JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

AN EMPIRICAL STUDY ON SUPPLY CHAIN MANAGEMENT IMPLEMENTATION ISSUES AND PRACTICES IN INDIAN CONSTRUCTION INDUSTRY: A REVIEW

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Abstract: The importance of supply chain management (SCM) has been discussed extensively in the scientific literature, especially in the context of improving companies‟ performance. Since the construction industry is a key social and economic activity of every country, the application of SCM strategies is considered helpful in achieving higher competitiveness of construction firms and construction sector as a whole. Thus the aim of this paper, in order to provide guidance for future research related to supply chains in construction, is to review existing research and synthesize main approaches and findings. In the present global market, the competition is not between the companies but between the supply chains. The critical effects of delay investigated are cost overruns, time overrun, and termination of the contract, arbitration, and litigation. This study aims to identify the effect of delays on completion of project & time of execution. And find the actual causes of project delay delivery factors that affect the supply chain management (SCM), and then carry out the quantitative analysis using a questionnaire survey among contractors, engineers, and suppliers by using the Relative Importance Index (RII) Method. All factors affecting SCM have been ranked using RII Method using the response acquired respondent.

Keywords - Supply chain management, Construction industry, Implementation issues.

I. INTRODUCTION

The construction industry in India can be separated into primary three market fragments: Real Estate, Industrial, and Infrastructure. And there is a huge venture stream into the infrastructural improvement in India. Construction companies experienced a decrease in productivity and an increase in costs. Owners of these firms thought that these cost increases were due to economic and inflation problems and research explained that was also attributable to poor management. With the expanding worldwide rivalry, Indian firms need to take all the stakeholders of the building supply chain who impact the efficiency of the work of labor.

Recently supply chain has become a major subject of management research and manufacturing theory. It has been defined as the network of organizations that 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. Currently, supply chain management is in its developing stage. In this current scenario to avoid conflicts and competition among the suppliers, a proper supply chain management system is needed. 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 conflicts and competition among the suppliers, a proper supply chain management system is needed. It mainly consists of several participants and is complex. There is no doubt that construction sector always has a strong impact on the entire economy of every country, and that it is a worldwide activity with many special characteristics in comparison with other economic activities. In order to improve performance and

productivity in construction sector, recent studies have highlighted the importance of adoption effective supply chain management (SCM) within construction companies.

SCM is a concept that started in the manufacturing industry. It is seen as a demanding innovation that is built on previous changes such as Total Quality Management (TQM) and Just-in-time (JIT) (Saad et al, 2002). According to Christopher (1992) the supply chain is "the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer." Similarly, a supply chain has been conceptualized as "a system whose constituent parts include materials supplies, production facilities, distribution services and customers linked via the feed forward flow of materials and the feedback flow of information" (Towill, 1996). But since the construction sector includes projects of dramatically different types, sizes and complexities and there is also a high degree of subcontracting within the industry, the definition of construction supply chain is a bit more complex.

1.2 SCM

'Supply chain' is the term used to describe the linkage of companies that turns a series of basic materials, products, and services into a finished product for the client. All construction companies, be they client, main contractor, surveyor, supplier, or designer are therefore part of a supply chain. Because of the project-based nature of construction and the way that procurement normally operates, they are usually members of different supply chains on different projects. Each company in the chain has a client – the organization to which the services are provided – but an integrated supply chain will have the objective of understanding and working wholly in the interests of the 'project client'. The movement of a product or service from supplier to customer takes place with the help of the organization, people, technology, and resources. According to Terry & Harrison "a supply chain is a network of facilities and distribution options that perform the functions of procurement of materials, the transformation of materials into intermediate and finished products and the distribution of the finished products to customers".

Supply chain management (SCM) is a well-established concept within the manufacturing industry although the terminology has changed over the years (McCaffer and Root, 2000). Ganeshan and Harrison (1995) defined supply chain as a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to the customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm.

Traditionally, marketing, distribution, planning, manufacturing, and the purchasing organizations along the supply chain operate independently. These organizations have their own objectives and that are often conflicting. This traditional way of managing is essentially based on a conversion (or transformation) view on production, whereas SCM is based on a flow view of production. The conversion view suggests that each stage of production is controlled independently, whereas, the flow view focuses on the control of the total flow of production (Koskela, 1992). Table 1 presents a comparison between traditional management and the SCM in the production process.

Element	Traditional	Supply Chain Management
Inventory management approach	Independent efforts	Joint reduction of channel
Total cost approach	Minimize firm-costs	Channel-wide cost efficiencies
Time horizon	Short term	Long term
Amount of information sharing and monitoring	Limited to needs of current	As required for planning and monitoring processes
Joint planning	Transaction based	Ongoing
Breadth of supplier base	Large to increase competition and spread risks	Small to increase coordination

Table 1: Characteristic differences between Traditional Ways of Managing the Supply Chain and SCM

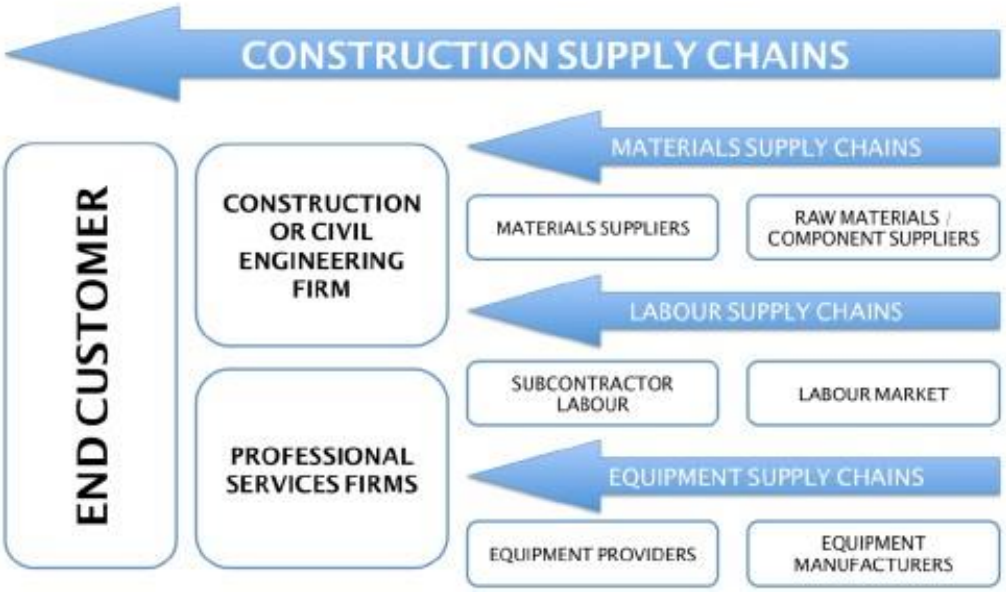

Figure 1: The myriad of construction supply chains (Cox et al., 2006)

Table 2: Principal component bodies of construction supply chain literature	
Supply Chain Management An examination of a modular supply chain The role of supply chain management in construction Construction supply chain collaboration and management Success factors in implementation of strategic partnerships ICT systems in construction supply chain management Supply chain management and risks in the construction industry Safety Decision Points in the Construction Supply Chain Management of Local SMEs Construction Business Demand uncertainty in construction supply chains	***Project Management*** Improving construction supply chain collaboration and performance Interdependence in supply chains and projects in construction Design and delivery solutions Principles for the design and operation of engineer-to-order supply chains
Sustainability Developing sustainable supply chains Barriers to Green Supply Chain Management in the Construction Sector	***Knowledge Management*** Supply chain capital in construction industry Organizational learning Generative Mechanisms of the Adoption of Logistics Innovation

Construction supply chain behavior	*Special scope of construction*
Multi-team communications in construction design under supply chain partnering	Tunneling construction project's supply chain
Construction supply chain relationships	Construction supply chain in the public procurement
Implementing supply chain partnering in the construction industry	Construction supply chain in the industrialized construction projects
Protecting workers through supply chains	Supply chain integration in the construction and shipbuilding industries
Safety Climate Instrument (mechanism to measure safety attitudes) for the Construction Supply Chain	Hydropower Development Construction Supply Chain
	Off-site precast concrete production as a case study for construction supply chain

Table 2: Principal component bodies of construction supply chain literature

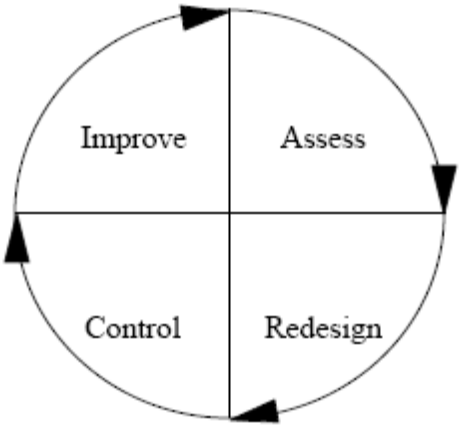

Figure 2: Generic Supply Chain Management Methodology, Vrijhoes and Koskela, 1999.

The above methodology is developed for the manufacturing industry but could also be applied to the construction industry, as purchasing and logistic operations are same in both industries. Proper time management of purchasing function may save money, which would benefit the entire organization. This paper will discuss the opportunities of SCM in the construction industry with possible benefits and underlying barriers.

1.3 Objective

The objective of validating a Supply Chain Management (SCM) for an Indian construction project is crucial to ensure its effectiveness and efficiency in supporting the project's management. Here are the key objectives:

1. To assess the current state of scm practices in the Indian construction industry, including procurement, inventory management, logistics and communication among stakeholders.
2. To identify the key challenges faced by construction companies in implementing effective supply chain management processes and strategies.
3. To propose strategies and best practices for enhancing supply chain management considering the unique challenges and opportunities present in the market.

1.5. Components of SCM

- **Supplier Management:** Identifying and managing reliable suppliers is crucial in construction SCM. Suppliers provide the necessary materials, equipment, and services required for construction projects. Maintaining strong relationships with suppliers, ensuring timely delivery of materials, and negotiating favorable terms are key aspects of supplier management.
- **Logistics and Transportation**: Efficient logistics and transportation management are essential in the construction industry, as they ensure that materials, equipment, and personnel are delivered to the project site on time. This includes managing delivery schedules, coordinating transportation modes, optimizing routes, and minimizing transportation costs.
- **Inventory Management:** Construction projects often involve large quantities of materials that need to be accurately tracked and managed. Implementing effective inventory management techniques ensures that materials are available when needed, minimizes excess inventory, and reduces holding costs.

- **Demand Forecasting:** Accurately predicting demand is crucial in SCM to avoid shortages or excesses of materials. Demand forecasting in construction involves analysing historical data, considering project timelines and requirements, and collaborating with project stakeholders to anticipate material needs.
- **Contract and Procurement Management:** Contracts and procurement play a vital role in the construction industry. Effective management involves defining project specifications, soliciting bids, negotiating contracts, monitoring supplier performance and ensuring compliance with contractual obligations.
- **Information Technology and Systems:** SCM in construction is increasingly reliant on technology and software systems to streamline processes and improve communication among project stakeholders. Utilizing software for project management, inventory tracking, and real-time collaboration helps enhance efficiency, reduce errors, and facilitate decision-making.

2. Literature review

Anders Segerstedt et.al., (2010), "Supply chain in the construction industry" The purpose of this paper is to introduce a special issue about the construction industry and the management of its supply chains. It aims to discuss and point to some differences and possible similarities with traditional manufacturing and its supply chains. The product specification process before the customer order arrives shows different degrees of specifications: engineer to order, modify to order, configure to order, select a variant. A construction company only executes a small part of the project by its own personnel and capacity. This is a way of risk spreading and risk mitigation and to compensate for an unstable market. If a construction company wants to establish a new concept, from "engineer to order", it must be engaged earlier in the business process and with other than usual customers.

M. Agung Wibowo, et.al., (2015) , The aim of the study is to analyze supply chain performance in road projects. The impact of various supply chain management practices on project performance has been measured through a combination of a survey and the development of simulation models. Performance measurement using the Supply Chain Operations References (SCOR) will analyze the supply chain management of contractor. This measurement using the SCOR model as a Key Performance Indicator (KPI) is calculated using the weighted criteria Analytical Hierarchy Process (AHP). Weighting and measurement results were analyzed using Objectives Matrix (OMAX) and traffic light. The results of the analysis and the measurement of supply chain performance are medium score or good enough for road projects. The factors that lead to the success of this supply chain are the readiness of the contractor, supplier partners, supply chain strategy, and the ability of labors.

Mirza et al., (2012), This paper addresses the fundamental issues and challenges in supply chain management within the construction industry. It likely discusses the complexity of construction supply chains, emphasizing the need for effective coordination and collaboration among various stakeholders. The challenges might include issues related to logistics, communication, and the integration of technology.

Ugwu et al.,(2004),This paper provides a comprehensive review of supply chain management in the construction industry. It likely delves into the historical development of supply chain management practices in construction and identifies key challenges. The focus might be on how these challenges impact project performance and delivery.

Fontana and Ferreira, (2013), This research may offer insights into the barriers hindering effective supply chain management in the construction sector. It could delve into both internal and external factors that act as impediments to the seamless flow of materials and information. Solutions or strategies for overcoming these barriers may also be discussed.

Wang et al., (2014), This paper likely introduces a framework for integrating sustainability into supply chain management practices in construction. It may explore how construction projects can align with broader environmental and social goals. The framework might cover aspects such as green procurement, waste reduction, and the use of eco-friendly materials.

Al Marshad and Abdul-Rahman, (2013), Focusing on lean construction, this research likely identifies critical success factors associated with implementing lean principles in supply chain management. The paper may explore how lean practices, such as just-in-time delivery and waste reduction, can be effectively integrated into the construction supply chain for improved efficiency and cost-effectiveness.

"Digital Transformation in Construction Supply Chains: A Literature Review", Addressing the role of technology, this review may explore how digitalization is transforming construction supply chains. It could cover topics such as Building Information Modeling (BIM), real-time tracking, and data analytics for improved decision-making and efficiency.

Environmental Impact Assessment of Construction Supply Chains, Focusing on sustainability, this literature review could assess the environmental footprint of construction supply chains. It might explore methods for evaluating and mitigating the ecological impact of construction materials, transportation, and waste management.

"Resilience in Construction Supply Chains: Lessons from Recent Disruptions", In the context of recent global disruptions (like the COVID-19 pandemic), this review might analyze the resilience of construction supply chains. It could discuss strategies for building resilient supply chains capable of adapting to unforeseen challenges.

Ethical Considerations in Construction Supply Chains", This paper could discuss the ethical dimensions of construction supply chains, considering issues such as fair labor practices, responsible sourcing of materials, and the social impact of construction projects on local communities.

The Role of Blockchain Technology in Construction Supply Chains, Examining emerging technologies, this review might explore how blockchain can enhance transparency, traceability, and security in construction supply chains. It could discuss practical applications and potential benefits. Quantitative Analysis of Supply Chain Performance in Construction Projects, This research might utilize quantitative methods such as surveys, statistical analysis, and modeling to assess the performance of supply chains in construction projects. It could involve collecting data from various projects and stakeholders to identify patterns, correlations, and key performance indicators.

Case Study Approach to Evaluating Lean Supply Chain Practices in Construction, A case study methodology could be employed to deeply investigate the implementation of lean supply chain practices in specific construction projects. This approach may

involve in-depth interviews, on-site observations, and analysis of project documentation to provide a rich and contextual understanding.

Qualitative Inquiry into Barriers to Information Sharing in Construction Supply Chains, A qualitative research design may be employed to explore the barriers to information sharing within construction supply chains. This could involve interviews, focus group discussions, and content analysis of documents to capture the perspectives and experiences of stakeholders.

Mixed-Methods Analysis of Sustainable Practices in Construction Supply Chains, This paper may employ a mixed-methods approach, combining both quantitative and qualitative methods to explore sustainable practices in construction supply chains. It could use surveys to gather quantitative data and interviews to provide deeper insights into the motivations and challenges of implementing sustainable practices.

Survey-based Analysis of Stakeholder Collaboration in Construction Supply Chains, Using a survey methodology, this research might gather data from a broad sample of stakeholders in the construction industry to assess the level of collaboration within supply chains. Survey questions could cover areas such as communication effectiveness, trust, and shared goals.

Comparative Analysis of Supply Chain Management Practices in Construction Across Countries. This study may adopt a comparative analysis approach, examining supply chain management practices in construction across different countries or regions. It could involve collecting data from construction projects in diverse settings and identifying variations in practices and challenges.

3. Research Methodology

A descriptive research method was adopted in this research by using a well-structured questionnaire for data collection. The data collected to determine the major factors which affect project delays was done through a survey by explorative questionnaire to the respondents involved in daily activities of construction firms.

The questionnaire was planned and designed so that respondents can give the rank to their answers based on their opinions. The analysis of these data was done by a ranking method named the relative importance index (RII) method.

4. Barriers in Implementation of Supply Chain Management

- Lack of guidance for creating alliances with supply chain partners
- Failure to develop measures for monitoring alliances
- Inability to broaden the supply chain vision beyond the procurement or product distribution to encompass
- Larger business processes
- Inability to integrate the company‟s internal procedures
- Lack of trust inside and outside a company
- Organizational resistance to the concept
- Lack of integrated information systems and electronic commerce linking firms
- Lack of suitable organizational setup

5. Conclusion

Supply chain management (SCM) is a great opportunity for the construction industry primarily to reduce cost and time, and thus improve profitability. SCM principles seem to have much strength to smoothen and integrate the construction processes. The supply chains in construction could be divided into two major groups as materials chain and the construction chain, which would help to separate the procurement and management operations. However, both chains are linked through a SCM database, which is further linked with the central project database. This would ensure the smooth flow of information within the different chains and results in increased collaboration within the supply chain partners. Obstacles for supply chain management are found to be poor level of logistical competence, lack of guidance for creating strategic alliances, inability to integrate the company‟s internal procedures, strong project focus as well as the attitudes and traditions in the construction industry.

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