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Significant Barriers Influencing Green Design Application among the Contractors in Construction Industry

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Abstract: This paper aims to find out the vital barriers that affecting the implementation of Green Design practice, which is part of the Green Supply Chain Management (GSCM) application in construction industry. GSCM is an innovative strategy that integrates environmental and social considerations with involving all parties in product (building) design stage, procurement, materials sourcing and selection, completion and handover to the ultimate users without overlooking the end-of-life management of the product. By the same time, GSCM also can improve both short and long-term competitiveness and profitability of the organisation. Green design application can reduce the environmental effects throughout the product lifecycle by minimising the resources and energy consumption. The objectives of this study are to determine and analyse the critical barriers that preventing Green Design related activities among contractors in construction industry. Quantitative research method with survey questionnaire was employed in this study. Total 450 sets of questionnaire were distributed with 21.8% response rate. The independent variables in this study was the barriers of Green Design implementation while the dependent variable was the adoption level of Green Design practice in construction industry. In short, four (4) barriers are identified, which were Government Supports, Company Resources, Knowledge and Information, and Financial issue barriers. Results of the study shown that Government Supports and Company Resources barriers were significant for Green Design practice. Significance of this research is to provide a better understanding of green practices, such as GSCM, to deal with current environmental issues and to realise the recent problems and obstacles faced by all construction players, so that further actions are required for a successful GSCM implementation in order to move towards a sustainable environment in the future.

Keywords: Green design, Green Supply Chain Management (GSCM), barriers, construction industry

1. Introduction

Construction industry is very significant in socio-economic development of every country around the world. It plays an active role in contributing Gross Domestic Product (GDP) and providing job opportunities specifically in developing countries. Around 3% to 5% of national GDP of Malaysia is steadily contributed by the construction industry since 2000s (Johnston, Everard, Santillo & Robèrt, 2007). Despite of the contribution of the construction industry, Studies found that one-third of the carbon dioxide (CO2) emission worldwide is contributed by concrete jungle (Melanta, Miller-Hooks & Avestisyan, 2013). Estimated 45% to 50% of global resources are used in erecting buildings and 80% of agriculture lands are lost to accommodate human being (Willmott Dixon, 2010). Construction industry has caused destructive effects to

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the environment. Those harms are attributed from massive material waste generated by the industry, resources exhaustion such as depletion of water, and etcetera (Aigbavboa, Ohiomah & Zwane, 2017).

Green Supply Chain Management (GSCM) is found to be an integrated supply chain-wide management approach with environmental management which is prospective to mitigate the environmental damages from the firms and achieve the operational performance concurrently (Zhu, Sarkis, Cordeiro & Lai, 2008; Zhu, Sarkis & Lai, 2012; Svensson, 2007). GSCM can be defined as an innovative strategy or concept that integrates environmental and social considerations with the involvement of all parties in product (building) design stage, procurement, materials sourcing and selection, completion and handover to the ultimate users without overlooking the end-of-life management of the product in order to improve both short and long-term competitiveness and profitability of the organization.

The Malaysian government has been promoting sustainability initiatives since year 2000 (Suliman & Omran, 2009). A lot of efforts have been invested by the government to encourage the green initiatives and reduce carbon emissions among firms, for example MyHijau programme which was launched in 2012, The National Sustainable Consumption and Production (SCP) Policy framework in the 11th Malaysian Plan (11MP; 2016–2020) and the up-to-date Construction Industry Transformation Programme (CITP) was launched in 2015. However, many firms in Malaysia are still in the learning stage of sustainable practices and gaps still exist between awareness and adoption of green strategies (Hajikhani, Wahiza & Idris, 2012).

In Malaysia, several green-building rating tools were introduced since 2009. The certification includes Green Building Index (GBI) was launched by the Institution of Architects Malaysia and the Association of Civil Engineers Malaysia. At the same time, other rating tools such as the Skim Penilaian Penarafan Hijau JKR, or the JKR Green Ratings Assessment Scheme (pH JKR), developed by the Public Works Department in 2012, and Green Real Estate (GreenRE) by the Real Estate and Housing Developers' Association, in 2013 have progressed alongside GBI [10]. In 2015, the Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST) has been released by the Ministry and Construction Industry Development Board (CIDB). MyCREST seeks to assess and encourage the reduction of carbon emissions throughout the design, construction, operation, and maintenance stages of a building lifecycle, by awarding 1–5 star ratings based on sustainability and carbon reduction goals that are achieved.

Regrettably, not more than 2% of qualified construction projects are evaluated with sustainable building rating systems like Green Building Index (GBI) in Malaysia according to CIDB statistics 2014-2015 (CIDB, 2015). For those assessed projects, not more than 50% had been rated with satisfied GBI.

Additionally, Malaysian government has set a target of 550 green buildings by year 2020 and 1750 by 2030. As of December 2017, there were only 442 private sector buildings certified by green building rating tool in Malaysia, which constituted less than 2% of total building nationally (Fadhlin & Abdullah, 2017).

In a nutshell, GSCM application in construction is still at infancy stage and there is a need to fill up the knowledge gap in construction field (Khan, Hussain & Ajmal, 2016). Thus, the objectives of this study are to find out and analyse the significant barriers that influencing the adoption of Green Design practice among contractors in the Malaysian construction industry.

2. Background of Research

The Green Design approach is discussed as well as the barriers of green initiatives adoption are covered in this section.

2.1 Green Design Approach

Green design is a strategy to encourage a company's environmental performance by practicing internal inter-functional cooperation all the way through the whole company while having external collaboration with other partners such as suppliers along the supply chain (Zhu & Sarkis, 2006). Green Design process can be categorized into three (3) key stages as follows: impacts assessment stage, design strategies formulation stage and design implementation stage (Charter, Keiller & Clements, 2013). Lifecycle Impact Tool (LIT) is useful to provide a structured means to discover the product or service's impacts at each stage in its lifecycle.

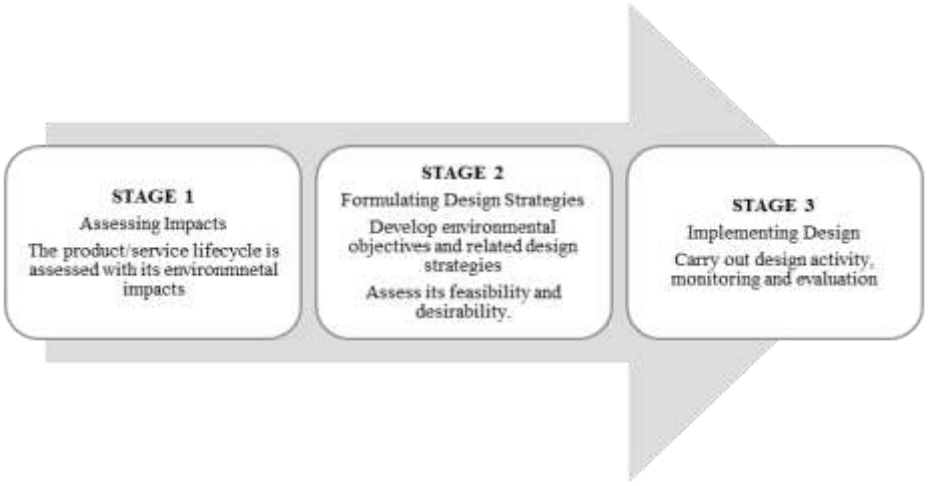

Fig. 1 - Three (3) Stages of Green Design (Zhu & Sarkis, 2006)

2.2 Barriers of Implementation

There are four (4) barriers in this study, which are government supports barrier, company resources issue barrier, knowledge and information barrier and lastly, financial issues barrier.

2.2.1 Government Supports Barrier

Government influential policies play a vital role in promoting green initiatives (Vachin & Klassen, 2006). Regulations set by the government is the major enabler in implementing GSCM. Yet it is also one of the barriers for the sustainable supply chain application. Occasionally, if there is no government initiatives system for green supply chain practitioners, which means that special paybacks are not given to the GSCM practitioners from the environmentally friendly policies (Dashore & Sohani, 2013).

2.2.2 Company Resources Issue Barrier

In addition, GSCM's multiple complexities and uncertainties have caused the firms less favourable to undertake GSCM practices in their operations. The complexity and uncertainty of GSCM may be due to the inter-organisational and cross-functional integration of environmental, production, engineering, marketing, and logistics personnel (Zhu & Sarkis, 2006). Lack of experienced and well-trained green experts such as architect, engineer and quantity surveyor in construction industry is a hindrance to the adoption of GSCM (Alzawawi, 2014). The examples of experts are green architects, contractors, professionals and developers. Sufficient green experts are required in order to well implement green supply chain (Holy & Ghobadian, 2009). The firm is likely to reduce the expenditure, increase competence and designate social and environmental responsibilities in a capable way with the existence of skilled and experienced green experts

Dashore and Sohani (2013) think that the incorporation of IT system into the green supply chain approach is an essential requirement for this new concept to be implemented properly. There are many computer-based applications, programmes, IT enabled procedures and software which are able to enhance the GSCM practices with advanced data analysis method and information interchange process (Dashore & Sohani, 2013)

2.2.3 Knowledge and Information Barrier

Furthermore, certain level of knowledge is required to perform green practices. However, lack of professional knowledge and information among managerial personnel, staffs and suppliers resulted in GSCM practices cannot be implemented successfully and this becomes the biggest barrier in GSCM adoption (Al Zaabi, Al Dhaheri & Diabat, 2013). Besides, limited access to knowledge and information causes low awareness level among employees on the importance of GSCM. Lack of information resources or expertise in dealing with environmental matters and the size of the organisation are the major factors for GSCM implementation. Thus, larger firms are more eager to be involved in green supply chain initiative when compared to smaller firms

2.2.4 Financial Issues Barrier

Ambec and Lanoie (2008) identified the most critical barrier to implement environmental practices were economic issues and costs related matters. Price is an important element that consumers always consider for. Most of the time, the consumers prefer lower price and thus actions are required to lower the cost incurred in order to offer lowest price deal. Unfortunately, numerous studies have discovered that integration of sustainability practices into the supply chain is more

expensive particularly for SMEs (Alzawawi, 2014). Study also found that SMEs have limited available resources and therefore incurring costs are particularly substantial for them with vulnerable inventories (Hervani, Helms & Sarkis, 2005). More than half of the SMEs think that the main challenge for green supply chain practices is the high cost to adopt such practices (Revell, Stokes & Chen, 2010).

3. Methodology

Quantitative research design approach was applied in this research with closed-ended questionnaire survey method. With quantitative strategy, a relatively large number of data can be collected in a short time compared with qualitative approach. Moreover, quantitative approach can be engaged to observe and measure information as well as employ statistical procedures.

The construction companies that hold a Grade 7 (G7) certificate of registration issued by the Construction Industry Development Board ("CIDB") and located in Penang, Wilayah Persekutuan and Johor were the population of this study. The reasons that G7 class was selected due to reason that the tendering sum exceed 10 million or even more in the construction projects, the projects involve a lot of parties such as sub-contractors and sub-suppliers either locally or internationally and advanced construction technologies and practices can also be discovered.

Two (2) types of variable were covered in this study, which were barriers of green design adoption (independent variable) and level of adoption for green design (dependent variable) in Malaysian construction industry. The variables and items of the questionnaire were listed as Table 1.

Table 1 - Variables and items of questionnaire survey

Variable	Description of Items
Green Design	• Design of building or structure for reduced consumption of material • Design of building or structure for reduced consumption of energy • Design of building or structure for reuse, recycle, recovery of material
Government Supports Barrier	• Lack of government support to adopt environmentally friendly policies. • Lack of government incentives for practitioners in greening the supply chain • Inadequate enforcement of environmental regulations by government officers • Lack of government incentives and tax reduction for green practitioners
Company Resources Issue Barrier	• Lack of new technology, materials and processes • Lack of human resources (eg. green architects, consultants, green developers and contractors) • Lack of Information Technology (IT) system such as environmental monitoring system • Lack of technical expertise • Current practices lack of flexibility to switch over to new system
Knowledge and Information Barrier	• Lack of professionals exposed to green system • Lack of environmental knowledge • Perception of "out-of- responsibility" zone • Lack of awareness about reverse logistics adoption • Disbelief about environmental benefits
Financial Issues Barrier	• High cost of hazardous waste disposal • Non-availability of bank loans to encourage green products/processes • High investment and less Return- On-Investment (ROI) • Financial constraints

4. Data Analysis and Results: Quantitative Study

450 questionnaires were distributed through mail and email in December 2016. Follow up process was made by phone calls and reminder emails. A total of 98 responses were received with different level of completeness after 3 months. 92 useable responses were used and loaded into SPSS software. Although 20.4% (92 out of 450) response rate is quite low, however it is not uncommon and tolerable as Dulami, Ling and Bajracharya (2003) stated that the normal response rate in the construction industry is in the range of 20-30% for postal questionnaire. Though, Morton, Bandara, Robinso and Atatoa (2012) declared that there is no indicative rate for greater or lesser accuracy but require the researchers to disclose details of both their participants and non-participants in, attempts to improve participation.

Table 2 - Results of coefficients for adoption barriers and green design

Model		Standardized Coefficients (Beta)	t	Sig.
1	(Constant)		3.745	0.000
	Government Supports	0.225	1.956	0.054*
	Company Resources Issue	-0.236	-1.739	0.086*
	Knowledge and Information	- 0.186	-1.585	0.117
	Financial Issues	0.098	0.778	0.439

* significant at 0.10 **significant at 0.05 ***significant at 0.01

The data is examined with multiple linear regression analysis with IBM SPSS Statistics software, version 22.0. The results of the analysis are displayed as Table 2 with the Beta coefficients value (β) of four (4) adoption drivers as independent variables and Green Design practice as dependent variable.

Table 2 depicts the result of the coefficients for Green Design practice and its barriers of adoption. When linking the independent variables (adoption barriers) with the dependent variable (Green Design), the Government Supports barrier (β=0.225, p=0.054) and Company Resources barrier (β=-0.236, p=0.086) indicate substantial characteristics to the Green Design variable. This shows that both barriers were the influencing variables among all four barriers, which exert positive and negative impacts onto the Green Design respectively while other barriers do not prove any statistical significance with the Green Design variable. Even though Knowledge and Information barrier has a β-value of -0.186 and was categorised as third influence barrier with Green Design practice with negative impact, but it did not show any significantly difference as the p value was more than 0.10. While Financial Issues barrier has low β-value of 0.098 and shown no significant relationship with Green Design.

5. Discussion

This study found that Government Supports barrier (β=0.225) and Company Resources barrier (β=-0.236) were two barriers that influence the adoption of Green Design practice.

Green Design practice was positively affected by Government Supports barrier (β=0.225). In other words, the implementation of Green Design practice can be stimulated by encouraging the Government Supports. Though, this does not seem sensible as barrier is a kind of hindrance that prevents or limits some actions or some activities to continue developing and it is supposed to limit the implementation of Green Design practice. Nevertheless, this can be explained in alternative way, which shows that supports from government can encourage the implementation of Green Design practice as government agencies are the influential groups that may affect the movements of an organisation. Therefore, encouragement could be made from government agencies in stimulating green initiatives.

Secondly, negative impact of Company Resources barrier (β=-0.236) indicated that increase of Company Resources barrier reduces the implementation of Green Design practice. Modern technology, materials, processes and human resources, suchlike architects, contractors and consultants are the examples of company resources. Lack of human resources such as green consultants and professionals might possibly reduce the interest of the clients to implement the green practices as there may have uncertainties in completing the project successfully. Insufficiency of all these resources might result in green design implementation failure. Besides that, IT system such as environmental monitoring system and technical expertise might also make the Green Design practice fail to be performed. In Malaysia, construction players are less likely to take initiatives in switching to contemporary construction methods as this may affect the inventories of the company and thus causes inadequacy of new technologies and machineries to support the implementation of Green Design practice. In short, Company Resources barrier is the major barrier to the adoption of GSCM initiatives. This finding matches with the study from Wooi and Zailani (2010) whom found that low level of adoption in green supply chain among SMEs was due to insufficiency of company resources.

6. Conclusion and Recommendation

This study provides an idea for construction players to realise the key barriers that slow down the popularity of green initiatives in construction industry and eventually let the players find out pertinent ways to overcome these barriers. More importantly, the effects of unsustainable construction activities can be reduced with green initiatives while the benefits could significantly reduce greenhouse gases emission, minimising consumption of natural resources and energy, cutting down the waste disposal from construction sites. With this, we can ensure the preservation of natural resources for our future generations. Recommendation for future studies is that more barriers could be identified and analysed which are related to the adoption of GSCM application. Additionally, studies can be conducted on different GSCM practices such as Green Purchasing and Investment Recovery approaches with same barrier variables.

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