

# GREEN SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION INDUSTRY: A REVIEW

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**Abstract** - Environmental pollution and climate change have turned out to be one of the greatest challenges of the twenty-first century, which have constrained governments and businesses alike to assess the environmental impacts of their activities. The need to green the construction sector has therefore turn out to be critically important. Green supply chain management (GSCM) is considered as an environmental innovation in construction industry. GSCM aims to integrate environmental parameters within the supply chain management. It also helps to reduce carbon emissions and improve environmental performances of organisations. As a result, GSCM has been integrated into the strategic planning of most of the construction organisations. In this paper, a literature review was conducted to study the necessity of green and green concepts on construction industry.

**Key Words:** Green supply chain management, construction industry, green practices, drivers, barriers, etc

## 1. INTRODUCTION

The construction industry practices are criticised mainly due to its negative impacts on the environment such as high energy usage, greenhouse gas emission and waste generation. Subsequently, it is important to reduce the negative impacts of construction activities on the environment reconsidering its traditional supply chain management (SCM) practices. Thus, green supply chain management (GSCM) can be recognized as one of the best solution to resolve the above mentioned issues. Green supply chain management is defined as incorporation of environmental thinking into SCM which includes the product design, material sourcing and selection, manufacturing practices, delivery of the final products to the consumers, and end-of-life management of the product after its proposed life. As a result of increase in competitive and marketing demands and regulatory pressures for environmental concerns, organisations tend to provide green practices in their work practices. Barriers or challenges are also expected to be present in the process of all radical innovations.

## 2. GREEN SUPPLY CHAIN MANAGEMENT

Green supply chain management (GSCM) is defined as incorporation of environmental thinking into supply chain management (SCM). It includes all the stages of the

production process such as design, raw material purchasing, manufacture, delivery and, after its useful life, end-of-life management of the product. Instead of simply attempting to diminish the environmental impact of the supply chain, GSCM involves driving value creation throughout the supply chain organisations to reduce total environmental impact. While the specific goal of GSCM is the reduction of carbon dioxide emissions, it also have other tangible benefits for an organization which includes greater efficiency of assets, less waste production, greater innovation, reduction of production costs, increased profitability, reuse of raw materials perception of added value to the client base and so on. GSCM also shows consideration for the owner's or customer's demand based on green construction theory and supply chain management technology. It involves designers, contractors, suppliers and other entities. The purpose is to make the building products from the design, material acquisition and construction, use to scrap processing during the entire supply chain process, the negative effects on the environment the smallest and highest efficiency of resources.

## 3. GREEN PRACTICES

These are practices that are carried out by firms to minimize the negative environmental impacts associated with their activities. The main objective is to identify the relevant green practices related to each of the supply chain stakeholders.

### 3.1 Green design

Green design is the most important stage, as conclusions made in the design phase will have a serious effect on the lifecycle environment of the project system. The concept of green design diminishes the environmental impact resulting from the establishment of construction design and construction processes. The purpose of green design is to design construction projects in environment friendly manner.

### 3.2 Green Materials Management

Green materials management refers to the elimination of potentially hazardous activities or materials with more environmentally friendly ones. It is divided into two processes which are green materials procurement and green materials selection. The major criteria in materials selection that can be processed in green materials management

include the materials used in construction should be easy to separate, adaptable or useful in streamlining existing processes.

### 3.3 Green transportation

The practices undertaken to minimize the environmental impacts are associated with green transportation. Construction projects usually have a significant amount of transportation activities, which involve both employee transport and material transport. About 6-8% of carbon emissions are caused during a construction project and it is due to the transportation of materials. Therefore transportation strategies such as full-truck quantities and fuel-efficient vehicles are used to minimize emissions.

### Green Construction

Green construction has the purpose of maximising the conservation of resources and reducing construction activities that cause negative impacts for the environment while achieving the goal of savings in the four resource areas such as energy, land, water and materials, in addition to ensuring environmental protection. Resource consumption reduction, waste reduction and emissions reduction are general concepts that are essential elements of green construction.

### 3.4 Green Operation and Maintenance

Green operation and maintenance programmes consists of the following activities such as training, clearance, work application and control to green materials in the project in accordance with environmental needs.

### 3.5 Reverse Logistics

Reverse Logistics is an activity of initiation and design, practice and managing of construction items and material flows. It includes the recycling, reusing, and remanufacturing of materials. Extraction of basic materials, diminished energy usage, and reduced air and water pollution are the major benefits of recycling.

## 4. APPLICATIONS OF GREEN SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION INDUSTRY

Mochamad Agung Wibowo *et al.* (2018) conducted a study on the factors for implementing Green supply chain management (GSCM) in construction industry. This paper proposed a conceptual framework for GSCM implementation in the construction industry. By applying the GSCM perspective, this study contributes to developing a GSCM standard in the Construction Industry. The results showed that GSCM comprises five concepts which include green initiation, green product design, green material

management, green construction, and green operation and maintenance 22 dimensions, and 86 elements.

Naniek Utami Handayani *et al.* (2018) conducted a study on the factors for implementing GSCM in construction industry. This paper proposed a framework for the implementation of GSCM in construction industries. The framework includes the concepts and the dimensions of the GSCM model that was adapted from manufacturing industry. This study is rooted in a background of managed SCM in construction that has increased efficiency and productivity in construction projects. These benefits can be obtained in the construction industry by reducing waste, energy used, and negative impacts on the environment. The concepts of GSCM in construction include green initiation, green design, green materials management, green construction processes, and green operation and maintenance. These concepts can be integrated throughout the project life cycle from the initiation phase to the operation and maintenance phase.

Reshma Raju E. *et al.* (2016) conducted an investigation on Green Supply Chain Management in the Construction Sector within Maharashtra. The study gives a vision on the importance of green supply chain management and identifies the various drivers and challenges in implementing GSCM practices in construction industries. In terms of barriers, the most important were lack of resources and short term planning, followed by problems on access to information and expertise, together with lack of government pressure. Few measures are suggested to eliminate or help to reduce the intensity of the barriers in Indian construction sector. The structural model developed will help to understand the interdependence of barriers. Keeping these factors aside there are few positive factors like cost benefit, image improvement, reduction of environmental risks, reduction of waste that can help to implement GSCM practices in the construction industry.

Yuanzhi Xing *et al.* (2017) conducted a study on the concepts of green supply chain management and evolution game theory, and pointed out the characteristics of green supply chain management in construction. This paper established the evolutionary game model between construction enterprises and recycling enterprises for the green supply chain closed-loop structure. The waste recycling evolutionary stability equilibrium solution is obtained to explore the principle and effective scope of government policy intervention. This paper put forward the relevant counter measures to the green supply chain management in construction recycling stage from the government point of view. The conclusion has reference value and guidance to the final product construction enterprises, recycling enterprises and the government during green supply chain.

Ankita Wyawahare *et al.* (2017) developed a conceptual framework for successful implementation of Green Supply Chain Management in construction organisations by

conducting a comprehensive literature review on GSCM. The main barriers for implementing GSCM are identified as technology, knowledge, finances, outsourcing and management. The main strategies to improve GSCM practices in construction organisations include commitment of top management, changes in existing policies and technologies, improve the awareness of environmental issues, training, education and implementation of most efficient materials and waste management systems.

Moon Gyu Kim *et al.* (2015) investigated a supply chain comprised of a major construction firm and 106 suppliers in Korea. The result shows that the suppliers self-evaluation scores of environmental capability are higher than the contractors evaluation scores. From both evaluators, suppliers received the lowest scores in the evaluation item rating the relationship with second-tier suppliers and the highest in the evaluation item rating the relationship with the contractor. The consistency between the suppliers and contractors evaluation is related to several characteristics of suppliers, such as industry type, firm size and partnership duration with the contractor.

Sreejith Balasubramanian *et al.* (2017) conducted a comprehensive green supply chain management oriented understanding of the construction sector through the context of the UAE construction sector and incorporating inputs from all key stakeholders including Developers, Architects or Consultants, Contractors and Suppliers. The study contributed for improving the efficiency and effectiveness of greening of the construction sector. The qualitative assessment of this research was based on only 31 interviews. Therefore, the empirical generalisations drawn are indicative rather than conclusive, and the qualitative assessment of the relationships is more intuitive than statistically based.

Se-Hak Chun *et al.* (2014) investigated how Green supply chain management activities of small and medium enterprises can be different in their green management activities across the process stages of their supply chain network. The results show there are correlations between upstream and downstream processes and also there was no significant difference between green purchase and production processes. However, there were significant differences between green purchase and other processes such as green logistics and green reuse.

Elizabeth Ojo *et al.* (2014) conducted a study on green supply chain management practices in construction industries in two countries, South Africa and Nigeria. This paper gives an insight on the importance of green supply chain management in construction industries, how it has improved the economy of developed countries like UK, USA, China etc. Also, it has compared GSCM in Nigeria and South Africa, and it was discovered that though there have been few literature review on South African Construction supply chain, much has been said about green supply chain

management and handful was found in any literature about Nigeria. This lack of literature, has pointed out that there is a need of green supply chain management in South Africa and Nigeria Construction firms.

M. M. G. Elbarkouky *et al.* (2013) developed a framework for Identifying essential GSCM requirements for the construction industry through literature review and interviews with experts by pointing out the various drivers and barriers of GSCM in developing countries and providing recommendations for improvement. Two case studies are presented to evaluate the GSCM practices performed in two construction companies in Egypt, identifying the drivers and barriers as well as suggesting proposals that will improve the efficiency of the companies environmental performance. The findings of the study indicate that the drivers of implementing GSCM in Egypt include ISO 14001 certification and market competitiveness, while the main barriers include lack of regulations, lack of government support, and lack of society pressure. It also indicates that the implementation of GSCM in Egypt can be achieved through coordination between various parties such as governments, owners, manufacturers, consultants, contractors, society and NGOs and universities.

Pankaj Srivastav *et al.* (2013) conducted a study in the construction industries which lead to find out the general view of green supply chain management in north India. The study was developed to improve the consciousness of green supply chain management. A review which focuses on the construction materials movement from the suppliers to the builders leads the north Indian construction companies. The study shows that most of the replies from the north India have awareness about the environmental inference of their activities. One questionnaire is used to examine the condition of the replies from the north India based on the green purchasing activities. Companies from north India have been implementing GSCM and co-operating with their suppliers. The pressures for GSCM are different for the companies from the north India. In addition to this, the problems met in the research were calculated and possible openings for future research are proposed.

Elizabeth M. Ojo *et al.* (2015) conducted a study on Green supply chain management practices in Nigerian construction. Responses collected through survey study from 35 respondents. This shows that construction firms in Nigeria are aware of the benefits of green supply chain management in construction. Also they are aware about that supplier need to be environmentally compliance and certified to a recognized body like ISO 141. The main problem is Nigerian construction firms are not facing issue of making law, rather it is implementation problem. Proactive industries usually have greater implementation of environmental practices that is beyond the requirements of laws and regulations. The reactive industries only seek compliance with regulatory requirements. Government,

regulation bodies like professional body must rise up to their duties and must ensure implementation of law. This study also provided a valid reason to green the construction industry and ample reason for Nigerian construction industry to adopt GSCM.

Mohammed A. I. Chowdhury *et al.* (2015) researched a study based on literature review of GSCM practices in the construction industries that highlights for the cost effective and easy to implement to achieve environmental sustainability. The adoption of GSCM practices in Bangladesh construction industry has a lot of barriers and most of the companies not responding positively. The overall green practices in Bangladesh are below the satisfactory level based on EPI ranks. However, the present green initiative taken by the Government will lead to future practice of green SCM. This study gives the benchmark to further research, to find out relationship between GSCM practices and construction industry for improving sustainability.

## 5. CONCLUSION

Construction activities are not eco-friendly and it contributes significantly to environmental deterioration in many countries. The environmental impact of emissions, energy usage and poisonous by-products from the production process and the end product is very immense. Supply chain management is a great opportunity for the construction industry primarily to reduce cost and time, and also it improves profitability. SCM principles seem to have much strength to integrate and smoothen the construction processes. The way to improve the construction supply chain delivers projects is necessary to achieve customer fulfillment, ecological efficiency, effectiveness, adequacy and benefit. Green Supply Chain Management improves the economic and environmental performance of an industry. In order to ensure the effective joining of environmental and supply chain management, it is important to perform the evaluation of GSCM. Evaluating supply chain sustainability can be useful and applicable for managers to make more informative and reliable decisions in anticipated changes of construction markets, since the competitive and global dimensions of GSCM are important.

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