

Factors Affecting Green Supply Chain Management Implementation in Construction Industry: Perspective of Contractors

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Abstract: A high volume of carbon emissions as a result of urbanisation alarms the government to look into mitigation strategies. Green supply chain management (GSCM) is one of the initiatives that incorporates the “green” aspect into different stakeholders’ practices and this initiative includes the construction industry. However, the adoption rate of GSCM in developing countries is still at the initial stage and is not moving in line with the sustainable development goals. Therefore, this study aims to investigate the status and factors of GSCM implementation from the perspective of contractors. Semi-structured interviews were employed. Nine contractors who have more than 10 years working experience in the Sarawak construction industry participated in this study and were selected through the purposive sampling method. The data were analysed using the content analysis method. The findings revealed the low adoption rate of GSCM in the Sarawak construction industry and government pressure as the most critical factors that affect GSCM implementation. This study could provide a guideline for the government on the factors upon which to focus to enhance sustainability uptake in developing countries, especially in the construction phase.

Keywords: Green supply chain management (GSCM), Environmental pollution, Construction phase, Contractor, GSCM in Sarawak

INTRODUCTION

Supply chain management (SCM) encompasses industrial production, transportation, distribution and the management of products at the end of their lifecycle (Vermorel, 2020). This management process centres on assessing, analysing and overseeing the production process from raw materials to the final product but does not consider its environmental impact. Moreover, in line with urbanisation, SCM is being criticised as it does not assist in moving forward with the global sustainable development goals (Filho et al., 2023). Global pollution is reaching an alarming rate, with the construction industry contributing nearly 40% of carbon emissions (Architecture 2030, 2021).

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Such high emissions signify the necessity for the construction industry to be mindful of the adverse impacts, such as greenhouse gases, air pollution, construction waste and water pollution, that arise from the expansion of SCM (Eliwa and Ayob, 2020).

To address these issues, green supply chain management (GSCM) offers a comprehensive approach by incorporating environmentally friendly components into SCM (Badi and Murtagh, 2019). The GSCM encompasses sustainable practices that are integrated into both the upstream aspects of SCM (including materials, owners, equipment, transporters, contractors and architects) and the downstream aspects (post-treatment). The aim is to achieve long-term benefits by fostering responsible social and environmental behaviour among all members of the supply chain community (Dadhich et al., 2015). The adoption of GSCM in the construction industry could positively impact its economic performance by reducing construction fines and penalties associated with environmental policies, lowering water expenses, decreasing materials purchasing costs and reducing waste treatment fees (Diab, Al-Bourini and Abu-Rumman, 2015; Balasubramanian and Shukla, 2017a; Petljak et al., 2018).

Malaysia is a developing country that is undergoing urbanisation and this has resulted in an increased negative environmental impact, particularly in the construction sector in which pollution from industrial activities has become a major issue (Khoo, 2021; World Bank, 2022). The construction projects in Sarawak, the largest state in Malaysia, produce approximately eight million tonnes of construction waste per year (Taha, 2015). Illegally disposed of wastes have predominantly been from small construction or renovation projects and such situation has persisted throughout the years (Ikau, Tawie and Joseph, 2012; Moh, 2020). This may be due to the lack of GSCM implementation in the construction industry along with no mandatory government enforcement or compliance (Sun et al., 2022). Challenges exist in GSCM implementation, such as the reluctance of stakeholders to share best practices and ideas in the early stages of a project due to having a competitive advantage (Balasubramanian and Shukla 2017a). Moreover, the expectation of developers for a quick project turnaround time conflicts with the longer processing time required for GSCM, thereby, leading to increased costs for contractors in terms of labour and machinery (Hwang and Tan, 2012). The inflexible deadlines set by stakeholders can also hinder efforts to make the construction sector more environmentally friendly (Balasubramanian and Shukla 2017a). With a high number of construction projects in Sarawak yet limited GSCM implementation, policymakers seem to be alarmed about the amount of construction waste being generated. The illegal dumping situation during the construction phase worries various municipal councils and government.

Therefore, this study aims to examine the factor of implementation of GSCM in the Sarawak construction industry from the perspective of contractors, as the contractor is the stakeholder who is involved in the construction phase of projects, with a large amount of waste being generated during this phase. This study is expected to contribute to the existing knowledge of GSCM from the perspective of contractors in a developing country by considering the unique cultural and geographical factors that might influence the outcomes. This study could increase the motivation of different contractor firms by placing more emphasis on improving the environment and exploring ways to enhance the environmental aspect of the supply chain, leading towards construction waste reduction in the long term. As such, the waste treatment and management expenditures in the construction industry could be reduced, which, in turn, would contribute towards the economic performance of Sarawak.

LITERATURE REVIEW

The connection between the green construction industry and GSCM adoption is vital because the changes in government regulations and citizens' lifestyles lead construction firms to GSCM for more sustainable practices (Saade, Thoumy and Sakr, 2019; Taghavi et al., 2021). Firms must change as the economic–environmental aspect constitutes a significant portion of firm performance (Fang and Zhang, 2018). Jum'a, Zimon and Ikram (2021) provided support that GSCM significantly affects the environmental sustainability of manufacturing firms in Jordan, which, in turn, affects financial performance. This type of finding could be applicable to the construction industry. However, research on GSCM in the construction industry has lagged compared to other sectors, only gaining momentum since the year 2000, with only 16% of the published GSCM literature between 2000 and 2011 related to the construction industry (Badi and Murtagh, 2019). The majority of the papers are focussed on the field of business, management and accounting (Tseng et al., 2019). In terms of geographical locations, the majority of GSCM papers have been based in China (18.6%) and the USA (18.2%), with only 3.8% of the papers from Malaysia.

Previous studies have been conducted in relation to GSCM in the construction industry on the concepts, drivers, barriers and frameworks (Badi and Murtagh, 2019). For instance, Mathiyazhagan et al. (2015) investigated the Indian construction industry and identified government regulations as the most crucial category for GSCM adoption. Somsuk and Laosirihongthong (2017) discovered that government pressure and top management support influenced GSCM adoption in Thailand. This finding was supported by a study by Wibowo, Handayani and Mustikasari (2018) that highlighted the significance of stakeholder pressure in the implementation of GSCM. Balasubramanian

and Shukla (2017a) validated a GSCM assessment framework (inclusion of barriers, drivers and sustainability performance outcomes) in the United Arab Emirates' construction industry. They found that all construction stakeholders benefited from the implementation of GSCM in terms of the economic, organisational and environmental performances. Al-Ma'aitah (2018) found that internal environmental management greatly influenced the Jordanian construction firms' performance to incorporate GSCM practices. Khoo et al. (2019) conducted a systematic literature review on GSCM factors and concluded that financial and cost considerations were the most important among the internal factors, while government regulations were the most important among the external factors.

Mojumder and Singh (2021) identified the adherence to GSCM in the Indian construction industry and discovered that such adherence differs in terms of the size and operational areas of companies through the opinions of senior project managers. Eliwa and Ayob (2020) provided support that GSCM impacted the Malaysian construction industry, but the lack of public awareness limited its implementation. Taghavi et al. (2021) found that external factors have the greatest influence on GSCM adoption. Xie et al. (2022) proposed that the government intervene for the public-private partnership to foster the implementation rate and performance of GSCM in construction firms in China. Table 1 provides a list of factors affecting GSCM adoption based on the literature, with the factors categorised into external and internal factors as suggested by Zhu, Sarkis and Lai (2013).

Table 1. Factors of GSCM implementation in the construction industry

Factor	Source								
	1	2	3	4	5	6	7	8	9
External Factor									
Institutional pressure	✓	✓	✓			✓	✓	✓	
Consumer satisfaction incentives	✓	✓	✓	✓	✓	✓	✓	✓	✓
Competitors' pressure	✓	✓	✓	✓		✓	✓	✓	✓
Support and motivation	✓	✓	✓	✓	✓	✓	✓	✓	✓
Economic benefits	✓	✓	✓	✓	✓	✓	✓	✓	✓
Energy consumption reduction	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regulatory requirements	✓	✓	✓	✓	✓	✓	✓	✓	✓
Community drivers	✓	✓	✓	✓		✓	✓	✓	✓
Globalisation		✓		✓	✓	✓	✓	✓	✓
Public awareness	✓	✓	✓	✓	✓	✓	✓	✓	✓

(Continued on next page)

Table 1. *Continued*

Factor	Source								
	1	2	3	4	5	6	7	8	9
Improve the image of the construction industry	✓	✓	✓	✓	✓	✓			✓
Material management	✓	✓	✓	✓	✓	✓	✓	✓	✓
Internal Factor									
Investment recovery			✓		✓		✓		
Green certification	✓	✓	✓	✓	✓	✓		✓	
Market opportunities	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tendency to maintain current practices	✓	✓	✓			✓	✓	✓	✓
Time consuming and complex	✓		✓	✓	✓		✓	✓	
Company reputation	✓	✓	✓	✓	✓		✓	✓	
Cost factor	✓	✓	✓	✓	✓	✓	✓	✓	✓
Perception of environmental risks	✓	✓	✓		✓	✓		✓	✓
Reverse logistics		✓	✓	✓	✓		✓	✓	✓
Training of suppliers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Environmental performance	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shareholder pressure	✓	✓	✓	✓	✓	✓	✓		✓
Green training	✓	✓	✓	✓	✓		✓	✓	
Eco design	✓		✓	✓	✓	✓	✓	✓	
Organisational performance	✓	✓	✓	✓	✓	✓	✓	✓	

Note: ✓ = Factor exists in the selected source; 1 = Balasubramanian and Shukla (2017a); 2 = Govindan et al. (2016); 3 = Somsuk and Laosirihongthong (2017); 4 = Taghavi et al. (2021); 5 = Wibowo et al. (2018); 6 = Mathiyazhagan et al. (2018); 7 = Khoo (2021); 8 = Zulkefli, Mahmud and Zainudin (2019); 9 = Eliwa and Ayob (2020).

Although multiple studies have been conducted on the factors affecting GSCM implementation, the results have mostly been generalised to all construction stakeholders with no specific reference to particular groups of stakeholders. This seems to indicate a flaw in the previous research that did not address the role of stakeholders (Badi and Murtagh, 2019). Wong, Wah and Wong (2023) investigated the barriers to GSCM implementation in the Malaysian construction industry during the pre-construction phase. However, the study did not discuss the construction and post-construction phases. Green construction aims to minimise environmental harm by conserving resources, such as energy, land, water and materials (Wibowo et al., 2018). It focuses on reducing resource use, waste and emissions. Challenges in adopting green construction practices include limited expertise and awareness, a shortage

of green suppliers and higher costs (Shi et al., 2013). Despite these obstacles, strategies like automated prefabrication, waste sorting, recycling, reuse and advanced machinery have been developed to mitigate environmental impacts. These approaches help to minimise on-site waste generation and landfill disposal (Balasubramanian and Shukla, 2017a).

Moreover, the contractor is the key stakeholder who handles projects and acts as the communication channel through the entire construction phase of the project (Adros and Abidin, 2019). Baranikumar, Bikila and Chala (2021) suggested that systematic waste management taking GSCM into consideration could reduce the carbon and environmental pollution footprint in the construction industry. Moreover, the increasing pressure from various stakeholders, including policymakers, related to environmental concerns has urged contractors to look into GSCM (Banihashemi et al., 2023). However, there seems to be an undiscovered area of the viewpoint of contractors on GSCM implementation during the construction phase in the Sarawak construction industry.

METHODOLOGY

This study adopted a qualitative approach to examine the perception of contractors on the factors affecting GSCM implementation during the construction phase. The semi-structured interview was selected because GSCM is not commonly adopted in the Sarawak construction industry and this method allows the researchers to have in-depth discussions with the interviewees to explore the topic. The previous research adopted similar methods, which indicates its validity (Balasubramanian and Shukla, 2017b). Although focus group discussions could achieve a similar outcome, the difficulties in synchronising a common time made this option unavailable for this study (Flick, 2021).

The purposive sampling method was adopted and the interviewees had to meet two criteria: (1) the contractors must be based in Sarawak and (2) the contractors must have at least 10 years of working experience in the construction field. The interviews were conducted from July to October 2022 and ranged from 20 min to 50 min. Nine contractors based in Sarawak were involved in this study (refer to Table 2). These contractors were from the well-known companies in Sarawak, with eight of them having experience in dealing with GSCM projects in Sarawak. One of the interviewees has not been involved in any GSCM project, but this interviewee was from a major construction firm handling heavy civil engineering construction with multiple involvement in government projects and has substantial knowledge about GSCM. Therefore, it was worth investigating the perspective of this contractor

to examine the reasons for not implementing GSCM in such a prominent firm. Moreover, the small number of GSCM projects indicated by the contractors signified that GSCM is not widely implemented in the Sarawak construction industry. For data privacy and confidentiality reasons, this study did not reveal the names of the companies and the locational details of interviewees were presented as northern and southern regions of Sarawak.

Table 2. Interviewees' details

Interviewee	Geographical Location	Years of Experience	GSCM Experience	GSCM Project	Interview's Mode
R1	Southern	18	No	None	Face-to-face
R2	Northern	20	Yes		
R3	Southern	25	Yes	1–2 projects	Virtual
R4	Southern	12	Yes		
R5	Northern	17	Yes	More than 2 projects	
R6	Southern	13	Yes	1–2 projects	Face-to-face
R7	Southern	16	Yes		
R8	Northern	14	Yes	More than 2 projects	
R9	Northern	12	Yes	1 – 2 projects	

The semi-structured interview questions started with the demographic details of interviewees, including their involvement with green procurement and years of working experience. The interviewees were asked about the status of GSCM implementation and factors that affect its implementation. The interview ceased when two to three interviewees repeated similar points. All interviewees gave consent for recording throughout the interview process and the interviews were transcribed and sent to the interviewees for verification to ensure the reliability of the transcripts. Content analysis was employed in analysing the data. The nodes were created and grouped under similar themes. The process ended when no new themes emerged.

RESULTS AND DISCUSSION

Current Status of Green Supply Chain Management Implementation

Out of the eight interviewees who have experience in dealing with GSCM projects, five were involved in a private project, while three interviewees were involved in a government project. The clients in both types of projects requested the implementation of GSCM. The private projects that involved GSCM implementation were related to the development of residential properties, such as detached, semi-detached and terrace houses (R3, R5 and R9). R7 depicted the experience of constructing a bamboo house on the usage of green materials as instructed by the client. This is supported by a previous study that indicated bamboo to be a green construction material that is quick to assemble and cost effective for construction (Patil and Mutkekar, 2014). The interviewees indicated their involvement with government projects, such as commercial building and affordable housing, with regards to the usage of environmentally friendly products like low e-coating glass.

Undeveloped

Three interviewees reckoned that Sarawak falls under the undeveloped status of GSCM implementation (R1, R2 and R3). The interviewees reckoned that Sarawak is at the initial stage of incorporating “green” elements into the SCM. R1 opined that “Sarawak is only at the beginning stage of GSCM implementation. [I reckoned] only those constructions that engaged internationally will include the environmental protection as required by the regulations for project completion”. Anwar, Rehman and Shah (2018) provided support that firms in developing countries, such as Pakistan, require government consent to access specific resources. A lack of accessibility in acquiring relevant materials may affect firms in moving towards GSCM. Eliwa and Ayob (2020) stressed that most of the construction firms in Malaysia have not adopted GSCM.

Low-to-medium level of implementation

Six interviewees opined that Sarawak currently has a low-to-medium level of GSCM implementation due to the gradual implementation in the government’s planning (R4, R5, R6, R7, R8 and R9). R7 stated, “The Sarawak government and the construction firms concern on green building...University of Technology Sarawak located in Sibu...Hock Seng Lee Tower located at Kuching-Samarahan Expressway”. The interviewee reckoned that Malaysia has no mandatory requirement for construction companies to incorporate GSCM or green standards, which leads to its slow adoption (R5). Saeed and

Kersten (2019) supported that there is slow adoption of GSCM in developing countries by identifying that GSCM has gradually been gaining focus, with more research publications starting from year 2012 onwards.

External Factors of Green Supply Chain Management Implementation

Government pressure

Eight interviewees mentioned that government pressure is the factor affecting GSCM implementation in the Sarawak construction industry. R4 mentioned, “Compliance with government regulations and laws definitely force construction firms to concentrate on environmental aspect in SCM. Suppliers will supply more environmentally friendly and energy efficient products”. Such a finding seems to indicate that the contractors rely on suppliers to supply green materials. Niemann, Kotze and Adamo (2016) stressed that governments should assist in reshaping Mozambican manufacturing firms’ perspectives to improve their environmental performance. In the Malaysian context, the government seems to have made limited efforts on the environmental practices of SCM in mandating construction firms to incorporate green practices (Zulkefli, Mahmud and Zainudin, 2019; Eliwa and Ayob, 2020). Ojo, Mbowe and Akinlabi (2014) offered an opposing viewpoint by stating that government pressure is an ineffective factor on time inefficiency and the coerced levies and/or fees could discourage smaller firms from the uptake of GSCM.

Public awareness

Seven interviewees mentioned public awareness as a factor affecting the implementation of GSCM (R1, R2, R3, R6, R7, R8 and R9). R3 stated, “Public is unaware about environmental impacts which leads to the difficulties to control environmental pollution...human behaviour has strong relationship with the environmental quality”. Ojo, Mbowe and Akinlabi (2014) stressed that low levels of technological advancement limit innovation on green products, which, in turn, restricts public awareness of demand for GSCM. The lack of public awareness and insufficient information on reliable research as well as a lack of education about green practices could hinder the adoption of GSCM. Increasing information and raising awareness among the public is important for driving acceptance and support for green initiatives (Darko and Chan, 2017). Taghavi et al. (2021) provided support that public awareness was the most important factor for the Iranian construction industry in the transition of the traditional system. A higher level of public awareness on the local and international GSCM regulations prompted China to have a higher

rate of GSCM implementation compared to Japan (Zhu et al., 2017). As such, public awareness plays an important role for GSCM implementation in the construction industry.

Improve brand image

Six interviewees mentioned that improving brand image is the factor that affects their decision of GSCM adoption (R1, R2, R4, R6, R7 and R9). R2 stated, “I believe that environmental problem is not the concern of all individual, as individuals are concerned on certain issue that exerted by a variety of pressures. For examples, compliance with government regulations...and company image”. Such a response seems to indicate that if the public accepts GSCM and recognises it as one of the criteria of a firm’s reputation that is important to its selection as the construction firm to carry out the project, this could foster GSCM implementation in the construction industry. Studies have proved that the effectiveness of GSCM in decreasing waste in turn improves the image of firms (Gandhi et al., 2015). A reputable firm could bring publicity and with improved customer satisfaction, the firm’s image could be enhanced through the adoption of green practices (Al-Ma’aitah, 2018; Aslam, Waseem and Khurram, 2019). Mathiyazhagan et al. (2018) offered another viewpoint, stating that Indian construction firms are focusing on profit rather than investment in green practices that could somewhat improve a firm’s image.

Material management

Six interviewees stressed that material management could affect GSCM implementation (R1, R3, R5, R7, R8 and R9). R5 emphasised that the favouritism for green material management decreases the release of pollutants throughout the lifecycle of buildings and infrastructures. Effective material management during the construction phase could ensure minimal energy consumption and toxic emissions generation (Wibowo et al., 2018; Mathu, 2019). Such material management could assist the effectiveness and productivity of construction firms in their operations (Iqbal, Kang and Jeon, 2020). Various strategies have been developed to mitigate the negative impacts of construction, including implementing waste sorting and recycling practices, promoting reuse and utilising high-performance machinery (Balasubramanian and Shukla, 2017a). However, such innovative adoption of GSCM comes with high capital costs inclusive of the procurement of green materials (Lin et al., 2020). This seems to point out that green material management affecting the GSCM adoption rate is yet limited by high capital cost.

Internal Factors of Green Supply Chain Management Implementation

Eco-design

Seven interviewees reckoned eco-design as the internal factor influencing GSCM implementation in the construction industry (R1, R3, R4, R6, R7, R8 and R9). R5 stated, “Indirect economic benefits from eco-design, including the usage as a promotional tool and its ability to inspire new product ideas”. Rahman, Ho and Rusli (2014) identified that eco-design is beneficial in the design of new green products and increases the competitiveness among Malaysian construction firms. Younis, Sundarakani and O’Mahony (2020) indicated that eco-design could increase both the internal and external publicity of the green practices of construction firms, which would increase workers’ awareness. Moreover, eco-design is the initial stage of product design which allow the product to be available on the market for consumers to purchase (Zaid, Jaaron and Bon, 2018). As such, the contractors who could be considered as the middle person between the suppliers and the end users, that is, the clients, have eco-design options to select.

Shareholder pressure for management commitment

Seven interviewees considered shareholder pressure as an internal factor that affects the GSCM implementation during the construction phase (R1, R2, R3, R5, R6, R7 and R9). R5 stated, “Shareholder needs to consider for quality control and the effectiveness of green initiatives”. This seems to indicate that the construction firms are driven by the profit margin and the productivity of green initiatives is of utmost importance. If the shareholder could see the benefits that are brought by GSCM, they would initiate such an initiative. Shareholders could influence the operation and decision of a firm, which can then create environmental awareness on the part of the operational team (Zhu, Sarkis and Lai, 2012; Khoo, 2021). Although shareholders could initiate GSCM awareness, Silva, Gomes and Sarkis (2019) stressed that the key supply chain stakeholders and demand stakeholders, such as clients, have the final decision on its adoption. Hence, it requires management commitment to make GSCM into practices. R7 emphasised, “Management commitment is essential as construction organisations contribute to environment issue through random consumption of resources and releasing harmful environment pollution elements”. Therefore, management commitment is essential in enhancing procurement and securing resources for GSCM implementation. Somsuk and Laosirihongthong (2017) determined that management commitment coordinates the employees in working together to achieve sustainable development goals.

Green training

Six interviewees mentioned that green training is essential for GSCM adoption (R2, R3, R6, R7, R8 and R9). The contractors identified that GSCM is not common in the Sarawak construction industry with limited project involvement. Green training that improves the skills of contractors could raise their awareness. Sezen and Cankaya (2018) supported this finding by stating that such training could allow the firms to look into their environmental management practices. Lop, Ahmad and Nik Zulkipli (2016) suggested collaboration between different professional bodies in Malaysia to recruit recognised international experts in the green aspect to provide training to engineers and architects. This finding seems to eliminate the roles of contractors in GSCM. Indeed, the contractor is the stakeholder who connects the design and operational stages of a project. Provision of green training could allow contractors to incorporate “green” elements in the construction stage. Green training that assists with environmental practices could also enhance workers safety, thereby reducing the cost of production by minimising accidents (Teixeira et al., 2016). Gandhi et al. (2016) argued that the drawback of green training is that it is more time consuming and suggested that top management instruction is more effective than green training.

CONCLUSION

The study investigated the perspectives of contractors on implementing GSCM in the Sarawak construction industry during the construction phase. The findings reveal that the GSCM implementation is until the initial stage in the construction phase. The contractors revealed that government pressure, public awareness, improved brand image, material management, eco-design, shareholder pressure for management commitment and green training are the factors that affect GSCM implementation. The study emphasised governmental pressure to create public awareness that, in turn, allows the construction firms to adopt GSCM practices. GSCM could be seen as a revolutionary tool that assists in meeting the sustainable development goals of a country. Hence, the Sarawak government could focus on the factors and on developing strategies to allow smoother transition of the construction industry from the traditional system into a “green” system. The study acknowledged the limitation of having only nine contractors involved in this study. However, eight contractors had experiences with GSCM and were able to share their real-life experiences in dealing with GSCM. The contractors acknowledged that GSCM implementation is not widely adopted in their firms. Future studies could employ a mixed-method approach for the triangulation of both quantitative and qualitative data to formulate a GSCM framework in assisting stakeholders’ decision making.

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