A Framework of Green Contruction Supply Chain

(Case Study in Project Renovation Stadium Gelora Bung Karno, Indonesia)

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Abstract*— The construction company in a highly competitive environment are trying to survive by continuing to find ways to create efficiencies and cost-effectiveness, innovation, expertise and timely execution of work. Green Contruction Supply Chain Management has an important role in driving competitive advantage through the performance that takes into environmental factors to provide sustainability in long-term. The purpose of this study was to analyze the Framework of Green Construction Supply Chain Management (GCSCM). The research methodology used the qualitative approach. The data collection will be taken through interviews and observations on key informants and then analyze the data and draw conclusions by reduction. The study highlights that a the framework model of green construction supply chain in project stadium Gelora Bung Karno which are defined by three phase. The first phase are called "resource" or input with consisting of the needs of the client, master plan project and financing. The second phase are a process. The process consisting of tender, design and construction. The last phase is the "result" or output of the work consisting with handover and maintenance. Green Supply Chain Management in the construction company can improving managerial effectiveness in achieving the goals of construction projects for the creation of strategic value and also important factor that could determine the sustainability of the company

***Keywords*—** *Supply Chain Management, Green Supply Chain Management, Contruction*

1. Introduction

Currently, Indonesia is among the most progressive countries in the construction of the world, making it a large and calculated construction market in the world. This is because Indonesia is a country with a vast territory, varying geographic and landscape conditions, the population of which is among the world's highest population groups, high urban growth rates. In the implementation of infrastructure today, an important aspect that is also the focus of attention besides the economic, social and cultural aspects is the environmental aspect. Few industries use environmentally friendly technology, because entrepreneurs are more likely to focus on making a profit than saving a costly environment. At the same time maintaining the environment is very important because without the environment will not be biased to do exploration and exploitation to reap the benefits. In this case the construction sector is required to contribute to reduce waste / waste (waste) of construction products, to the application of the concept of green (Green Concept).

In the construction sector, an understanding of the importance of environmental safety is also increasing through the implementation of green infrastructure development or better known as sustainable construction. Therefore, the world of construction services in Indonesia is pushed to the inevitable situation to implement sustainable construction through the implementation of green supply chain construction. Businesspeople relating to construction services must inevitably consider the integrated application from upstream to downstream due to market demand that has been heavily committed to the implementation of sustainable construction. In the research of [1] disclosed that some construction companies use Green Supply Chain Management strategy to gain competitive advantage. While research [2] explained in the development of Construction Supply Chain Management need to consider the specific characteristics and local conditions of the supply chain construction and supervision. The Green Construction Supply Chain Management strategy is required for organizational efficiency and effectiveness.

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2. Literature Review

2.1. **Supply Chain Management (SCM)**

SCM covering all organizations and activities relating to the flow and transformation of goods from the raw material stage, to the end user, as well as the flow of related information. The concept of supply chain management sees that logistics concepts are inadequate in an attempt to achieve the optimum flow, so it needs to be extended beyond the organization's boundaries upstream with its suppliers and downstream with its customers [3]. Another opinion explains that Supply Chain Management is a supply chain covering all activities related to moving goods from the raw material stage to the end user [4]. Supply Chain Management represents a significant change in how most organizations view themselves. Traditionally, firms viewers as having customers and suppliers. Historically, a firm did not consider the potential for either its supplier or its customer to become a partner. According to [5] supply chain management describes the coordination of all supply chain activities, starting with raw materials and ending with a satisfied customer. Thus, a supply chain includes suppliers: manufacturers and / or service providers; And distributors, wholesalers, and / or retailers who deliver the product and / or service to the final customer. Furthermore [6] define A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also the transporters, warehouses, retailers, and even customers themselves. In the flow of supply chain there are usually three kinds of flow that must be managed by the company that is flow of goods flowing from upstream (downstream) to downstream.

2.2. Construction Supply Chain Management (CSCM)

Contractor is a construction organization that provides construction work services based on technical planning and specifications that have been established. Nowadays there are growing organizations that act as contractors, ranging from individual companies to large companies with large numbers of workers. Supply chain in the construction industry is very complex, so that the supply chain system that occurs in the production process also becomes very complex. The supply chain management pattern of construction will also contribute to the efficiency of a project implementation, so that construction supply chain management has the potential to become one of the possible spaces for improvement in the construction industry.

In the context of construction where fragmentation is already part of the industry's characteristics, an improvement that can be made is through the management of relationships to the organizations involved in a supply chain management arrangement that produces certain construction products. Thus, it is necessary to do a good supply chain management so as to reduce the futility (inefficiency) and optimization of value achievement in its supply chain, so that the services provided in accordance with the needs and provide customer satisfaction.

2.3. Green Contruction

Green construction is planning and managing a construction project in accordance with the contract documents in order to minimize the impact of the construction process on the environment. Green construction according to [7] is the planning and management of construction projects so that the influence of the construction process on the environment to a minimum. The contractor must play a proactive role in the environment, always improving efficiency in the construction process, energy conservation, water utilization efficiency, and other resources during the construction period as well as minimizing and managing construction waste well. Green construction only because of the requirements contained in the contract documents. The contractor builds on the development of sustainable development. The instrument used to assess green construction is called the Green Contractor Assessment Sheet covering the following:

a. Appropriate land use,
b. Efficiency and energy conservation,
c. Water conservation,
d. Environmental management of construction projects,
e. Source and material cycle,
f. Health and comfort within the construction project site.

Each of these activities has the potential to have a negative impact on the environment, therefore efforts to improve this green performance need to be implemented at a broader level, ie in the supply chain level.

2.4. Green Supply Chain Management (GSCM)

GSCM aims to maximize overall environmental benefits by adopting lifecycle approaches through product design, material selection, manufacturing, and sales and recovery. [8] defines GSCM as the way in which innovations in supply chain management and industrial

purchasing/ manufacturing consider environmental issues. The greening of supply chains is based on green innovation processes along the entire chain in two organizational phases: design and realization. According to [2], the main challenge in greening is the necessary resources and capabilities (i.e. material, information, know-how and other resources) and actors in the supply chain. In this chapter, the actors are also referred to as 'resource holders', as they dispose of resources.

GSCM involves the traditional practices of supply chain management that are integrated with environmental or environmental criteria in every decision to buy products as well as long-term relationships with suppliers [9]. The green supply chain seeks to limit waste in industrial systems to save energy and prevent the disposal of hazardous materials into the environment. Accordingly, the GSCM is concerned with efforts to improve the environmental performance of a purchased or held goods / services supplied by the supplier [10]. In practice, there are two types of GSCM, which use a product-based approach and a process-based approach. The product approach seeks to modify the purchased product or its by-product, for example by reducing packaging, reducing hazardous materials, and accommodating the recycle receipt of the product.

Green Supply Chain Management improves operational work by using environmentally conscious solutions:

a. Increased acceleration: GSCM helps to reduce risk and accelerate innovation;
b. Improve adaptation: GSCM analysis often results in innovative processes and continuous improvement;
c. Promote alignment: GSCM involves policy negotiations with suppliers and customers, resulting in better alignment of business processes

Adding the Green concept will lead to the involvement, influence and relationship between SCM and the natural environment [6]. According to [11] there are several factors that influence green supply chain management: leadership, coordination, competency and commitment of supplyers.

2.5 Green Contruction Supply Chain Management(GCSCM)

According to Xue et al., (2005), GCSCM is defined as coordinating inter-organizational decision making in supply chain construction and integration of key business processes of construction and key members involved in CSC, including clients / owners, designers, general contractors, subcontractors, suppliers, Etc. The main purpose is to improve the construction performance and value of clients at less cost. Supply chain management has its beginnings in physical distribution and logistics, and has recently concentrated on the close relationship between parties involved in the flow of goods from suppliers to customers. Relationships must go beyond the exchange of materials or services for pricing toward objective alignment.

The construction industry can be realized as a product of construction, production and construction of construction products. The construction industry plays an important role in shaping society's physical environment: its output is used for production, commerce and shelter, and for providing vital utilities. Given the size of resource consumption in construction implementation and environmental impacts and risks, it is important to implement green construction concepts aimed at making construction processes and construction products more environmentally friendly.

In a construction activity, there are many parties involved with many interrelated activities. Therefore, it can be interpreted that in this sustainability objective can not be achieved only by contractor business, but each party must contribute in achieving sustainability objectives, so that green concept needs to be applied in a wider scope, that is in supply chain, plus 70% cost Construction is used for the purchase of construction materials. Green Construction Supply Chain Management (GCSCM) is more concerned with the coordination of discrete quantities of materials (and associated specialty engineering services) delivered to specific construction projects. e organization and sourcing of materials is becoming increasingly complex across the global construction industry. The concept of supply chain in the construction industry is very useful to see how far the performance of the industry is. This is highly suited to the economic approach of industrial organizations which states that the structure of the supply chain and the behavior of the parties in the supply chain will affect the performance of the supply chain [13].

Based on the above description, the concept of supply chain in the world of construction is very influential on the improvement of project performance. By designing the right supply chain pattern, it is expected that each supply chain actor can contribute greatly to the efficiency and productivity of the implementation of its activities so as to assist the housing construction services industry which is experiencing a very tight level of competition.

3. Methodology

This study uses postpositivism paradigm. Reality, comes through the reduction of the way a person sees something. Postpositivism views social reality as something holistic / intact, complex, dynamic,

meaningful and symptomatic relationships are interactive. Research is done on a natural object. A natural object is an object that develops as it is, not manipulated by the researcher and the presence of the researcher does not affect the dynamics of the object.

The type of this research is descriptive research with qualitative approach, where the focus of research is still emergency / tentative, all the variables studied will be measured by interactive data analysis from [14], primary and secondary data types, informant data source, activity and documentation While the technique of collecting data by interview, observation and documentation study.

4. Result & Finding

4.1. Result

Based on the results of interviews and field studies found the concept of Green Construction Supply Chain in the Project are as follows:

4.1.1. Green Design

The concept and design stage is the foundation in every construction project. This stage also affects costs to project performance. The purpose of green building concept at this stage is to minimize the impact of development, from implementation to the use of buildings. When this stage is not efficient, it will have adverse effects on the environment. For example the use of building materials is very much or waste. The project design created on this project refers to the use of environmentally friendly materials and energy. In addition, the efficiency of funds is also one of the things that are quite a concern. Some designs related to eco friendly design include:

a) Improved roof structure design that refers to environmentally friendly design
b) Design for lighting using solar panels, so it can be energy efficient
c) Rainwater utilization system for main stadium watering
d) Use of water-saving systems for plumbing

4.1.2. Green Procurement and Purchasing

In the field practice related to procurement and purchasing in material purchases, contractors:

a) Focus on environmentally friendly products on the supply side (eg product design for dismantling and recycling);
b) Focus on selecting suppliers that deliver environmentally friendly products more environmentally friendly (eg reduction of supplier waste, ISO certificate);

4.1.3. Green Transportation and Warehouse

In this project Green transportation deals with:

a) Optimization of route / quantity / capacity in material delivery
b) The use of modes of transport that pay attention to fuel economy and exhaust gas emission reduction.

Green warehousing in projects related to:

a) Optimizing the amount, capacity, layout, and material handling in warehousing.
b) Controlling the movement of goods and documents to improve the efficiency of warehouse usage so that the number and timeframe of goods is kept at minimum or as planned.

4.1.4. Green Construction

In the process of implementation of construction that refers to the use of environmentally friendly materials and energy and the use of resources that are effective and efficient. This is done in relation to construction efficiency such as:

1. Material Efficiency

Contractors strive to make material efficiencies used for major venue stadium improvements. In the development carried out the efficiency associated with using materials that fit the needs, no more and not less on civil works, architecture, Mechanical and electrical. In addition, the contractor focus on implementing development that refers to the design with the concept of green building that has been made. Besides, it is also endeavored the use of recycle material for development cost savings.

2. Energy Efficiency

In the development process also pay attention to energy efficiency. Energy efficiency in buildings related to the use of energy-efficient electricity is the use of solar panels. Electrical installation system in the main stadium vanue is also designed more effectively and efficiently.

3. Water Efficiency

Implementation of the development also pay attention to the efficiency of water usage is related to how to get water and its environmentally friendly management. For example to get water can with rain water tandon. In this project also made the rain water utilization system for stadium watering and the use of water-saving system for plumbing.

4. Efficiency of Structure Design and architecture

In the implementation of the work in the project carried out efficiency related to the design of structures and architectures in the form of roof structure improvements that pay attention to green design. Besides it is related to the work of architects are also carried out some renovation

work that still pay attention to the integrity and preservation of buildings because the building Gelora Bung Karno stadium entered the cultural heritage buildings.

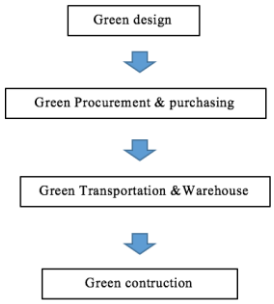

Figure 1. Model Green Construction Supply Chain di Proyek

4.2. Findings

GCSCM is defined as the coordination of inter-organizational decision making in the supply chain construction and integration of key business processes of construction and key members involved in CSC, including clients / owners, designers, general contractors, subcontractors, suppliers, etc. The main objective is to improve construction performance. In addition GCSCM implementation objectives for resource saving, pollution reduction and economic effects. In today's infrastructure implementation, an important aspect of focus is the environmental aspect. The construction sector is required to contribute to reduce waste / waste (waste) from construction products, to the application of green concept (Green Concept). Green Concept is born from a human consciousness or reflection in order to extend the life of human life on earth for the sake of the next generation. In the construction sector, an understanding of the importance of environmental safety is also increasing through the implementation of green infrastructure development or better known as sustainable construction.

The result of the research is Green Construction Supply Chain Model as in figure 2

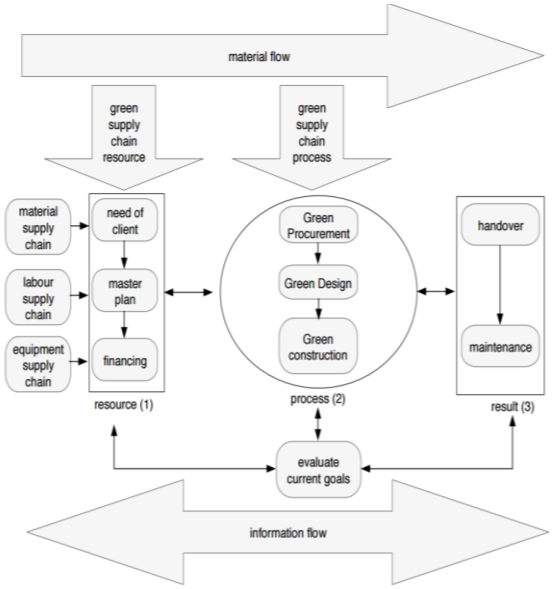

Figure 2. Model Green Construction Supply Chain

Model for Green Construction Supply Chain consisting of Green Supply Chain Resources, Green Supply Chain Process and result.

1. Green Supply Chain Resources

The basic principle in the first chart is a decision-making process related to the needs of the client, master plan and financing and supported by the supply chain material, labor supply chain and equipment supply chain sufficient to achieve organizational goals. At this stage also supported by: Material, Labor and Materials.

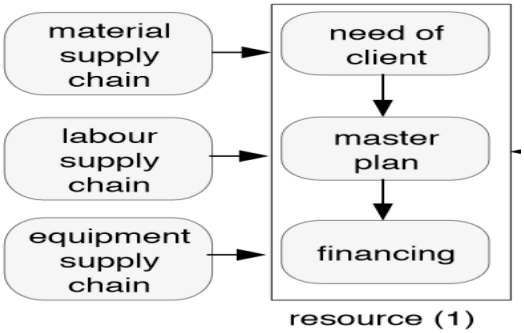

Figure 3. Step 1. Resources

Aspects that exist in the resource chart must be interconnected between one aspect with other aspects. So that will be achieved organizational goals related to green supply chain

***2.* Green Supply chain Process**

In connection with the stages of the process there are 3 things that must be considered are:

a. Green Procurement

Green procurement is the process of procuring and purchasing goods and services that are environmentally friendly. The purchase of goods and services is expected to give minimal impact to

the environment and pay attention to environmental aspects. In the procurement of goods and services in the construction is encouraged to remain concerned with the sustainability and environmental sustainability through environmentally friendly procurement system. The product life cycle and its ecological impact through production, operation, maintenance and disposal are all considered in green procurement. Similarly to product choices, service providers are selected with ecological considerations, including commitment to the use of less harmful and environmentally friendly products and practices to deliver.For example the purchase of building materials conblock, which is selected using plastic waste recycling raw materials. In addition, concrete material, selected concrete that the manufacture does not use the composition of cement in large quantities but using rice husk ash so as to save costs and environmentally friendly. Green procurement and the sustainability of related supply chains require coordination and collaboration with internal and external supply chain partners to retest delivery, product, packaging and measurement method

b. Green Design

Green design relating to construction designs that focus on the efficiency of energy use so as to impact the environment. The purpose of green building concept is to minimize the impact of development, from the implementation to the use of buildings.Programs related to green design, for example:

- Designs that support environmental legislation and regulations
- Design with the use of environmentally friendly materials and energy

c. Green Construction

Associated with green construction there are several things to note that is:

1. Green Purchasing

Associated with green purchasing in material purchases, contractors

- Focus on adjusting demand for environmentally friendly products on the supply side (eg product design for dismantling, recycling);
- Focus on improving environmental performance by choosing suppliers that deliver environmentally friendly products more environmentally friendly (eg reduction of supplier waste, ISO certificates);
- Companies focus on working with suppliers to improve green performance (eg joint planning activities, supplier development with focal materials).

Green Purchase for companies to realize programs designed to improve environmental issues and to improve financial performance, in line with GSCM to build action on environmental issues in such a field understood as making and implementing purchasing policies, selecting / evaluating / developing suppliers, logistics , Packaging, 3R, and waste treatment [15].

2. Green Transportion

Eco-friendly transportation facilities is one of the efforts to create sustainable transportation development that also support the sustainable development process. Sustainable transportation facilities (Green Transportation) increasingly prevalent encouraged to reduce air pollution that increasingly growing and threaten the life of human life. Air pollution generated from the use of fuel is not environmentally friendly is one contributor to the development of global warming kris. Environmentally Friendly Transportation can be applied such as the determination of the policy for the amount of transportation available in an area by looking at the carrying capacity of the environment to receive pollution from motor vehicles. In addition, Green Transportation is also related to the optimization of route / number / capacity as well as green transportation modes.

3. Green Warehousing

Green warehousing deals with how to optimize the amount, capacity, layout, and material handling.

4. Green Instalation

Associated with green installation of a process of installation / construction that has a system and energy friendly to the environment and human health. For example related to:

a. Procurement Energy-efficient energy systems.
b. Use of solar panels
c. Green Roof Installation
d. System Making utilizes rainwater
e. Manufacture of Waste Recycling System

An important role of this total engineering and practice is to have a concern for improving the energy efficiency of buildings, with parameters prescribed for buildings with consequences of saving energy resources, which support the reduction of environmental consequences

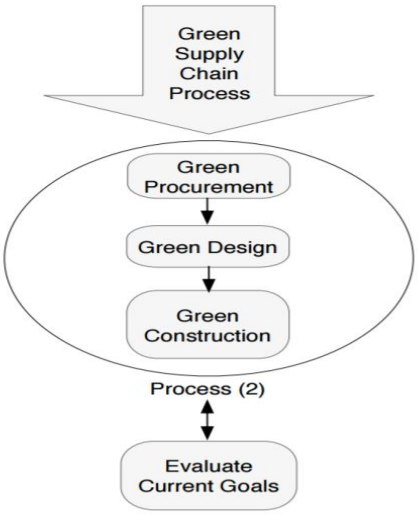

Figure 4. Step 2. Process

3. Result

In the Result phase consists of:

a. Handover

At the end of the implementation of the construction of the handover of work to the client. In the process of handover of the work must be transferred knowleged associated with the operation of the system built for example related to mechanical and electrical systems in the building to the client.

b. Maintenance.

This stage is the stage of maintenance and maintenance of construction results. In this process the repair of damage to the building and maintain the condition of the building to function properly. This work consists of 2 types of prevention and improvement both planned and unplanned. Maincenance focuses more on engineering service work, ie mechanical or plumbing work, electrical work and civil works / architects.

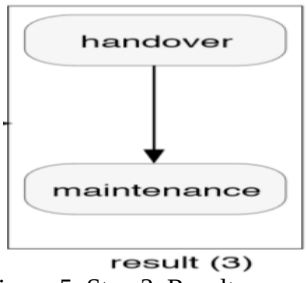

Figure 5. Step 3. Result

5. Conclusion

With regard to Supply Chain Management essentials necessary for successful operation, is improving customer service, achieving an effective balance between cost and service, enhancing the competitiveness of the corporation, increasing flexibility, developing new markets and improving work efficiency. In the supply chain in the field of construction of the supply chain design should be designed according to the conditions of the company. With the implementation of Green Construction Supply Chain Management it is expected that the construction industry becomes more efficient and effective by appropriately utilizing resources, reducing waste and changing the environment more environmentally friendly and spurring workers to be more productive for sustainable supply chain construction.

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