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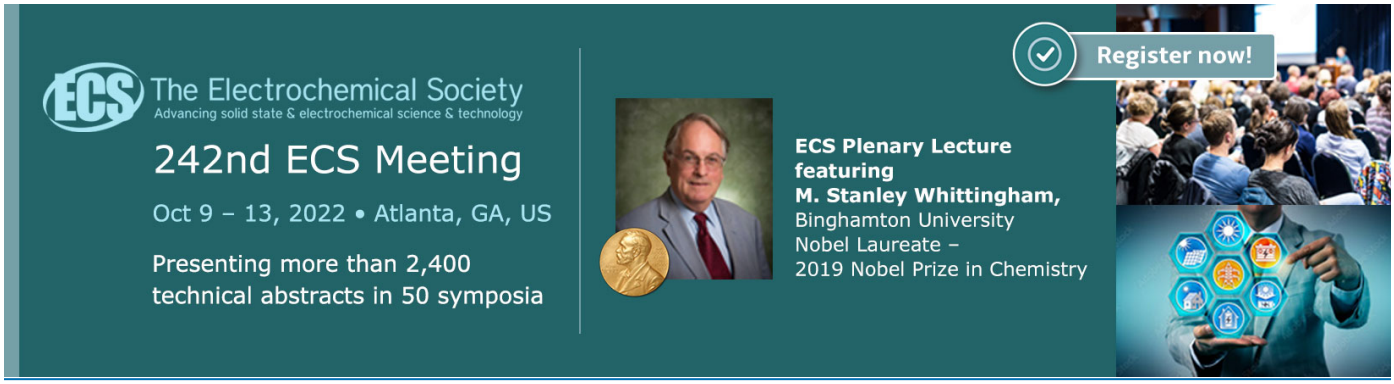

A Short Review of the Concept and Principles of Supply Chain Management in Building Construction Industry

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Abstract. Supply chain management concept has found its way into the construction sector of the economy as a result of the inherent opportunity to improve performance. The concept has continued to attract increasing support among major stakeholders in the execution of construction projects. However, it was observed that the strategy is still at low level of adoption among professionals in the industry. Moreover, the low level of knowledge of the strategy and the inability to effectively put the principles of supply chain management to practice hinders the application. This study therefore advances the knowledge of supply chain management by undertaking an examination of few key areas on the concept with a view to improving the awareness and understanding among professionals and assist in designing a supply chain management strategy suitable for building development process. Relevant studies were identified for review by literature search using key words and concepts related to the topic of the current study. Thematic areas of discussion include the construction industry outlook, building development process, the principles and essentials of construction supply chain management. The understanding of basic principles and essentials of supply chain management is important to adopting, adapting, designing and deployment of the strategy in the construction industry and this constituted the purpose and focus of the study.

Keywords: Supply Chain, Building, Principles, Construction, Industry, Management.

1. Introduction

The construction sector of a nation's economy is the production platform for physical transformation. Early in the history of human existence, the quest for basic needs such as food, shelter, clothing and security compelled man to improve or modify the immediate environment. Thus, the development of the environment is as old as human history. The forces of population growth, civilization, urbanization, industrialization and globalization over the years have heightened demand and increased the scarcity of resources and other factors of production. These have not only caused technological turnaround but also led to agricultural and industrial revolution. Despite the turnaround recorded in manufacturing, information and communication technology in the last century, as well as the impact of the 3rd industrial revolution, there still remains a huge infrastructure deficit especially in most developing countries. The

construction industry is one sector that has not been able to operate optimally principally for lack of funds and inability to manage resources and construction process efficiently. Fulford and Standing (2014) stated that construction industry is among the earliest industries around the globe that is characterized by low productivity. The array of stakeholders to construction project, huge capital requirement, intrigues of decision-making at every stage of development, long period of project execution as well as the enormous risks and uncertainties involved, have complicated the production process of construction and greatly reduced the efficient use of resources in the industry.

Consequently, investors have sought a more efficient approach towards optimizing the process, resources and benefits in recent times. Amongst these are knowledge management, construction procurement and supply chain management. Supply chain management is one of the modern concepts that are been adopted and adapted in the building industry. The strategy has been engaged primarily to reduce time and cost overruns and increase the results in the sector. Supply chain management according to Vrijhoef and Koskela (2000) originated in the manufacturing industry and used to regulate the supply of production inputs and increase productivity. The concept describes a system of product delivery beginning with the producer through the various intermediaries to the user. Furthermore, it is a web of institutions and stakeholders involved in the processes and activities of a production line with a view to creating products that meet the needs of the consumer (Tiwari, Shepherd and Pandey, 2014). Being a strategy to enhance the poor productivity that characterizes construction industry, SCM is very important to all and as such, gained the attention of stakeholders in the industry. Supply chain management is a multi-disciplinary concept explained from diverse perspectives due to its application in different economic sectors. Project development process on its own is riddled with lots of tasks and activities that necessitate contribution of important actors. The tendering, commitment and construction are often delicate activities where material procurement and other logistics deserve good management attention. In view of the foregoing, this study conducted a methodical review of extant writings on certain vital aspects of supply chain management and construction that further enrich the knowledge about the relationship and application. Subsequent sections discuss the construction industry outlook, supply chain management, principles of SCM, essentials of construction SCM and conclusion.

2. Research Methods

The qualitative research approach was adopted for this study. Literature search was conducted using key words and concepts in the topic of the study. Among the various studies and articles that resulted from the online search, twenty-eight relevant papers were identified and selected for review from the multitude of articles. The articles were further grouped and discussed under the subtitles of construction industry outlook, building development process, supply chain management and principles of construction supply chain management. Thus, a total of twenty-eight articles were identified through literature search on the topic and were therefore used to establish the rationale for the study and bridge the gap in literature.

3. Construction Industry Outlook

Construction embodies all activities that change the physical environment to serve certain purposes. It entails the development of all kinds of structure for diverse purposes. For example, the road and rail infrastructure that connects almost every region of developing nations. This in turn has facilitated the expansion of trade and commerce as well as the transformation of several rural settlements to towns and cities over the last fifteen decades. Essentially, the construction sector in Nigeria develop and maintain various infrastructure and engineering works ranging from rail tracks, highway, bridges, ports etc. as well as housing and retail real estate (BusinessDay Research and Intelligence Unit, 2017). Construction activities obviously impact on every other sector of the economy and have significantly influenced the provision of shelter, infrastructure and job creation (Oladinrin, Ogunsemi and Aje, 2012). Olanipekun and Saka (2019) also stated that construction sector is an essential component of a nation's economic system and constituted a major job provider to millions of skilled and unskilled workforce especially in developing countries. In Nigeria, the sector accounts for about 70% of the nation's capital formation,

1.4% GDP (Odediran, Adeyinka, Opatunji and Morakinyo 2012) and employs 25% of the nation's workforce (Ibrahim and Musa-Haddary, 2010). Population growth and urbanization in Nigeria has placed high demand on infrastructure for diverse purposes such as housing, commercial, industrial, transportation, health, education etc. Thus, the construction industry plays important roles in providing these critical infrastructures. The construction industry is very crucial to the overall development of nations all over the world, and according to Adamu, Bioku and Kolawole (2015), the industry is being transformed to meet the needs of the 21st century in recent times. Corroborating this assertion, Van den broeke (2013) stated that across the globe, the industry has begun to adjust its modes of operation as occasioned by observing and complying with new legislations and regulations and through extensive use of technology, innovative management tactics and concepts. The avoidance or limitation of wastage, enhance output, distribution and overall client's experience being the principal motives behind the adjustment being witnessed in the construction industry. Most times, the industry is used as a measure of the performance for governments' development agenda while individuals and corporate bodies also assess their success or otherwise by the level of accomplishments in the construction industry (Iheme and Chiagorom, 2018). The industry is a vast economic sector that makes use of inputs and resources from different stakeholders. The bulkiness and complexity of construction projects have always made it reliant on inputs from different companies, professionals and service providers in the industry. The sequential process of procurement and service delivery by the numerous players, participants and professionals in construction industry is generally referred to as "supply chain management". The concept as explained in Constructing Excellence (2004) describes the network of organizations that render services or convert different materials or products into a finished product for the client. It is an innovative way for organizations to make profit, continuous service and development (Al-Werikat, 2017) while providing optimum use of resources and value for investment for the client. The concept has therefore been found beneficial to building construction and adopted in various aspect of the industry. Al-Werikat, (2017) admits that supply chain management processes in the building industry sector are to some extent modified and distributed.

4. Building Development Process

The success of building development process is largely a function of the procurement as well as the effectiveness of the supply chain management approach. The construction procurement process according to Idoro (2012a) comprises a chain of interconnected and consecutive processes, the usefulness and efficacy of which determines the success or otherwise of a project. Different problems of construction procurement management include schedule delay, lack of specified quality, resources wastage and suppliers default (Inuwa, Wanyona, Diang'a, 2014). All tasks and activities associated with construction procurement and development play out in two major dichotomies of economic activities, that is, the demand and supply. Moreover, the challenges of demand and supply are not only related to the products, but also the parties and stakeholders involved. The construction process combines information and resources from different parties at different stages to achieve desired result. Ameh and Odusami (2010) explicitly states that the construction sector is made up of a group of diverse firms and within firms, each having a great diversity of operations. Cox et.al, (2006) also averred that construction industry is unique in the manner it delivers its products. The process of delivering construction project is a complex, time-consuming, capital intensive and multidisciplinary human endeavour (Kohlhepp, 2012). The process according to Gehner (2008) is modelled as a series of sequential phases embedded with diverse tasks and activities coordinated to achieve certain result. Thus, there exist an intricate relationship and interaction between the firms, professionals' other parties and the market. Therefore, to undertake construction project successfully, there is the need to ensure effective management of the interactions and flow of resources to and from the markets through the phases of construction and this constitutes the primary purpose of engaging the principles of supply chain management in construction industry.

5. Concept of Supply Chain Management

Supply chain involves different players who carry out series of undertakings in a particular order starting from source to consumption. A modest supply chain involves stakeholders in the sequence of: producer or manufacturer, wholesaler, retailer and user/consumer (Crandall, Crandall and Chen, 2015). In this perspective, supply chain management entails the activities of delivering products, passing relevant information and increasing proceeds for the network of parties involved at various levels of a supply chain. Christopher (1992) defined supply chain as a chain of two or more entities (individual/organization) directly connected to the upstream and downstream movement of funds, services, products and information from the origin to the user/customer. In short, supply chain management incorporates request and resource administration across and within organizations. Butković, Kaurić and Mikulić (2016) disclosed that SCM in construction is an advanced form of partnership and recently, the number of organizations that engage SCM strategies to improve performance is rising. Saad, Jones and James (2002) listed the different areas of partnership in construction projects such as design and build, management contracting, construction management and two-staged tendering. Ojo, Mbohwa and Akinlabi (2014); Muya, Price and Thorpe (1999) iterates three components of construction supply chain. These are:

a) The primary supply chain – that deals with materials for the final construction product
b) The support chain – that covers equipment, expertise and materials to facilitate construction
c) The human resource supply chain – which is concerned with labour

Significant to the components of construction supply chain is the flow of information, finance and resources Crandall Crandall and Chen (2015). Vrijhoef and Koskela (1999) highlighted the kind of information and pattern of flow. Information (e.g. orders, programs, estimates, procedures) originates from the owner/user/consumers and flows upstream to suppliers while resources (e.g. supplies, finished products, equipment, expertise, materials) flow downstream from suppliers to consumers. Serpell and Heredia (2004) also submitted that key parts of supply chain network are the supplier's network, the transformation unit and the client's network. Thus, the successful transition from one phase of project development to the other requires tactical deployment of the principles of supply chain management throughout the development process. This further entails identifying the tasks, activities as well as the inputs and parties required to deliver resources for each phase of the project development. The management of materials, information and human resources is critical to construction industry. The operative combination, coordination and administration of the network from suppliers to end users are therefore required for satisfactory performances (Serpell and Heredia, 2004).

6. Principles of Supply Chain Management

Principles are operational codes, cues and procedures for engaging innovative concept or strategy for effective organizational performance. The principles of SCM provide a good structure for conceptualizing the supply chain strategy of an organization. According to Serpell and Heredia (2004), the principles of SCM are applied in construction to obtain economical and relative gains through value addition, limiting cost and assimilation of all the participants, with the objective of meeting the needs of clients within and without. Arising from the multi-disciplinary nature of supply chain management, different views have been put forward about the definition, scope, approach as well as the principles of SCM. Anderson, Britt and Favre (1997) and Elliot (2008) outline seven principles of supply chain management.

i. Adapt supply chain based on service needs of each customer segment
ii. Customize logistics network for each segment
iii. Align demand planning across the supply chain
iv. Differentiate products closer to customer
v. Outsource strategically
vi. Develop information technology that support multi-level decision making
vii. Adopt both service and financial metrics

The application of the principles in construction is discussed in subsequent section.

6.1. Adapt supply chain to customer's needs
In order to make an organization supply chain effective, it is important to identify client and group them appropriately into segments. Segmentation can be along product line, industry or trade channel. Clients are the consumers or buyers of services or products of an industry and for construction projects, it is important to group the buyers along the line of production, i.e. the stages of development process. Identifying customer's need in each phase brings about deeper understanding for each project and developing the most appropriate strategy that serve the purpose.

6.2. Customize logistic network for each segment
The grouping of consumers helps provide customized logistic network suitable for each segment of customer. For instance, the logistics required for initiation and planning of a project may be different in type, quantity and size from ones required for feasibility, commitment or construction phase. The project size, location as well as duration are factors that significantly affect logistic requirement at each stage of the development process.

6.3. Align demand planning across the supply chain
This requires sharing demand data with trading partners so as to avoid unnecessary time wastage on procurement of services or materials for the project. This is particularly important in development because no single contractor, goods or service providers is able to provide all resources required for a project at the same time. Aligning demand data with partners therefore gives the manager leverage for reliable and efficient supply chain management.

6.4. Differentiate products closer to customer
Construction projects vary significantly in terms of project size, location, terrain, duration and material specifications. The fact that materials and other resources are used on project site or precast based on project specification requirements makes the logic behind differentiating products closer to customer appropriate for development projects. An efficient supply chain acknowledges the peculiarity of each project and explores the market based on the nature of the project. The chain manager takes into consideration the characteristics of the project in order to engage appropriate tendering technique and contract negotiation method.

6.5. Outsource strategically
The primary purpose of supply chain management in construction is to achieve value for money for the client and avoid loss of time, money and materials. Thus, in the course of project development, outsourcing is an important strategy to achieve this purpose. Outsourcing is required principally for the aspects that a firm is less competent to handle or a supplier's scope of services does not cover. Unbundling the development process enables a manager to identify the areas of core competence in each phase of development and put up a supply chain that make provision for strategic outsourcing.

6.6. Develop information technology that support multi-level decision-making
As much as the segmentation of consumers is important along the phases of development process, it is equally important that the supply chain manager adopt a one stop information technology or software that can support analysis and decision making process at different phases of the project. Such technology must be capable of handling other construction projects as well regardless of the complexity, location, size or duration.

6.7. Adopt both service and financial metrics
Performance can be assessed on the basis of productivity and profitability. Therefore, for undertakings like construction, which comprises several fragmented activities and service providers, it is rather

advised that stakeholder's performance is not measured from pecuniary perspective alone but also from the point of view of service delivery. It is therefore important that both service and financial metrics are engaged to gauge the effectiveness of the supply chain strategy put in place for the project.

7. Conclusion

The construction supply chain management keeps evolving with the unraveling of theories, models and concepts that directly or indirectly affects practical application in building development process. In order to make supply chain management work in the markets of developing economies, a better understanding of the concept, its principles and current trends that link participants in supply network together is crucial and required. These critical aspects were examined as it relates to construction industry and building development process. The concepts, principles and essentials of supply chain management strategy reviewed in this study constitute the building blocks for designing efficient construction SCM plan and goes a long way to providing the academia, clients and other stakeholders in the construction industry the necessary awareness and understanding for practical application of the principles of supply management to building industry processes.

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