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Assessment of suppliers' collaboration on construction project in Ebonyi state

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Abstract

In Nigeria, the concept of suppliers' collaboration is still a new area to construction stakeholders. The construction companies in Ebonyi State are faced with enormous challenges which involve the integration of all construction processes and activities of different agents and specialists hired by clients for successful project delivery. To address the problem of construction project in Ebonyi State, construction stakeholders require collaboration which suppliers' collaboration is the most pertinent. The aim is to assess the factors affecting contractors–suppliers relationship on successful construction project delivery in Ebonyi State. The general objective is to identify and determine the factors affecting contractors–suppliers relationship in construction industry and impact of supplier's collaboration on the cost of construction project in Ebonyi State. The research sought to ensure at least 95% level of confidence with a total population of 400 and sample size set to 250. Primary and secondary sources were used to generate data with the aid of structured questionnaire and oral interviews directed to both private firms and public firms in construction industry. In total, 250 forms containing a set of question were submitted randomly to selected medium and large-sized construction firms in Ebonyi State. Data collected were presented in tables containing frequencies of the responses and their corresponding percentages. Frequency distribution, relative importance index (R11), Chi-square (X2), Python spyder IDE, statistical package for social science students(SPSS) and Pearson product moment correlation coefficient were the analytical tools used in the study. The result of the analyses revealed that, correlation matrix used to measure the relationship between contractors and supplier variables. The matrix depicts there is a linear correlation between all possible pairs about contractors and suppliers. There exist a relationship between contractors and suppliers as shown with other pairs in the correlation matrix that connects to objective number 3 and addresses the research question number 3. This implies that as the contractor-supplier approach short term or/and long term increases, the supplier collaboration on the cost of construction project in the Ebonyi State is expected to increase. The study concludes that the main drivers of the success of supplier collaboration appear to be the elements of trust and teamwork. It is these which ensure the continued relationship and ensure that both parties derive the benefits necessary for the partnership to continue and therefore; made the following recommendation. A detailed schedule of materials supply should be provided by the contractor. The schedule should contain the time required for material to arrive on site. Thus, results in reducing unproductive time on site and cost saving.

Keywords: Suppliers' relationship; Partnering; Construction Industry; Management; Project; Contractor

1. Introduction

The construction industry in Nigeria accounts for almost 70% of the nation's fixed capital formation, 1.4% GDP (Federal Office of Statistics: 1998). Inuwa, Usman and Dantory (2014) report has it that the construction industry in Nigeria employs approximately 8 million people, which represents approximately 25% of Nigeria's workforce and the largest employer of construction labour in Africa. Isa, Jimoh and Achuenu (2013) submitted that the construction industry in Nigeria has witnessed an overwhelming upsurge in construction contracting dominated by expatriate companies with few indigenous companies. Supply chain management in construction can be very complex owing to hundreds of

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subcontractors, suppliers involved, especially in a large scale project. A typical construction supply chain management involves information flow such as order, schedules, forecast, and materials such as supplies, production, deliveries (Vrijhoef and Koskela, 1999).

According to Love, Irani and Edwards, (2004), Supply Chain Management in construction is the system of facilities and activities that can contribute a profitable worth to the functions of material procurement, design development, service and contract management. According to Ojo, Mbohwa and Akinlabi, (2014), maintained three types of construction supply chain as follows: - the primary supply chain which delivers the material that is needed in the final construction product. - the support chain which provides equipment and materials that facilitate construction. - The human resource supply chain which involves supply of labour.

Supply chain management (SCM) is a concept that has flourished in manufacturing industry. It originated from just–in–time (JIT) production and logistics (Vrijhoefand and koskela, 1999).

Construction projects require numerous agents and specialists hired by clients who involved project designers (architect and structural designers), main contractors, subcontractors, suppliers, or project management consultants/third–party consultants. They are all expected to manage the supply chain of construction projects by integrating all process and activities of different agents as well as effective co-operation for a successful project delivery (Yadav, 2015).

It is in this light, that Saka and Mudi (2007) supported that supply chain management synchronize a firm‘s functions and those of its suppliers to match the flow of material services and logistics in the supply chain. Therefore, construction supply chain management is the management of suppliers, subcontractors, related parties, all agents and processes in order to deliver information to planning, ordering, producing, delivery and installing materials and services for construction project through an organized network of organizations (Saka and Mudi, 2007).

In Nigeria, although the concept of supply chain management is still a new area to construction stakeholders, there exist certain elemental challenges identified as inhibitors to the effective development of construction supply chain management practices in the construction industry. These inhibitors commonly reported in the construction industry are inadequate investment in information technology, diverse objectives, ineffective communication, poor understanding, inappropriate tendering methods, ignorance, lack of training, ineffective problem solving mechanism, passive subcontractors and the like (Olaniyan, Bosede and Olusola, 2015). The aforementioned challenges have become enormous problems faced by Nigerian construction companies in the management of supply chain which is the bane of successful project delivery.

This research is to bring to the fore, the relevance and benefits of this pragmatic concept, in Ebonyi state construction industry.

1.1. Statement of the problem

There has been a lot of literature documenting the application of supplier collaboration in construction projects (Akintoye et al., 2000, Holweg et al., 2005, Beamon, 1999, Polat & Ballard, 2003) but many of these scholars stated that supplier collaboration in the construction sector is at its infancy. The construction companies in Ebonyi State are faced with enormous challenges in this area of supply chain management which to a large extent involve the integration of all construction processes and activities of different agents and specialists hired by clients for successful project delivery. The challenges mostly faced by construction stakeholders are inadequate investment, ignorance of buildability issues which are commonly witnessed in the construction industry. Based on this, poor project planning, variation of project scope, faulty designs, and wrong estimates were witnessed in the past as a result of these inhibitors or challenges in the construction industry (Moneke and Echeme, 2016).

These are results of not aligning its conduct and practices fully to supplier collaboration in construction projects delivery. In dealing with these challenges, this research project seeks to identify the factors preventing effective contractors – suppliers’ relationships in construction industry in Ebonyi state.

This prompted the need for this research and the purpose to assess the impact of supplier collaboration in construction projects in the Ebonyi state, with the objective to find out how effective it has been over the years, by comparing its impact on major construction projects adopting this tool and identifying areas of improvement on in this area.

Objectives of the study

The aim of this study is to assess the factors affecting contractors – supplier's relationship on construction project in Ebonyi State.

The specific objectives of the study are:

- To identify the factors affecting contractors – suppliers relationship in construction industry in Ebonyi
- To determine the relationship between contractors and suppliers in Ebonyi State
- To determine the impact of suppliers collaboration on the cost of construction project in Ebonyi State

Significance of the study

This study will improve the time, cost and quality of the project characteristics in Ebonyi State, it will reduce the cost of delay and abandonment and money will be saved to Ebonyi State government.

Theoretically, the study will serve as a contribution to knowledge regarding to construction project delivery as a viable option for infrastructural development in Nigeria and Ebonyi State in particular.

More so, it serves as a reference material for administrators and policy makers at all level of government and the profession.

Scope of the study

The scope of the study focused on the assessment of supplier's collaboration on successful construction project in Ebonyi State. The study examined in details the factors influencing contractors – suppliers' relationship on construction project in Ebonyi State. The focus is limited to client, consultants, constructor management, construction suppliers, contractors and sub-contractors in the downstream of the construction project supply chain in Ebonyi State.

2. Review of related literature

2.1. Conceptual literature

Several factors make supplier collaboration challenging, Projects may require significant time and management effort before they generate value, leading companies to prioritize simpler, faster initiatives, even if they are worth less. Collaboration requires a change in mind-sets among buyers and suppliers, who may be used to more transactional or even adversarial relationships. And most collaborative efforts need intensive, cross-functional involvement from both sides, a marked change to the normal working methods at many companies. This change from a cost-based to a value-based way of thinking requires a paradigm shift that is often difficult to come by the actual value generated by collaborating can also be difficult to quantify, especially when companies are also pursuing more conventional procurement and supply-chain improvement strategies with the same suppliers, or when they are simultaneously updating product designs and production processes. And even when companies have the will to pursue greater levels of supplier collaboration, leaders often admit that they don't have the skill, lacking the structures they need to design great supplier-collaboration programs, and being short of staff with the capabilities to run them. After all, what great supplier collaboration necessitates is much more than the mere application of a process or framework-it requires the buy-in and long-term commitment of leaders and decision makers. Building trust takes time and effort. Often this means starting small, with simple collaboration efforts that deliver results quickly, building momentum. This way, companies can demonstrate a serious approach to collaboration and their willingness to share gains fairly. More importantly, companies should base their relationships on transparency and information sharing as a foundation, The Supplier Collaboration Index has already revealed several major opportunities for companies seeking to expand and improve their supplier-collaboration efforts. Some of those opportunities are quite straightforward, such as more proactive management of cross-functional teams involved in collaboration projects, or the introduction of formal governance systems to manage those projects. Others, such as greater cost transparency between buyers and suppliers, or the use of performance-based supplier-incentive mechanisms, may require more time and effort to achieve (Gutierrez *et al.*,2020).

2.2. Theoretical literature

Recent developments in the construction industry resulted in an increased importance of collaboration with and managing of suppliers by prime contractors. The focus is of this study is on getting insights into existing knowledge on

this topic and the gaps in this knowledge base. The goals of this study are stated in 3-folds: to verify the current state, gain insight and provide suggestions for supplier-constructor research.

2.2.1. Design/methodology/approach

Approach

The current state of supplier-contractor research in the construction industry is verified through a taxonomic approach to the literature on buyer-supplier research over the last decade (2000-2009).

2.2.2. Research limitations/implications

This study concludes that future research should focus on longitudinal studies, testing organizational barriers to partnering, and the benefits of partnering in practice, conditions under which the formation of collaborative relationships between suppliers and contractors takes place, and experiences with this formation process.

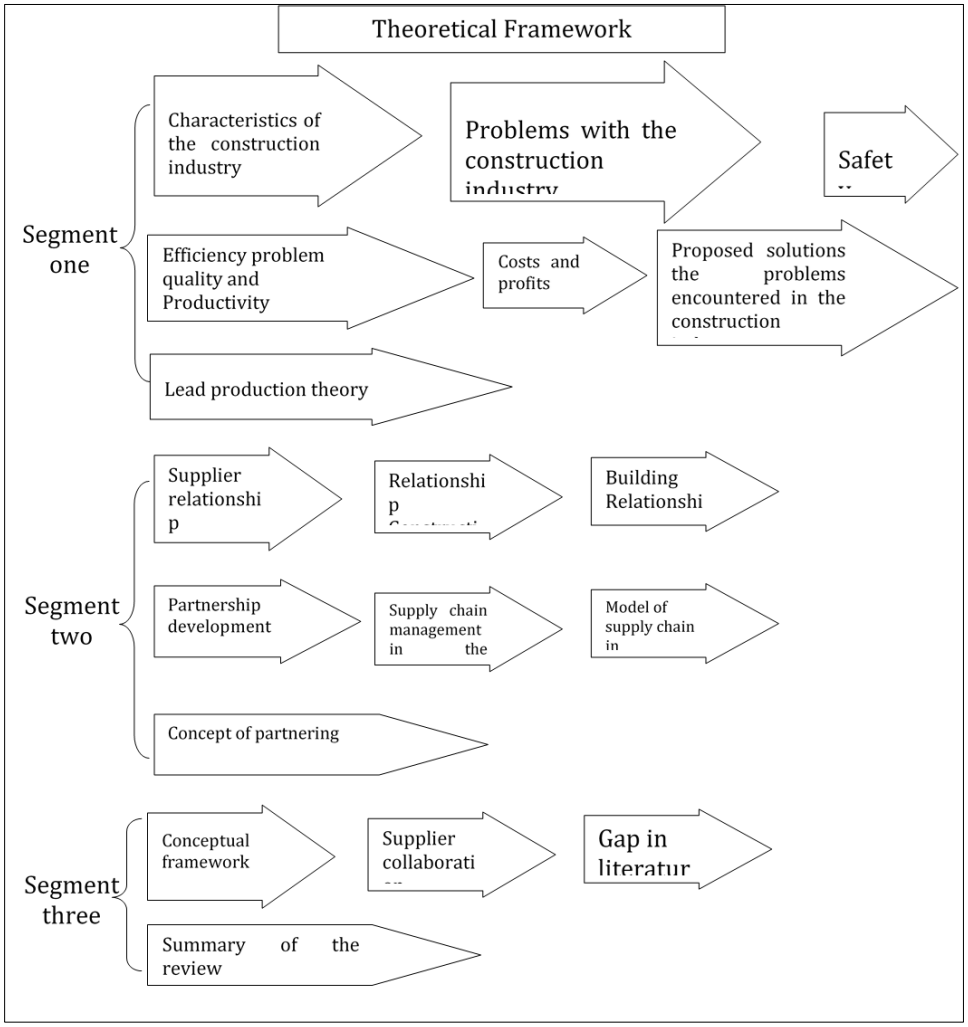


Figure 1 The structure of the theoretical framework divided in three segments

2.3. The structure of the theoretical framework divided in three segments

2.3.1. Characteristics of the Construction Industry

Construction involves the assembly of materials and components designed and produced by a multitude of suppliers, working in a diversity of disciplines and technologies in order to create the "built environment". This involves processes including planning, regulations, design, manufacture, construction, maintenance and the eventual decommissioning of the building and other structures (Burtonstraw - Gunn & Brindley, 2004).

In particular, there are a number of key features of construction projects which Koskela (1997) identified as peculiar to this industry, including the one-of-a-kind nature of projects, site production, temporary multi organization, and the design-bid-build system used. These are important when considering the application of solutions from other industries to the construction industry as they may present obstacles to application. The relative importance of the industry to the Nigeria economy therefore explains the interest in research for improvements, and further supports the need to fully understand how issues within the industry may be successfully resolved.

The construction process is highly complex (Baccarini, 1996), involving different parties in projects with the aim of creating value by fulfilling customer requirement (Bertellen & Koskela, 2002). Baccarini (1996) further stress the fact that the construction industry even could be considered as the industry containing the most complex processes. The performance of construction are not clearly defined in literature (Olsson, 2000), however, there are authors that have defined some characteristics of construction processes (Baccarini, 1996; Femandes-solis, 2007; Ballard & Howell, 1998; Olsson, 2000). In addition to the complexity brought up by Baccarini, the nature of construction is a dynamic process, where the contractor's interpretation of the product may not be aligned with the client's vision, making the process even more complex (Fermandes-solis, 2007). Furthermore, Koskela (1992) state that projects carried out within the construction industry can be defined by

- Uniqueness,
- Site production and
- Temporary multi-organizations.

Therese characteristics will be further developed below.

Uniqueness

It has been a common statement that construction is different from other industries with respect to the uniqueness of project. However, Egan (1998) do not agree with such statement, arguing that many buildings (e.g. house are essentially repeated products, and moreover, that the construction process itself is repeated from project to project. Furthermore, he presents figures from research, estimating that 80% of inputs into buildings are repeated.

In contrast, Ballard and Howell (1998) formulate the uniqueness of projects as a relative matter, where one end of the spectrum represents mass production of prefabricated components, and the other represents customization. Although the spectrum has a side of standardization, depending on the location of the construction site, different preconditions will emerge, any logistical constraints, soil and ground conditions, the weather, and the relationship and interrelationships in each project undertaken (Dainty, Moore & Murray, 2006; Koskala 1992). Moreover, different clients have different requirements to be fulfilled in order to achieve customer satisfaction affecting the work to be under taken, such as the architectural design (Koskela, 1992).

Site-Based Production

The character of site production can be divided into further categories namely

- Fixed position manufacturing and
- Rootedness-in-place.

The former category considers manufacturing of products that eventually become too large to move through workstations, which changes the conditions of developing the end product. Instead, resources (e.g. craftsman) have to move through the product with the evolvement of prefabrication, much construction activities can be made in factories, with a more stable environment, compared to construction sites, resulting in a higher degree of efficiency. However, the final assembly must be made on site, where planning and control are two important aspects in order to achieve an efficient flow of materials and work (Ballard & Howell 1998). The latter category emphasizes risks and uncertainties that come along with the construction object being rooted in place. As mentioned above, soil and ground conditions are preconditions that vary depending on location, which are difficult to determine prior to production. Other risks and uncertainties are the weather conditions (precipitation, wind leads and seismic), physical surrounding (space limitation) and codes and regulations that may constraint any further development of the project (Ballard & Howell 1998; Koskela 1992).

Furthermore, due to the decentralized nature of the production phase, improvements are difficult to implement into new projects (Koskela, 1992).

Temporary multi-organizations

Construction temporary multi-organizations construction is a project-based industry, involving a range of companies and disciplines, working together to achieve fulfillment of customer requirements within the constraints of time, cost and quality. It is a disparate industry, with disciplines that have not necessarily worked together (Dainty et al., 2006; Koskela, 1992). Problems that may occur in such environment can be related to communicating data and to sharing design solutions and knowledge across organizational boundaries (Koskela, 1992).

Bresnen et al., (2004), have made a similar statement, auguring that the fragmented nature of construction aggravate to capture and share knowledge across projects. In addition, it is also difficult to establish a shared understanding in a fragmented environment (Lindkvist, 2004). As a solution, procurement can be made amongst organizations with long-time cooperation, and moreover, involved parties in a project can interact in a team building session (Koskela, 1992).

2.3.2. Supply Chain Management in the Construction Industry

Supply chain management in the construction industry can be explained with three characteristic. First, it is considered to be a converging supply chain where the assembly of the object is made on site. Second, the supply chain has a temporary lifetime, resulting in instability and fragmentation, especially due to the separation of the design and production phase.

Third, construction is a typical make - to - order supply chain, where the object is designed after customer requirements (Vrijhoef & Koskela, 2000). Moreover, Vrijhoef and Koskela (2002) present four roles of supply chain management in construction, as illustrated in figure 2 - 5, which are dependent on whether the focus is on the supply chain, the construction site, or both. The first role has its focus on the interface between the supply chain and the construction site. By decreasing the number of disruption in the workflow, costs and durations of site activities can be reduced.

Hence, the authors made following “Here, there has been a focus on the cooperation between suppliers and contractors for improving the total flow of material, whereas traditional treatment of construction logistics and material handling has predominantly concentrated on activities occurring on site”. Vrijhoef & Koskela, 2000; 192.

The second role fragmentations in the industry, many building are poorly constructed in terms of sustainability maintenance and operating costs, and flexibility of use (Egan, 1998). In manufacturing, by inviting suppliers and subcontractor in to the design phase, efficiency and quality have been enhanced. An equivalent arrangement is of need in the construction industry.

The second roles emphasize the supply chain only, with the goal of reducing costs related to logistic, inventory and lead-time. The third role has its focus on transferring activities from the construction site to the supply chain. An example of such transfer is prefabrication of concrete elements, which are partly assembled in a factory and where the final assembly occurs on site. The fourth role considers integration of the supply chain and the construction site. Here, the goal is to transform construction’s temporary chains with permanent supply chains (Vrighoef & Koskela, 2000).

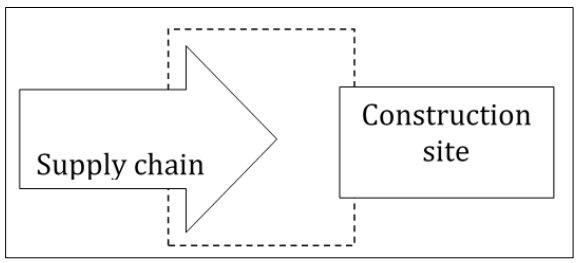


Figure 2 Focus on the interface between the supply chain and the construction site

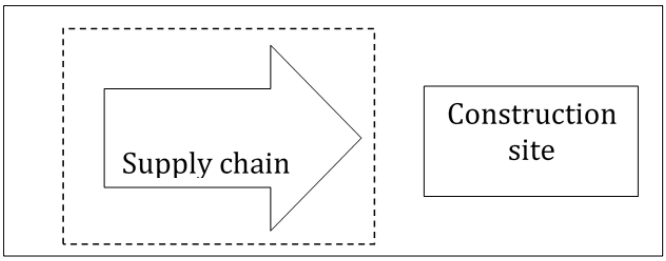


Figure 3 Focus on the supply chain

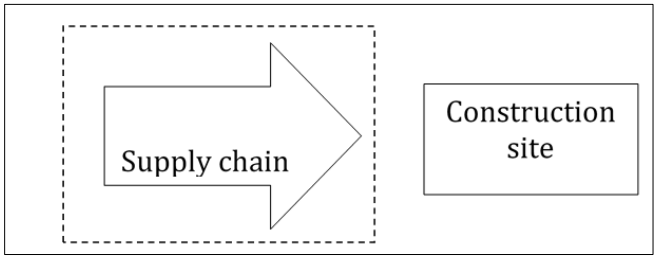


Figure 4 Focus on transferring activities from the construction site to the supply chain

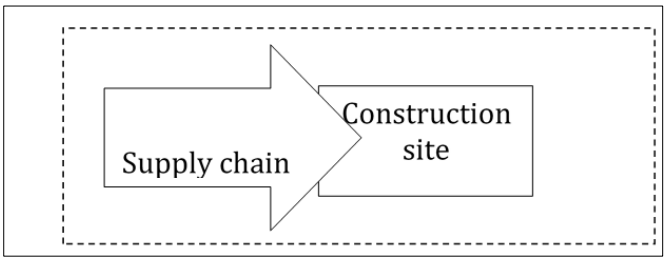


Figure 5 Focus on the integrated management of the supply chain and the instruction site

2.4. The four different roles of supply chain management is construction, defined by Vrijhoef and Koskela (2002)

2.4.1. Problems within the Construction Industry

It is well recognized that there are a number of problems faced by the construction industry. These problems include, but are not limited to low productivity, poor safety records, low quality working conditions and poor quality of delivered product (Koskela, 1997). Some of the key problems are discussed in further detail in this section.

2.4.2. Safety

World statistics suggest that the construction industry remains one of the most dangerous in which to work, despite improvements in many countries, including the Nigeria (Hinze, 2008). In particular there are concerns on safety in Scotland, which has a higher rate of fatal and major incidents than the rest of the Nigeria combined (Cameron et al., 2008).

There are various suggestions as to why the industry still faces safety problems. Based on evidence from Hong Kong, Choudhry and Fang (2008) suggest that factors such as workers' attitudes and awareness of safety are likely to be major causative factors. They also discuss work pressures and organizational factors as key issues, with the role of management and safety procedures identified as particularly important. The role of these factors is also implicated in the level of performance from safety initiatives, with management commitment being one of the major factors required for safety program success (Aksorn & Hadikusumo, 2008).

2.5. Efficiency Problems, Quality and Productivity Problems

The construction industry has been recognized as poor in efficiency for a long time (Koskela, 1997). There are numerous explanations for this inefficiency, for example the uniqueness of the industry and the delivered product, misalignment between design and construction processes and procurement methods (Naoum, 2003).

There are not only efficiency problems associated with the construction process, but also problems with the quality of the product delivered (Koskela, 1997). The main problem which may lead to poor quality end products being delivered by the construction industry is the traditional bidding process used for procurement of projects. This leads to the projects inevitably being awarded to the lowest bidder, with little consideration given as to the quality of the project (Naoum, 2003). It is the selection of inappropriate suppliers which is associated with poor performance in the industry (Kashiwagi et al., 2005).

2.5.1. Costs and Profits

It is possible that there may be problems associated with costs of projects aside from those which impact on quality. In desperation to win bids by appearing to be the lowest, it is not uncommon for construction companies to exclude profits and overheads from their bid. In addition, the emphasis on cost constraints may lead to delays and lower consideration of time constraints (Naoum, 2003). It is also possible that costs may escalate during the course of a project from those originally projected (Kaliba et al., 2008). There are numerous reasons for this, some controllable and some non-controllable. For example, reasons may include unexpected problems in supply of raw materials and unpredicted inflation on costs of supplies (Flyvbjerg et al., 2002).

2.6. Proposed Solutions to Problems Encountered in the Construction Industry

There are numerous solutions which have been proposed to deal with the problems encountered in the construction industry. Many of these have been identified through similarities drawn between the construction and other industries, particularly manufacturing (Green et al., 2005). For example, there are many shared issues which have been successfully addressed in the manufacturing industry, leading to the suggestion that similar methods should be adopted within construction. There is however also several key differences which may indicate that success in these other industries is no guarantee of success in construction (Polat and Ballard, 2005, Green et al., 2005).

2.6.1. Lean Production Theory

Lean production theory is a solution which has been successful in manufacturing. There are four key features which also suggest that it would be suitable to address some of the issues present in construction:

- The one-of-a-kind nature of projects is addressed through standardization of certain elements, for example off-site production
- The difficulties which may be associated with on-site production are addressed through improvements and increases in the amount of pre-fabrication used, and also through initiating multi-functional teams
- Longer term alliances are created which reduces the problems associated with temporary linkages between organisations during the project
- Concurrent engineering is used to address the problems associated with the design-bid-build system (Crowley, 1998)

There have been a number of studies which have identified lean production theory as successful in addressing problems associated with the construction industry. For example the technique has been suggested by Kartam (1995) to reduce project duration by up to 55% and improve productivity by up to 37%.

Despite the apparent success of lean production theory, studies have suggested that there remain valid reasons for which many contractors may not utilize the entire system (Polat & Ballard, 2005). It may therefore be important to identify whether there are any benefits which remain from utilizing only specific elements of the theory. The key element which is of interest here is the third point, which indicates that long-term strategic alliances are likely to be beneficial in reducing problems in construction. This has also been investigated as an individual solution to problems and is usually referred to as partnership development (e.g. Beach et al., 2005).

2.6.2. Building Relationships

There are a number of different forms which relationships between organizations may take, and not all are partnerships. For example market relationships are those which allow products to be purchased at the lowest possible cost. This type

of relationship is fraught with distrust as it is possible that one or other party will still engage in opportunistic behavior outside the partnership (Johnston & Lawrence, 1988). This is the type of relationship which has traditionally dominated the construction industry (Beach et al., 2005) although it would not appear to necessarily be beneficial. In particular, it may lead to generation of extensive further costs due to the additional steps taken to reduce risk in such an adversarial and uncertain relationship (Rahman & Kumaraswamy, 2002; Beach et al., 2005). This therefore indicates that the industry needs to move away from this method of working.

A further type of relationship which has had limited success in some industries is that of vertical integration, where a firm acquires other business areas in order to maintain its own manufacturing and supply operations. Beach et al., (2005) suggest that the reason this has not been widely pursued in the construction industry is due to large capital investment requirements and fluctuating workloads. It would therefore appear that partnership development may be the most beneficial form of relationship within the construction industry, and this is discussed in the next sub-section.

2.6.3. Partnership Development

Partnership development was initiated in various industries successfully before being adopted by the construction industry, and has been used in many different ways (Burnes & New, 1996). It offers the benefits of both market relationships and vertical integration without many of the drawbacks (Beach et al., 2005). The only real cost to construction companies is in fact an increase in effort towards cultivating the relationship (Barlow et al., 1997). There are two main types of partnership which may be cultivated in construction: strategic (long-term) and project (short-term) partnerships (Barlow & Jashapara, 1998).

There are a number of functions which partnerships within the construction industry may provide. This includes increased innovation, access to new markets, overcoming local restrictions and entry barriers and sharing risk (Stanek, 2004). In addition to this, there are numerous benefits to partnership development which have been identified.

Hamza et al., (1999) identified that collaborative partnerships allowed for minimization of waste, improved efficiency and productivity, and improved supply chain coordination (Hamza et al., 1999). It is also possible that all costs associated with a project may be lowered through collaboration (Egan, 1998; Black et al., 2001; Scott, 2001., Haksever et al., 2001). In particular, Black et al. (2000) found that costs could be lowered on projects through collaboration, although only when trust could be maintained. Egan (1998) suggests that the fact that overruns and capital costs could be reduced could also result in around a 10% increase in turnover and profits for construction companies. Also, Egan (1998) suggests that collaborative partnerships may reduce accident rates by up to 20%, although other studies were unable to confirm this (Black et al., 2000, Scott, 2001, Haksever et al., 2001). The results therefore indicate that the majority of the problems in the construction industry outlined in the first part of this chapter may be addressed through collaboration. As a direct result of these recognized benefits, partnering has actually become commonplace as a pre-tender requirement, particularly for government funded projects in health, education, defense and energy (Beach et al., 2005).

It must be noted however that many of the benefits which may result from collaboration are highly dependent on how effective the partnership is. There are numerous factors which have been identified as critical to the success of these collaborative partnerships in industry. These include the commitment of management, mutual trust, evaluation, communication, conflict resolution and commitment (Black et al., 2000, Lenard et al., 1996, Thomas et al., 2002). Chan et al., (2004) suggest that there are five factors which must be present for a partnership in construction to succeed, establishment and communication of a conflict resolution strategy, willingness to share resources, clear definition of responsibilities, commitment, and regular monitoring of processes.

2.6.4. Supply Chain Management

Christopher, (1992) defines a supply chain as the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer. Handfield et al., (1999) then goes on from this to define supply chain management as a process that involves the coordination of all activities associated with goods and information from raw materials to product delivery and finally, to the end customers. In other words supply chain management is a process which focuses more on increasing efficiency especially during the implementation process of a construction project (Humphreys et al., 2003).

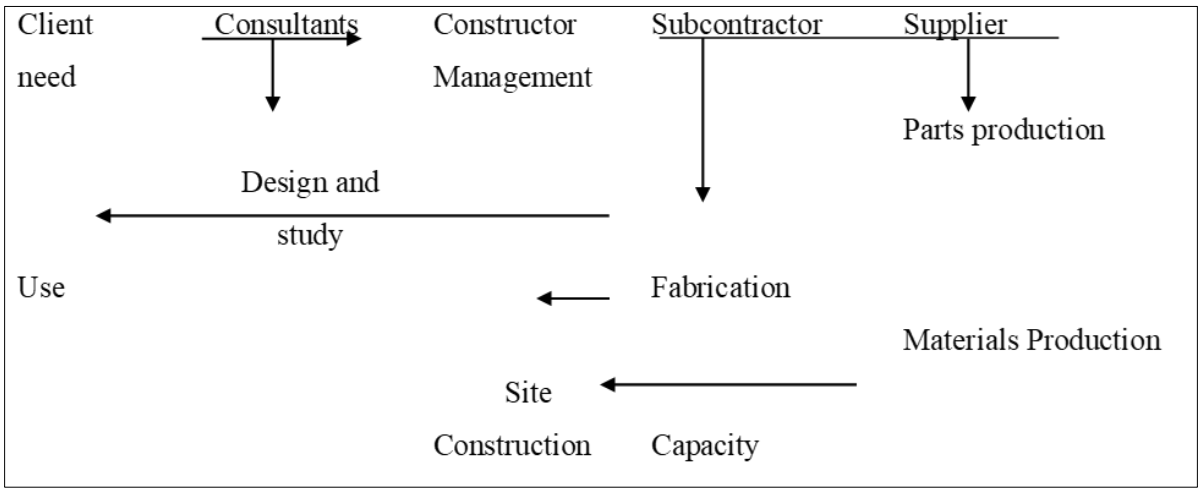
Simchi-Levi et al., (2000) specifically define supply chain management in the construction sector as the management of information, flow, and money in the development of a construction project. Vaidyanathan & Howell (2007) observe that the goal of supply chain management in construction projects is to reduce information lag and operational inefficiency.

This is usually achieved by addressing various causative factors such as data duplication from the customer to the supplier. Supply chain management has been seen as a key element in reducing construction project costs (Atkin et al., 1995; Agapiou et al., 1998) within the construction supply chain process while adding value to the overall process. This is not surprising given that problems with supplies are associated with adverse outcomes such as delays, increased costs and lowered profitability (Kaliba et al., 2008). The realization that coupling this with partnership strategies may further increase benefits then gave birth to concept of supply chain collaboration.

According to Ojo, Mbohwa and Akinlabi (2014). Maintained three types of construction supply chain as follows: 1. the primary supply chain which delivers the material that is needed in the final construction product. 2. The support chain which provides equipment and materials that facilitate construction. 3. The human resource supply chain which involves supply of labour. Though the construction process is different from production processes in factories, supply chain management can be effective and relevant in construction (Ojo et al., 2014).

3. Model of supply chain in construction

A view from construction industry



Source: Ojo et al., (2014).

Figure 6 Supply chain in construction

3.1. Model of Supply Chain in Construction

Supply Chain Management in Construction Industries in South Africa and Nigeria. From figure 1 above, it is evident that construction firm has various supply chains in construction projects. In other words, for each project, there is a corresponding supply chain suitable for it, based on the client's requirements with respect to project characteristics which might be different.

3.2. The concept of partnering

Project partnering according to Baker (1990), is a method of translating contractual relationships into a cohesive, cooperative project team with a single set of goals and established procedure for resolving disputes in a timely and effective manner.

Construction Industry Institute (CII) defines partnering as a long-term commitment between two or more organization in order to achieve specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing the traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based on trust, dedication to common goals and an understanding of each other's individual expectation and values.

Expected benefit include improved efficiency and cost effectiveness increased opportunity for innovation and the continuous improvement of quality products and services (Cook et-al., 1990, Crowley et-al 1995).

Partnering is a way of doing business that helps the providers of services and the recipients of those services work together to achieve their mutual, as well as individual goals and objectives.

3.3. Why partnering?

The primary thrust behind partnering are:

- To improve quality in the production of capital goals and services to ensure their sustainability (Adinna, 2007; Ajartor and Onyeador, 2007).
- Capital project development and management using traditional approach is facing numerous problem such as poor communication, adversarial contractual language, cost over-runs, time over-runs, lack of continuity from project to project, poor quality work, proneness to abuse/corruption, high change orders or variation, high abandonment.
- To stem the loss of the second order multiplier economic & social benefits and value-added to the nation resulting from the development programmes.
- These make project development partnering a sine-qua-non for the owner, partnering solves problem of unskilled personnel optional project planning, emergency response capability, market responsiveness and cost reduction.
- For the contractor, partnering provides long-term work load, quality management, association with recognized industry leaders for performance bench working and continuous improvement.

3.4. Key element of partnering

A typical partnering relationship involves the elements of commitment, trust mutual advantage and opportunity.

3.5. Commitment

Commitment is the more important element in a partnering relationship. Partnering companies (professionals) must commit to long term improvement of relationship understand goals of the partners and each tenaciously seek ways to assist the partner is achieving its goal and gaining competitive advantage commitment must not be personality-driven. The commitment to partnering grows even when the leaders of the partnering groups are change or redeployed.

3.6. Mutual trust

Mutual trust is crucial in partnering. It enables partners (project team, agencies, professionals believe that, by granting information, reduced control of part of their operation and tolerating context with outsiders, each firm can obtain benefits that would exceed the firm's individual capacity. ACEC/AIA (1993) and Cook et al., (1990) posit that trust serves to combine the resources and knowledge of the partners in a fashion intended to eliminate adversaries relationship. There are more advantages and more opportunities for partnering firms than are available in traditional business relations (Ajator, 1999; Onyeiwe, 1998).

3.7. Application of project partnering

A construction project can be said to be successfully completed if it is executed within time, within budget and of the required level of performance and quality specification, with all stakeholders realizing their planned interests on the project.

The key to this success if project partnering application of project partnering will improve quality, lower life-cycle cost, and lower fixed-resource requirements and create improvements in safety, quality, profitability resources planning, market responsiveness and innovation.

3.8. Conceptual and Operational Definitions

- Building construction industry are general contractors and operative builders primarily engaged in the construction of residential, farm, industrial, commercial or other buildings.
- Special trade construction industry are special trade contractors who undertake activities of a type that are specialized either to building construction, including work on mobile homes, or to both building and non-building projects. This includes projects such as painting, electrical work and plumbing.
- Contractors are organizations that carry out construction works, that is, any building, civil engineering or engineering construction work.

- Stakeholders in a construction project is often big and includes the owners and facility users, project management, team members, facilitates managers, designers, shareholders, public administration, workers, sub-contractors, services suppliers competitors, banks insurance companies, media and community.
- Supplier's collaboration is a joint activity that increases the capabilities of the suppliers and business, in area of cost management, process improvement, and product/service innovation.
- Construction industry is the branch of manufacture and trade based on the building, maintaining, and repairing structures. This includes drilling and solid mineral exploration.

3.9. Construction industry categories

- Heavy Construction industry, all general contractors primarily engaged in heavy construction other than building, such as highways and streets, bridges, sewers, rail/roads, irrigation project, and flood control projects and marine construction. This includes special trade contractors primarily engaged in activities not normally performed on buildings such as highway grading or underwater rock removal. This does not include special trade contractors primarily engaged activities performed on buildings.
- A sub-contractor is a type of contractor who works in a specialized area and could be a freelance, independent contractor, or vendor.
- Client is a person or group that uses the professional advice or services of lawyers, accountant, advertising agency, architect.
- Consultant is a person who provides professional or expert advice in a particular field of since or business to either an organization or individual.
- Supplier is a person or organization that provides something needed such a product or service.
- Construction project means the new buildings or other substantial improvements to be constructed, or the alteration of existing improvement, as described.

Source: Chalmers library and Google scholar where used as main sources for conceptual and operational definition.

3.10. Empirical Review of Suppliers Collaboration

Further elaborating on the concept of supply chain management discussed in the previous section, supplier collaboration may be considered as a process within a process (supply chain). It can be viewed as a tool for increasing production efficiency in a project, reducing waste and production cost, while adding value to the overall process. Its focus is on building trust and long-term relationship between the stakeholders especially fostering client-supplier relationships with the project environment. Specifically, it is a type of strategic partnership which is built between contractors and their suppliers (Barlow & Jashapara, 1998).

The importance of developing and maintaining good relationships with customers and suppliers in any construction project is a critical factor affecting such a project's success. A key feature of the present day construction and business environment is that it is the supply chains that compete, not companies (Christopher, 1992) and that the success or failure of these supply chains is ultimately determined in the market place by the end consumer (Towill and Christopher, 2002).

Burtonastraw-Gunn and Brindley, (2004) explain that the aim of supplier collaboration is to eliminate or at least reduce adversarial relationships and replace them with a long term relationship based on trust and benefit not just in harmonious working but also in reducing traditional risks. This would eliminate many of the adverse outcomes associated with traditional market based relationships, where adversarial relationships may become a problem (Johnston & Lawrence, 1988).

To date there have been several studies conducted into supplier collaboration in the construction sector. The findings of these studies have varied widely in terms of the benefits identified through the practice. Akintoye et al. (2000) presented a questionnaire survey of supply chain collaboration and management issues being undertaken by the top Nigeria construction industry contractors. The results indicate the formation of a significant number of partnerships/collaborative agreements between contractors, suppliers and clients following the publication of the (Latham 1994, and Egan 1997) reports.

Love (2000) using Proverb and Holt's generic cost minimization model also argued that supply chains downstream from the principal contractor, i.e. forming part of these key construction practices (material suppliers, subcontractors, plant and equipment providers etc.) should be targeted as a means of effectively reducing overall construction costs. He advocated for the use of 'downstream strategic alliances'.

Dubois & Gadde (2000) explored the effects of supplier collaboration in the construction industry and stated that the benefits arising when firms adapt to one another in terms of technical solutions, logistics or administrative routines was unusual in construction industries. He concluded that these characteristics have a hampering effect on both efficiency and innovation within the construction industry.

3.11. Summary of Literature Research Gap(s)

The literature review examined works by different authors in supplier collaboration, which indicate the need for this research and the purpose this research is to assess the impact of suppliers collaboration in construction projects, with the objective to find out how effective it has been over the years, by comparing it's impact on major construction projects adopting this tool and identifying areas of improvement.

Construction involves the assembly of materials and components designed and produced by a multitude of suppliers, working in a diversity of disciplines and technologies in order to create the "built environment". This involves processes including planning, regulations, design, manufacture, construction, maintenance and the eventual decommissioning of the building and other structures (Burtonstraw - Gunn & Brindley, 2004).

Hamza et al., (1999) identified that collaborative partnerships allowed for minimization of waste, improved efficiency and productivity, and improved supply chain coordination (Hamza et al., 1999). It is also possible that all costs associated with a project may be lowered through collaboration (Egan, 1998; Black et al., 2001; Scott, 2001., Haksever et al., 2001). In particular, Black et al. (2000) found that costs could be lowered on projects through collaboration, although only when trust could be maintained. Egan (1998) suggests that the fact that overruns and capital costs could be reduced could also result in around a 10% increase in turnover and profits for construction companies. Also, Egan (1998) suggests that collaborative partnerships may reduce accident rates by up to 20%, although other studies were unable to confirm this (Black et al., 2000, Scott, 2001, Haksever et al., 2001). The results therefore indicate that the majority of the problems in the construction industry outlined in the first part of this chapter may be addressed through collaboration. As a direct result of these recognized benefits, partnering has actually become commonplace as a pre-tender requirement, particularly for government funded projects in health, education, defense and energy (Beach et al., 2005).

It must be noted however that many of the benefits which may result from collaboration are highly dependent on how effective the partnership is. There are numerous factors which have been identified as critical to the success of these collaborative partnerships in industry. These include the commitment of management, mutual trust, evaluation, communication, conflict resolution and commitment (Black et al., 2000, Lenard et al., 1996, Thomas et al., 2002). Chan et al., (2004) suggest that there are five factors which must be present for a partnership in construction to succeed, establishment and communication of a conflict resolution strategy, willingness to share resources, clear definition of responsibilities, commitment, and regular monitoring of processes.

Simchi-Levi et al., (2000) specifically define supply chain management in the construction sector as the management of information, flow, and money in the development of a construction project. Vaidyanathan & Howell (2007) observe that the goal of supply chain management in construction projects is to reduce information lag and operational inefficiency. This is usually achieved by addressing various causative factors such as data duplication from the customer to the supplier. Supply chain management has been seen as a key element in reducing construction project costs (Atkin et al., 1995; Agapiou et al., 1998) within the construction supply chain process while adding value to the overall process. This is not surprising given that problems with supplies are associated with adverse outcomes such as delays, increased costs and lowered profitability (Kaliba et al., 2008). The realization that coupling this with partnership strategies may further increase benefits then gave birth to concept of supply chain collaboration.

Burtonastraw-Gunn and Brindley, (2004) explain that the aim of supplier collaboration is to eliminate or at least reduce adversarial relationships and replace them with a long term relationship based on trust and benefit not just in harmonious working but also in reducing traditional risks. This would eliminate many of the adverse outcomes associated with traditional market based relationships, where adversarial relationships may become a problem (Johnston & Lawrence, 1988).

To date there have been several studies conducted into supplier collaboration in the construction sector. The findings of these studies have varied widely in terms of the benefits identified through the practice. Akintoye et al. (2000) presented a questionnaire survey of supply chain collaboration and management issues being undertaken by the top Nigeria construction industry contractors. The results indicate the formation of a significant number of

partnerships/collaborative agreements between contractors, suppliers and clients following the publication of the (Latham 1994, and Egan 1997) reports.

Dubois and Garden (2000) carried out a research on the effects of supplier collaboration in the construction industry and stated that the benefits arising when firms adapt to one another in terms of technical solutions, logistics or administrative routines was unusual in construction industries. He concluded that these characteristics have a hampering effect on both efficiency and innovation within the construction industry. This work failed to examine the factors affecting contractors - supplies relationship in construction industry. The work did not also look into the relationship between contractors - suppliers and the impact of suppliers' collaboration on the cost of construction project. This existing gap in previous works as stated above is what this thesis is researching upon. This is the assessment of suppliers' collaboration on contractors - suppliers' relationship in construction industry. The impact of supplier's collaboration on the cost of construction project.

4. Research methodology

4.1. Research Design

The study adopted the descriptive research design that enables easy data collection, interpretation and analysis. Nwodu (2006: 10) states that "Design here bothers on what issue events or phenomenon is to be investigated" the study used sample survey which enabled me to collect data on the topic through questionnaire and interviews. That was advantageous to me because it permitted a wide coverage in an easier way.

It also enabled me to collect data from a literate audience which made most of the data generated by the researcher objective and valid.

4.2. Area of the Study

Ebonyi state is in South Eastern Nigeria. It is inhabited and populated primarily by the Igbo with the city of Abakaliki as its capital and largest city. It has on area of 5,533km^2 (2,136sq.m) and a population of 4,816,675 of the 2006 census. The postal code of the area is 480. Ebonyi State has good soil-land and climatic conditions all year round, sitting at below 125meters or a little above 245 meters above sea level, the vegetation is tropical savannah, and the major crops are rice, yam, potatoes, maize, beans and cassava. The solid minerals are: Lead, crude oil, salt and natural gas. The mean temperature in Ebonyi State in the hottest month of February is about 8.716 of (30.64^{0}C), while the lowest temperatures occur in the month November, reaching 60.54 of (15.86^{0}C) and the density is 870/km^2 (2,300/sq.).

4.3. Population of the Study

The study was carried out in Ebonyi State located in South-Eastern zone of Nigeria. The study target private firm and public sector workers in construction industry. Building project, civil engineering and heavy engineering in construction projects within Ebonyi State constitute the population of the study. It was divided into three (3) senatorial zones in Ebonyi State namely: Ebonyi south, Ebonyi central and Ebonyi North to have a total population of 400 as shown in table.

Table 1 Ebonyi State Senatorial zones

S/N	Senatorial zones	Population
1	Ebonyi South	130
2	Ebonyi central	240
3	Ebonyi North	130
TOTAL POPULATION		400

4.4. Sampling and sampling Technique

Then in this industry we have building project, civil engineering and heavy engineering construction which defer. The professional involved are selected based on their knowledge and disposition to the profession they have different academic qualification.

The term sampling is defined by Creswell (2009) as a process of selecting the sample for estimating the population characteristics and sampling technique. And sampling technique refers to the rules and procedures by which some elements of the population are included in the sample. The sampling technique adopted for this study is purposive sampling. Purposive sampling also known as judgmental sampling is a form of non–probability sampling in which researchers rely on their own judgmental when choosing members of the population to participate in.

In determining the sample size that is adequate for this study; the Taro (1963) model was used given in equation 3.1. The research sought to ensure at least 95% level of confidence with a total population (N) of 400 and probability error of using sample rather than surveying the whole population.

$$\text{Sample size (n)} = \frac{N}{I+N(e)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

Where

N is the population recorded to be 400,

e is the error margin =100% - 95% = 5% = 0.05 and I is a constant =1.

$$n = \frac{400}{1+400(0.05)^2} = 200$$

Therefore sample size (n) = 200

Table 2 Sampling of Ebonyi State Senatorial zones

S/N	Senatorial zones	sampling
1	Ebonyi South	66
2	Ebonyi Central	68
3	Ebonyi North	66
Sample Size(n)		200

4.5. Method of Data Collection

The two main sources of data collection for this study were primary and secondary sources of data. The primary source of data is the main on instrument of data collection through the use of well-structured questionnaire. The secondary source of data include: textbooks, journals or internet, government document.

4.6. Validation of Research Instrument

The instrument used is questionnaire and personal interview. It is valid because it is ideal for measuring what it is designed for, which is assess the factors affecting effective contractors-suppliers relationship on construction project delivery. Obasi (2008:20). Says "validity is the appropriateness of instrument in measuring what is intended to measure".

4.7. Techniques of Data Analysis

The statistical tools were used in the analysis of data collected and to know the factors which are most important that are responsible for preventing effective contractor-supplier relationships on successful construction in Ebonyi State.

The empirical discoveries from the questionnaires were analyzed using frequency distribution, relative importance Index (R11), chi-square (X^2) and Pearson Product Moment Correlation Coefficient (PPMCC) were the analytical tools used in the study. The factors are least discouraging, rarely discouraging, not discouraging. Discouraging and most discouraging that has the least influence on contractors-suppliers relationship on construction successful project in Ebonyi State.

The mathematical operation for the calculation was analyzed by the use of frequency distribution and Relative Importance Index (R11), Pearson Product Moment Correlation Coefficient (PPMCC) and Chi-square (x^2) are indicated below,

$$RII = \frac{\sum = 1^{ri}}{i\ j\ N\ X\ H}$$

Where

Ri = Rating given by the 1th respondents ranging from 1 – 5
H = Highest rating
N = Total number of respondents

4.8. Pearson Product moment correlation coefficient (PPM)

$$r_{xy} = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{n\Sigma x^2 - (\Sigma x)^2 (n\Sigma Y^2 - (\Sigma Y)^2}}$$

Chi–Square

$$\mathbf{X^2 = \sum_{ij} \frac{(O_i - E_i)^2}{E_i}}$$

The software used is SPSS (Statistical Package for Social Sciences) version 20.0 and Python (Spyder IDE) version 4.0

4.9. Data Presentation, Analysis

4.9.1. Data Presentation and Analysis

This chapter focuses on the presentation and analysis of data collected and it is worthy to note that the presentation and analysis of data were based on the relevant of questions in the questionnaire and research questions.

This chapter evaluates the responses from the respondents as it relates to the objects of the research. The data were collected using questionnaire and oral interview. Their opinion is elicited through the questionnaire structured in five point scale i.e (a) least discouraging (b) Rarely discouraging (c) Not discouraging (d) Discouraging and (e) Most discouraging.

4.9.2. Analysis of distributed questionnaires

This section specifically captured distribution of questionnaires, its retrieval, as well as the percentage of the questionnaires returned/retrieved from respondents. It also covers Social bonding, structural bonding, contractual relationship, personal relationship, joint venture and partnering. Further details can be seen in tables; 1, 2, 3 and 4. These tables were also followed by further explanations.

Table 3 Number of questionnaire distributed and returned

Description	Number	Percentage
Total No. of Questionnaire Distributed	250	50%
Total No. of Questionnaire returned	200	40%
Total No. of Questionnaire Not returned	50	10%

Source: Field survey, 2019

Table shows the total number of distributed, returned and not returned questionnaires. A total of 250 questionnaires were distributed, 200 returned and 50 not returned.

Table 4 Types of contractor-supplier relationships used on last project

s/n	Contractors-suppliers relationship system	Percentage
1	Social bonding	9.5
2	Structural bonding	3.5
3	Contractual relationship	29.5
4	Personal relationship	42.5
5	Joint venture	2.0
6	partnering	13.0

Source: fieldwork (2019)

From table joint venture and structural bonding produced the least percentage as 2% and 3.5% respectively, followed by social bonding, partnering. Contractual and personal gave the highest percentage in terms of contractors – supplier relationships as shown in table 4.

Table 5 Factors responsible for types of contractor-suppliers relationship used by contractors

s/n	Factors	Percentage
1	Simplicity of the project	29.5
2	Complexity of the project	39.0
3	Familiarity with the supplier	22.0
4	Time constraint	3.5
5	Easy way of achieving project completion	2.0
6	The best means of avoiding unproductive activities	2.0
7	Contractor's long/short-term approach	0
8	Construction methodology	2.0

Source: fieldwork (2019)

In table 5, shows the factors responsible for types of contractor-supplier relationship used by contractors. Factors such as Simplicity of the project produced(29.5%), Time constraint 3.5%, Easy way of achieving project completion (2.0%), The best means of avoiding unproductive activities(2.0%), Contractor's long/short-term approach(0%) and Construction methodology(2.0%).

Table 6 Approach contractors take on suppliers

s/n	Approach	Percentage
1	Long-term	35.5
2	Short-term approach	64.5

Source: fieldwork (2019)

In table 6, shows the long-term and short-term Approach contractors take on suppliers. The long-term approach produced 35.5% as the least compared to the short-term approach which gave 64.5% as the highest.

The essence is to avoid ambiguity in their responses and to easily enable the researcher aggregate their responses for statistical analysis. A total of 250 questionnaires were administered randomly to selected medium and large-sized construction firm in Ebonyi State. But 200 of those questionnaires were successful retrieved giving a response rate of 200% of the entire population and making a total of 200 returned questionnaires available for analysis.

Table 7 System of contractors-suppliers relationship

System of contractors-suppliers	Never used	Rarely used	Occasionally Used	Often Used	Most often used
Partnering	24.0	14.5	16.5	33.5	11.5
Personal/individual	3.5	11.0	7.5	15.0	63.0
Social bonding	39.0	13.0	31.5	11.0	5.5
Structural bonding	40.5	15.0	28.8	11.0	5.5
Contractual	11.0	3.5	18.0	37.5	30.0
Alliance	40.5	13.0	20.5	13.0	13.0
Joint venture	50.0	18.5	16.5	7.5	7.5

Source: fieldwork (2019)

Table 8 Types of contractors-suppliers relationship

S/N	Types of contractors-suppliers	NU 1	RU 2	OU 3	OU 4	MU 5
1	Partnering	48	29	33	67	23
2	Personal/individual	7	22	15	30	126
3	Social bonding	78	26	63	22	11
4	Structural bonding	81	30	56	22	11
5	Contractual	22	7	37	74	60
6	Alliance	81	26	41	26	26
7	Joint venture	100	37	33	15	15

Source: fieldwork (2019)

Table 9 Factors preventing effective contractors-suppliers relationship

S/N	Factors preventing effective contractors-suppliers	LD 1	RD 2	ND 3	D 4	MD 5
1	Contractors decentralization	37	22	59	30	52
2	Inconsistency in the projects way of work	22	18	67	56	37
3	Nature and size of project	74	26	63	22	11
4	Contractors short-term approach	26	41	59	37	37
5	Organization's lack of maturity for long-term relations	18	26	41	48	67
6	Market forces of demand and supply	14	30	63	41	52
7	Lack of trust for suppliers	11	22	37	44	86
8	Contractors and suppliers work on different geographical market	34	26	77	37	26

Source: Field survey, 2019

Table 10 Factors that can improve suppliers, collaboration on the cost of construction project

S/N	Factors that can improve suppliers, collaboration on the cost of construction project	LL 1	RL 2	NL 3	L 4	ML 5
1	Long-term relationship of contractors to suppliers	11	15	22	34	118
2	Emphasis on the benefits of maintaining a permanent set of suppliers	15	18	37	44	86
3	Employment of skilled professionals who can handle inconsistencies	18	15	57	30	78
4	Specialization in the construction industry	18	34	37	41	70
5	Partnering with suppliers organizations on the projects	18	11	37	56	78
6	Contractors should be mandated to provide list of suppliers before final award of the contractor	18	22	34	63	63

Source: fieldwork (2019)

The data were presented in a tabular form and analyzed using frequency distribution, relative importance index (R11), Chi-square (X^2) and Pearson Product Moment Correlation Coefficient (PPMCC) with the formula below:

$$\text{RII} = \frac{\sum = 1^{\text{ri}}}{\text{i j N X H}}$$

Where

Ri = Rating given by the 1th respondents ranging from 1 – 5
H = Highest rating
N = Total number of respondents

4.9.3. Pearson Product moment correlation coefficient (PPM)

$$\text{rxy} = \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{n\Sigma x^2} - (\Sigma x)^2 (n\Sigma Y^2 - (\Sigma Y)^2}$$

Chi–Square

$$\mathbf{X^2} = \Sigma \frac{(O_i - E_i)^2}{E_i \text{ ij}}$$

The software used is SPSS (Statistical Package for Social Sciences) and Python (Spider IDE)

5. Results

Table shows that 33.5% of the respondents often make use of partnering as a system of relating with the suppliers, 24.0% of the respondents had never used partnering, 16.5% of the respondents occasionally use partnering, 14.5% rarely use partnering, while 11.0% most often use partnering. The table reveals also that 63.0% of the respondents most often use personal relationship with the suppliers, 14.5% and 11.0% often and rarely use personal relationship respectively, 3.5% had never use personal relationship with the suppliers, while 7.5% occasionally use personal relationship with their suppliers. For social bonding, 39.0% and 31.5% of the respondents had never used and occasionally use social bonding with their suppliers respectively, while 11.0% 11.0% and 5.5% rarely use, often use and most often use social bonding with their suppliers respectively. 40.5% had never used structural bonding, 15.0% and 28.8% rarely use and occasionally use structural bonding respectively, while 11.0% and 5.5% often used and most often use the structural bonding system with their suppliers. The table also shows that 11.0% of the respondents had never use contractual relationship with their suppliers, 3.5% rarely use system and 18.0% occasionally use the system and 30.0% most often use contractual system. Also 40.5% had never used alliance relationship with their supplier, 13.0% rarely use it, it and 13.0% most often use alliance relationship with their suppliers. As occasionally use it 13.0% often use it and 13.0% most often use alliance relationship with their supplier. As for joining venture system 50.0% had never used it, 18.5% rarely use it, 16.5%, 7.5% and 7.5% occasionally, often and most often use it respectively.

Table 11 Structure of the relationship between contractors and suppliers

s/n	System of contractors -suppliers relationship		Categories and frequencies						
			Never used %	Rarely used %	Occasionally used %	Often used %	Most often used %	X^2	P vale
1	Partnering	F_1	24.0	14.5	16.5	33.5	11.5	31.3	0.00
2	Personal/individual	F_2	3.5	11.0	7.5	15.0	63.0	238.4	0.00
3	Social bonding	F_3	39.0	13.0	31.5	11.0	5.5	83.350	0.00
4	Structural bonding	F_4	40.5	15.0	28.8	11.0	5.5	80.050	0.00
5	Contractual	F_5	11.0	3.5	18.0	37.5	30.0	76.350	0.00
6	Alliances	F_6	40.5	13.0	20.5	13.0	13.0	56.750	0.00
7	Joint venture	F_6	50.0	18.5	16.5	7.5	7.5	122.7	0.00

Source: fieldwork (2019)

Table 12 Factors preventing effective contractors–suppliers relationships

s/n	Factors preventing effective contractors suppliers relationships	Categories and frequencies				
		Least discouraging %	Rarely discouraging %	Not discouraging %	Discouraging %	Most discouraging %
1	Contractors' decentralized organization	18.5	11.0	29.5	15.0	26.0
2	Inconsistency in the projects' way of working	11.0	9.0	33.5	28.0	18.5
3	Nature and size of project	39.0	13.0	31.5	11.0	5.5
4	Contractors' short-term approach	13.0	20.5	29.5	18.5	18.5
5	Organizations' lack of maturity for long term relations	9.0	13.0	20.5	24.0	33.5
6	Market forces of demand and supply	7.0	15.0	31.5	20.5	26.0
7	Lack of trust for suppliers	5.5	11.0	18.5	22.0	43.0
8	Contractors and suppliers work on different geographical market	17.0	13.0	38.5	18.5	13.0

Source: fieldwork (2019)

As shown by table, lack of trust between the contractors and suppliers is the most discouraging factors preventing effective contractors-suppliers relationship as if ranked most with 43.0% other factors preventing effective contractors – supplier relationships as shown by table 5 include: the decentralization of the contractors' organization with 29.5% and not discouraging according to the respondents, also not discouraging to the respondents is the inconsistency in the projects way of working (33.5%), contractors' short-term approach (29.5%), market forces of supply and demand (31.5%) and contractors and suppliers work on different geographical market (38.5%), while another most discouraging factor is the organization's' lack of maturity for long term relationship (33.5%) and the least discouraging factor is the nature and size of projects (38.5%). Table 5a (see appendixes) shows that lack of trust between contractors and suppliers ranked first and has the highest influence on contractors suppliers relationships, while and has the least influence on contractors suppliers relationship. The R11 of the factors is 3.22 as shown in table 5.

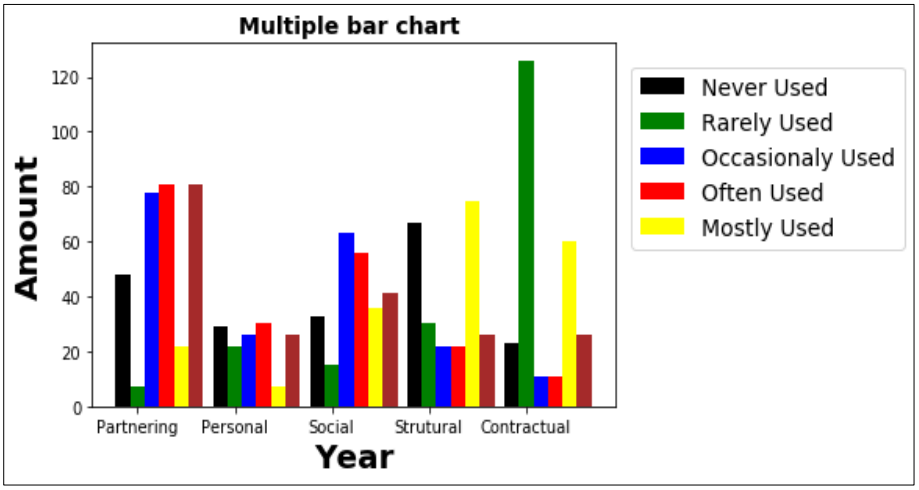


Figure 7 Multiple bar chart

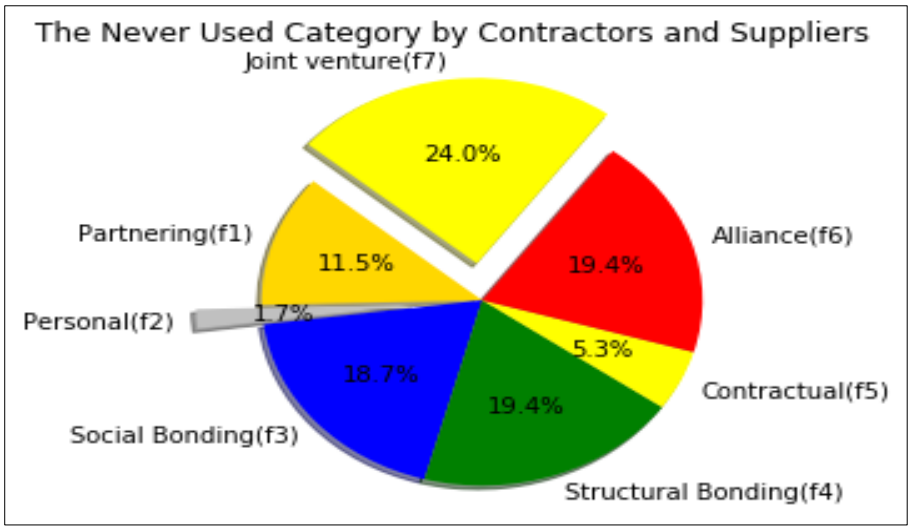


Figure 8 Never used category by Contractors and suppliers

From Figure 8, depicts the pie plot for never used category by contractors and suppliers. 24.0% as majority of the respondents subscribed to the joint venture by contractors and suppliers in the never used category, alliance and structural bonding gave 19.4%, social bonding produced 18.7%, partnering 11.5% and contractual gave 5.3% as the least as shown in figure.

Figure 9, is the pie plot for rarely used category by contractors and suppliers and 20.9% of the respondents supported the joint venture by contractors and suppliers in the rarely used category, alliance and social bonding 14.7%, structural bonding produced 16.9%, partnering 16.4%, and contractual gave 4.0% as the lowest among the rarely used category.

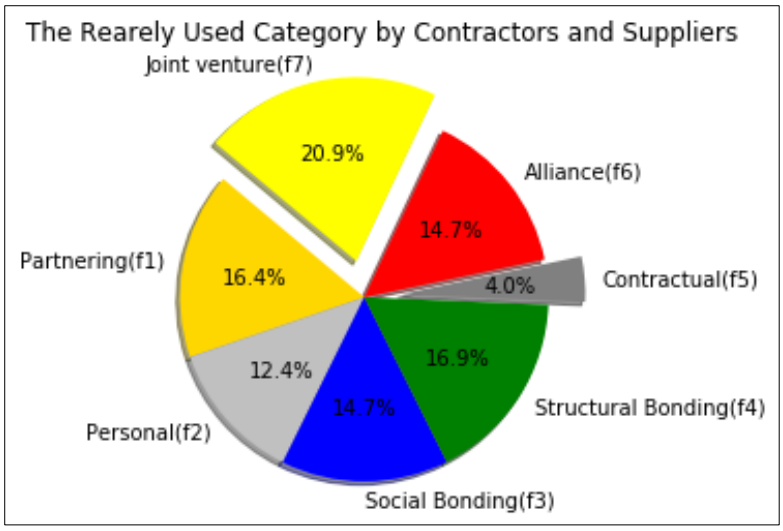


Figure 9 Rarely used category by Contractors and suppliers

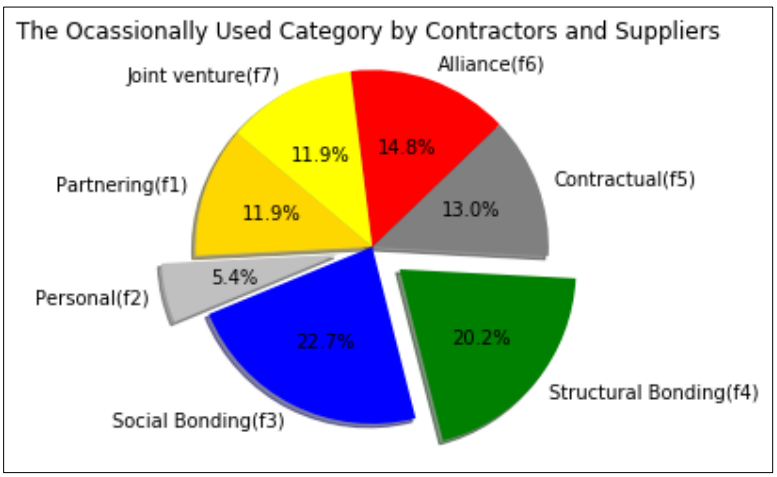


Figure 10 Occasionally used category by Contractors and suppliers

The 20.2% of the respondents gave their consent to structural bonding, social bonding 22.7%, partnering and joint venture 11.9% respectively, alliance 14.8%, contractual 13.0% and personal 5.4% recorded as the least among the occasionally used category by contractors and suppliers.

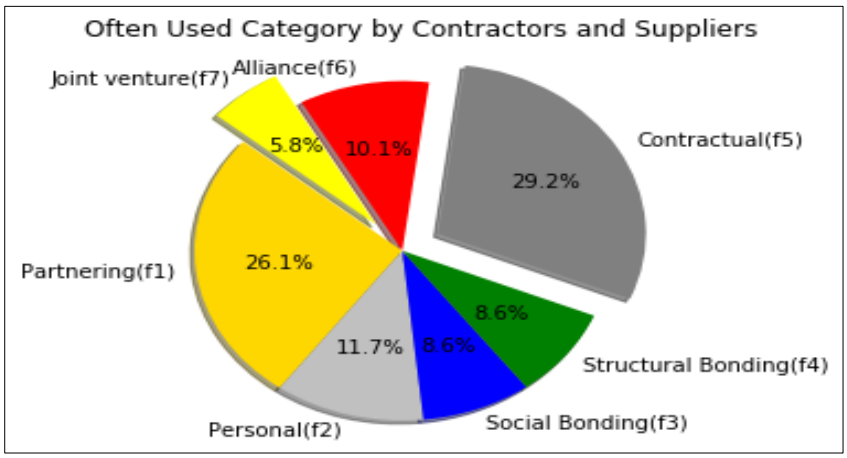


Figure 11 Often used category by Contractors and suppliers

Figure 11, is the pie plot for often used category by contractors and suppliers and 29.2% of the respondents supported the contractual by contractors and suppliers in the often used category, 10.1% agreed with alliance, 8.6% for both structural bonding and social bonding, 11.7 for personal, 26.1% for partnering and 5.8% support joint venture as the lowest among the often used category.

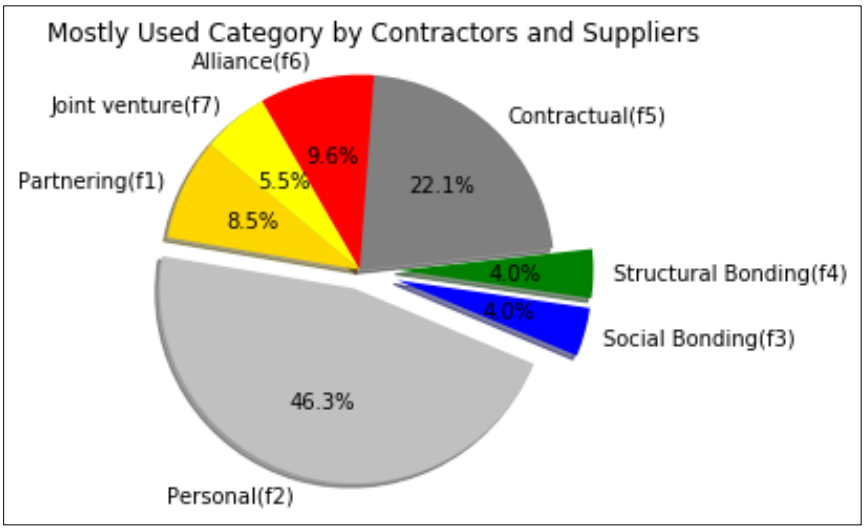


Figure 12 Mostly used category by Contractors and suppliers

The 46.3% of the Respondents in the mostly used category by contractors and suppliers supported personal, while 8.5% supported partnering, 5.5% for joint venture, 9.6% agreed with alliance, 22.1% supported contractual, structural and social bonding 4.0% respectively as the least.

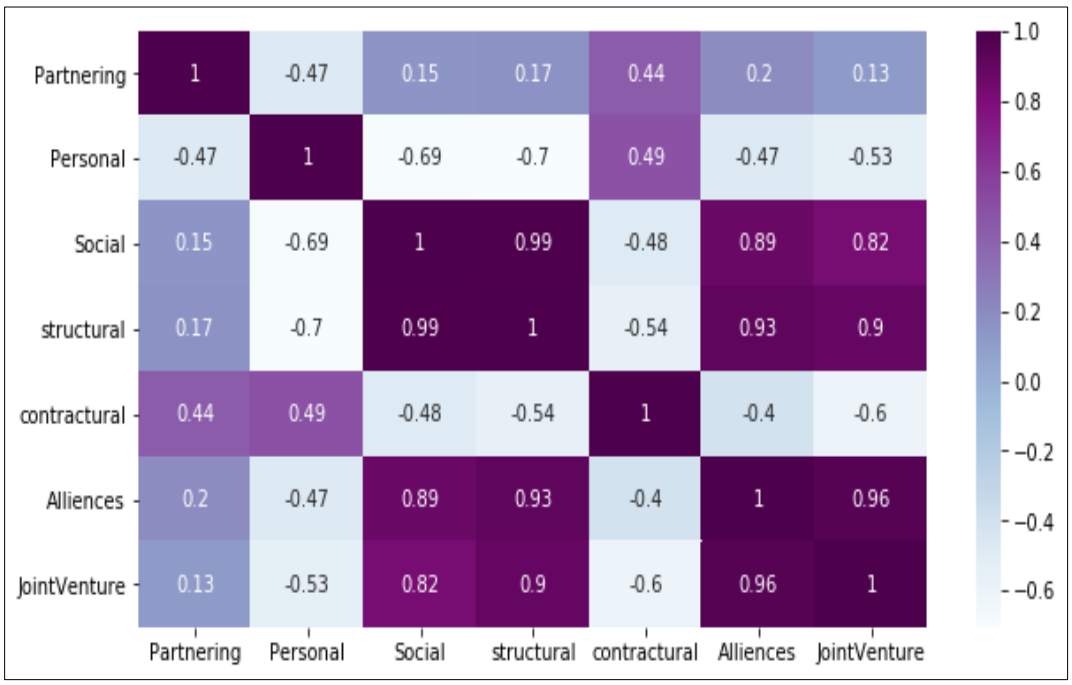


Figure 13 The correlation matrix of used category by Contractors and suppliers

Figure is the correlation matrix used to measure the relationship between contractors and supplier variables. The matrix depicts there is a linear correlation between all possible pairs about contractors and suppliers for partnering, personal, social bonding, structural bonding, Alliances and joint venture. There exist a relationship between contractors and suppliers as shown with other pairs in the correlation matrix that connects to objective number 3 and addresses the research question number 3.

Table 13 Improving suppliers' collaboration on the cost of construction project

s/n	System of improving suppliers collaboration on the cost of construction project	Categories and frequencies				
		Least likely to improve %	Rarely likely to improve %	Not likely to improve %	Likely %	Most likely %
1	Long-term relationship of contractors to suppliers	5.5	7.5	11.0	18.0	58.0
2	Emphasis on the benefits of maintaining a permanent set of suppliers	7.5	9.0	18.5	22.0	43.0
3	Employment of skilled professionals who can effectively handle inconsistencies in construction operations	9.0	7.5	29.5	15.0	39.0
4	Encouraging specialization in the construction industry	9.0	17.0	18.5	20.5	35.0
5	Partnering with suppliers organization on construction projects	9.0	5.5	18.5	28.0	39.0
6	Mandating contractors to provide list of suppliers before final award of the contract	9.0	11.0	17.0	31.5	31.5

Source: fieldwork (2019)

Table shows the factors that can improve supplier's collaboration on the cost of construction project according to the respondents. Factors such as long-term relationship between contractors and suppliers (58.0%), emphasis on the benefits of maintaining a permanent set of suppliers (43.0%) employment of skilled professionals who can effectively handle inconsistencies in construction operation (39.0%), specialization in the construction (39.0%), specialization in the construction industry (35.0%), partnering with suppliers organizations on construction projects (39.0%) ad provision of suppliers list by contractors before the final award of contracts (31.5%) were indicated as most likely to improve contractors- suppliers relationships. The index of relative importance of these factors as shown in table 6a is 3.78 with long-term relationship ranking first and specialization in the construction industry ranking sixth among factors that can improve suppliers' collaboration on the cost of construction project.

Table 14 Correlation analysis result

Long-Term Relationship	C1	C2	C3	C4	C5	C6
A1	0.830	0.874	0.795	0.846	0.838	0.859
P – Value	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	200	200	200	200	200	200

Where

A_1= Contractor – supplier
C_1= Long-term relationship contractor
C_2= Emphasis on the benefits of maintaining of a permanent set of suppliers
C_3= Employment of skilled professionals who can handle inconsistencies
C_4= Specialization in the construction industry
C_5= Partnering with suppliers organizations on the project
C_6= Contractors should be mandated to provide list of suppliers before final award of the contract

Table represents the correlation analysis result of the impact of suppliers' collaboration on the cost of construction project in Ebonyi State the result shows that correlation coefficient values are all positive which shows a positive impact

of supplier collaboration on the cost of construction project. This implies that as the contractor – supplier approach (short term or/and long term) increases, the supplier collaboration on the cost of construction project in the state is expected to increase.

6. Discussion

Findings from table; shows that majority of the construction supply chain management systems were occasionally used except the personal and contractual relationships that were often used. Personal relationship ranked first which means it is the most often used system, while joint venture relationship ranked seventh, meaning that it was most often not used as a supply chain management system.

Table shows the type of contractor supplier relationship systems that the respondents used on their last project. The table reveals that 9.5% of the respondents used social bonding, 3.5% used structural bonding, 29.5% used contractual relationship, 42.5% used personal relationship and 2.0% used joint venture relationship, while 13.0% used partnering systems on their last projects respectively. Majority of the respondents used personal relationship with their suppliers on their last projects as shown in table 4.4. The factors affecting the choice of contractor-supplier relationship systems were shown in table 3. The table shows that complexity of a project is the most important factor that determines the choice of supply chain management systems as 29.5% thought it was the simplicity of a project 22.0% chose the familiarity of the contractor with the supplier, and 3.5% picked time constraint, 2.0% indicated easy way of achieving project completion, 2.0% also went for the best means of avoiding unproductive a activities, 0.0% took contractor's long or short term approach, 2.0% selected construction methodology, while 39.0% indicated the complexity of the project. It is imperative to survey the approach that contractors take in their relationships with the suppliers. Table 4 revealed that most of the contractors take a short-term approach (64.5%) in their relationships with the suppliers as compared with long-term approach.

7. Conclusion

The study it may be concluded that the most construction companies in Ebonyi state appear to engage in supplier collaboration at the present time. The non-professional are involved in the construction industry become very of the contacts or supply are awarded on the basis of political affiliation or patronage and relationship with the client in question.

The main drivers of the success of supplier collaboration appear to be the elements of trust and dependence. It is these which ensure the continued relationship, and ensure that both parties derive the benefits necessary for the partnership to continue.

Impact of supplier collaboration in construction projects is positive with most construction companies adopting it today. This implies that the effective application of supplier collaboration has allowed for the effective and proactive management of value adding processes thus having a positive impact on construction project's delivery to time, cost and agreed quality.

Suppliers' collaboration in improving profits, reduced cost, improved predictability of service, reduced the frequency of disputes in construction industry in Ebonyi state and addressing problems such as efficiency and production problems, there are still some problems in the construction industry which it does not appear to impact on. For example one of the major ongoing problems is that of safety, and suppliers' collaboration does not appear to do anything to improve this issue.

Recommendations

Based on the findings of the study, the following recommendation was made:

- Contractors should establish long-term relationships with manufactures and suppliers to develop methods of delivery to avoid inventory and delays. A details schedule of materials supply should be provided by the contractor. The schedule should contain the time required for material to arrive on site. Thus, results in reducing unproductive time on site and cost saving.
- Participating in collaborative relationships with suppliers may help a company to address issues such as efficiency and production problems – it should therefore be considered as an option for companies having problems in these areas

- Small companies would be particularly likely to experience benefits from improved communication, while larger companies would be more likely to increase profits – these differences should be born in mind when deciding on adoption
- It would be advisable to collaborate with more than one supplier as this appears to increase the benefits attained.

Contribution to knowledge

- Able to assess the factors affecting contractors - supplies relationship in construction industry.
- Ascertaining the relationship between contractors-suppliers and the impact of suppliers' collaboration on the cost of construction project.
- It contributes significantly to both literature and adding new knowledge to practice of establishing long and short term relationships with manufactures.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors have declared that no conflict of interest exists.

References

[1] Adinna, E. N. (2009). Environmental management problems sequel to the neglect of the National Building Code, paper presented at the 3-day National Conference/Training Workshop on Building, Construction and Built Environment and the Millennium Development Goods, the journey so far held at ESUT Auditorium, Enugu.

[2] Agapiou, A., Flanagan, R. and Norman, G., (1998). The change role of builder merchants in the construction supply chain. Construction Management and Economics, 16, 351-361.

[3] Ajator, U. O. (1999). Inter Relationship of Builders and other construction stakeholders: A 21st century perspective, text of invited paper presented at "UZU" 1999, NIOB Benial conference, Held on the 20th – 25th July at Ikenga Hotel Ltd Awka.

[4] Ajator, U. O. and Onyeador, S. O. (2007). Partnering: A veritable tool for success of the National Building Code. Paper presented at the 3-day National Conference/Training Workshop on Building, Nigerian Built Environment, held at Unijos Law Auditorium on the 27th – 29th September 2007.

[5] Ajator, U. O. and Onyeador, S. O. (2007). Sustainable Building Development, Construction and Built-Environemnt in Nigeria and the National Building Code, paper presented of Training Workshop on the Anatomy and Implementation of the National Building Code, held at the ESUT permanent site Auditorium on the 27 – 29th June, 2007.

[6] Akintoye, A., McIntosh, G. and Fitzgerald, E. (2000). A survey of supply chain collaboration and management in the UK construction industry. European Journal of Purchasing and Supply Management, 6, 159-168.

[7] Aksorn, T. and Hadikusumo, B.H.W. (2008). Critical success factors influencing safety program performance in Thai construction projects. Safety Science, 46(4), 709-727.

[8] American Consulting Engr. Council ACEL and American Inst. Of Arc. AIA (1993). Project Partnering Guide for Design Profession, USA.

[9] Atkin, B., Flanagan, R., March, A. and Agapiou, A. (1995). Improving Value for Money in Construction: Guidance for Chartered Surveyors and their Clients. London: Royal Institute of Chartered Surveyors.

[10] Baccarini, D. (1996). The concept of project complexity a review. International Journal of Project Management, 14(4), 201 – 204.

[11] Balcer, S. T. (1990). Partnering: A contracting for the future, Cost Engineering, 32(4), 7 – 12.

[12] Ballard, G. & Howelth, G. (1998). What kind of production is construction? In the International Group for Lean Construction, Guaruja, Brazil.

[13] Barlow, J. and Jashapara, A. (1998). Organizational learning and inter firm partnering in the UK construction industry. Learning Organization Journal, 5(2), 86-98.

[14] Barlow, J., Cohen, M., Jashaparar, A. and Simpson, Y. (1997). Towards positive partnering: Revealing the realities in the construction industry. Bristol: Policy Press.

[15] Beach, R., Webster, M. and Campbell, K.M. (2005). An evaluation of partnership development in the construction industry. International Journal of Project Management, 23(8), 611-621.

[16] Beamon, B.M (1999). Measuring supply chain performance. International Journal of Operations and Production Management, 19(3), 275-292.

[17] Bertelsen, S. & Koskela, L. (2002). Managing the three aspects of production in construction. In 10th International Group for Lean construction, Gramdon Brazil.

[18] Black, C., Akintoye, A. and Fitzgerald E. (2000). An analysis of the success factors and benefits of partnering in construction. International Journal of Project Management, 18(6), 424-434.

[19] Bresuen, M., Goussavskaia, A. & Swan, J. (2004). Embedding new management knowledge in project-based organizations organization studies, 25(9). 1535 – 1555.

[20] Burnes, B. and New, S. (1996). Strategic Advantage and Supply Chain Collaboration. London: UMIST.

[21] Burtonstraw-Gunn, S.A. and Brindley, C. (2005). Examining Risk and Supply Chain Collaborative Working in the UK Construction Industry. Ashgale Publishing Ltd., 99-109.

[22] Cameron, I., Hare, B. and Davies, R. (2008). Fatal and major construction accidents: A comparison between Scotland and the rest of Great Britain. Safety Science, 46(4), 692-708.

[23] Chan, A.P.C., Chan, D.W.M., Chiang, Y.H., Tang, B.S., Chan, E.H.W. and Ho, K.S.K. (2004). Exploring critical success factors for partnering in construction projects. Journal of Construction Engineering and Management, 130(2), 188-198.

[24] Choudhry, R.M. and Fang, D. (2008). Why operatives engage in unsafe work behavior: Investigating factors on construction sites. Safety Science, 46(4), 566-584.

[25] Christopher, M. (1992). Logistics and Supply Chain Management. London: Prentice Hall.

[26] Cook, E. L. and Hancher, D. E. (1990). Partnering: Contracting for the future, Journal of Management in Engineering, 6(4), 431 – 446.

[27] Crowley (1998). Construction as a manufacturing process: Lessons from the automotive industry. Computers and Structures, 67(5), 389-400.

[28] Dainty, A., Moore, D. and Murrey, M. (2006). Communication in Construction, first edition. London: Taylor & Francis.

[29] Dubois, A. and Gadde, L.-E. (2000). Supply strategy and network effects: Purchasing behavior in the construction industry. European Journal of Purchasing & Supply Management, 6(3-4), 207-215.

[30] Egan Report (1997). Rethinking Construction. London: HMSO.

[31] Egan, J. (1998). Rethinking Construction Department of Environment, Transport and the Region.

[32] Egan, J. (1998). Rethinking Construction: The Report of the Construction Task Force. London: Department of the Environment, Transport and the Regions.

[33] Fernandes – Solis, L. (2007). The systemic nature of the construction industry. CIB World Building Congress, 1598 – 1625.

[34] Flyvbjerg, B., Holm, M.S. and Buhl, S. (2002). Underestimating costs in public works projects – Error or lie. Journal of the American Planning Association, 68(3), 279-292.

[35] Green, S.D., Fernie, S. and Weller, S. (2005). Making sense of supply chain management: A comparative study of aerospace and construction. Construction Management and Economics, 23(6), 579-593.

[36] Growley, L. G. and Karim M. A. (1995). Conceptual model of partnering, Journal of management in engineering, 11(5), 33 – 39.

[37] Gutierrez et al. (2020). Taking supplier collaboration to the next level, retrieved from McKinsey_Website_Accessibility@mckinsey.com

[38] Haksever, A.M., Demir, I.H. and Giran, O. (2001). Assessing the benefits of long-term relationships between contractors and subcontractors in the UK. International Journal of Construction Markets, 3(1).

[39] Handfield, R.B. and Nicholas, E.L. (1999). Introduction to Supply Chain Management. New Jersey: Prentice Hall.

[40] Hinze, J. (2008). Construction safety. Safety Science, 46(4), 565.

[41] Holweg, M., Disney, S., Holmstrom, J. and Smaros, J. (2005). Supply chain collaboration: Making sense of the strategy continuum. European Management Journal, 23(2), 170-181.

[42] Humhrey, P., Matthews, J. and Kumaraswamy, M. (2003). Pre-construction project partnering: From adversarial to collaborative relationships. Supply Chain Management: An International Journal, 8(2), 166-178.

[43] Inuwa, I.I; Usman, N.D. and Dantory, J.S.D. (2015). The Effects of Unethical Professional Practice in Construction Projects Performance In Nigeria". African Journal of Applied Research (AJAR) 1 (1).

[44] Isa, R.B; Jimoh, R.A and Achuenu, E. (2013). A view of the construction sector to sustainable development in Nigeria". Net Journals of Business Management.1 (1): 1-6.

[45] Johnston, R. and Lawrence, P. (1988). Beyond vertical integration: The rise of value-adding partnership. Harvard Business Review, 66(4), 94-101.

[46] Kaliba, C., Muya, M. and Mumba, K. (2008). Cost escalation and schedule delays in road construction projects in Zambia. International Journal of Project Management, doi: 10.1016/j.ijproman.2008.07.003.

[47] Kartam (1995). Reengineering Construction Planning Systems. Berkeley, CA: Department of Civil Engineering, University of California.

[48] Kashiwagi, D., Sullivan, K.T., Greenwood, D., Kovell, J. and Egbu, C. (2005). Source of construction industry instability and performance problems. Proceedings of the Congress, April 5 – 7, 2005, San Diego, California.

[49] Koskela (1997). Lean production in construction. In Alarcon, L. (Ed.) Lean Construction. Rotterdam: Balkema, 497.

[50] Koskela, L. (1992). Application of the new production philosophy to construction (No. 72). Stanford, CA: Stanford University.

[51] Koskela, L. (2000). An exploration towards a production theory and its application to construction. VTT technical research Centre of finland:ESPOO, Finland. (VTT Publications 408).

[52] Lenard, D.J., Bowen-James, A., Thompson, M. and Anderson, L. (1996). Partnering: Models for Success. Adelaide: Construction Industry Institute.

[53] Lindkvist, L. (2004). Governing project based firms: Promoting market-like processes within hierarchies. Journal of management and governance, 8(1), 3 – 25.

[54] Love, E. D (2000) Editorial. European Journal of Purchasing and Supply Management, 6(3-4), 145-147.

[55] Love, P.E.D., Z. Irani and D.J. Edwards, (2004). A seamless supply chain management model for construction. Supply Chain Manage. Int.J.,9:43-56.

[56] Moneke, U. U. & Echeme, I. I.(2016): Assessment of Supply Chain Management in Nigeria Construction Industry for Effective Project Delivery in Imo State, Nigeria uu -249- International Journal For Quality Research, Uk – 378. 014.3 (479.11) Short Scientific Paper (1.03), 193 – 206.

[57] Naoum, S. (2003). An overview into the concept of partnering. International Journal of Project Management, 21(1), 71-76.

[58] Nwodu, L. (2006). Public enterprises management and privatization 6th edition; New Delhi: Chan & Co. Ltd.

[59] Ojo, E.; Mbohwa, C. and Akinlabi, E. (2014). Green Supply Chain Management in Constriction Industries In South Africa and Nigeria||. International Journal of Chemical, Environmental & Biological Sciences (IJCEBS) 2(2), 46 – 150.

[60] Olaniyan, A.,Bosede, A. and Olusola, O. (2015). Supply Chain Management Practices in Construction Procurement: Perceptions of Professional Quantity Surveyors in Ondo State, Nigeria||. PM World Journal 4(4), 1 – 12.

[61] Olsson, F. (2000). Supply chain management in the construction industry-opportunity or Utopia? (Licentiate in Engineering, Department of Design sciences, Logistics).

[62] Onyeiwu, E. C. (1998). Budgeting for International Development Project: Opportunities for Professionals, the Quantity Surveyor, 25(12), 35 – 49.

[63] Polat, G. and Ballard, G. (2003). Construction supply chains: Turkish supply chain configurations for cut and bent rebar. Proceedings of the 11th Annual Conference on Lean Construction, Blacksburg, VA, July 22-24, 319-331.

[64] Polat, G. and Ballard, G. (2005). Why is on-site fabrication of cut & bent rebar preferred in Turkey. Proceedings IGLC – 13 July 2005, Sydney Australia, 449-456.

[65] Punch, K.F., (2013). Introduction to Social Research: Quantitative and Qualitative Approaches. 3rd Edn., Sage Publishing, Los Angeles, California.

[66] Rahman, M. and Kumaraswamy, M. (2002). Joint risk management through transactionally efficient relational contracting. Journal of Construction Managers Economics, 20, 45-54.

[67] Ruane, J.M., (2005). Essentials of Research Methods: A Guide to Social Science Research. Blackwell Publishing, New York.

[68] Sahay, B.S. (2003). Supply chain collaboration: The key to value creation. Supply Chain Management Journal, 52(2), 76-83.

[69] Saka, N. and Mudi, A. (2007). Practices and Challenges of Supply Chain Management by Building Construction Firms in the Lagos Metropolitan Area, Association of Researchers in Construction Management.

[70] Scott, B. (2001). Partnering in Europe: Incentive Based Alliancing for Projects. London: Thomas Telford.

[71] Simchi-Levi, D., Kaminski, P and Simchi-Levi, E. (2000). Designing and Managing the Supply Chain. New York: McGraw-Hill.

[72] Stanek, M.B. (2004). Measuring alliance value and risk: A model approach to prioritizing alliance projects. Management Decisions, 42, 182-204.

[73] Thomas, S., Rose, T.M., Mak, M. and Chen, S. (2002). Problematic issues associated with the project partnering: The contractor perspective. International Journal of Project Management, 20(6), 437-449.

[74] Towill, D. and Christopher, M. (2002). The supply chain continuum: To be lean or agile or to be lean and agile? The International Journal of Logistics: Research and Application, 5(3).

[75] Vaidyanathan, K. and Howell, G. (2007). Construction supply chain maturity model: Conceptual framework. Proceedings IGLC-15, July 2007, Michigan, USA.

[76] Vrighoef, R., & Koskela, L. (2000). The four roles of supply chain management in construction. European journal of purchasing & supply management, 6(3), 169 – 178.

[77] Vrijhoef, R and Koskela, L. (1999). Roles of Supply Chain Management in Construction‖. University of California, Berkeley, CA, USA