

# A Literature Review of Supplier Selection for Construction Project

M. Tech. Scholar Sanket D. Alone

Veer mata Jijabai Technological Institute  
Mumbai, India

sanketaloney127@gmail.com

**Abstract-** This paper is about the selection of supplier for materials required in a construction project. Apart from making a proper schedule of the project for marking the start and completion dates of the project, for optimizing the cost of the project, material supplier is very important from the quantitative as well as quantitative point of view. In order to make an adequate suppliers selection use different criteria depending on the specific case. The supplier selection process deploys an enormous amount of a firm's financial resources and plays crucial role for the success of any organization. The main objective of supplier selection process is to reduce purchase risk, maximize overall value to the purchaser, and develop closeness and long-term relationships between buyers and suppliers.

**Keywords-** SCM; MCDM; AHP; ANP; TOPSIS.

## I. INTRODUCTION

To understand project management, one must begin with the definition of a project. A project can be considered to be any series of activities and tasks that: have a specific objective to be completed within certain specifications, have defined start and end dates, have funding limits, consumer human and nonhuman resources (i.e., money, people, equipment), are multifunctional (i.e., cut across several functional lines).

If the project is large and complex, then careful planning and analysis must be accomplished by both the direct and indirect-labour-charging organizational units. The project organizational structure must be designed to fit the project work plans and schedules must be established so that maximum allocation of resources can be made; resource costing and accounting systems must be developed and a management information and reporting system must be established. Effective total program planning cannot be accomplished unless all of the necessary information becomes available at project initiation.

Construction industry is an unorganised sector where a lot of individual parties in Construction Supply Chain come together to complete one project. We think that if suppliers and subcontractors are integrated at an early stage of a project then reduction in time and cost variation is possible. This means that is inputs from suppliers and subcontractors are taken during design stage itself, then the project schedule prepared will be more precise as the subcontractors and suppliers will be present to tell the times and the buffer that they would require to complete a certain activity; at same time they can tell us about the cost related to the activity based on the material, man-power

And equipment required. Recently supply chain has become a major subject of management research and manufacturing theory. Supply chain has been defined as the network of organizations which are involved through upstream and downstream linkages, in the different processes and activities that produce value in the form of services and products in the hands of the ultimate customer. The readiness of supply chain in integrated material procurement is one of the important indicators to define the performance of contractors. Contractor will be called competent if they can order the material and build without any delays.

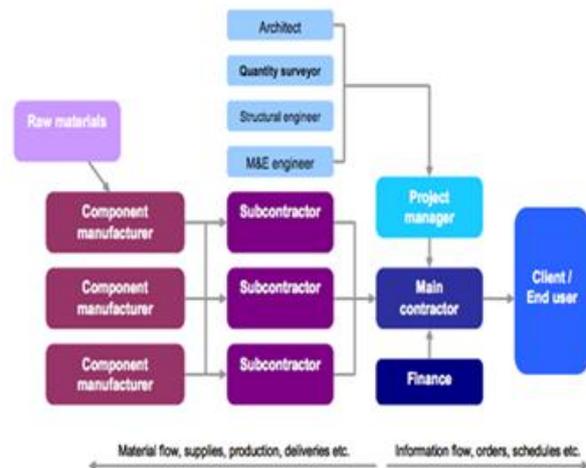


Fig 1. Work methodology in construction industry.

Supply chain management (SCM) has been widely regarded as an effective and efficient management measure and strategy to improve the performance of the construction industry, which has suffered from high fragmentation, large waste, poor productivity, cost and time overruns, and conflicts and disputes for many years.

Currently supply chain management is in its developing stage. In this current scenario to avoid the conflicts and competition among the suppliers a proper supply chain management system is needed. It mainly consists of number of participants and is complex in their nature. The construction sector players including engineers, contractors, suppliers and clients.

Number	Criterion	Number	Subcriterion
1.	Logistics	1.1.	Delivery time
		1.2.	Support lots
		1.3.	Flexibility
		1.4.	Reliability
2.	Technology	2.1.	Capacity to meet demand
		2.2.	Involvement to formulating new products
		2.3.	Improvement effort in their products and processes
		2.4.	Problem solving capability
3.	Business	3.1.	Reputation and position
		3.2.	Financial stability
		3.3.	Management skills and compatibility
4.	Relationship	4.1.	Easy communication
		4.2.	Past experience
		4.3.	Sales representative's competence

Fig 2. Various criteria for selecting material supplier along with their sub criterion.

They have major roles in establishing and developing SCM and collaboration. There are many challenges that are faced by construction industry in India, and the important challenge among them is improper material supply chain in construction. Each and every product that reaches an end user is the cumulative effort of multiple organizations. These organizations refer collectively as a supply chain. Supply chain Network of organizations and business process for procuring materials, transforming raw materials into finished products and distributing the finished products to the customers. Supply chain management is an integration of suppliers, distributors and customer logistics into one cohesive process.

## II. RESEARCH METHODOLOGY

The methodology adopted for performing this research for selection of construction material supplier is as follows In Fig 3.

In this research the criteria for selection of supplier is to be determined first. The criteria on which basis the supplier is to be shortlisted will be determined. Then weights of the criteria's will be decided by using various MCDM (Multi Criteria Decision Making) methods. After that a matrix for different criteria's will be formed and that will lead to MCDM model construction and then finally that mathematical model will choose between the different suppliers available for a particular material.

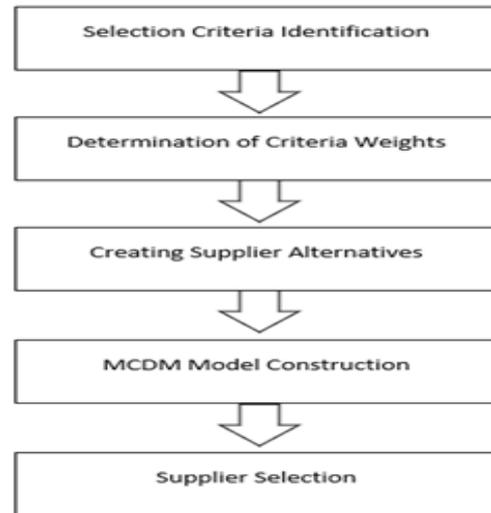


Fig 3. Flowchart showing the entire process for supplier selection.

Selecting and evaluating suppliers is complicated task due to the fact that various criterion must be considered in the decision-making process. Supplier selection is one of the strategic elements in managing purchases, as the ability of a company to satisfy its clients, as well as its own continuity, depends to a large extent on its suppliers. The researchers in supplier selection field have been applied multi-criteria decision-making methods, such as Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), and Technique for order preference by similarity to ideal solutions (TOPSIS), Fuzzy TOPSIS, and VIKOR.

Approaches of Supplier Selection Most common reviewed methods that are used in decision making are briefly discussed below:

### 1. Analytic Hierarchy Process (AHP):

An AHP method was first introduced by Saaty. In AHP, the problem is constructed as a hierarchy breaking down the decision top to bottom. The goal is at the top level, criteria and sub-criteria are in middle levels, and the alternatives are at the bottom layer of the hierarchy.

### 2. Analytic Network Process (ANP):

The ANP methodology is a general form of the AHP, both were introduced by Saaty. Although AHP is easy to use and apply, its unidirectional relationship characteristic cannot handle the complexity of many problems. ANP, however, deals with the problem as a network of complex relationships between alternatives and criteria where all the elements can be connected.

### 3. Technique for order preference by similarity to ideal solutions (TOPSIS):

The basic concept of this method is that the selected alternative is the one that has the best value for all criteria, i.e. has the shortest distance from the negative ideal solution.

### III. LITERATURE REVIEW

**Željko Stević, International Journal of Engineering, Business and Enterprise Applications 2017.** It can be concluded that the traditional criteria such as quality, price and delivery still play an important role in the evaluation of suppliers. However, the goals the everyday is use of integrated approaches that require a larger number of factors and criteria such as communication system, method of payment, logistics capacity, clean of business and other get more and more important and more often used in this area.

**S. Patil, Prof. Mrs. P. R. Adavi, ISSN: 2248-9622, October 2012.** In spite of its importance, construction industry has not made necessary managerial advancements in formation of Supply Chain to augment productivity and responsiveness in the Industry. In this research, we have made an attempt to explore and understand the nature of supply chain in Indian construction Industry with special attention to supplier selection issues.

**A.E. Cengiza, O. Aytakinb, I. Ozdemirb, H. Kusanb, A. Cabuka, creative construction conference June 2017.** Supply chain management (SCM) is a sophisticated concept which contains all material-related activities of construction projects. In the last decade, construction supply chain management (CSCM) has become a new challenge for construction managers in order to procure right quantities of materials to construction site on time, and within the pre-defined budget. Supplier selection as a significant process in SCM is a multi-criteria decision-making problem. There is a broad literature on supplier selection that examines selection of supplier evaluation criteria and multi-criteria decision-making methods. Individual and integrated multi-criteria decision approaches are studied by many researchers. Whilst literature review and expert panel are employed in order to identify criteria, weights of each criterion are determined by an extensive questionnaire survey.

**Phong Thanh Nguyen, International Journal of Advanced and Applied Sciences, September 2018.** The construction material is one of the critical factors to create products from construction processes. Proper evaluation and selection of building material supplier can increase product quality, reduce defects and costs, etc. To select good material suppliers, defining core criteria for evaluating them is one of the most important economic decisions in the success of any construction contractors, this study presents an overview of the criteria for evaluating and selecting construction material supplier based on the reference of domestic and foreign documentation combining in-depth interviews with construction professionals.

The research data collected through expert interviews were qualitatively analyzed by word tags. The results show that

the five most important criteria are price, quality, number of projects involvement, ability to deliver on time, and supplier relationship.

**Martin Skitmore, International Journal of Construction Management, January 2008.** The Indian construction industry is known to be inefficient and highly resistant to change. Even with a changing market and increasing competition, there are no obvious signs of commensurate changes in methods and approach. The responses and suggestions provided by the returns are studied and reviewed. These indicate that the Indian construction industry is growing and most of its consultants know of the existence project management. Barriers for the application of project management knowledge do exist, A particular issue is the lack of encouragement from the construction organizations.

**S. Hasim, M. A. Fauzi, Z. Yusof, I. R. Endut, A. R. M. Ridzuan, Malaysia, AIP Conference Proceedings, October 2018.** Supply chain (SC) is a new term that emphasizes interaction between marketing, logistics, and production. The discussions on the evolution of SCM have also been included to show how SC is defined and practiced today, with the intention of highlighting new opportunities to improve the performance of materials SCM. This paper indicated that SCM has transferred us from ultra-functional material chain insights to intervention and even between organizations. The SCM concept is now commonly used in businesses for corporate interests in the SC (from organizations that extract basic raw materials to end customers). The basic principles of SCM are integration. However, SCM is not well-known in the construction industry. This paper considers the potential of applying SCM to integrate the construction process in Malaysia and hence, addressing urgent issues including poor cost, practices and environmental performance associated with the traditional process

**M. Rabieha, A. Fadaei Rafsanjania, L. Babaeia, M. Esmaili, Iran, Scientia Iranica, July 2018.** The purpose of the current study is to select suppliers and determine their order allocation in a way that the performance of the sustainability of the supply process gets optimized on the whole. In this research, after reviewing the literature and investigating the supply chain of the case study (Iran Khodro's supply chain) through Delphi method, a set of evaluation criteria related to the performance of the suppliers in economic, social, and environmental terms was identified. In the next stage, by using the identified criteria, the multi-objective mathematical integer programming was presented to solve the problems of supplier selection and order allocation. The suggested mathematical programming in this research is designed to be multi-product, single-period, and multiple sourcing

**Abhishek P. Mohitea, Tushar R. Mohiteb, Ketan M. Mathakarc, Sachin B. Khotd, International Journal of**

**Engineering Research & Technology, January 2014.** The objective of this paper is review of all developed appropriate methods and tools that deal with decision making problems in supplier selection. Supplier selection has become an important part of supply chain management and hence selecting and evaluating suppliers is complicated task due to the fact that various criterion must be considered in the decision-making process. An extensive range of decision-making methods have been suggested to handle the supplier selection problem by a large number of authors in this area.

**Slawomir Biruk, Piotr Jaskowski, Agata Czarnigowska Poland, "Fuzzy AHP for selecting suppliers of construction materials." IOP Conference Series: Materials Science and Engineering 2019.** The selection of suppliers is one of the key issues of supply logistics of any business entity. Due to the globalization of the economy and the rapid technological progress, the choice of products and the number of vendors is growing, which makes the selection process difficult. The specific character of the construction projects (one-off contracts with no incentives of the steady orders from one client, the need to adjust the batch size to the pace of the construction works whereas this pace is affected by risks and uncertainties, short time for planning, etc.) poses extra challenges to the suppliers' production and transportation capacities and defines what "capable suppliers" mean for the project success.

**Akshay A. Patil, Prof. Madhav B. Kumthekar, International Research Journal of Engineering and Technology June 2016.** The evaluation and selection of suppliers, structuring the supplier base is an important task in any organization. It assumes utmost importance in the current scenario of global purchasing. A supplier evaluation shall comprise all aspects that are important for a well-set and cordial working co-operation between the Customer firm and the supplier. While developing a supplier survey for the purchaser it is to be decided which performance categories to include. The preliminary criteria are cost/price, quality and delivery, which are generally the most obvious and most critical areas that affect the buyer. For most of times, these three performance areas would be enough, however for critical items needing a detail analysis of the supplier's capabilities, a more detailed supplier evaluation study is required

**Daniel Castro, Gursel A. Süer; Julian Gonzalez-Joaqui; and J. K. Yates, Vol. 135, No. 10, 1 October 2009.** This article evaluates the viability of using mathematical models for determining construction schedules and for evaluating the contingencies created by schedule compression and delays due to unforeseen material shortages. Networks were analyzed using three methods: manual critical path method scheduling. The efficiency of a construction project depends on many variables e.g., early start time, early completion time, late

start time, late completion time, normal cost, crash cost , conditions e.g., priorities, milestones, budget, expected duration, and material requirement and uncertainties e.g., delays, schedule growth, cost growth, and material constraints that have to be accounted for by providing forecasts to realistic construction networks that generate a favorable schedule, minimize the project completion time and costs and that also consider material constraints

#### IV. CONCLUSION

This paper presented a review of construction project material supplier literatures published over the last decade. It focuses on the development of methods and parameters for effective selection of supplier among the choices available. It also focuses to contribution of different researches on the various techniques and theories. The literature on supplier selection criteria and methods is full of various analytical approaches. The current paper provides an overall picture of research on supply chain management, supplier selection criteria and supplier selection evaluation method.

From the study of the research, it was found out that in construction project the various suppliers for different materials need to be selected with proper evaluation of various factors such as price, quality, number of projects involvement, ability to deliver on time, and supplier relationship.

The review had confirmed that supplier evaluation shall comprise all aspects that are important for a well-set and cordial working co-operation between the customer firm and the supplier

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