

# Green Supply Chain Management in Construction Industries in South Africa and Nigeria

Elizabeth Ojo, Charles Mbohwa, and Esther Akinlabi

**Abstract**—The trend towards developing green supply chain is now gaining popularity among different industries and research with significant environmental management tools to address these problems. This paper is based on literature review of the green supply chain management practices in construction industries in two countries, South Africa and Nigeria.

**Keywords**— Construction, Green, Supply chain Management

## I. INTRODUCTION

**G**REEN supply chain management (GSCM) has a key role in ensuring that the factors driving the competitive advantage through environmental performance as market expectations, risk management, regulatory compliance and business efficiency are addressed (Zhu et al., 2012). Responsively, manufacturing organizations have begun to implement green supply chain management (GSCM) practices in response to customers' demands for products and services that are environmentally sustainable and that are created through environmentally sustainable practices and in response to governmental environmental regulations (Green Jr et al., 2012).

Management scholars researched organizational environmental practices in 1990s and advocated more holistic and responsible practices in the supply chain (Shi, 2012). Responsively, the GSCM literature has grown considerably over the last decade. Theory and empirical research to date has explored the implementation and effects of such practices as eco-design, cleaner production, environmental purchasing, and green/reverse logistics, on selected performance outcomes, using financial, operational and environmental measures (Wu et al, 2012). Studies on green supply chain management have been carried out at different places (Zhu et al, 2012; Green Jr et al., 2012; Xiao,

2006; US Environmental Pollution Agency, 2000; Wu et al., 2010; Wu et al., 2012).

## II. GREEN SUPPLY CHAIN MANAGEMENT

The definition of Green supply chain management (GSCM) has ranged from green purchasing to integrated supply chains flowing from the supplier, to manufacturer, to the customer and reverse logistics, which is “closing the loop” as defined by supply chain management literature (Zhu and Sarkis, 2004). Green supply chain management (GSCM) integrates environmental thinking into supply chain management, it includes extensive stages from designing a product, material sourcing and selection, manufacturing processes, product delivery, and end-of-life management of the product (Srivastava, 2007, Ojo et al., 2012). Similar to the concept of supply chain management, the boundary of GSCM is dependent on the goal of the investigator. Supply chain management has the potential to make construction projects less fragmented, improve project quality, reduce project duration, and hence reduce the overall total project cost, while creating more satisfied customers. The green supply chain management (GSCM) has emerged as an effective management tool and philosophy for proactive and leading construction organizations (Ojo et al., 2012). Green supply chain management (GSCM) has been adopted as an antidote for a best practice in the construction industry. Green supply chain management aims to maximize the overall environmental profit by adopting a life cycle approach through product design, material selection, manufacturing, and sales and recovery. Therefore, it helps the firm to realize its sustainable development and improvement (Shi et al., 2012). It has become a popular and notable concept in sustainable construction because it largely takes environmental elements into consideration. Others, such as Wu et al., defined Green or sustainable supply chain management as a strategic, transparent, integration and achievement of an organization's social, environmental, and economic objectives in the systemic coordination of key inter-organizational business processes for improving the long-term performance of the firm and its supply chain partners (Wu et al., 2012). The scope of GSCM practices and implementation range from green purchasing (GP) to integrated life-cycle management supply chains flowing from the supplier, through to the contractor, customer, and closing the loop with reverse logistics (Thipparat, 2011). Green supply chain management (GSCM) has a key role in ensuring that the factors driving the competitive advantage

Elizabeth Ojo is with the Mechanical Engineering Science Department, University of Johannesburg, P.O Box 524, Auckland Park Kingsway Campus, Johannesburg, South Africa. 2006 (phone; 0788663668, email; ejoj1978@gmail.com).

Charles Mbohwa is with the Quality and Operations Management Department, University of Johannesburg, P.O Box 524, Auckland Park Kingsway Campus, Johannesburg, South Africa. 2006, (e-mail: cmbohwa@uj.ac.za).

Esther Akinlabi is with the Mechanical Engineering Department, University of Johannesburg, P.O Box 524, Auckland Park Kingsway Campus, Johannesburg, South Africa, 2006. (e-mail: etakinlabi@uj.ac.za).

through environmental performance as market expectations, risk management, regulatory compliance and business efficiency are addressed (Zhu et al., 2012). Responsively, manufacturing organizations have begun to implement green supply chain management (GSCM) practices in response to customers' demands for products and services that are environmentally sustainable and that are created through environmentally sustainable practices and in response to governmental environmental regulations (Green Jr et al., 2012).

GSCM has a huge impact on American industry. Among the Fortune 100 top firms in the United States, 21 of them have published sustainability reports, 44 have published a corporate social responsibility report, and 63 maintain a webpage dedicated to sustainability or the environment (The Sustainable Supply Chain Project, 2007). As the largest retailer in the United States, Wal-Mart has an interesting story of adopting GSCM for their organization. In October 2005, Lee Scott, Wal-Mart's Chief Executive Officer (CEO), committed the company to three goals: to be supplied 100% with renewable energy, to create zero waste, and to sell products that sustain Wal-Mart's resources and the environment. With such strategies and outlines, Wal-Mart launched a business sustainability to reduce the company's impact on the environment, and became the most competitive and innovative company in the world (Plambeck, 2007).

The introduction of the Restriction of Hazardous Substances (RoHS) made a significant impact on how companies manage their hazardous waste worldwide. After July 1, 2006, RoHS regulation limited the amount of lead and five other substances that may be used in products sold in Europe (Jorgensen, 2005). Product Manufacturers, suppliers, distributors and customers were impacted by this new regulation. One change was that suppliers were required to assign new part numbers to all lead-free components. Although it applied only to products sold in Europe, RoHS regulation affected manufacturers from several countries, such as China and Japan, since they needed to comply with the regulation to sell products in Europe. Similar to European RoHS, Chinese restrictions of hazardous substances regulation was enforced on March 1, 2007. At this stage, the regulation was only enforced for electronics and electrical products. Although this regulation is similar to European RoHS, it added, restrictions on packaging, and requirements for production materials and testing certification (Field, 2007). The regulation on hazardous material from electronics and electrical products was not implemented in China alone. Several other countries such as Canada, Japan, South Korea, Switzerland, and Taiwan have proposed similar regulations for electronics products. There are several articles studying the GSCM in China for many aspects such as driving force (Zhu & Sarkis, 2007; Christmann & Taylor, 2001) and the GSCM adoption (Zhu & Cote, 2004; Zhu, Sarkis, & Lai, 2008a).

In the literature, there are studies that point out to the role of GSCM in the construction or manufacturing industries. For example, Hu and Hsu (2006) developed a set of critical factors of GSCM practices that could be used by Taiwanese managers in implementing and adopting GSCM. They surveyed the

electrical and electronics industries in Taiwan. Results showed that there were four critical factors for the implementation of GSCM: (i) supplier management, (ii) product recycling, (iii) organization and involvement, (iv) and lifecycle management. Even though GSCM is relatively a new concept in Southeast Asia as reported by Rao (Rao, 2002). There is, however, one study that investigated the awareness of GSCM in the Southeast Asian countries of Philippines, Indonesia, Malaysia, Thailand, and Singapore. Results showed that GSCM, referred as supply chain environmental management (SCEM), was already adopted by some construction and manufacturing industry. Not only did they held the green awareness seminars in their companies, but most companies also worked with their suppliers either by informing them about the benefits or guiding their suppliers to set up their own environmental program. Another related study, such as Zhu et al. (2005) surveyed 314 Chinese manufacturers to evaluate and describe GSCM drivers, practices, and performance. Results showed that regulatory, competitive, and marketing pressures and drivers were important factors that increased Chinese corporate environmental awareness.

### III. CONSTRUCTION INDUSTRY

The construction industry is one of the most important sectors for the human civilization by improving society's physical environment: its output is used for production, commerce and shelter, and for providing vital utilities (Moavenzadeh, 1994). However, construction usually has a significant and irreversible impact on the environment. Impacts such as the massive use of natural resources, pollution of the environment, and high energy consumption are among the whole supply chain from production of construction materials to the end user (CIEC, 1992). With the increasing need for environmental awareness, the term 'sustainable construction' is becoming popular. According to Wyatt (1994), the sustainable construction should include 'cradle to grave' appraisal, not only in the serviceability of a building during its lifetime, but also the recycling of resources to reduce waste stream associated with the after use.

Material purchasing in the construction industry is the vital process of supply chain management (Muya et al., 1999). According to Ofori (ofori 2000), the increasing environmental consciousness and commitment of businesses, governments, and individuals has inspired the development of procurement and purchasing policies incorporated with environmental requirements. Adding to the sentiments made by Ofori, Hamner and Del Rosario (1998), outlines a set of green purchasing strategy with four principle attributes that must be incorporated in GSCM. Most companies have found that implementing green supply chain management results in not only environmental benefits, but can also enhance quality of product, raise productivity, and reduce the risk of supply chain interruption or damage to reputation (Lippmann, 1999). However, Ballou et al., (2000) cautions that the realization of the benefits is hard even if the benefits of such an approach may be easy to identify.

#### IV. SOUTH AFRICAN CONSTRUCTION INDUSTRY

In line with the global trend, the South African government acting both as a regulator and client is actively promoting an efficient and effective construction industry that uses resources efficiently, reduces waste and transforms the working environment of its people for better employment and productivity (CIDB, 2004; van Wyk, 2004 cited by Shakantu et al., 2007). Despite the pressure on the industry to reform, research reports indicate that construction remains confined to its old ways of doing business. Risk allocation is consistently disproportionate in the supply chain unlike what is obtainable in other industries. While most industries have undergone important transformations over the past three decades, the South Africa construction industry presents an obvious and glaring exception to such trends (Shakantu et al., 2007). The CIDB (2004 cited by Shakantu et al., 2007) posits that the South African construction industry is renowned for its inefficiencies as well as the reluctance of its participants to adopt significant improvements. The CIDB report claims that fragmentation reduces the efficiency of the industry and leads to much rework and wastage downstream. The review of the point is that construction projects in South Africa rely on a diversity of firms with poorly integrated professional and contractor organizations. Each individual firm performs a variety of wasteful activities within its own discipline which creates inefficiencies resulting in substantial delays and costs.

#### V. NIGERIAN CONSTRUCTION INDUSTRY

Amongst others, United Arab Emirate (UAE)'s oil fuelled growth, China's industrial/export driven growth and the resultant construction boom in these economies over the last decade, are all pointers to the high correlation between strong economic growth and the construction industry (Oluwakiyesi, 2011). Nigeria recently crossed the 7% growth rate, and has innate potential to record higher growth. This, coupled with healthy revenues from strong oil prices and increasing investors' interest in bridging the infrastructure deficit brings one question to mind- is Nigeria next in line for a construction boom? (as cited in Construction Industry report, 2011). Across board, be it road/bridges, rail, ports, or real estate, the opportunities are enormous but latent. In real estate for instance, the demand for commercial real estate in Lagos is ever rising – office rent in Lagos ranks 5th highest globally (according to Knight Frank Research as cited in Construction industry report, 2011). More than 70% of the households are single rooms, mostly in urban slums and rural areas. In rail transportation, about 77 million tonnes of goods is transported per kilometre of railway per annum - a far cry from frontier market average of 52.4 billion tonnes. In almost every yardstick of measuring infrastructural development, especially in transportation and real estate, Nigeria lags most peers in the frontier and emerging markets.

Nigeria's operating environment, no doubt, has major constraints, both from a policy and politics point of view. Notwithstanding, Nigeria compares quite commendably relative to the big emerging markets – India, China and Brazil in some key metrics employed by the World Bank to compare general business environment, for the construction industry.

One of such metrics is “dealing with construction permits” in which Nigeria ranks 167th (out of 183 economies) compared to India (177th), China (181th), Russia (182th), according to World Bank 2011 Ease of Doing Business Survey (The Global Competitiveness Report 2012–2013).

#### VI. CONSTRUCTION SUPPLY CHAIN

Past research investigates lean production models for application in construction supply chains (Tommelein 1998, O'Brien 1995). There is no doubt that improvements are needed in the handling and distribution of materials to the construction site. According to Muya et al., (1999) there are three types of construction supply chain:

- The primary supply chain which delivers the material that is incorporated into the final construction products.
- The support chain which provides equipment and materials that facilitates construction.
- The human resource supply chain involves supply of labour.

According to Xue et al., (2005), construction supply chain management can be defined as the coordination of inter organization's decision making in construction supply chain and integration of key construction business processes and key members involved in CSC, including client/owner, designer, general contractors, subcontractors, suppliers, etc. Its ultimate goal is to improve construction performance and client value at less cost.

Supply chain management has its beginnings in physical distribution and logistics, and it has recently concentrated on close relationships between parties involved in the flow of goods from the supplier to the customer. Relationships should extend beyond the exchange of materials or services for a price towards the alignment of goals. Handfield and Nichols (2002) define generic supply chain and supply chain management clearly, they say the supply chain encompasses all organisations and activities associated with the flow and transformation of goods from the raw materials stage, through to the end user, as well as the associated information flows. These materials and information flow up and down the supply chain. While, supply chain management is the integration and management of supply chain organisations and activities through cooperative organisational relationships, effective business processes, and high levels of information sharing to create high-performing value systems that provide member organisations a sustainable competitive advantage. This definition identified managing information systems, inventory management, warehousing, customer service, and after-market disposition of packaging and materials as part of the supply chain (Handfield and Nichols, 2002). The network of the supplier consists of all organisations that provide inputs, either directly or indirectly, to the focal firm.

Though the construction process is different from production processes in factories, supply chain management can be useful and effective in construction (O'Brien, 1999). When working effectively and efficiently, modern supply chains allow goods to be produced and delivered in the right quantities, to the right places, at the right time and in a cost

effective manner (Christopher and Peck, 2004). The huge fragmentation in the construction process as evidenced by the lack of integration of its supply chain makes supply chain management a very appealing approach to achieve integration between internal and external supplies designers, contractors, subcontractors and clients (Sepell and Heredia 2006: 457) The model of supply in construction is presented in Figure 1.

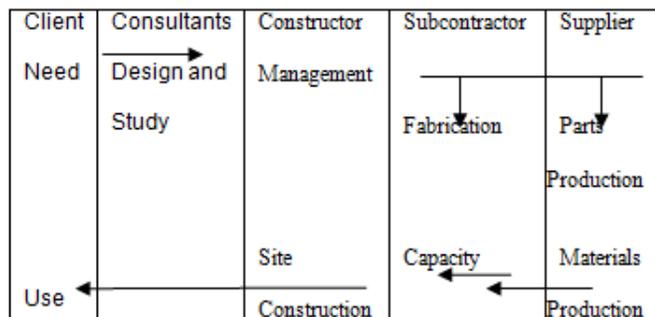


Fig. 1.0 Model of Supply Chain in construction (Adapted from Koskela, 1999).

Information Flow (orders, programs, estimates, procedures, etc.)

Resources Flow (supplies, finished products, equipment, etc.)

From the above Figure, it is evident that a construction firm has as many supply chains as it has construction projects, because for each project, the clients' requirements and the project's characteristics might be different.

## VII. SOUTH AFRICAN SUPPLY CHAIN MANAGEMENT

Over the past decade, the construction industry in South Africa has undergone several changes in the local environment occasioned by the upsurge in contracting activities financed by both public and private sectors of the economy. In Johannesburg, the commercial centre of South Africa (Emuze, 2009). A great number of small firms that specialize in specific construction work such as foundation, earth works, formworks, masonry and finishings are prevalent in the industry. The supply chain management in South Africa construction industry is now a network formed by a great number of heterogenous firms working together on the same project (Emuze, 2009). Most of these firms interact with each other during the production stages. However, in line with the global trend, the South African government acting both as a regulator and client is actively promoting an efficient and effective construction industry that uses resources efficiently, reduces waste and transforms the working environment of its people for better employment and productivity. (CIDB, 2004; van Wyk, 2004 cited by Shakantu *et al.*, 2007).

## VIII. NIGERIAN SUPPLY CHAIN MANAGEMENT

The study of supply chain management in Lagos, Nigeria is relatively new, especially in the construction industry (Olayiwola, 2008). The level of awareness of supply chain management is low in Nigerian construction industry and awareness campaign was proposed to sensitize all stakeholders in the construction industry (Ahiakwo *et al.*, 2012).. The

causes of abandoned project within Nigerian construction industry include: inadequate or poor project planning, variation of project scope, faulty designs and wrong estimates. However, if clients undertook adequate project planning and control of their projects using improved planning process improvement tools that lean techniques offers, the issue of abandoned project would be minimised. Olayiwola stated that there is need to improve supply chain management in the construction industry to improve contractor's profit margin.

## IX. ANALYZING GREEN SUPPLY CHAIN MANAGEMENT IN SOUTH AFRICAN AND NIGERIAN CONSTRUCTION FIRMS

Presently, construction firms in Nigeria and South Africa operate in a very competitive environments and the only way to survive in these business environments is to continuously find a way of creating good records of cost-effectiveness, innovation, expertise and timely-execution of contracts. However, the extent to which these expectations can be met is to have functional, effective GSCM that can translate the strengths and opportunities of their construction firm into what could enhance their competitive advantage, thereby giving a long-term survival and relevance in the industry. It is unarguably evident that SCM of construction companies are part of the key determinants of the level and kind of innovation and cost effectiveness. In the light of recognizing GSCM in construction companies as a critical factor that could determine their survival in the industry, construction companies in South Africa and Nigeria are slowly, but with much disarray trying to follow developed countries. However, one cannot specifically say much about GSCM implementation in Nigerian and South African construction companies because there has not been any empirical study to assess this as well as to provide justification for adopting an effective GSCM while such studies had been carried out in countries like the United Kingdom, China and United State of America. Therefore, there is an urgent need for an empirical study to provide insight into the assessment of GSCM in Nigerian and South African construction companies. This gap in the literature is currently being addressed by the authors.

## X. CONCLUSION

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.

## XI. GAPS IN THE LITERATURE

- Though there are studies on Construction supply chain management in South Africa, but there are a few on Green Supply Chain Management.

- In South Africa, studies have been done on Construction Supply Chain Management, but in Nigeria, literatures are scarce.
- There are many studies on green supply chain management in manufacturing industry, but few in the construction industry.

#### ACKNOWLEDGEMENT

This research is supported by the University of Johannesburg research fund

#### REFERENCES

- [1] Ahiakwo, O., Suresh, S., Oloke, D. and Khatib, J. (2012) Client perspective for the implementation of lean construction in Nigerian construction industry In: Laryea, S., Agyepong, S.A., Leiringer, R. and Hughes, W. (Eds) Procs 4th West Africa Built Environment Research (WABER) Conference, 24-26 July 2012, Abuja, Nigeria, 133-146.
- [2] Ballou, H., Gilbert, M. and Mukherjee, A. (2000) 'New Managerial Challenges from Supply Chain Opportunities' *Industrial Marketing Management*, 29, pp. 7-18.
- [3] Christopher, M. and Peck, H. (2004) Building the resilient supply chain. *The international journal of logistics management*, 15(2), 1-14.
- [4] CIEC (Construction Industry Employers Council) (1992) *Construction and the Environment, Building Employers Confederation*, London.
- [5] Green Jr K.W., Zelbst P.J., Meacham J., and Bhaduria V.S., (2012), "Green supply chain management practices: impact on performance", *Supply Chain Management: An International Journal*, Vol. 17 Iss: 3 pp. 290 – 305.
- [6] Emuze, F.A (2009). The impact of construction supply chain management on the vale projects. A master's degree thesis submitted at school of Built environment, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa.
- [7] Hamner, B., Del Rosario, T., 1998. Green purchasing: A channel for improving the environmental performance of SMEs. In *OECD, Globalization and the Environment: Perspectives from OECD and Dynamic Non-Member Countries*. OECD, Paris, pp. 75-90.
- [8] Koskela, L. (1999) Management of production in construction: a theoretical view. In: 7th annual Conference of the International Group for Lean Construction proceedings, July 1999. California: IGLC, 241-252.
- [9] Lippmann, S. (1999) 'Supply Chain Environmental Management: Elements for Success' *Environmental Management*, 6, (2), pp. 175-176.
- [10] Moavenzadeh, F. (1994) *Global Construction and the Environment: Strategies and Opportunities*, Wiley, New York.
- [11] Muya, M., A.D.F. Price, A. (1999) 'Thorpe, Contractors' supplier management, Proceedings of a Joint CIB Triennial Symposium' Cape Town, vol. 2, pp. 632– 640.
- [12] O'Brien, W. (1995). "Construction supply-chains: Case study, integrated cost and performance analysis." *Proc. 3rd Ann. Conf. Int'l. Group for Lean Construction*, Albuquerque.
- [13] Ofori, G (2000), Greening the Construction Supply Chain in Singapore, Original Research article, *European journal of purchasing and Supply Management*, Volume 8, Issues 3 -4, December 2000, pages 196-205.
- [14] Ojo, E, Akinlabi E.T and Mbohwa C (2012), Benefits of green supply chain management in construction firms – a review, 2nd Nelson Mandela Metropolitan University, Construction management conference
- [15] Olayiwola, M.L.A (undated), The level of awareness and use of ICT in supply chain management in the Nigerian Construction Industry, Procurement of Construction and reconstruction projects in the international context.
- [16] Oluwakiyesi O (2011), Construction report, vetiva capital report.
- [17] Serpell, A. and Heredia, B. (2006) Supply chain management in construction: Diagnosis and application issues. In: *CIB World Building Congress publications*, 455-466.
- [18] Shakantu, W., Tookey, J., Muya, M. and Bowen, P. (2007) Beyond Egan.s supply chain management: advancing the role of logistics in the South African construction industry. *Acta Structilia*, 14(1), 93-115.
- [19] Shi V.G. and Lenny Koh S.C., Baldwin J. and Cucchiella F. (2012) Natural Resource Based Green Supply Chain Management. *Supply Chain Management: An International Journal* Volume 17 No 1 pp 54-67, 2012.
- [20] Thipparat T. (2011) Evaluation of Construction Green Supply Chain Management. *International Conference on Innovation, Management and Service IPEDR* vol 14(2011).
- [21] Tommelein, I.D. (1998). "Pull-driven Scheduling for Pipe-Spool Installation: Simulation of lean Construction Technique." *ASCE, J. Constr. Engrg. and Mgmt.*, 124 (4) 279-288.
- [22] Vrijhoef, R. and Koskela, L. (1999) Roles of supply chain management in construction. In: 7th annual Conference of the International Group for Lean Construction proceedings, July 1999. California: IGLC, 1-10. [www.ce.berkeley.edu/tommelein/IGLC-7/PDF/Vrijhoef](http://www.ce.berkeley.edu/tommelein/IGLC-7/PDF/Vrijhoef)
- [23] Wu J. Dunn S. and Forman H. (2012): A Study on Green Supply Chain Management Practices among Large Global Corporations. *Journal of Supply Chain and Operations Management*, Volume 10, Number 1, February 2012.
- [24] Zhu, Q. H., Sarkis, J. and Lai, K. H. 2012. Environmental management innovation diffusion and its relationships to organizational improvement: an ecological modernization perspective, *Journal of Engineering and Technology Management*, 29 (1), pp. 168-185.
- [25] Wyatt, D.P. (1994) 'Recycling and Serviceability: The Twin Approach to Securing Sustainable Construction. In Proceedings of First International Conference of CIB TG 16 on Sustainable Construction, Tampa, Florida, 6-9 November, pp. 69-78.
- [26] Xiao X. (2006). Green Supply Chain Management in the UK and China Construction Industry. A master's degree thesis submitted at School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ.
- [27] Xue, X., Li, X., Shen, Q. and Wang, Y. (2005) 'An agent-based framework for supply chain coordination in construction' *Automation in Construction* 14: pp. 413-430.
- [28] Zhu, Q. and Sarkis, J. (2004) 'Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises' *Journal of Operations Management*. 22: pp. 265-289.
- [29] Zhu, Q. H., Sarkis, J. and Lai, K. H. 2012. Environmental management innovation diffusion and its relationships to organizational improvement: an ecological modernization perspective, *Journal of Engineering and Technology Management*, 29 (1), pp. 168-185.