No

The extent to which integrated construction supply chain practices applied in building projects

The tables below contain list of integrated construction supply chain practices depending on the dimensions of integration; information integration, process integration and trust integration. Based on the project, please rank five point likert scale questions according to the extent to which you are applying them as indicated below.

Information integration

	1 – Never	2 - Rarely	3 - Occasionally	4 - Often	5 - always
Use of integrated shared information management system	○	○	○	○	○
Use of joint project location	○	○	○	○	○
Information sharing in supply and delivery schedules forecast	○	○	○	○	○
Order fulfillment and shipment are tracked at each step across the supply chain	○	○	○	○	○
Continuous follow up meetings with all parties joint decision making.	○	○	○	○	○

Process integration

	1 – Never	2 - Rarely	3 - Occasionally	4 - Often	5 - always
Use of mutual objectives	○	○	○	○	○
Is there joint risk management with all parties	○	○	○	○	○
Early involvement of project teams in design process	○	○	○	○	○
Dispute resolution techniques	○	○	○	○	○

Trust Integration

	1 – Never	2 - Rarely	3 - Occasionally	4 - Often	5 - always
Transparency among parties	○	○	○	○	○
Team building activities	○	○	○	○	○
Long term relationships with suppliers and subcontractors	○	○	○	○	○
Repetitive supply chain team on new projects	○	○	○	○	○

What are the challenges faced in the application of integrated construction supply chain practices in building projects?

The table below contains some of the challenges in the application of integrated construction supply chain practices in building projects, based on your experience, please rank the five point likert scale question according to the level which you agree as indicated below.

	1 – strongly Disagree	2 – Disagree	3 – Neutral	4 - Agree	5 – strongly agree
Inadequate organization structure	○	○	○	○	○
Poor knowledge on management	○	○	○	○	○
Lack of staff training	○	○	○	○	○
Lack of production staff	○	○	○	○	○
Lack of top management support	○	○	○	○	○
Lack of willingness to invest in SC integration	○	○	○	○	○
Information system support accounting & finance only	○	○	○	○	○
Unable to invest in SC integration	○	○	○	○	○
Multiple independent departmental system	○	○	○	○	○
Lack of reward system	○	○	○	○	○
The “us vs them” culture	○	○	○	○	○
Inefficiency of traditional procurement method.	○	○	○	○	○
Lack of Trust	○	○	○	○	○
Lack of Team spirit	○	○	○	○	○
Lack of mutual objectives	○	○	○	○	○
Lack of timely information flow	○	○	○	○	○

Any other challenges you can write below

_____

_____

What should be done in order to promote the application of integrated construction supply chain in building projects?

The tables below contain some of the strategies to promote the application of integrated construction supply chain practices in building projects, based on your experience in construction, please rank the five point likert scale questions according to the level which you agree as indicated below.

	1 – Strongly Disagree	2 – Disagree	3 - Neutral	4 - Agree	5 – Strongly agree
Application of IT in modern way to enhance supply chain integration	○	○	○	○	○
Training staff on supply chain integration	○	○	○	○	○
Identifying non value adding activities and eliminate them	○	○	○	○	○
Setting goals or bench marking prior to the process	○	○	○	○	○
Involvement of all key supply chain participants at an early stage of design process	○	○	○	○	○
Encouraging repetitive supply chain on new projects	○	○	○	○	○
research and development	○	○	○	○	○

Any other strategy you can write below

_____

_____

Appendix II

Interview guide questions

Interview guide

TITLE: ASSESSMENT OF APPLICATION OF INTEGRATED CONSTRUCTION SUPPLY CHAIN PRACTICE IN BUILDING PROJECTS IN TANZANIA.

Client ☐ Consultant ☐ Main contractor ☐ Sub-contractor ☐

Supplier ☐

Objective one: To assess the extent by which the integrated construction supply chain practice are applied in construction of building projects.

1. How do you share information with other parties i.e. client, consultant, main contractor, sub-contractor and suppliers?
2. How are you involved in various processes of construction i.e. design, procurement and in risk assessment?
3. How do you perceive trust and transparency in sharing information with other parties i.e. client, consultant, main contractor, sub-contractor and suppliers?

Objective two: To determine challenges facing the application of integrated construction supply chain practice in construction of building projects.

4. What challenges are you facing in the application of integrated construction supply chain?

Objective three: To propose strategies that would promote the application of integrated construction supply chain practice in building projects.

5. What are your comments on improving the application of integrated construction supply chain?