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### SUPPLIER SELECTION PROCESS IN THE CONSTRUCTION MATERIAL PURCHASING FUNCTION

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#### ABSTRACT

Construction materials occupy a significant part of the construction's value contributing nearly 50%. Thus when selecting construction materials, it is very important that correct decisions should be made. Literature evidences show that the main issue with building materials purchasing comes with supplier selection, and depend on careful examination of supplier economics among other criteria. Supplier selection is the purchasing function that forms the foundation for the success or failure of projects. Therefore supplier selection criteria should be well defined. Supplier selection is a multi-criteria decision making problem which includes both qualitative and quantitative considerations. This paper presents a review of supplier selection processes and decision making methods reported in academic and other literature related to the construction industry.

**KEYWORDS:** Construction materials, purchasing function, Supplier selection Criteria, Supplier selection methods.

#### INTRODUCTION

According to the definition provided by McConville (as cited in Hadikusumo et al., 2005, pp 48), purchasing is “a fundamental function of material procurement that refers to the acquisition of goods and services and an establishment of mutually acceptable terms and conditions between a seller and a buyer”. Considerable attention has been paid to the purchasing function in past literature mainly due to its contribution to profitability, survival of business organisations and firms” performances (Bayazit et al., 2006, Carr and Pearson, 1999). Gadde and Hakansson (2001) found that purchasing is not seen as a separate function but as an integral part of running a company. As far as the construction industry is concerned, purchasing can occur in all phases of a construction project.

The purchasing function of a construction firm is central to materials management and especially includes the commitment of project funds for construction materials. Purchasing within an organization typically involves all activities associated with the buying process. According to van Weele (2005), these activities include: determining the need, selecting the supplier, arriving at a proper price, specifying terms and conditions, issuing the contract or order, and ensuring proper delivery. The step involving supplier selection is one of the most significant steps in the building construction process. Past literature and anecdotal evidence suggest that the main issue with materials purchasing is with supplier selection in the building materials industry, which depends on careful examination of supplier economics. It is recommended that construction organisations should select their material suppliers based on value-added capabilities rather than competitive process considering today” aggressive sourcing environment (Benton and McHenry, 2010).

Quality and cost of material procurement are two attributes that are directly affected by the material supplier selection process (Yong and Qi, 2012). In order to maintain both of these attributes, material supplier selection should be well defined, in a way that decreases project logistics and supply chain management costs (Wang and Xiaolong, 2004). Benton and McHenry (2010) suggest that construction material supply managers make the following common mistakes:

- lack proficiency at identifying the capabilities of their suppliers
- base materials supplier decisions on convenience

- delay the assessment of the value added by suppliers and service providers
- fail to recognize the impact of economic changers on bulk materials prices

Benton and McHenry (2010) further suggest the following success factors to overcome the mistakes outlined previously.

- Perform a realistic assessment of the capabilities and expertise of each potential supplying firm (e.g. If core competencies exist, what happens if a key supplier goes out of business? Can the supplier be easily replaced?)
- Evaluate alternative strategic supplier arrangements and select appropriate suppliers
- Share information with all strategic suppliers and request their input.

## LITERATURE REVIEW

### Overview of Literature Review

The initiation of supplier selection is the choosing of potential suppliers for each type of material for a specific project. In general, past performance of suppliers is a key criterion in the selection process. Once a data of potential source is formed, requests for quotations are sent out, negotiations conducted, and specific suppliers are selected. Ma and Yang (2010) suggest that it is essential to establish different relationships with different material suppliers which mean that the assessment methods are dependent on the type of material purchased. Therefore, in order to select suppliers who continually outperform the competition, suppliers must be carefully analysed and evaluated. Usually the detail process of supplier selection involves 7 major steps (Mendoza, 2007)(see Table I).

*Table I 7 major steps of supplier selection*

Step 1	Recognize the need for supplier selection
Step 2	Identify key sourcing requirements and criteria
Step 3	Determine sourcing strategy
Step 4	Identify supply sources
Step 5	Limit suppliers in selection pool
Step 6	Determine method for final selection
Step 7	Select suppliers and reach agreement

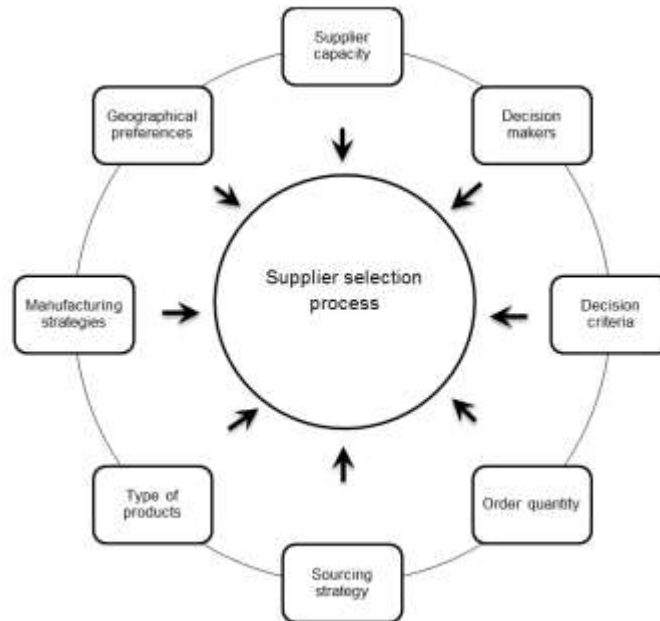
More information about these key steps is explained by the Table 2 with appropriate examples where applicable.

*Table II. Description of 7 major steps of supplier selection*

Step	Key Information
Identification of the need for a specific product	Different situations may trigger the need for supplier selection. For example, new product development, modifications to a set of existing suppliers due to a bad performance, the end of a contract, expansion to different markets, current suppliers' capacity is not sufficient to satisfy increases in demand.
Identify key sourcing requirements and criteria	Defining the proper criteria becomes critical since the nature of supplier selection involves multi-criteria decision making. The set of criteria to be chosen largely depends on the company's objectives and the type of industry in which the company competes.
Determine sourcing strategy	Sourcing requires that companies clearly define the strategy approach to be taken during the supplier selection process. Examples of sourcing strategies are: single versus multiple suppliers, domestic versus international and short term versus long term.
Identify Potential supply sources	The importance of the item under consideration influences the resources spent on identifying potential suppliers.
Limit suppliers in selection pool	Given the limited resources of a company, a purchaser needs to pre-screen the potential suppliers to reduce their number before proceeding with a more detailed analysis and evaluation
Determine method for final selection	There are some multi-criteria techniques which are widely used to evaluate the suppliers (these will be discussed in this paper).
Select Suppliers and Reach Agreement	The final step of the supplier evaluation and selection process is to clearly select those suppliers that best meet the company's sourcing strategy. This decision is often accompanied with determining the order quantity allocation to selected suppliers.

### Criteria for Supplier Evaluation

Process-based evaluations and performance based evaluations are known as the main categories of supplier evaluations. In the process based evaluation, supplier's production or services process is evaluated. Numerous factors are considered for the evaluation procedure of supplier selection. Figure 1 demonstrates the key factors which affects the supplier selection process.



*Fig. 1 Factors affecting supplier selection*  
(Source: Khaled et al., 2011)

Supplier evaluation is carried out by the construction organization as an inspection at the supplier's site to measure the capability level of the operating system. As a result, non-value-added activities can be eliminated to enhance the business efficiency. In performance-based evaluation, supplier's actual performance is evaluated based on different criteria (delivery reliability, cost, quality defect rate etc.). This evaluation measures daily performance of the supplier and hence it is known as after-the-fact-evaluation. In general, performance based evaluation is more common and practical than process based evaluation. This could be due to the ready availability and easy measurement of objective data.

In the selection of supplier, the cost of the material is not the only criteria but quality and service of the supplier and the previous history should be taken in to account. However, an appropriate number of criteria should be included in the supplier selection process and these criteria based on which, the project manager would be able to define the rightest supplier for the job under consideration (Aretoulis et al., 2009). Benton & McHenry (2010) explain that the most critical criteria for supplier selection in the construction industry are material quality, delivery dependability and price although the degree of importance varies in line with the nature of individual firms (Ho and Nguyen, 2007).

Generally, high-quality materials are expected from every potential supplier and it is assumed that the suppliers' quality performance is continuing as shown in the past. It is hard to find any formal measures taken to ensure the quality of materials delivered on the site other than by visual inspection. Quality is rarely a problem in the construction industry, simply because the buying firm provides the supplier with specifications and the supplier must comply. If a supplier cannot provide adequate quality, it will not receive consideration for future business from the contractor. Therefore, after the potential suppliers have been selected, considerations of delivery dependability and price play a more important role in actually selecting one supplier over another.

Delivery dependability: Today's fast-track construction environment boosts the importance of delivery dependability as construction begun before completing the architect's final design. Loss of delivery deadlines could cause costly

results (loss of time and additional labour cost) for both owner and contractor as time is considered as money in the construction industry. The faster delivery company will get the chance of being selected as the supplier. Therefore, delivery consideration is the key criterion used in selecting suppliers for the construction industry.

Price: Price has a significant effect on the process of supplier selection while it is not given the chance to overshadow other criteria by the nature of the supplier selection practice. A balanced should be maintained between price and the other criteria to engage the best supplier for a given material. Subsequently, negotiation permits to reach the price agreement that satisfy both contractor and supplier.

Studies conducted in the USA, Taiwan, and Vietnam construction industry recognised some supplier evaluation and selection criteria as the most important ones (Ho and Nguyen, 2007, Kannan and Tan, 2002). These are presented in Table III.

**Table III Comparison of five most important supplier selection criteria**

Rank	(Kannan and Tan, 2002) USA	(Ho and Nguyen, 2007) Taiwan	(Ho and Nguyen, 2007) Vietnam
1.	Ability to meet delivery due dates	Commitment to quality	Commitment to quality
2.	Commitment to quality	Ability to meet delivery due dates	Prices of materials, parts and services
3.	Technical expertise	Prices of materials, parts and services	Ability to meet delivery due dates
4.	Prices of materials, parts and services	Reputation of supplier	Technical expertise
5.	Honest and frequent communications	Supplier’s process capability	Industry knowledge

Further, Aretoulis et al (2009) suggests other pertinent criteria to include: discount, progress payments/cost of money, special chargers, freight chargers, total evaluated cost to destination, terms of payment, escalation, acceptance of project terms and conditions, promised delivery date based on award, shipping weight, and expiration date of bidder’s quotation. However, it is apparent that specific criteria and their relative importance are highly dependent on the type of purchase being made.

**Supplier Selection Methods**

Literature show that there are number of studies have been devoted to examining performance based supplier selection methods. However, there has not been any general set of standards for supplier selection and evaluation. Basically, the characteristics of the firms, their goals and many other reasons actually decide the criteria for supplier selection and these are very subjective (Ho and Nguyen, 2007). *Categorical method, the cost ratio method, and the linear averaging method* are the three general types of supplier evaluation systems used today (Benton and McHenry, 2010). Implementation and overall reliability are the guided factors of the system basically determine the best fitted method.

**1. Categorical Method**

The categorical method involves categorizing eachsupplier’s performance in specific areas defined by a list of relevant performance variables. The buyer develops a list of performance factors for each supplier and keeps track of each area by assigning a “grade” in simple terms, such as “good,” “neutral,” and “unsatisfactory.” At frequent meetings between the buying organization and the supplier, the buyer will inform the supplier of its performance. See Table IV

**Table IV. Performance characteristics**

Supplier	Cost	Material Quality	Speed	Total
A	Good (+)	Unsatisfactory (-)	Neutral (0)	(0)
B	Neutral (0)	Good (+)	Good (+)	++

C	Neutral (0)	Unsatisfactory (-)	Neutral (0)	-
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The categorical method is a simple and informal system in the sense that detailed performance achievements or shortcomings are not measured. Instead, it is primarily used as a basic evaluation tool between top managers in the buying organization and the selling organization, while still permitting the discussion of past performance, future expectations, and long-term plans. The advantages associated with implementing this sort of evaluation program are that it can be implemented almost immediately and is the least expensive of the three systems discussed here. This method's major disadvantage is its dependence on the judgment of its users. The system is largely dependent on the memories of personnel to explain what "unsatisfactory" or "good" means. With this method, there is no concrete supporting data.

## 2. *Cost Ratio Method*

Timmerman (1986) proposed a method named "cost-ratio" which collects all costs related to quality, service, and delivery, and express them as a percentage of the total unit price (Pi and Low, 2005). The cost-ratio method evaluates supplier performance using standard cost analysis (Willis and Huston, 1989) and relates all identifiable purchasing costs to the value of the shipments received from the respective suppliers. The cost categories used depend on the products involved. The total price is calculated by accounting selling price and buying organisation's internal operating costs associated with quality, delivery and service (Thiruchelvam and Tookey, 2010). The calculation procedure consists of four key stages: (1) Determining the internal cost associated with quality, delivery, and service; (2) Conversion of each element to a cost ratio; (3) Obtaining the overall cost ratio by summing the individual cost ratios; and (4) Allocation of overall cost ratio to the supplied quoted unit price to obtain the net adjusted cost figures. As the basis of comparison of supplier's performances, the net adjusted cost figure is used. In this evaluation, all the costs associated with conducting business with suppliers should be gauged as penalty. The best supplier is selected as one with lowest net adjusted cost. The cost oriented nature of the results provides the major advantage of this technique. Therefore, it is essential to recognise all the associated costs. This method is more expensive when compared to the categorical method. Further, this is a complex methodology, necessitating a wide-ranging of cost accounting system to create accurate cost data (Dobler et al., 1990, Timmerman, 1986). Moreover, as another drawback, this method does not take in to account other aspects of supplier performance and it is assumed that all the required data are readily available (Willis and Huston, 1989).

## 3. *Linear Averaging*

Linear average method is also known as weighted point method (Humphreys et al., 1998) and it is possibly the most frequently used supplier assessment method (Willis and Huston, 1990). In this method, the subjective nature of the categorical approach is improved by providing numerical weights to the evaluation criteria and individual supplier's performance. Then a composite performance index is calculated to determine "the winner". Further, specific performance factors used are basically quantitative including quality, service (delivery), and price. A weighting system is considered for those factors depending on the nature of the project. As an example, a builder may consider quality as the most imperative for complex bridge projects while price might be given equal or greater weight in an evaluation system used by the highly competitive residential housing project. However, purchase price is a one of the key attributes which is given a higher priority and all the other attributes are considered as non-price attributes (Ittner et al., 1999). Firstly, it is necessary to assign appropriate weights to each performance factors in such a way that the summation of all weightings keep as 100. The allocation of weights is decision making process taken by the contractor's top management. Secondly, the suppliers are rated on each performance factor according to a numerical scale. Finally each performance factor is multiplied by its respective weight as a percentage and a numerical rating system is created for each supplier. The supplier with the highest score is then selected. However, in this method, the issue of assigning weight is subjective and varied based on the decision maker (Ordoobadi, 2009).

## SUMMARY AND CONCLUSIONS

Excellent performance of material suppliers is most crucial for the smooth procurement of materials. Supplier evaluation and selection is a usual multi criteria decision making (MCDM) issue. Interestingly, the multi-criteria signify both qualitative and quantitative characteristics. Construction contractor should be able to select the

appropriate decision making tool which is easy, reliable and affordable. It is essential to have an applicable structured decision making system in today's complex construction industry. This particularly helps quality decisions and consistency and transparency under complex multi-criteria conditions.

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