Analyse the Barriers that Influencing Green Design Implementation 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. First of all, the objectives of this study are to determine the barriers that preventing Green Design related activities among contractors and also analyse the critical barriers for Green Design application in construction industry. Quantitative research method with survey questionnaire is employed in this study. Around 450 sets of questionnaire are distributed with 21.8% response rate. The independent variables in this study are the barriers of Green Design implementation in construction industry while the dependent variable is the level of adoption of Green Design practice in construction industry. In short, four (4) barriers are identified, which are Government Supports, Company Resources, Knowledge and Information, and Financial issue barriers. Results of the study show that Government Supports and Company Resources barriers are 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.

1. Introduction
Construction industry is very significant in socio-economic development of every countries around the world. It plays an active role in contributing in Gross Domestic Product (GDP) and also 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 [1]. Despite of the contribution of the construction industry, it has caused destructive effects to the environment. Those harms are attributed from massive material waste generated by the industry, resources exhaustion such as depletion of water, and etcetera [2].

Green Supply Chain Management (GSCM) is found to be an integrated supply chain-wide management approach with environmental management which is likely to mitigate the environmental damages from the firms and achieve the operational performance concurrently [3, 4 & 5]. After revising some previous studies about the definition of GSCM, it can be defined as an innovative strategy/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 [6]. 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 [7]. For those assessed projects, not more than 50% have been rated with satisfied GBI.

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 [8]. Thus, the main objective of this study is to find out 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 practising 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 [9]. Green Design process can be categorized into three (3) key stages as follows: impacts assessment stage, design strategies formulation stage and design implementation stage [10]. 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.

![Figure 1. Three (3) Stages of Green Design [9]](image)

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 [11]. 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, the stipulated techniques and requirements from the environmental regulations might inhibit the innovation and creativity [12]. But 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 environmental friendly policies [13].

Porter and van der Linde (1995) illustrated that strict environmental regulations is the primary driver for sustainable supply chain management which can encourage the companies to become more resourceful and effective [12]. Friedman (1992) finalized that environmental management was integrated to become a foremost attention within the organisations after 1970s due to the financially significant regulation [14].

2.2.2 Company Resources Issue Barrier
In addition, GSCM’s multiple complexities and uncertainties has caused the firms are 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 [9]. Lack of experienced and well-trained green experts in construction industry is the hindrance of the adoption of GSCM [14]. The examples of experts are green architects, contractors, professionals and developers. Sufficient green experts are required in order to well implement green supply chain [15]. The firm is likely to decrease the expenditures, increase competences and designate social and environmental responsibility 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 [13]. There are a lot of 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 [13].

2.2.3 Knowledge and Information Barrier
Furthermore, certain level of knowledge is required to perform green practices, however, the lack of professional knowledge and information among managerial personnel, staffs and suppliers resulted that GSCM practices cannot be implemented successfully and this becomes the biggest barrier in GSCM adoption [16]. Besides, insufficient information causes the importance of GSCM hard to be delivered to the employees and causes them do not have adequate awareness about the benefits 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 [17]. Thus, larger firms are more eager to be involved in and practise green supply chain initiative when compared to smaller firms.

2.2.4 Financial Issues Barrier
Ambec and Lanoie (2008) identified the most critical barriers to implement environmental practices are the economic issues and costs related matters [18]. Price is an important element that consumers always consider for. Most of the time, the consumers used to ask for lower prices and thus actions are required to lower the cost incurred in order to offer lower price deals. Unfortunately, numerous studies have discovered that integration of sustainability practices into the supply chain is more expensive and it requires large amount of money particularly for SMEs [14]. Study also found that SMEs have limited available resources and therefore incurring costs are particularly substantial for them with vulnerable inventories [19]. More than half of the SMEs think that the main difficulty for them to practise green supply chain practices is the high costs to adopt such practices [20].

Hence, most of the SMEs do not implement GSCM as they face scarcity of information about the environmental benefits when greening their products, weak environmental legislation as well as requirements and also, they do not recognize their social responsibility in greening the environment [21]. Wycherley (1999) stated that implementation of GSCM will change the current investment, information system and habits which are too expensive and overpriced [22].

3. Methodology
Quantitative research design approach is applied in this research with closed-ended questionnaire survey method. With quantitative strategy, a relative large number of data can be collected in shorter time if 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 are the population of the study. The reason that G7 class is selected is because 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 are covered in this study, which are independent variable and dependent variable. The independent variables in this study are the barriers of Green Design adoption, while the
dependent variable is the level of adoption of Green Design in the construction industry. The variables and items of the questionnaire are shown as Table 1.

| 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 environmental 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 are used and loaded into SPSS software. Although 21.8% (98 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 [23].

The data is examined with multiple linear regression analysis with IBM SPSS Statistics software, version 22.0. The results of the analysis is 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.

| 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*|
Table 2 depicts the results 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 ($\beta=0.225$, $p=0.054$) and Company Resources barrier ($\beta=-0.236$, $p=0.086$) indicate substantial characteristics to the Green Design variable. This shows that both barriers are the influencing variables among all four barriers, which exert positive and negative impacts onto the Green Design respectively as the other barriers do not prove any statistical significance with the Green Design variable. Even though Knowledge and Information barrier has a $\beta$-value of -0.186 and is categorised as third influence barrier with Green Design practice with negative impact, but it does not show any significance as the $p$ value is more than 0.10. While Financial Issues barrier has low $\beta$-value of 0.098 and shows no significant relationship with Green Design.

5. Discussion
This study found that Government Supports barrier ($\beta=0.225$) and Company Resources barrier ($\beta=-0.236$) are two barriers that influence the adoption of Green Design practice. Green Design practice is positively affected by Government Supports barrier ($\beta=0.225$). In other words, the implementation of Green Design practice can be stimulated by encouraging the Government Supports barrier. Nevertheless, 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 ($\beta=-0.236$) indicates that increase of Company Resources barrier decreases the implementation of Green Design practice. Modern technology, materials, processes and human resources, suchlike architects, contractors and consultants are the examples of company resources. Lacking 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 a failure of green design implementation. Besides that, Information Technology (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) [24].

6. Conclusion and Recommendation
This study provides a platform 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 be reducing greenhouse gases emission, minimising consumption of natural resources and energy, cutting down the waste disposal from construction sites and so on. With this, we can only 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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