International Journal of Civil Engineering and Technology (IJCIET)
Volume 8, Issue 12, December 2017, pp. 1142–1148, Article ID: IJCIET_08_12_123
Available online at http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=8&IType=12
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

IMPACT OF LOGISTICS FACTORS ON MATERIAL PROCUREMENT FOR CONSTRUCTION PROJECTS

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ABSTRACT

The study assessed the impact of logistics factors on material procurement for construction projects. The research was based on a quantitative research design with the use of questionnaire. Convenience sampling technique was used to distribute 85 questionnaires to contractors in Abuja, Nigeria. Data collected were analyzed by means of descriptive statistics such as bar charts and inferential statics like Principal Component Analysis (PCA) and Categorical Regression Analysis. Vendor qualities and competence of procurement officer were found to be the two most critical components required for successful material procurement on construction sites. Moreover, certain factors were found to affect material procurement on site. These factors include: late delivery of materials, inability to forecast activity period with accuracy, delivery inaccuracies, transportation challenges, increased waiting time and supply of poor quality materials. The study recommends that competent procurement officers having good pricing and negotiation skills be appointed for material procurement on construction sites.

Key words: construction projects, logistics, material procurement, vendor qualities.

Cite this Article: Patience F.Tunji-Olayeni, Adedeji O. Afolabi, Rapheal A. Ojelabi and Beatrice A Ayim, Impact of Logistics Factors on Material Procurement for Construction Projects. *International Journal of Civil Engineering and Technology*, 8(12), 2017, pp. 1142-1148.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=8&IType=12

1. INTRODUCTION

Efficient logistics on site can enhance overall construction project outcomes. Specifically, it can cut down on time and material wastages: both of which have negative implications for construction cost. Logistics involves planning, implementation and controlling of construction resources in terms of supply, storage, processing and handling (Regassa, 2015). However, challenges arising from poor logistics on construction sites still persists including errors in ordering materials, difficulties in ordering materials in small materials (Bossink and Brouwers, 1995); delays in material delivery (Aibinu and Odeyinka, 2006),problems associated with material transportations, handling and storage (Glass, Osmani and Price, 2008), production of defective materials (Formoso et al., 2002) and general poor resource

control on site (Poon, Yu and Jaillon, 2004). Logistics for construction projects can be a challenging task involving material procurement, transportation, material handling and storage. Material procurement in particular requires special skill because it is a highly technical field (Ibegbulem and Okorie, 2015). Material procurement consists of recognizing, defining and describing the need, investigating and selecting the vendor, ordering materials, receipt and inspection of goods supplied, auditing invoices and closing the order (Ayoade, 2004). Material in particular covers about 60% of total construction cost (Gulghane and Khandve, 2015; Patil, Smita and Pataskar, 2013 and Ibironke 2013). Moreover, the rising price of building materials (Amusan, Dolapo and Joshua, 2017) and the escalating cost of construction have become topical in many countries (Tunji-Olayeni and Omuh, 2010). Hence, efficient material procurement holds great potentials for significant cost savings for construction projects. An understanding of the components necessary for efficient material procurement can assist project managers in successfully sorting out the material component of projects thereby enhancing overall project outcome. This paper focuses on the components of material procurement that are necessary for efficient material procurement and the impact of logistics factors on these components.

2. LOGISTICS

Logistics is a part of supply chain process that regulates plans and implements the planned activities in respect to material procurement ensuring that quality materials are procured, delivered and properly stored (Council of logistics management, 1991). Logistics in the context of construction can be described as a management function involving the procurement, transportation, handling, storing and efficient use of materials on site. Logistics is a complex task comprising of several activities including: making a list of required materials, sourcing material vendors, placing orders, arranging for transportation, providing storage space, keeping material inventory and allocating material for use (Council of Supply Chain Management Professionals, CSCMP, 2013).

2.1. Rationale for Effective Material Procurement for Construction Projects

The construction industry has been described as one of the most wasteful industries (Watuka and Aligula, 2002; Kareem, Olusola and Lawal, 2015). Waste particularly from material stems from inefficient logistics which may result in time and cost overruns. However, minimizing waste stems from identifying the causes of waste (Hoe, 2006). Inefficient material procurement is one of the major causes of time and material wastes in the construction industry (Bossink, and Brouwers, 1996).This could take the form of delays in material delivery (Abinu and Odeyinka, 2006), problems associated with material transportation, handling and storage (Glass, Osmani and Price, 2008) procurement of defective materials (Formoso et al., 1997) errors in ordering materials, difficulties in ordering materials in small quantities (Bossink, and Brouwers, 1996) and general poor material control on sites (Poon et al., 2004).

2.2. Material Procurement

Material procurement is one of the activities involved in logistics. Material procurement involves the analysis of various vendors, making adequate decision to ensure that materials are bought at the right quality, in the right quantity, at the right time, at the right price, and from the right source (chand, 2016). In the construction industry, material procurement follows a procedure to ensure that adequate materials are made available on site at the right time and of the right quality which includes: material indent, searching for vendors,

interviewing/comparing vendors, selecting vendors, placing order and evaluating the performance of the vendors

Hines (2004) noted that certain components are necessary for successful material procurement including: price, quality, quantity, capability of vendor, vendor reputation, waiting time and sales offer. These factors have both direct and indirect impacts on project outcomes. Furthermore, certain logistics factors have been found to affect material procurement for construction projects. These factors include:

2.2.1. Late delivery of materials and components

This could be as a result of several factors including people, policies and procedures (Ritte, 2010). It could also be as a result of lack of experience of the procurement officer or inability to understand specification in vendor's quotation (Richardson, 2012).

2.2.2. Inability to forecast activity period with accuracy

Many procurement officers will prefer to procure materials in bulk so as to take advantage of sales discounts. However, material procurement for construction projects requires that procurement officers accurately forecast activity periods on site. Otherwise, it will be wasteful to stock pile materials without using them almost immediately.

2.2.3. Delivery Inaccuracies

This can also result in cost and time wastages. In a situation where a purchasing manager orders for a material and a different material is delivered, time would have been wasted in delivering the wrong material. Where large volume of material is delivered inaccurately, great amount of time is wasted in correcting the inaccuracies thereby affecting scheduled project completion time.

2.2.4. Transportation:

Most of the materials used on construction sites are not manufactured on site but are procured from other places and transported to site. Transportation is a key factor that affects the efficiency of material logistics. Bowersox, Closs and Cooper (2000) noted that transportation cost covers a large percentage of logistics cost. Availability of transportation enhances material procurement on site. Inadequate transportation can lead to increased waiting time which translates into delays and eventually impacts negatively on project outcome.

2.2.5. Storing Materials on Site

Storing material on site can also have some negative impact on project outcomes. Material can be damaged by weather, moving equipments or people (Fei, 2014). Efficient material logistics will require the use of innovative techniques like Just in Time (JIT) in order to minimize the negative impacts of storing materials on site.

2.2.6. Increase Waiting Time between Activities

Construction activities are usually done in stages. Each stage depends on the completion of previous activity. Late completion in an activity can affect start time of the next activity. Hence, adequate activity planning is required for efficient material logistics on site.

3. METHODOLOGY

The research was based on a quantitative research design with the use of questionnaire. Convenience sampling technique was used to distribute 85 questionnaires to contractors in Abuja, Nigeria. A total of 55 questionnaires were properly filled and returned, representing 65% response rate. Data collected were analyzed using SPSS v 21. The data was further analyzed by means of descriptive statistics such as bar charts and inferential statics like Principal Component Analysis (PCA) and Categorical Regression Analysis.

3.1. Data Analysis

3.1.1. Critical Components for Material Purchasing

Table 1 PCA for Critical Components for Material Purchasing

Material Purchasing Requirements	Component1	Component 2
Price	0.652	-
Waiting Time	0.557	-
Component 1 Vendor reputation	0.623	-
Capability of procurement officer	-	0.797
Volume of order	-	0.792
Component 2 Sales offer	-	0.809

From table 2, component 1 shows critical components such as price, waiting time and vendor reputation. While component 2 reveals components like capability of procurement officer, volume of order and sales offer.

3.1.2. Logistics factors affecting material procurement on construction sites

Table 2 Logistics factors affecting material procurement on construction sites

Beta	Sig.	Beta	Sig.
	Component 1	Component 2	
R square	0.560	0.626	
F	2.349	0.014	3.078	0.002
Late delivery of materials	-0.985	0.000	0.352	0.004
Inability to forecast	0.073	0.826	0.552	0.000
Delivery inaccuracies	1.002	0.000	-0.605	0.000
Transportation challenges	0.717	0.000	0.556	0.000
Poor material storage	-0.151	0.226	-0.103	0.474
Increased waiting time	0.247	0.020	0.223	0.061
Poor quality materials	-0.322	0.042	-0.286	0.019

Table 2 shows the categorical regression (CAT REG) of logistics factors affecting material procurement on construction sites. The CATREG shows that logistics factors affect components 1 and 2 with R square values at 56% and 63% respectively. The significant factors affecting Component 1 are late delivery of materials (98.5%), delivery inaccuracies (100%), transportation challenges (71.7%), increased waiting time (24.7%) and supply of poor quality materials (32.2%). Inability to forecast activity period with accuracy and poor material storage on site both had no statistically significant impact on component 1 (with $0.826 > 0.05$ and $0.226 > 0.05$ respectively). The significant factors affecting component two are: late delivery of material (35.2%), inability to forecast activity period with accuracy (55.2%), delivery inaccuracies (60.5%), transportation challenges (55.6%) and supply of poor quality material (28.6%). Poor material storage on site and increased waiting time both had no statistically significant impact on component 2 (with $0.474 > 0.05$ and $0.061 > 0.05$ respectively).

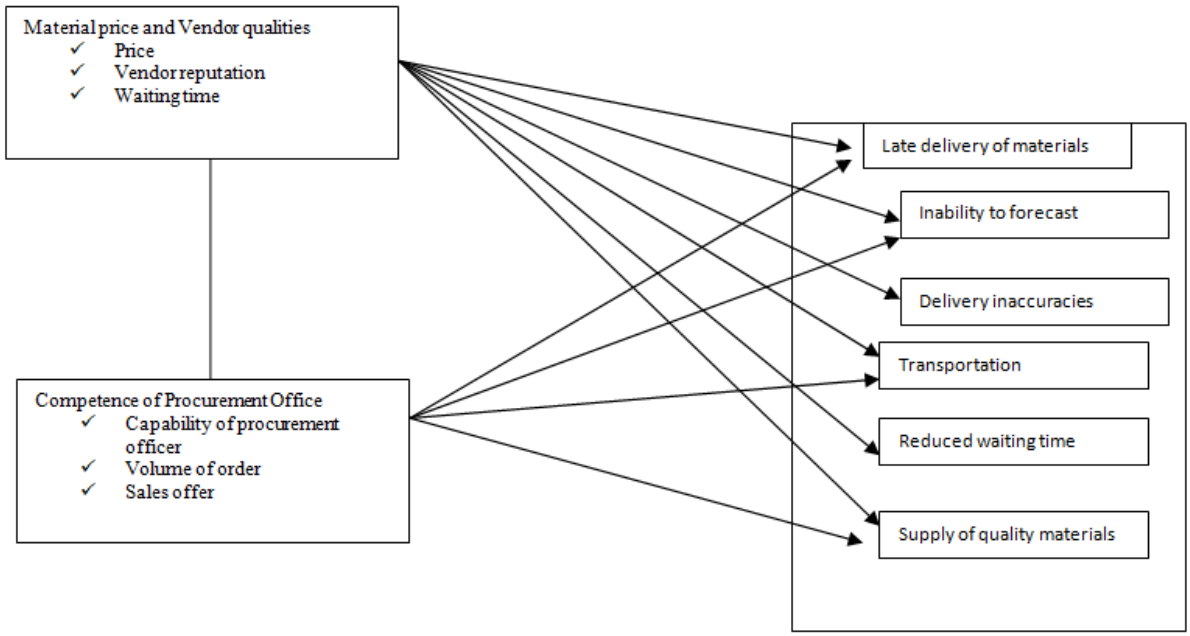

Figure 1 Framework for logistics factors affecting material procurement

3.2. Discussion of Findings

Waiting time and vendor reputation are things that depend on the vendor. Hence, the factors represented by component one can be titled vendor qualities. Component two revealed significant factor like capability of procurement officer, volume of order and sales offer. These factors revolve around the competency and experience of the procurement officer. Great skill is required in procuring materials particularly in translating and synchronizing project activity with volume of order to be procured, availability and adequacy of storage space and opportunities for lowest prices due to sales offer. Hence, factors of component two can be named competence of procurement officer. Tunji-Olayeni, Emetere and Afolabi (2017) revealed that project managers were in charge of material procurement in most construction sites. Ogunde et *al.,* (2017) further revealed the need for the engagement of competent project managers for better efficiency and quality delivery of projects. Certain factors affect both components one and two. These factors are assumed to be the most critical factors affecting material procurement on construction sites. The factors are: late delivery of materials, inability to forecast activity period with accuracy, delivery inaccuracies, transportation challenge, increased waiting time and supply of poor quality materials. The categorical regression revealed that poor material storage on site had no statistically significant effect on both component one and component 2.

4. CONCLUSION AND RECOMMENDATION

The research identified critical components necessary for successful material procurement on construction sites. Vendor qualities and competence of procurement officer were found to be the two most critical components required for successful material procurement on construction sites. Moreover, certain factors were found to affect material procurement on site. These factors include: late delivery of materials, inability to forecast activity period with accuracy, delivery inaccuracies, transportation challenges, increased waiting time and supply of poor quality materials. The study recommends that competent procurement officers having good pricing and negotiation skills be appointed for material procurement on construction sites.

5. APPRECIATION

The authors are grateful to Covenant University for sponsorship.

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