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Current Supply Chain Management in Construction Industry

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Abstract

Supply Chain Management (SCM) in construction industry is a developing field of study. This paper analyses the results of a questionnaire survey on supply chain management in top US construction industries. A survey was sent out via online tool to more than 100 contracting companies in the US, mapping the relationship between contractors and suppliers, the tools and methods employed in executing the supply chain practices. The survey results indicated that SCM in the construction industry is still in its developing state. They also indicated that the construction industry has been relatively slow in adopting SCM as a tactic due to its complexity and uniqueness. The study recommends several solutions to overcome the above mentioned problems and improve the efficiency of the SCM in the construction industry.

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1. Introduction

The construction industry is a major contributor to the Gross Domestic Product (GDP) of many countries. In the United States, the construction sector employs more than 6 million people and accounts for about \$3.4 billion to GDP. As many scholars' states construction sector as a back bone to the economic development of a country. With advances in technology and management aspects throughout the entire world, these strides do not lead to the implementation of supply chain management principles.

Supply chain principle adoption in various industries has led to successful results. SCM comprises of logistics, sourcing, and transporting raw materials, to deliver end products to customers [1]. The advantages of implementing these principles are numerous such as enhanced communication and information sharing between contractor and suppliers, customer satisfaction, cost reduction, and responsiveness. The important factor pressing against the implementation of these principles is the fragmentation of the construction industry [2]. There is a lack of communication between the participants, namely, clients, contractors, subcontractors, and suppliers, which leads to disputes and delays.

In order to address the demands of the construction industry, this paper analyses the current status of supply chain management in the construction industry [3]. A survey was conducted to shed some lights on the relationships between contractors and suppliers, tools and methods used in implementing supply chain practices, and the principal objectives in developing SCM. The survey results help understand the construction industry stand on supply chain principles.

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2. Survey result

A five-page survey was sent to a wide range of construction companies in the United States. For the analysis, the respondent companies were classified into three groups, namely, small, medium, and large. The classification, which was based on the workforce and annual turnover of their companies.

The survey has been divided into five sections to investigate supply chain relationships. It starts with the demographic information of the respondent's company. Then, the survey asks for the factors that reduce the efficiency of supply chain management practices. Next, the survey inquiries about the conflict causes between contractors and suppliers as well as supply chain tools and methods. Finally, the questionnaire addresses risk mitigation methods in case of emergencies and the flexibility performance incorporated in the supply chain.

The survey was designed with the important factor as to define and analyse the scope of responsibilities in the construction industry [4]. With the understanding of literature reviews, the issues pressed against supply chain principles were derived. To have a detailed understanding of the collected results and to make a qualitative analysis, it is common to have ordered categorical data, where responses to statements may be rated as Very Low, Low, Moderate, High, and Very High or Strongly agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree. With ordered categorical data the number labels should form a rational sequence, because they have some numerical meaning, namely, 5, 4, 3, 2 and 1.

The survey was sent out to 100 contractors in the United States using the online survey tool 'Survey Monkey'. A total of 67 responses were received. The reply percentages from small, medium, and large companies were 29%, 24%, and 47%, respectively. Table 1 summarizes survey reply results.

Table 1: List of activities

Companies in Groups	Responses	Percentage
Small Workforce (i.e., less than 5,000 workers)	19	28.8%
Medium Workforce (i.e., between 5,000 and 10,000 workers)	16	24.2%
Large Workforce (i.e., larger than greater than 10,000 workers)	31	47.0%
Small Workforce (i.e., less than 5,000 workers)	19	28.8%
Total	66	

The percentage of respondents from commercial, industrial, and residential construction companies were equal to 46.27%, 34.33% and 19.40%, respectively. Table 2 summarizes the response results by construction industry type.

Table 2: Response results by construction type

Specialization in Construction	Responses	Percentage
Industrial	23	34.33%
Residential	13	19.40%
Commercial	31	46.27%
Total	67	

3. Factors impacting SCM efficiency

The first set of questions asked the contractors about the factors reducing the efficiency of supply chain management. To enhance the performance of supply chain, the common problems associated between contractors and suppliers were derived. The literature review indicated five critical factors. The results, which are summarized in Table 3, show that the most important problem is the lack of command flow in supply chain. The involvement of many sub-contractors and suppliers leads to delays and complexities that increase disputes between supply chain members. The extended time buffers between each supply chain process and poor communication between your company and suppliers are also potential problems. Even with the advancements in technology, there is a lack of information sharing and communication in the construction industry. With the use of database and computer algorithms, the participants can be interconnected and monitored. Apart from these, isolated geographical locations and placing the material order without proper design data are considered to have less impact on supply chain management efficiency.

Table 3: Survey response for factors reducing the efficiency of SCM

Function	Very Low	Low	Moderate	High	Very High	Total
Poor Communications between your company and its suppliers	11	16	12	15	6	60
Extended(long)"time buffers" between each supply chain process	0	1	22	23	14	60
Lack of Command flow in the supply chain	0	1	21	24	14	60
Isolated geographical locations in supply chain	7	22	19	11	1	60

4. Causes of problems between contractors and suppliers

The survey results, which are summarized in Table 4, show that lack of planning is considered as the most important causes of problems between contractors and suppliers are the lack of control by supplier and insufficient communication.

Table 4: Problem causes between contractors and suppliers

Function	Responses			
	Small	Medium	Large	Total
Poor Communications between your company and its suppliers	11	16	12	15
Extended(long)"time buffers" between each supply chain process	0	1	22	23
Lack of Command flow in the supply chain	0	1	21	24
Isolated geographical locations in supply chain	7	22	19	11

5. Tools and methods of supply chain

5.1. Mapping of critical functions

Mapping of critical function in the supply chain starts at its basic level, by monitoring all the persons participating in the process at every single stage. It consists of our suppliers and their networks in obtaining raw materials to delivering to the end customers. The most underrated basic technique of SCM is mapping and drawing of our critical functions. With the growth of our company network, the supply chain becomes twisted network.

5.2. Client-Supplier diagram

Both client and supplier should have a proper understanding of their scope. With the better relationship it increases performance and boosts rapid delivery of quality of products to the end destination [5]. Close relationship between client and supplier is maintained when there are less suppliers involved [6] and it becomes more complex with large complex project. Mapping of critical functions can assist the client supplier differences to overcome.

5.3. Productivity measurement

Productivity measurements are used to measure and enhance the efficiency and the quality of the business services. Traditional measurements are considered to be ineffective, as they do not separate non-value-added costs [7]. Additionally, supplier's evaluation and client satisfaction survey were regarded as positive feedback if used with proper knowledge.

5.4. Waste identification survey

Waste identification survey was considered as one of the most underrated technique in supply chain management [8]. This technique was considered as a significant method to reduce cost and time. With the proper mapping of raw materials to end products, wastes can be minimized.

Table 5: Tools and methods used in supply chain

Function	Responses						
	Yes			No			Total
	Small	Medium	Large	Small	Medium	Large	
Mapping of Critical Functions	15	12	30	2	0	0	59
Client-Supplier Diagram	9	10	6	5	2	24	56
Productivity Measurement	12	11	19	5	1	8	56
Cause-effect Diagram	9	6	13	7	8	14	57
Brainstorming	8	7	15	9	4	13	56
Effective Meeting Techniques	13	11	29	3	0	1	57
Documentation System	15	10	27	2	2	0	56
Client Satisfaction Survey	8	7	7	9	5	20	56
Waste Identification Survey	6	6	5	10	6	22	55
Suppliers Evaluation	11	9	16	5	3	12	56

The results of the survey on tools and methods are summarized in Table 4. The contractors were asked to select the significant tool to improve the efficiency of SCM. The most effective tool selected by the respondents was mapping of critical function, followed by effective meeting techniques and productivity measurement. The least effective tools were waste identification and client satisfaction surveys. Moreover, waste identification client satisfaction surveys were regarded as positive feedback if used with proper knowledge.

With the advancements in technologies, the tools employed in SCM are subjected to continuous growth. Using GIS applications to monitor logistics and RFID tags [9] to monitor material availability on construction sites are advancing methods used in the construction industry supply chain. The fragmentation in the construction industry can be overcome by connecting all the participants and updating the information on the database pool.

6. Principal objectives in developing supply chain management

The last section of the survey was about the principal objectives in developing supply chain management in the construction industry. Implementing the supply chain principle can bring various benefits to the company with that objective in mind, few factors were selected for this section and contractors were asked about their opinion on these principals. The survey results, which are summarized in Table 6, show that the benefits to the client's was the main objective in developing SCM, followed by increased market competitiveness and increased profitability. An ideal company should work on benefiting client by reducing the costs within the company, which can aid in market competitiveness and increased profitability. By following these principles, products are delivered on time, which benefits the clients. This scenario is a win-win situation for all project participants.

Table 6: Principal objectives in developing supply chain management

Function	Small	Medium	Large	Total
Benefits to the clients	15	13	30	58
Increased profitability	16	12	17	45
Increased market Competitiveness	14	15	17	46
Benefits to the Suppliers	9	8	8	25
Cost Reductions Within the company	4	2	1	7
Improved quality assurance	4	1	1	6

7. CONCLUSIONS

In order to gain competitive advantage over others, supply chain management and partnership, which evolved from Japanese car manufacturer, are used in many other industries. Although the supply chain made its way into every industry, the construction industry has been relatively slow to adopt SCM due to its uniqueness of the product, the change in locality of the project and several other characteristics that was almost irreplaceable at the beginning. Because of their significant role in the construction industry, the contractors were surveyed about their opinions of different areas of supply chain management.

The study reveals that the contractors are more favored towards benefitting the clients rather than giving equal importance to the suppliers. Instead of forming a contractual agreement with its suppliers for the many years to come, they certify them based on different parameters and provide incentives to appreciate their success. Most of the small companies tend to avoid forming a contract as it is set a bind them together for years. Also, the communication in the supply chain seems to be a main concern affecting the performance. Thus, focusing on improving the efficiency by creating a compatible communication system within the supply chain can prove significant.

The survey also revealed that the suppliers lacked the planning of the process and then controlling it after. Planning by the contractor alone isn't sufficient enough as the supplier needs to be take control of his part of the supply chain. But this defect can be easily rectified just by conducting training sessions by the supplier. Competent workforce minimizes the chance of error and also reduces the time involved between each link in the supply chain on the supplier's side. The lack of involvement and support by the top management also affects the supply chain.

Among other problems, the US construction industry needs to implement the above mentioned tools and techniques by laying certain rules and regulations. They should also set their principal objectives clear of benefitting both their clients and suppliers in addition to cutting their costs.

Implementing SCM to the fullest scale benefits in various ways such as reducing waste linked to the supply chain, cutting down costs, increasing market competitiveness and profitability in addition to other indirect ones. Even-though supply chain management is catching on in the US construction industry, there are some of the factors that need to be looked upon in order to achieve high performance and increase its efficiency.

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