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APPLICATION OF ELECTRONIC COMMERCE SYSTEMS (e-Commerce) IN CONSTRUCTION MATERIALS PROCUREMENT

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ABSTRACT

The emergence of information and communication technology (internet technology) has made information to be exchanged and shared through a common global network in an efficient and relatively low cost environment. The procurement of materials by the contractor in the traditional procurement process commences at the tender stage in the traditional contractual arrangement when the design of the projects have been finalized which solely depends on paper-based document system of a purchasing function and time consuming during the post contract stage of a project. Therefore, this paper presents an e-commerce system for construction materials procurement based on the electronic market system design and identifies the problems with the traditional procurement systems, hence its limitations and how e-commerce can be applied in the procurement of construction materials. E-commerce applications which can improves efficiency and effectiveness of the procurement process through web services includes e-catalogue, bidding, requisition etc are identified and discussed which saves time and money as compared to the traditional materials procurement that is based on paper work.

KEYWORDS: *e-commerce, construction materials, web services, electronic catalogue, bidding.*

1.0 INTRODUCTION

Globally, the rapid growth in the adoption of information and communication technologies (ICT) provided by the internet has been a stimulus for improvement and change in all sectors of the economy and in particular the industry, enhancing them to reconsider how their businesses are executed. One of the main drivers is the possibility of wealth creation through new business practices or e-commerce. The construction industry/sector has an estimated annual turnover of $36 trillion (10% of the world's economy) (Gek et.al., 2000).

The value of materials for construction that are required to be purchased and used for any construction contract contributes a large percentage of the total contract sum of the project and such material accounts for about 40 – 45% of the cost of the contract work (Andrew et. al.,1998). In today's environment, efficient and effective maintaining material procurement system as well as procuring materials at the right price, quality and time are essential for contractors to remain competitive in the sector.

Internet technology emergence has made information to be exchanged and shared through a common network (global) in an efficient and relatively low cost environment. Many organisations are conducting their businesses through/using a web-based e-commerce system. E-commerce has been suggested to provide a win-win situation for both buyers and suppliers as it can provide a wide market place within which buyers and suppliers can directly communicate with each other (Cheng et.al., 2001). Online trading (construction) market are limited not only to physical limitation of store spaces hence, it can carry as much larger variety of products which ranges in style and size. At the same time a wide range of products with low transaction cost at any convenient time. Multiple middlemen that exist between the two can be eliminated through direct communication between buyers and suppliers, and products can be procured at lower cost/prices and are delivered to the purchaser quickly (Bakos, 1991).

This paper however presents an e-commerce system that is used for material procurement in construction and identifies some related problems to retrieval of information, recording and sharing in traditional material procurement processes.

2.0 CONSTRUCTION MATERIAL PROCUREMENT – THE TRADITIONAL PROCESS

Procurement of materials by the contractor commences at the tender stage in the traditional contractual arrangement when the design of the projects have been finalized. Construction materials main concerns are the right materials provision at the appropriate time, at the right place and within the agreed budget so that the progress of work on site is not interrupted (Canter, 2012).

The activities and sequence of a typical construction material procurement is illustrated in figure 1 below. Contractors start estimating and sending enquiries out to their various and selected suppliers after receiving the tender documents. Contractors will receive and the best quotes and complete the documents (tender) when they receive quotes from the suppliers. However if the contract is awarded at a time in the future of later stage, the purchasing function will reconfirm the validity of the original quote from the supplier or a revised price of materials will be negotiated. Once a suitable supplier is selected in the purchasing process, the next step is to raise and issue to the supplier a purchase order which will form a legal contract when he (supplier) accepts or acknowledge the receipt of the order.

Figure 1.Sequence of material purchasing

***Source**: Kong et.al., 2001*

At the tender stage in the traditional material procurement process, from requisition of quotations to signing invoices and actual receipt of materials, the production of different paper-based documents are done, copied, referenced and passed by different participant groups. Information on construction materials are obtained by contractors estimating team from physical catalogues of suppliers during the tender stage.

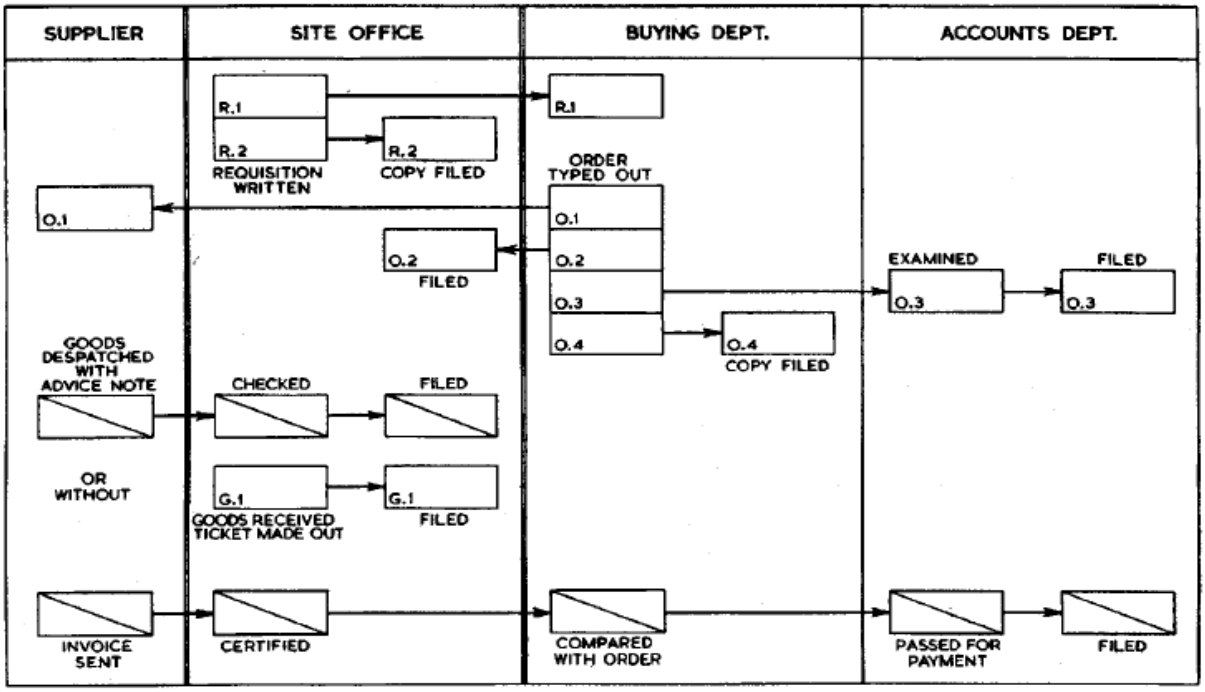

Fig 2: Required paper work in the purchasing system (adapted from Calvert, 1995)

The figure above shows a typical paper-based document system of a purchasing function during the post contract stage of a project. Two copies for the requisition of materials are prepared in the site office in

the paper-based document system. A copy is sent to the buying department and the other copy is filed. More so, four copies of the purchase order are then prepared by the buying department. One copy of the requisition is sent to the selected supplier and the site office. The remaining copies are kept in the account department and buying department for their records. An advice note and invoice will be issued to the site office by the supplier when the materials arrive on site. Hence the invoice will be compared with the purchase order and after confirmation by the buying department, it is sent to the accounts department tom issue payment to the supplier.

3.0 LIMITATIONS OF THE TRADITIONAL MATERIAL PROCUREMENT PROCESS

The limitations of the traditional material procurement process are as follow according to Love et.al., 2011. The traditional process can only work with suppliers that are within a geographical region and has a specific business hour. In addition limited information about products and their suppliers via the collection of physical catalogue can only be collected through the traditional process. Physical catalogue requires storage areas that are large and are very cumbersome to use. This limitations makes it difficult for contractors to stay abreast of market conditions and the selection of a suitable supplier and materials for a project to be very difficult.

On the other hand, the transaction system using the paper-based is used commonly within the traditional material procurement process is time consuming and thus does not add value. Different copies of documents are produced manually and used by different parties in the process of procuring materials. As information increases, so also the probability of error increases from one document to another. Appropriate sections/department depends on ensuring thy obtain copies of the document in order to do their job with the paper-based system.

4.0 APPLICATION OF E-COMMERCE IN CONSTRUCTION MATERIALS PROCUREMENT

Electronic commerce (e-commerce) refers to business activities involving manufacturers, service providers, consumers and intermediaries using computer network (Kong et.al., 2011). Electronic data interchange (EDI) has been widely used to forge automated linkages between suppliers and buyers to transfer orders, payments and receipts through electronic means. Study conducted by Mukhopadhyay 1998 show that the so called “channel partners” when linked with EDI can help in cycle-time process reduction, improve accuracy and hence strategic value is created. EDI adoption rate does not grow proportionally to its anticipated benefits such as less transaction costs, error rates etc. However, the main factor that limits the EDI acceptance are high entrance cost and complex EDI standards (Li et al., 2002). EDI transactions are exchanged traditionally via value-added networks (VAN), which are very expensive. However, the emergence of Internet and Web technologies makes the business information link to extend to a global network, hence provides common platform and network for transmitting and displaying information in an efficient and relative low cost way. The web technology overcomes system incompatibility problem of EDI by encapsulating enterprise systems as object components, made accessible by standardized protocol for documents transmission between the components through the internet (Gek et al., 2000).

Businesses are now conducted by many companies via Web-based E-commerce systems. A lot of E-commerce systems for trading construction materials are developed in countries like Hong Kong, Taiwan and mainland China (Stephen et al,. 2003). It has been suggested that e-commerce can provide a win – win situation for buyers and sellers (suppliers) as expanded market place within which buyers and suppliers can directly communicate with each other is provided by e-commerce (Cheng et. al., 2001). Physical limitations of store space are not limited through online construction materials trading market hence it can carry a larger variety of products, which ranges in size and style. At the same time, a wide range of products with low transaction cost can be searched by buyers at any time convenient to them. Hence communication is direct between buyers and suppliers (sellers) and will eliminate middlemen that exist between suppliers and buyers. Consequently, products can be purchased at lower prices and delivered on time to the purchaser (Bakos et al., 2006).

As a proliferated business practice, e-commerce has four types in the internet.

- Off- line order, off-line delivery
- On-line order, off-line delivery
- On-line order, on-line delivery
- Off-line order, on-line delivery

For the off-line order, off-line delivery, information is available in the internet, but deliveries are executed off-line.

The on-line order, off-line delivery provides on-line information for products and allows user to make orders on-line. Once the products are ordered, it will be delivered off-line.

In an on-line order, on-line delivery e-commerce system, information for the products is made available on line, hence users can order the product in the system. Once the products are ordered, it will be delivered to the customer/buyer on-line.

The off-line order, on-line delivery requires the buyer to make order of products through the

traditional way, but the products are delivered through the internet.

For construction material exchange, the off-line order, off-line delivery and the on-line order, off-line delivery types of business practice are applicable in e-commerce business practice.

There are three major players in construction material trading; buyers, suppliers and agents (brokers). Buyers are customers who purchase/buy materials or product. Suppliers are product and/or service providers. Agents are intermediaries who assist the buyers and suppliers to complete a transaction. Buyers and suppliers must exist in any trading while agents only exist in certain trading situations.

5.0 SYSTEM DESIGN FOR E-COMMERCE CONSTRUCTION MATERIAL PROCUREMENT

An e-commerce system for product procurement created electronic links between buyers, suppliers and agents (Sirinivasan 1994; Wang et al., 1995 and Choudhury 1998). These links can be organized in different ways as illustrated in fig 2 below.

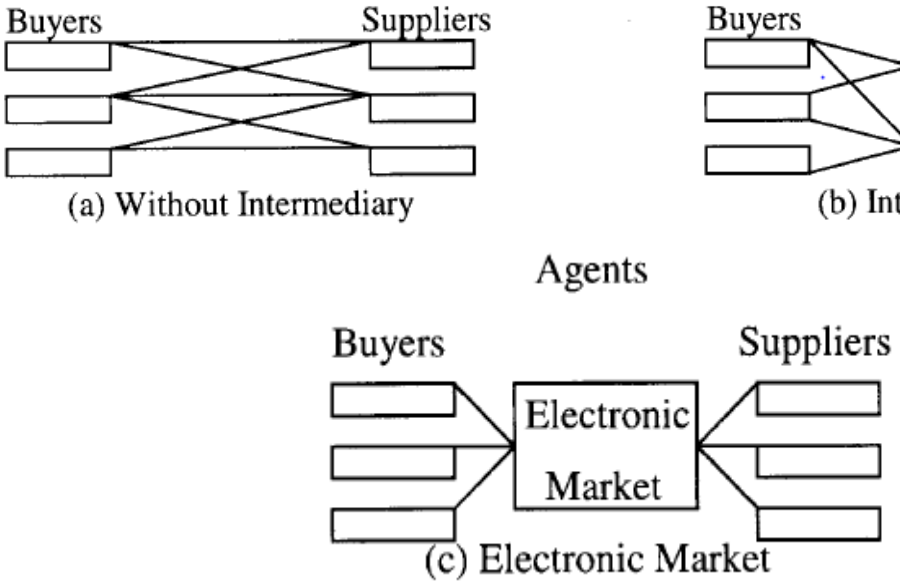

Figure 3: Three types of buyer – supplier communication structure in e-commerce

From the figure above, the buyer and supplier can either form direct connections without any intermediary (fig 2a) or with intermediary (fig 2b) or acquire the product direct through electronic market (fig 2c) (Strader and Shaw, 1997). Product information of suppliers and product request by buyers are allowed by the three types of connections to be assessed through a network, hence provides a platform of buying and selling electronically.

Buyers and sellers have a direct linkage which supports bargaining and bidding situations as shown in figure 3a but difficult to support other trading situations (auction and contract). Type (b) only allows buyers to search and compare products from intermediaries and facilitates auctions and contract based trading, hence the intermediaries become unavoidable part of the supply chain which makes it inconvenient for the buyers to have direct communication with the suppliers. Therefore bargaining and bidding trading situations are not supported by type (c). The electronic market in type (c) provides a platform for the suppliers to supply and make online products information available. Buyers can search and compare products from different suppliers easily and to easily contact suppliers directly. In construction material trading, the c-type has the most flexible and functionality to support all the four trading situations encountered.

Therefore, the e-commerce business model presented in this paper is based on the type (c) electronic market hence has the following modules; e-catalogue, bidding, requisition, quotation and order as shown in figure 3 below.

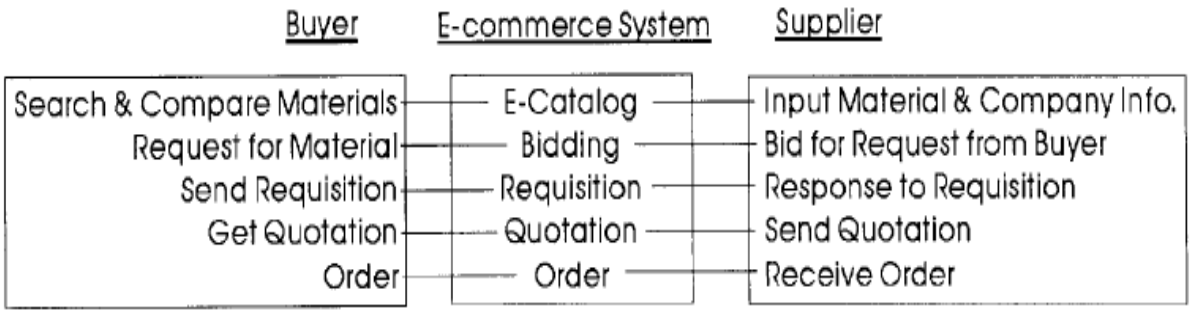

Figure 4: An e-commerce system for construction material procurement

E- Catalogue module

This module provides an interface for suppliers to advertise their products information into a classified material catalogue. Information about the product includes the price, photos, unit, quality standard, brand name and other details relevant in order to allow buyers make suitable decisions on the product. Suppliers information such as company name, address, telephone and other details of the supplier should also be provided. The function of the search in the e-catalogue allows searching criteria to be specified such as range of prices, product categories and key words so that the buyer cam quickly found the desired materials and products. Product comparisons can be made through the retrieved results.

Bidding module

Buyers specify material they are interested in buying when the material/product cannot be found in the e-catalogue. Hence buyers request for material can be viewed by the suppliers on-line and bid for the order. Instant messages are sent to the buyers to inform them of the responses from suppliers. Buyers can accept a bid on-line and will constitute an order from the buyer to the supplier. They can use the order module to follow up the tender.

Requisition module

This allows buyers to send their requisition to suppliers after identifying the suitable material from the e-catalogue. Although the unit price of material is stated in the system, and suppliers may give discount to buyers according to the amount of product purchased, their relationship and method of payment with the buyer. The requisition can be viewed by suppliers on-line and the quotation module is used to reply the buyer.

Quotation module

This module allows quotations to be sent to the buyers after receiving requisitions. Notice of the quotation will be received by the buyers and will be able to view the details of the quotation on-line. They can use the order module to raise orders.

Order module

Buyers sending order to suppliers is allowed in this module. Order module can be used by the buyer in the following three cases;

a) Once the buyer identifies suitable material from the e-catalogue the buyer wants to make direct payment

b) Quotations were received by the buyer form the supplier

c) The bid is accepted by the buyer from the seller.

The order module is used by both the buyer and supplier to proceed with the transaction.

The modules identified above are the main modules of an e-commerce system to facilitate construction materials trading.

6.0 CONCLUSION

This paper presents the application of e-commerce in construction materials procurement, hence identifies the limitations of the traditional construction materials procurement method and identifies the areas of e-commerce applications that may help in solving the problems of the traditional procurement method of construction materials.

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