Identification and Analysis of Key Integrating Factors of Material Supply Chain Process in Construction Industry

Mr. Neeraj A. Gangurde[1], Prof. A.R.Vasatkar[2]
[1, 2] Department of Civil Engineering
[1, 2] TSSM's BSCOER, Narhe, Pune, India

Abstract- *Supply chain management (SCM) is a concept that has originated in the manufacturing industry to control logistics. It represents a management process by which enterprises administer and control the worldwide network of suppliers, factories, warehouses, distribution centers and retailers through which raw materials are acquired, transformed and delivered to customers. In construction, procurement and procurement related activities occur during all phases of a construction project. Because of inevitable complexity and fragmentation of the construction process, supplies of resources like equipment, labor, material and other services may not be always available on time, in right amounts and in the desired quality and price. Current materials management practices in the construction industry are performed on fragmented basis with unstructured communication and no clearly established responsibilities between the parties involved. An overall management process like supply chain management is essential to monitor and control all such activities.*

The aim of this research is to develop a framework for the best practice of material supply chain process through the project phases that suits the local construction industry in order to helps the organizations to have the right materials in the right quantities (at the right place) at the right moment at minimal cost. This will assist organizations to improve their productivity, minimize losses and increase competitiveness. To realize the research aim, the survey questionnaires and some case studies were used to achieve the following objectives: exploring the current practices of material supply chain process, identifying the important activities that form the material supply chain process, studying the contractor/ supplier relationship, providing solution to the risks and uncertainties in the construction industry, identifying the most occurred problems facing the contractors through the project phases and finally identifying the key factors that may contribute in integrating the phases of the material supply chain process. Questionnaires were distributed to the construction organizations, received back and analyzed.

Keywords- Supply Chain Management, Framework, MSCP

I. INTRODUCTION

Supply Chain Management (SCM) is a concept originating from the supply system by which Toyota was seen to coordinate its supplies and manages its suppliers. The basic concept of the SCM includes tools like Just-In-Time (JIT) and logistics management. The current concept of the SCM is somewhat broader but still largely dominated by logistics. SCM deals with the management of materials and information resources across a network of organizations that are involved in the design and the production process. The objective of supply chain management is to be able to have the right products in the right quantities at the right place at the right moment at minimal cost.

The study aims to find out the stages in the material supply chain process, with knowing the current practices of the material purchase or supply process to the construction site. It is also essential to know the materials which are critical to procure, so the precision is maintained for purchase of such materials. Awareness among the construction industry personnel regarding supply chain management, challenges of the supply chains, relationships in the supply chains and finally the success of the supply chains is checked with the questionnaire survey. The study also aims to find out the problems encountered in material supply chain process, their possible solution and the key integrating factors for the successful material supply chain process.

Supply Chain Management is fragmented into three streams of approach as Strategic purchasing/supply management, Logistics integration, Supply network coordination. [2] Material Supply Chain Process is phased into five basic parts as, Bidding Phase, Sourcing Phase, Materials Procurement, Construction Phase, Post Construction Phase.[3] Roles of Supply Chain Management in Construction are Improving the interface between site activities and the supply chain, improving the supply chain, transferring activities from the site to the supply chain, integration of site and supply chain.[4]. SCM is a concept that has flourished in manufacturing, originating from Just-In-Time(JIT) production

and logistics, The objective of SCM is to achieve sustainable competitive advantage .[1] The methodology of SCM consists of four main element as supply chain assessment, supply chain redesign, supply chain control and continuous supply chain improvement. SCM is divided into two basic stages as procurement phase and construction phase.[5]

II. METHODOLOGY

The study was conducted in four main stages. The first stage included identifying the research problem, setting out the research's aim and objectives and developing the research plan. The second phase included reviewing the literature related to supply chain management and construction supply chain management. The third phase was studying case studies to know the phases in material supply process in local industry as well as to know about the materials required for the critical activities. The third phase also includes developing the questionnaires to investigate the awareness among the organizations regarding supply chain management and its success, factors that form the material supply chain process, the factors that could help in mitigating the risks and uncertainties in the material supply chain process, the problems to be faced by the organizations through the material supply chain process and the factors that may contribute in integrating the phases of the material supply chain process. Statistical analysis for questionnaires was done by using Relative Important Index method. Discussion for the obtained results was also made. The fourth phase was developing the MSCP based on the results obtained from the field survey and literature review. Finally, conclusions of research and recommendations were then drafted.

Formulae used for the questionnaire analysis are as follows-

$$Avreage\ index = \frac{\sum 1X_1+2X_2+3X_3+4X_4+5X_5}{\sum X_1+X_2+X_3+X_4+X_5}$$

$$Relative\ index = \frac{\sum 1X_1+2X_2+3X_3+4X_4+5X_5}{5\sum X_1+X_2+X_3+X_4+X_5}$$

Where,

X1 = no of respondents for not important.
X2 = no of respondents for less important.
X3 = no of respondents for average.
X4 = no of respondents for important.
X5 = no of respondents for very important.

By using these average and relative indices ranking is given and the same ranking is used for further result and discussions.

III. RESULT AND DISCUSSION

The study of shows that there are basically five stages in which the material supply chain process can take place; biding is the first stage in which the contractors bid for some contract, as they win the contract then second phase of sourcing that is vendor selection arises, the actual purchase takes place in material procurement phase and then it is actually consumed in construction phase. Study also suggested one more stage named as post construction phase in which the processing of surplus materials takes place.

While studying the case studies of the material purchase process in local construction industry one can come to the point that, the process is mainly divided into four basic parts. Very first of it is a requisition phase, in which the actual requirement of the material is found. In second phase the quotations are called for purchase of the requires materials. In third stage the received quotations are compared and best one is selected to proceed further. In last stage the purchase order is issued in the name of supplier who wins the comparison phase of the quotations. The purchase order includes material specification, its rate, taxes, total amount, some conditions, address of delivery, etc

Critical activities are the activities on the critical path of the project scheduling, if the critical activity delays then project completion also delays. One can get the idea of the critical path and critical activities with the help on MS Project software. Studying the MS project case study it is known that, the materials required for the critical activities must be procured with precision to avoid the delay, such materials are cement, concrete, steel , bricks, paints, etc.

With the detailed analysis of questionnaire one can come to result that; everyone agrees that the supply chain management is capable of resolving high fragmentation in construction. Many of the organizations knows or realizes the benefits of implementation of the supply chain management. The overall quality of the work including material can be improved by supply chain management. By implementing the supply chain management there is good availability of the required quantities, JIT & Lean Principles are the keys to achieve successful management, and Client satisfaction is achieved by the supply chain management. The most important thing in the every management is the time, the time for the construction is optimized by the supply chain management. The challenging schedules can be simplified by the supply chain management. And the most important aspect of supply chain management is, the cost can is reduced by the collaboration between the members of the supply chain management.

Also there are some parameters which affect the

supply chain management. The location of the site affects the extent of the supply chain management. Lack of partners having knowledge of supply chain shortens the extent of supply chain. Bad weather conditions, plant breakdowns, recession, improper communication, access to site, changes in design or specification, wrong measurement affects the supply chain management. Delays in the delivery very badly affect the supply chain.

Materials identification process is the first step in the Bidding Phase that involves identifying materials needed and special requirement or special materials that used in project. Materials are classified into two categories as off the shelf items and the materials to be manufactured. Most of the companies use computer applications such as Excel for preparing the estimate as it makes the estimating process easier and faster. The contracting company verifies the estimates many times before submitting the bid. The project managers must be involved in the estimating phase because this will lead to preparation of more realistic estimate due to the project's manager's experience. After winning the bid for a project, companies schedule a meeting that includes the managers, the project manager and all the concerned engineers in which they generate a material requisition schedule specifying materials types, quantity, dates when the materials should be delivered and any additional information.

The first stage in sourcing phase is selection of suppliers and manufacturers. Most of contractors prefer to buy materials from suppliers they worked with on previous projects and the contractor needs to verify that theses suppliers are capable of delivering the right materials (type, quality and quantity) when needed (at dates specified). In order to get reasonable prices for the materials, they request quotations from different suppliers. Suppliers are usually selected based on the lowest prices, still, contractors may consider the suppliers with higher prices but that will provide better services or that have a record of supplying the right materials in the quantities needed at the times specified, for major materials contractor often negotiates prices directly with the suppliers.

The procurement process starts with generation of material requisition schedule that usually started by the site personnel and then is sent to the purchasing department for material request from the suppliers. In small projects, materials may be directly ordered by the site personnel. The material requisition schedule specifying material types, quantity needed, dates, when the material should be delivered. In companies that have store, the purchasing department first verifies the availability of the materials in the store before ordering the materials from the suppliers. Once a requisition is generated, suppliers are contacted for purchasing the material needed with type of material needed, quantities and the time when the material is needed is specified to the supplier.

When material is needed at site, material requisition process is started by site personnel. The process involves generating a material requisition form in which material description, quantities needed, dates when the materials are needed and the delivery locations are specified. In case the material is delivered at construction site, the designated site personnel verify the material received against the requisition form and purchase order and quantities received are noted. If there is problem in material quantities, damaged material or items not delivered, the site personnel notes it in the form and forwards a copy of this form to the purchasing department for follow up with the concerned supplier.

There are some problems in material supply chain process as listed and ranked below:

Table 1 Problems in Bidding Phase

No	Problems in Bidding Phase	Rank
1.1	Not a good definition of what is wanted from the owner and suppliers	3
1.2	Lack of communication between the parties involved	1
1.3	Incomplete drawings and details are missing	4
1.4	Using specifications different from those commonly used	5
1.5	Ambiguities between plans and specifications	2

Table 2 Problems in Sourcing Phase

No	Problems in Sourcing Phase	Rank
2.1	Having too many suppliers and do not have information about them	2
2.2	Incomplete proposals by the suppliers (Suppliers did not include all the documents with the proposal)	1
2.3	Time spent investigating non-qualified suppliers	3

Table 3 Problems in Procurement Phase

No	Problems in Material Procurement	Rank
3.1	Unavailability of required material	2
3.2	Late submittals by the contractor to be approved by the Supervisor Engineer (Submittals are not submitted as planned)	5
3.3	Incorrect of submittals by the suppliers	3
3.4	Late approval of submittal by the Supervisor Engineer	4
3.5	Poor communication between the parties involved	1
3.6	The contractor sets delivery dates that are impossible to meet by the suppliers	6
3.7	The contractor does not communicate exactly what is wanted to suppliers	7

Table 4 Problems in Construction Phase

No.	Problems in Construction Phase	Rank
4.1	Late deliveries (Materials do not arrive as scheduled)	1
4.2	The delivered materials do not comply with the required specifications	2
4.3	Re-handling of materials- Materials have to be moved from one place to another before being installed	5
4.4	Storage of materials- storage area are limited or far away from working area	6
4.5	Loss of materials	8
4.6	Theft of materials	9
4.7	Damaging- Materials are damaged while handling or by other conditions	4
4.8	Poor communication between the parties involved	3
4.9	Receiving, handling and storage of the unused materials	7

Table 5 Factors that Contribute to Integration of Supply Chains

No	Factors Contributing the Integration of Supply Chains	Rank
1.1	The design team should be expanded such that to includes contractors, subcontractors and materials suppliers	12
1.2	Using design construct arrangement between the contractor and the client	11
1.3	Entering a partnership relationship with suppliers and subcontractors based on commitment over extended time period, mutual information sharing, trust, openness, dedication to common goals	8
1.4	Understanding the client needs and objectives by the contractor, subcontractors and suppliers and committing for these needs and objectives	1
1.5	Executing the projects activities by the contractors own sources (Not sourcing all the project to subcontractors)	9
1.6	Negotiating contracts with the suppliers and subcontractors rather than using competitive tendering	4
1.7	The participation of the designers should not end at the design phase but continues during construction phase	5
1.8	Establishing a protocol for dealing effectively with disputes and problems that may arise among the project participants during the course of project implementation	2
1.9	Conducting workshop for suppliers and subcontractors to discuss the quality, innovation, health and safety issues	10
1.10	Aligning the system and procedures of your own company with that of the client, suppliers and subcontractors	6
1.11	Establishing a system between the project participants for communication and project information sharing in timely and accurate manner	3
1.12	Using Web Based system for information access and exchange between the project participants that include memos, request for information, transmittal, site instruction, etc.	7

IV. CONCLUSION

From the results and discussions obtained after working on the methodology one can conclude that:

- In the local construction industry, the material supply or purchase process takes place in four steps. First is to identify the requirement of the material under the title requisition. Second, requesting the quotations from the suppliers. Third, comparing the quotations sent by the

suppliers in various bases and selecting the best one. Ultimately, awarding the purchase order to the supplier selected in the comparison step.

- With help of MS Project case study, we can conclude that the materials like cement, concrete, steel, bricks, paints must be procured precisely. As these are the materials required for the activities which are on critical path of scheduling of case study project.
- • The implementation of the supply chain management in the local construction industry is in primary condition. Organizations know the benefits of implementation of supply chain management but actual application is not up to the mark to achieve the sustainable development. There are so many obstacles which affects the growth or development of the supply chain management environment.
- With analysis of questionnaire survey of material supply chain process we come to know that what are the actual problems to be faced in various phases of material supply chain process and what are the key factors which can contribute in the integration of supply chains. Ultimately with help of these two we can make framework which will help the construction industry to mitigate the problems arising during supply chain process, with possible solutions and exact use of key integrating factors for the same.

REFERENCES

[1] Chandan Deep Singh et al.(2013), "APPLICATION OF LEAN AND JIT PRINCIPLES IN SUPPLY CHAIN MANAGEMENT". International Journal of Management Research & Business Strategy, 2(1), 85-98.

[2] J. CHEN and A. PAULRAJ (2004). "Understanding supply chain management: critical research and a theoretical framework". International Journal of Production & Resources,42(1), 131-163.

[3] Perdomo, Luis Jose (2004), "A Framework for a Decision Support Model For the Supply Chain Management in the Construction Industry", Doctor Philosophy Dissertation, 2004.

[4] Ruben Vrijhoef and Lauri Koskela(2000)," A STUDY ON THE ROLE OF SUPPLY CHAIN MANAGEMENT IN INFRASTRUCTURE CONSTRUCTION PROJECTS", Project Management National Conference India, Bengalure, pp. 3-5.

[5] Syed Mahmood Ahmed et al.(2002). "SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION SCOPE, BENEFITS AND BARRIERS". Delhi Business Review, 3(1), 1-6.