Effects of E-Commerce on Purchasing Building Materials for Sustainable Building

Dash Debadutta[1], R.Thirumalai Raja[2]
[1,2] Gandhi Institute for Education and Technology, Baniatangi, Bhubaneswar

Abstract:- In order to meet the needs of construction stakeholders both now and in the future, sustainable building construction has become crucial in the sector. Selection and procurement of appropriate materials that satisfies the principles of sustainability is paramount in construction. To this end, the traditional method of materials procurement has been found to be inefficient considering the increased innovations and diversity of materials available for construction. This paper explores the implementation of E- commerce especially e-procurement as a strategy for improving the process of materials procurement in the South African construction industry. This study obtained data quantitatively through questionnaires administered to 150 construction professionals in the Western Cape Province of South Africa. A total of 93 responses were retrieved and analysed. Findings indicated: building cost reduction, enhanced environmental protection and enhanced implementation of government policies as benefits of sustainability in materials procurement towards sustainable building production. However, e- procurement implementation during materials procurement are hindered by (a) lack of awareness, (b) resistance to change, high cost of installation and operation and (d) internet fraud. Given the benefits and impacts of e-commerce, adequate implementation of these findings should proffer a suitable strategy in addressing the challenges of materials procurement towards sustainable building construction.

Keywords- Construction industry, E-commerce, E-procurement, Materials procurement, Sustainable building.

I. INTRODUCTION

Electronic Commerce (E-Commerce) is a revolutionary approach to construction materials procurement. E- Commerce has been widely acknowledged to breach the boundaries of time and distance; expand and modify the scope of business operations; and increase the level of competiveness amongst building contractors by drastically reducing the cost of building production. To buttress this, [1] added that the advent of e-commerce has enabled organizations in the construction industry achieve greater economic results faster and easily through tactical and strategic operations.The concept of electronic commerce has very much been in existence since the late 1960s in various forms such as Electronic Data Interchange (EDI), Electronic tendering (e- tending), Electronic mails (e-mails), Electronic procurement (e-procurement), e-commerce is a platform for the exchange of construction project information between individuals who are geographically dispersed through the aid of internet services [2]. The review of the evolution of the process of electronic commerce in the construction industry reveal that the adoption of the electronic approach in the acquisition of construction materials for sustainable building production is a bid to improve the traditional procurement method to ensure productivity, accountability and value for money. However, despite the advantages of e-commerce in the process materials procurement during sustainable building construction, construction companies in South Africa have been observed to portray some level of reluctance in adopting the strategies of internet-enabled procurement systems.

As a result, researchers in South Africa have published works to posit the challenges faced currently during materials procurement and the barriers of implementing the strategies of e-commerce specifically e-procurement in the construction industry. Published research works such as: “A framework for the implementation of E-procurement” [3]; “The use of electronic commerce in the materials procurement in SA construction industry” [4]; “Patterns of technological innovation in the use of e-procurement in construction” [5] were identified to buttress the challenges encountered during materials procurement.

In order to improve the process of materials procurement in sustainable building construction in South Africa, there is a need to investigate and understand the current state of construction materials procurement and the extent to which companies in the private and public sectors adopt the strategies of e-commerce to achieve the goals of sustainability during construction. Therefore, this paper explores the implementation of E-commece especially e- procurement as a strategy for improving the process of materials procurement in the South African construction industry.

II. CONSTRUCTION MATERIALS PROCUREMENT AND E-COMMERCE

Construction materials are a collection of materials consumed or incorporated in buildings or structures at any stage or phase of construction [6]. Reference [6] added that construction materials typically accounts for 40-60% of the total cost of construction projects to buttress the relevance of materials procurement. Therefore, it is essential for every construction company to maintain an effective and efficient materials procurement system to remain abreast of all market conditions towards promoting value for money, accountability, transparency and social equality in the procurement of construction materials.

The International Standard Organization [7] defined Construction procurement as a phase of building construction which involves the formation, management and execution of building contracts with respect to the provision of materials, machinery (labor and equipment) and money required towards client satisfaction. Procurement in sustainable building construction has over the years translated to a strategy for cutting production cost, improving building quality and enhancing procurement efficiency [8]. Hence, construction materials procurement emphases on the ability of a construction company to satisfy the expectations of its clients through materials acquisition without incurring time and cost overruns during construction. To buttress this, [9] highlighted that the optimum aim of the project manager is to make decisions on enhancing productivity and value for money at the materials procurement phase effectively; in order to meet the goals and objectives of the project. As a result, the materials procurement strategy implemented by the project manager is prone to have a great

impact on the cost, quality, time and sustainability of a building.

A The Traditional Materials Procurement Strategy (TMPs)

In a traditional contractual status quo, the process of materials procurement is a paper-based system. This strategy involves the search for materials and suppliers from paper-based documents and potentials suppliers are communicated with through telephones and fax. Reference [10] defined the traditional materials procurement strategy as is a systematic and specialized procurement process which is predominantly a paper-based technique for materials acquisition during construction. The procurement process comprises of the generation, copying and transfer of various contract paper documents such as materials requisition documents, quotations, purchase orders etc as illustrated in Fig. I.

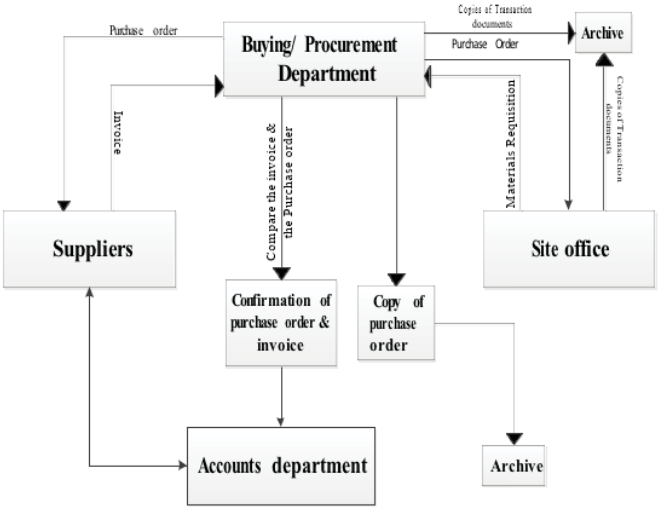

Figure I. Typical Paper-work cycle in Traditional Materials Procurement (Adapted from [11])

1 Limitation and Impacts of the Tradition materials procurement strategy

Reference [10] proffered that the TMPs is limited by the following operational factors in developing countries, South Africa inclusive. These factors are considered to be fostered by communication setbacks:

- Geographical limitation
- Stipulated business hours
- Limited supplier and product information.
- Labour intensity
- High operational and transactional cost related to poor data management
- The use of physical catalogue and other paper-works, makes the procurement process cumbersome and lengthy.
- The adoption of the paper-based system has made the process of materials search and cost/quality comparison a strenuous task.

Reference [12] added that as a result of the ineffective purchasing practices of the paper-based procurement strategy, construction companies have experienced various setbacks such as: loss of profit due to time, labour consumption, loss of materials information, and high level of process uncertainty. To further buttress this [13] stated that the impact of these mentioned factors also reduce the competitive level of the contractors in the business market. This is as a result of the use of out-dated supplier details from catalogues, production time consumption etc. With reference to Fig. I, it is noticed that the materials procurement process involves the transfer of different copies of document between the procurement parties all through the process. Thus, it is worthy of note that there exist a high possibility of documentation errors and information transcription. Furthermore, it is perceived that the likelihood of experiencing a bridge in information transfer in the paper-based system is inevitable due to document mix-ups or lost information. Due to the unending challenges and barriers of TMPs, the implementation of innovative approaches such as the use of Electronic Information and Communication Technology EICT) enabled techniques were introduced into the materials procurement system. This approach was initiated to enhance the performance and production processes of materials procurement activities.

E-commerce Strategies for Construction Materials Procurement

E-commerce is defined as the use of electronic technology and software programmes for the purpose of processing, transferring, storing and presenting information between different parties [12]. The United Nations Commission on International Trade Law (UNCITRAL) from an economy improvement perspective further describes e-commerce as a procurement process which adopts the function of the Electronic Data Interchange (EDI) and other internet based communication methods to improve international trade. Based on the evolution of e-commerce, e-commerce was initiated to create a platform for buyers and sellers to exchange purchase information. Thus, e-commerce provides a virtual space (e-market place) which permits the exchange of information (specifications and price) between procurement participants on considerable materials via an 'inter-organisational' internet-based information system [14]. Hence, e-commerce provides a dual win situation for both the buyers and the suppliers.

Subsequently, [15] buttressed in their study that the adoption of the strategies of e-commerce in the execution of construction materials procurement activities improves the system of communication as well as to promote accurate, effective and timely exchange of materials information among the different procurement participants. Another vital benefit and feature of the electronic commerce system is the facility to better manage of materials information overtime. Table I itemises other benefits of e-commerce and its impacts on the construction industry. However, on the other hand, the key barriers of the adoption of e-commerce, particularly e- procurement in the construction industry are generally associated with social, environmental, technological, governmental, organisational and cultural factors.

Table I Benefits and Impacts of e-Procurement in Sustainable building construction

Benefits	*Reference*	*Impacts*
Advanced Global Communication.	[14]; [16]; [17]; [18]; [19]; [20]	Company and Product promotion, Customer Satisfaction, Unlimited & direct communication with suppliers (new & old); Global market place for buyers and suppliers; Wide range of materials to choose from; Standardization of communication network; increased productivity; increases the speed of returns on investment (ROI)
Reduced Transaction Cost	[16]; [14]; [17]; [18]; [19]	Economic benefits, Budgetary control, Materials Procurement Decentralization; Reduced labour cost/ overhead; Reduced materials cost; Eliminates Maverick expenditure, timely delivery of information; Increase in profit margin

Easier Materials trade process	[10]; [21]; [18]; [19]; [20]	Wide range of materials to choose from; Materials procurement decentralization, Service standardization; Electronically enabled supplier payment; enhanced inventory management; Transaction Error elimination; improved documentation style
Reduced Transaction Time	[21]; [19]; [20].	Suppliers' management, Business process Re-engineering, Eliminates the participation of multiple middlemen; faster communication; shorter overall procurement cycle
Fraud Prevention	[18]; [22]; [16]; [23]	Improved technical interoperability, Legal harmonisation, Improved ICT Skills and Infrastructure, Security and Authentication integration, Risk management.
Prevalent Corruption Reduction	[22]; [21]; [18].	Transparency, Legal Framework reformation, Internet Security improvement, Efficient & effective public procurement system,
Sustainable Societal Development	[16]; [14]; [19]; [20]	Employee development, Supports SME development, Environment protection, Waste reduction, Customer Satisfaction, Environmental purchase opportunities.

I. Research Design And Methods

This study is exploratory in nature and it is a fragment of a larger on-going MTech research project. The research adopted the use of a close-ended questionnaire survey administered randomly to selected construction professionals in the Western Cape Province. This sampling technique was adopted in order to obtain precise data from companies in the district to reach generalizable conclusions. Consultants, government department heads, engineers and contractors were selected as target groups for the survey. These groups were selected because they are capable of performing various significant functions in the construction supply chain and their perspectives would be highly valuable to this research. In order to specifically gain their perspectives, the target groups were subdivided to site managers, project managers, quantity surveyors, procurement officers and company suppliers.

The questionnaires were designed to explore the extent to which e-procurement implemented as a strategy of e-commerce in materials procurement towards sustainable building construction. The questionnaires were completed anonymously to ensure a true reflection of the respondents' opinions and to meet the ethical criterion of confidentiality. It is therefore assumed that the respondents were sincere in their responses. The survey tool was designed based on findings from reviewed literature and interactions with construction professionals in the course of the pilot study prior to this study. One hundred and fifty (150) questionnaires were administered to the earlier mentioned groups. A total of ninety-three (93) responses (63%) were retrieved were after many phone calls, and visitation to the construction sites and consulting offices. This was observed to be as a result of the busy schedules of the respondents, considering they occupy key positions in their organisations. Data analyses was conducted using the descriptive statically analysis in the Statistical Package for the Social Science (SPSS) version 23 tool.

II. Data Analysis And Discussion Of Findings

A Biographical information of respondents

Table II outlines the background information of the respondents' in-terms participating company, current position, years of working experience, highest qualification and age group.

From the results presented in Table II, it is shown that the nature of the participating company, 29% of the respondents are from engineering firms, 22.6% in government establishments, 17.2% in project management firms, 15.1% in contracting and quantity surveying firms respectively and 1.1% from an architectural firm. This indicates that an equitable number of the respondents are knowledgeable in line with the procurement and management of construction materials towards sustainable construction. Further results indicate that 50% of the respondents occupy the position of a manager, 45% are junior managers and 5% are senior managers. Table II shows that 45% of the respondents have 6-10 years of experience, 30% have 11-15 years' experience, 1-5 years' experience and 7% have more than 16 years' work experience. This reveals that majority of the respondents are professionally in the position to grant all relevant information required for the study. However, the study shows that 65% of the respondents hold Diploma degree as the highest qualification, 32% holds a Bachelor's degree and 3% hold Masters degree respectively. The results of analysis on respondents demographic and background information have shown that the respondents sampled were qualified and experienced practitioners in construction industry whose judgments on issues of construction materials procurements can be reliable.

Table II: Biographical information of respondents

Questions		Percentage %	Frequency
Participating company	Project management firm	17.2	16
	Contracting firms	15.1	14
	Engineering firm	29.0	27
	Quantity Surveying firm	15.1	14
	Government	22.6	21
	Other	1.1	1
Current position	Senior manager	5.4	5
	Manager	49.5	46
	Junior manager	45.2	42
Working experience	1-5years	18.3	17
	6-10years	45.2	42
	11-15years	30.1	28
	16-20years	5.4	5
	Above 20years	1.1	1
Highest qualification	Diploma	64.5	60
	Bachelor	32.3	30
	Masters	3.2	3
Age group	20-35 years	88.2	82
	36-45 years	10.8	10
	46 years and above	1.1	1

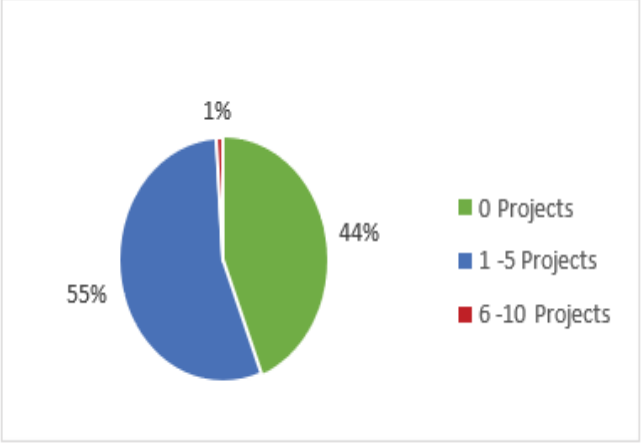

Figure II Percentage of sustainable building construction participated in the past years

The respondents were evaluated the frequency of their participation in the participation of sustainable building construction. Fig. II shows that 55% of the participating companies have been involved in the construction of 1-5 projects and 1% were involved in 6-10 projects. However, 44% of the respondents indicated that the principles of sustainable constructions are yet to be adopted in their individual organizations. This findings indicates that a significant amount of the respondents are aware of the practice of sustainability in building construction with respect to materials procurement in the South African construction industry

B. Importance of Sustainability in Construction Materials Procurement

The questionnaires explored the respondents' perception on the relevance of adopting sustainable principles in construction materials procurement. Table III presents a summary of the responses.

The survey results in table III, it was inferred that reduced building cost (MV= 3.16) ranked first, environmental protection (MV= 3.11) ranked second, enhanced implementation of Government policies (MV= 3.02) ranked third and elicited sustainable development (MV= 2.96) ranked fourth are the most ranked relevance of sustainability in materials procurement. These relevance can be affiliated with the benefits of e-procurement in addressing most barriers to the adoption of sustainable building practices on building construction projects as highlighted by [23]

Table III Importance of sustainability in construction materials procurement

Importance	***Mean***	***Rank***
Reduces the building cost	3.16	1
Enhances environmental protection	3.11	2
Enhances the implementation of government policies	3.02	3
Triggers sustainable development	2.96	4
Ensures reliability and accountability during procurement	2.87	5
Positively influences the procurement decisions of organizations	2.69	6

C. Barriers of electronic procurement in construction materials procurement towards sustainable building construction.

The respondents were asked to rate a set of selected barriers of materials procurement based on the extent to which it affects the adoption of e-procurement towards sustainable construction.

Table IV Barriers of e-procurement in construction materials procurement activities

Questions	***Mean Value***	***Rank***
Lack of general awareness in the industry	3.48	1
High fear of fraud	3.28	2
Resistance to change in the construction industry	3.28	2
Ineffective system of communication between contractors and supplies.	3.15	3
Lacks standardized documentations in materials requisition and procurement	3.08	4
High cost of materials procurement	2.97	5
Ineffective Government policy on materials procurement	2.85	6
Size of procuring company (size of available manpower)	2.77	7
Risk of information error during information transfer or duplication	2.71	8
Permits unplanned purchases from random suppliers at a higher price (Maverick buying)	2.57	9
Cumbersome nature of the materials selection	2.34	10

The findings in Table IV indicates that general lack of awareness in the industry (MV= 3.48) ranks first, high fear of internet fraud and resistance to change in the industry (MV= 3.28) were ranked second respectively, ineffective medium of communication between client, contractors and suppliers (MV= 3.15) was ranked third and lack of standardised documentations in materials requisition and procurement (MV= 3.08) ranked fourth. It was inferred that the findings are practically valid in the sense that resistance to change and the high fear of fraud are as a result of lack adequate knowledge in the industry. To buttress this, [24] in their study on "Barriers that impact on the implementation of sustainable design in Kwazulu Natal Province of South Africa" also identified high cost of procurement, materials procurement strategy implementation and education as other barriers to the adoption of e-procurement in materials procurement

III. Conclusions And Recommendations

This study evaluated and analyzed the present state of electronic materials procurement during sustainable building construction. Based on the findings of the study, the following conclusions can be made: Firstly, it can be concluded that the adoptability of e-procurement in materials procurement by construction professionals have been enhanced by recounting the benefits of e-procurement in sustainable building construction. Despite the positive impacts of e-procurement in materials procurement, the construction professionals unanimously agreed in the ranking of the barriers of e-procurement that most of the barriers are lucidly limiting factors to the adoption and development of electronic materials procurement. It was inferred that a proper understanding of the relevance of sustainability in materials procurement with relation to the benefits of e-procurement tends to proffer a solution to most barriers of e-procurement. To ensure the construction of buildings that satisfy the present housing needs of construction stakeholders' without infringing on the ability to meets the social, economic and environment needs of the future generations, construction professionals are advised to educate and train construction stakeholders on electronic materials procurement strategies for future construction projects. Thus, more research studies should be conducted in other provinces in South Africa.

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