



## The Barriers of Implementing Green Building in Penang Construction Industry

Open  
Access

Ha Chin Yee\*, Radzi Ismail and Khoo Terh Jing

School of Housing, Building and Planning, Universiti Sains Malaysia, Pulau Pinang

### ARTICLE INFO

#### Article history:

Received 7 January 2020

Received in revised form 8 February 2020

Accepted 10 February 2020

Available online 15 February 2020

### ABSTRACT

Green practices and strategies in housing development has been proved to bring obvious positive contribution to the environment while green building has been identified as the current trend in environmental protection. However, various benefits and impediments are attracting and holding developers to implement and practice green in their construction projects. Although Green building have been proven to bring significant environmental impact and it has been introduced into Malaysia construction industry for about ten years, only low number of green concepts are spotted in construction projects. Therefore, this research is conducted to identify barriers that restrict the implementation of green building in Penang. Qualitative method is adopted to evaluate the construction projects from the beginning which started from the pre-construction stage to post construction stage. 13 massive developers in Penang construction industry have been selected to participate in this research study to collect their precious experience and opinion upon the implementation and practice of green practices on their current and past construction projects. The research found that property developers are playing crucial roles in making green building a trend. However, there are many impediments that stopping developers from adopting green practices such high initial cost, insufficient of green expertise and lack of collaboration from stakeholders and suppliers. Thus, this study has provided insight to overcoming the barriers in green practices is important to ensure developers can obtain the benefits from constructing green building. It is recommended to clone this study and investigating the actual condition on other states in Malaysia to obtain wider perspective on current construction industry.

#### Keywords:

Green Practices, Green Building,  
Construction Industry, Development,  
Barriers

Copyright © 2020 PENERBIT AKADEMIA BARU - All rights reserved

## 1. Introduction

Sustainable development has been promoted into Malaysia manufacturing sector since earlier Ninth Malaysia Plan 2006-2010 [1]. The sustainable development is slowly evolved into today's green practices which focus on the economic, social and environmental performance of an organization [2]. [3] have highlighted that due to the improvement in organization performance, the green practices are promoted into construction industry to solve the environmental issues that have been enormously affect

\*Corresponding author.

E-mail address: [chinyeeha@yahoo.com](mailto:chinyeeha@yahoo.com)

the world due to the rapid development. However, the willingness of construction stakeholders to implement green practices are not as positive as initial thought [4].

Green initiatives have been long introduced to construction industry, but there are still small number of construction projects and complete buildings are practicing green practices in their operation [5]. Multiple barriers that are stopping construction developers from carrying green practices in their construction projects [5]. [6] mentioned that the financial factor is believed to act as the main impediment to developers in practicing green but there are still other factors like lacking of knowledge, expertise and experience in green practices. These barriers might be the reason causing the slow assimilation process of green concept into construction industry.

This research is conducted to identify the barriers of green concept assimilation on construction industry which can help construction firms to overcome the issue and adapt themselves into the new trend and era. Related literature reviews are discussed in section 2, which included the barriers of green practices in construction industry while section 3 mentioned the methodology used to collect the data from experts in developers' firms.

### 1.1 *Green Building Definition*

Green building is a sustainable building that concerns about durability, economy, utility and comfort. It is a practice of creating and constructing a building or structure by using environmental friendly and sustainability method throughout the process [7]. A green building is designed to improve the human health, living and natural environment quality by using the 3R's activities (reduce, reuse and recycle) which are reduce the uses of natural resources to prevent waste, pollution and degrading the environment quality; reuse or recycle the materials in construction process or made from renewable resources.

According to U.S. Environmental Protection Agency, green building is des to mitigate the negative impacts of properties development to the environment and residents in the earth by being energy and resources efficient while recycling usable construction materials to reduce pollution and waste [7]. This practice is to enlarge and enhancement the building design that concern about the sustainable, durability and comfortability.

Green buildings are a creation to alleviate the environmental issues that risen by construction activities. There are evaluation systems to assess the performance of green building such as planning, design, construction and operation of buildings with the rating elements which are energy efficiency, materials used, indoor environment quality and minimization of negative impacts on the environment [8]. Being green is not the sole main objective in the green building concept but high performance is one of the aims in this concept where it is aimed to reduce the use of energy without affecting the user satisfaction level [9].

Green building can be understood as a property that concerns about the environmental issues pre and post of the construction. During construction period, the construction activities should be clean and environment friendly while after the completion of building, the maintenance and daily operational should remain green and energy efficiency to achieve maximum environment protection.

## **2. Literature Review**

According to Douglas, the awareness of public towards the importance of environment has increase due to the climate changes that cause by pollution and the decrease of natural resources in the Earth [10]. This will be a serious issue that will affecting everyone. Therefore, green will be the trend in construction projects in the future. By implementing the green practices in construction site, the awareness of construction industry will increase and mitigate the pollution that cause by construction works [11].

## 2.1 Type of Barriers

The barriers can be understood as factors that slow down the process of an organization to success. There are two kinds of barriers which are physical and social barriers [12]. Physical barriers mean there are initial cost problem and materials used in a project. The example of these barriers is significant when a party is starting to consider green initiatives. Construction companies will face problem of higher initial cost and difficulty to find materials that fulfil the green criteria. Furthermore, there are very less data to support the life span of the materials which is very crucial in deciding the break-even point of the financial cost that party invested in the project. This surely will affect the party when they are decided to adopt the green initiatives in their projects since profit are an organization's main goal.

According to [13], sustainable development brings benefits to environment and human health, but the development is still facing the obstructions to implement green building into construction projects. Construction industry will face the challenges of implement green building and there are five categories of the barriers which are economic issues; attitude and market; management and government; product information and sourcing; and technology and training [14]. The challenges of green building can be classified into two categories which are internal barrier and external barrier.

## 2.2 Internal Barriers

The internal barriers are barriers that happened within the organization and these barriers are controllable though the manipulation of upper management team. Normally, the organization will treat the financial factor as their major barrier in practicing green as earning profit in always organization main goal.

### 2.2.1 Economic Issues

Compare to the ordinary buildings, the cost of sustainable building will be higher due to the green materials very expensive [15]. The company that lack of financial resource will face the problem to implement sustainable construction. Besides, this will be a long-term profit return, so the developer or client will worry about their profitability [16]. The client will more concern about their profitability than sustainable to environment.

Builder incentive also an issue to the construction industries to practice the green construction [17]. The construction industries will only implement the green practice in their project when they get incentive by government or private sector. However, there are few of institution and organization that provide builder incentive. This will bring the financial issue to the construction industry that concern about the profit and refuse to practice the sustainable construction.

### 2.2.2 Management Barrier

The top management will affect the adoption of green initiatives. If top management does not highly aware of the environmental issues and refuse to implement green initiatives, the adoption of green building technologies will be rejected [18]. The workers will also influence by the top management and change their attitude toward the implementation of green building.

Currently, there are still a lot of upper management refuse to accept the new construction method. This is because most of them are concern about the profits and they do not wish to take any risks that might be obstacle to them to earn more profits. If the upper management refuse to implement green building development, the workers below also have no any change to make changes in the construction method. This will lead to the obstacle in green building implementation.

### 2.2.3 *Technology and Training*

As green building concept just promoted into Malaysia and it needs use new materials and technologies to construct. However, the materials and technologies is still rare so it is a difficulty for the developers, contractors and subcontractors to get all the materials and technologies for the construction of green building [19]. Every new application of materials should be tested before use to determine the capabilities. The new materials and technologies should be evaluated and compared its performance with a similar product to obtain the most precise result. There are some unknown challenges towards green building concept and its materials and technologies, so this make the barriers.

Majority of green technologies are complicated and it requires professional knowledge to be success. There are also a policy and standard that need to fulfil when practice the green practices in construction projects. The lack of professional or technical staff will cause the stakeholders and clients lack of confidence in green technology implementation.

Some of the company are not willing to send their workers for training to gain the new knowledge and soft skill towards the green building. This is because they worry that the workers will turnover to another company for higher salary after training and this will cause them loss of talents and also waste their time and money. Therefore, the workers that do not attend any training will not able to control and handle the new technology that are complicated [20].

### 2.2.4 *Organizational and Personal Behavioral Barriers*

Lack of incentives will be a barrier to investors to start investing. There are many construction firms in Asia developed countries face the problem in lacking of incentives [21]. However, there are problem that created by the stakeholders and company which is lack of awareness towards the environmental quality and protection [22]. Lack of awareness and communication among the stakeholders and party that involved in the project will obstruct the implementation of green initiatives [22]. Besides, [23] stated that individuals' behavioral play vital role in adopting green building concept.

### 2.2.5 *Lack of Knowledge/awareness*

Lacking of awareness and knowledge stopping the development of green building. According to [24], an in-depth interview has been done and show that lacking in knowledge and awareness of top management will affect the intention of the construction firm to implement green practices in the projects. The study shows the top management are not really understand about the sustainable development although they are worry about the environmental issues. Furthermore, the construction firm will face the problem of their staffs and workers are not literate in the new technology, so the workers are not able to handle and control the green technology. This will make difficulty to the implementation of sustainable development [24].

Moreover, lack of communication among the parties involved also will lead to difficulty in practicing green building in construction industry [25]. In addition, green concept is still new and complicated, so it is difficult to be practiced by the construction stakeholders if they do not have intensive experience and sufficient knowledge in related field. This will lead to the benefits of development of sustainability be ignore and construction firm resist to change [26]. In the end the efforts to increase the awareness of construction firm will fail and the development of sustainability building will be retarded [26].

### 2.3 External Barriers

External barriers are referring to those factors that happened outside the control of the organization such as government policy, customer satisfaction and market conditions. These factors can only be understood and mitigated through adjustment on the services and products in order to fulfil the third parties' requirements.

#### 2.3.1 Attitude and Market

There are old generation workers that are full of experience in the construction site and they are refusing to learn the new things and technology. They believe that the traditional method is the best for the construction work. However, the traditional method is not green to the environment and will cause pollution [27]. Besides, clients' attitude also influences to the adoption of green technology into construction projects. The client that willing to accept the trend without counting his/her profit will encourage and ensure the project team is convinced with the positive impacts of green initiatives on buildings [28].

When market demand is low on green building, green building will not be constructed by construction industry. Therefore, the attitude of public and clients is affecting the market to invest in green building development.

#### 2.3.2 Government Issue

Government also should play main role in encouraging green building construction and development as government's involvement such as provision of financial and non-financial incentives, regulations and policies to building construction impact the implementation of green building [29]. However, some of the governments lack of concern about this issue and do not guide in green building market by giving financial help or incentive cause the discouragement of practicing the green building technologies [30].

If government has low awareness about the environmental issue and importance of green practices, the construction industry will also have no concern about this issue. This is because there will not have any regulations and laws to enforce them to practice green on site.

#### 2.3.3 Production Information and Sourcing

Green building development is having insufficient product's information [17]. This is because the green building technologies are the new technology and lack of construction industry implement it into construction projects. The lack of information about the performance and cost needed of the technology will cause the construction industry to bear their risk of adopting the green building practices. Besides, the architects and workers will face the problem of the products do not perform well. The final products that do not perform well will influence the reputation of the company and this will reduce the profits that they can earn. Therefore, the developers and stakeholders will hesitate to start participating in green building development.

In addition, insufficient guidelines from available sources is within the consideration of developers to implement green building as there is no any precedent can refer to if there is any problem occur. Guidelines are always important to lead practitioners. Without sufficient guidelines, stakeholders and clients will worry about the potential hidden risks of this new construction method. The amount of the materials and equipment needed cannot be measured and this might lead to the increment of wastage.

#### 2.3.4 Lack of Incentives

Incentives is important to a firm to develop or adopt new technologies and practices. However, the incentives will not work if the construction firms are lacking of awareness and knowledge in green development. In 2007, Richardson and Lynes have examine the decision making of construction process and found that the practice of green building is influenced by the decision that made by stakeholders and clients [22]. Besides, the operating and maintenance cost is too high and the incentives given are not enough to cover it. Therefore, the implementation of sustainable development will be prohibited although it is environmentally friendly and energy efficiency.

The motivation of people to consider sustainable development also a barrier to conduct the sustainable development. Lack of incentives will decrease the motivation of construction firm to consider sustainable development due to the construction firm do not receive any incentives and support when the construction projects are energy efficiency. For the small and medium enterprise which do not have enough capital and do not receive any incentives and funds make them not able to implement the sustainable development. There is study stated that there are less opportunities and rewards in high education and lead to less of people with high education do not have the knowledge about the new technology [31]. In addition, lack of infrastructure also will decrease the motivation of construction firm to participate in the sustainable development [32]. Without incentives, the implementation of sustainable development will not be successful as there is no motivation force to push the realization of green building.

#### 2.3.5 Lack of Mimetic Pressure for Green Development Policy

Lack of mimetic pressure for green development policy is obstructing green development and most of the stakeholders are yet prepared to adopt the green building policy since there are many unsolved obstructions. In 2010, [33] stated that there are many professionals declared that lack of institutional interest, different of senior management and lack of regulation and policy are barriers of implementation of sustainable development. According to [32], most of the firms are not focus on the green development and this led to the time constraints and lack of motivation in implementation of green building. Majority of the construction firm choose to ignore the environment condition and benefits of green development and this led to the resistance to change of construction firm. Besides, lack of mimetic pressure for green development policy will increase the resistance to change and ignore to the benefits of new technology [24]. Therefore, the championing for the sustainable development will face the problem and challenge due to the resistance to change of construction firm.

### 3. Research Methodology

This study is adopting qualitative method where interview session is the main data gathering tool. From 2017 to 2018, 13 in-depth, semi-structured interviews were conducted which last between 60 to 90 minutes. The data obtained from interviews were supported with secondary data to enhance the validity. The interviewees were from big and influencing properties developers in Penang Island such as site supervisors, quantity surveyors and purchasers in the organizations. In order to improve the validity of data, different remedies such as providing various sources of proof and having key informants review of the relevant case were used [34].

Next, the interviews and their analysis were deeply discussed to further enhance the validity of primary data. Based on exploratory research concept, the data collection process indicates this study reached its saturation when the information obtained from interviewees shows repetition and ongoing verification of already understanding information during data collection process. The primary data were coded to ease the data analysis works.

#### 4. Discussion and Findings

Table 1 below shows the respondents' background and we can see that most of the respondents have been involved in construction industry for quite several of years. This will be helpful in this research as their opinion and information given tends to reflect the reality.

**Table 1** Respondents' background

Respondents	Occupation	Working Experience
A	Site Supervisor	1-4 years
B	Project Manager	10-14 years
C	Professional	15-19 years
D	Construction Manager	5-9 years
E	Construction Manager	10-14 years
F	Project Manager	20 years and above
G	Site Supervisor	5-9 years
H	Professional	1-4 years
I	Construction Manager	15-19 years
J	Professional	1-4 years
K	Site Supervisor	10-14 years
L	Construction Manager	10-14 years
M	Construction Manager	5-9 years

Table 2 and table 3 shown below show the keywords that obtain from thirteen respondents after the interview sessions with them. From the survey we can see that attitude and market, time consuming, regulation and governance, financial issue and lack of knowledge are the factors that restrict the developers as mentioned in others researcher papers such as [3], [35], [36], [37] and [38]. The findings show the considerations of developers as their purpose is to fulfil the requirements of clients and obtain profit from the projects is the same as stated in [39]. Therefore, the massive amount of capital needed for the adoption of green building will influence them to make decision of invest in the sustainable development [40].

**Table 2** The Barriers of Implementing Green Building in Construction Industry

Barriers	A	B	C	D	E	F	G	H	I	J	K	L	M
<b>Insufficient guidelines</b>		✓											
<b>Low Level of Knowledge</b>	✓		✓		✓		✓	✓					
<b>Financial Constraint</b>		✓	✓	✓	✓	✓				✓			
<b>Regulation and Governance</b>						✓	✓		✓				
<b>Time Consuming</b>				✓							✓		
<b>Attitude and Market</b>								✓	✓	✓		✓	✓

**Table 3** Rank of Identified Barriers in Green Practices Implementation

No.	Barriers	Frequency	Rank
1.	Insufficient guidelines	1	5
2.	Low Level of Knowledge	5	2
3.	Financial Constraint	6	1
4.	Regulation and Governance	3	3
5.	Time Consuming	2	4
6.	Attitude and Market	5	2

From the findings, it is significant that most of the respondents are concerning about the financial issue. This can be explained by the high initial cost in green development and respondents worry about the breakeven point of the project will be very late and affect the profits that they can earn. This is supported by [35] research where financial matter is always organization priority. Besides, respondents from developers' company also lacking of knowledge on green building. Based on the research, most of the developers have no knowledge about the green building and their workers prefer the conventional construction method. This made them cannot make the changes to implement the green development to solve the problem of environmental issues. In [5] research, it is highlighted that lacking of knowledge in green will enormously affect the implementation of green concept in building. From the interview, it can be said that most of the workers in site refuse to learn the new things and they feel that the new technology is a mission impossible to them and they are satisfied with the status quo. As a worker who already use to the conventional method, they are not willing to leave the comfort zone and change their attitude to learn the new things [37].

Attitude and market are also a barrier to the developers to develop a green building. According to the result of this study, there are two respondents never heard about the term of green building. They do not even know that there is regulation and standard to enforce them to implement green building. This reflected that there are some of the people do not care about the trend happen surrounding and cannot keep up pace of the time as they are disinterested on the new things or new technology that is current trend. [41] highlighted that green concept and regulations should be enforced by authority as it is current trend that should not be ignored and should be pursued to achieve higher achievement as pollution can be reduced, environmental problems can be solved, protect ecosystem and achieve energy and water efficiency [37].

There are also respondents declared that there is no enforcement from the government to employ green building. Although there is law and regulation but the government do not have any enforcement about the implementation of sustainable planning and development. From the statement above, the respondents' company do not have the awareness on green practices. Besides, the respondents also feel that government do not give sufficient effort in promoting green building into construction industry in Malaysia. [38] has presented the importance of government roles in regulations and standards enforcement. Thus, the lack of exhibition or workshop to introduce green building and its strengths to construction industry will cause many firms not aware that green building is the construction trend nowadays.

In addition, Bag and Anand [42] has mentioned the time-consuming factor which is exactly the same as respondents in this research commented that time consuming also one of the issues that they concern about. Most of them have an opinion that development of green building will spend a lot of time and they do not wish to spend too much of time in a project as this will affect their profits. Design which can cover green concept is complicated and this needs huge time and effort to produce splendid outcome [37]. This has been mentioned by the respondents and they also said that the processes to get the approval on design to construction stage are too long. If there is a mistake in the process, they need lots of time to figure out the solution and waiting for approval again. Therefore, they prefer the



conventional method that sustainable method due to the conventional method can save more time than sustainable development. Besides, this statement is not mentioned in Literature Review. This has shown that no researcher found this factor which is one of the considerations among developers in Pulau Pinang, Malaysia but the respondents from the field feel that it is a vital factor that restrict them from implementing green building in construction project.

## 5. Conclusion

This paper is intended to study the similarity of the obstructions in Pulau Pinang construction industry and other countries which already researched by other researchers. Therefore, the findings of this study might be difference from other research's results. From this study, it is significant that most of the mentioned and discussed issues are similar to majority of the countries and studies but the outcome of this research can be used to inspire construction industry firms in Pulau Pinang to study their firms' strengths and weaknesses by referring to the barriers studied in this study.

Since, this study has identified several critical barriers that obstructing construction firms in Pulau Pinang to adopt green practices in construction projects. It is a good beginning point for those construction firms who wish to practice or already practicing green to minimize the pollution to the environmental impacts while increasing their organization performances by referring and studying onto this study.

To conclude, construction industry in Pulau Pinang is facing the same main barrier in other places which is the financial constraint [3] but there are still other obstacles such as lacking of knowledge in green concepts and practices, market condition and attitude and less enforcement of authority regulations and standard. These should be overcome by related parties in order to increase the implementation and adoption of green building in Pulau Pinang construction industry.

## Acknowledgement

The authors would like to express the gratitude towards the financial support from the short-term research grant under vote number 304/PPBGN/6316231. Special thanks would be awarded to Dr Radzi Ismail for his constructive comments throughout the research.

## References

- [1] Hsu CC, Tan KC, Zailani SHM, Jayaraman V. Supply chain drivers that foster the development of green initiatives in an emerging economy. *International Journal of Operations & Production Management*. 2013.
- [2] Fahimnia B, Sarkis J, Davarzani H. Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*. 2015;162:101-14.
- [3] Sreejith B, Vinaya S. Green supply chain management: an empirical investigation on the construction sector. *Supply Chain Management: An International Journal*. 2017;22(1):58-81.
- [4] Zailani S, Govindan K, Iranmanesh M, Shaharudin MR, Chong YS. Green innovation adoption in automotive supply chain: the Malaysian case. *Journal of Cleaner Production*. 2015;108:1115-22.
- [5] Liu JY, Low SP, He X. Green practices in the Chinese building industry: drivers and impediments. *Journal of Technology Management in China*. 2012.
- [6] Luthra S, Garg D, Haleem A. The impacts of critical success factors for implementing green supply chain management towards sustainability: an empirical investigation of Indian automobile industry. *Journal of Cleaner Production*. 2016;121:142-58.
- [7] Agency USEP. *Introduction to Green Building*. 2016.
- [8] Zuo J, Zhao Z-Y. Green building research—current status and future agenda: A review. *Renewable and Sustainable Energy Reviews*. 2014;30:271-81.
- [9] Council WGB. *The Business Case for Green Building—A review of the costs and benefits for developers, investors and occupants*. World Green Building Council Washington, DC; 2013.
- [10] Douglas J. *Building Adaption (2th edition ed.)*: Oxford: Butterworth-Heinemann; 2 edition (May 4, 2006); 2006.
- [11] CIDB. *Strategic Recommendations for Improving Environmental Practices in Construction Industry*. 2007.
- [12] Hoffman AJ, Henn R. Overcoming the social and psychological barriers to green building. *Organization &*

- Environment. 2008;21(4):390-419.
- [13] Darko Amos C, Albert Ping Chuen, Ameyaw, Ernest Effah H, Bao-Jie, Olanipekun, et al. Examining issues influencing green building technologies adoption: The United States green building experts' perspectives. *Energy and Buildings*. 2017;144(Supplement C):320-32.
- [14] Chan AP, Darko A, Ameyaw EE, Owusu-Manu D-G. Barriers affecting the adoption of green building technologies. *Journal of Management in Engineering*. 2017;33(3):04016057.
- [15] Kibert CJ. *Sustainable construction: green building design and delivery*: John Wiley & Sons; 2016.
- [16] Ametepey O, Aigbavboa C, Ansah K. Barriers to successful implementation of sustainable construction in the Ghanaian construction industry. *Procedia Manufacturing*. 2015;3:1682-9.
- [17] Davis A. *Barriers to Building Green*. 2001.
- [18] Du, Ping, Zheng, Li-Qun, Xie, Bai Chen, et al. Barriers to the adoption of energy-saving technologies in the building sector: A survey study of Jing-jin-tang, China. *Energy Policy*. 2014;75:206-16.
- [19] Corbett T. *Managing Risk in Green Building Projects*. 2007
- [20] Tagaza E, Wilson J. *Green buildings: drivers and barriers e lessons learned from five Melbourne developments*. Report Prepared for Building Commission by University of Melbourne and Business Outlook and Evaluation. 2004.
- [21] Studer, Sonja, Welford, Richard, Hills, Peter. Engaging Hong Kong businesses in environmental change: drivers and barriers. *Business Strategy and the Environment*. 2006;15(6):416-31.
- [22] Richardson GR, Lynes JK. Institutional motivations and barriers to the construction of green buildings on campus: A case study of the University of Waterloo, Ontario. *International Journal of Sustainability in Higher Education*. 2007;8(3):339-54.
- [23] Nagesha N, Balachandra P. Barriers to energy efficiency in small industry clusters: multi-criteria-based prioritization using the analytic hierarchy process. *Energy*. 2006;31(12):1969-83.
- [24] Wright TS, Wilton H. Facilities management directors' conceptualizations of sustainability in higher education. *Journal of Cleaner Production*. 2012;31:118-25.
- [25] Horhota, Michelle, Asman, Jenni, Stratton, Jeanine, et al. Identifying behavioral barriers to campus sustainability: A multi-method approach. *International Journal of Sustainability in Higher Education*. 2014;15(3):343-58.
- [26] Dahle M, Neumayer E. Overcoming barriers to campus greening: A survey among higher educational institutions in London, UK. *International Journal of Sustainability in Higher Education*. 2001;2(2):139-60.
- [27] Khoo TJ. *Investigating Green Site Management Practices in Penang's Construction Projects*. 2016.
- [28] Kibert. *Sustenance: Green building design and delivery*. Wiley, Hoboken, NJ; 2012.
- [29] Qian QK, Chan EH. Government measures needed to promote building energy efficiency (BEE) in China. *Facilities*. 2010;28(11/12):564-89.
- [30] Chan, HW E, Qian, K Q, Lam, TI P. The market for green building in developed Asian cities—the perspectives of building designers. *Energy Policy*. 2009;37(8):3061-70.
- [31] Hopkins EA. Barriers to adoption of campus green building policies. *Smart and Sustainable Built Environment*. 2016;5(4):340-51.
- [32] Horhota M, Asman J, Stratton JP, Halfacre AC. Identifying behavioral barriers to campus sustainability: A multi-method approach. *International Journal of Sustainability in Higher Education*. 2014;15(3):343-58.
- [33] Cupido, Anthony, F, Baetz, Brian, W, et al. Evaluating institutional green building policies: A mixed-methods approach. *Journal of Green Building*. 2010;5(1):115-31.
- [34] Gibbert M, Ruigrok W, Wicki B. What passes as a rigorous case study? *Strategic Management Journal*. 2008;29(13):1465-74.
- [35] Zutshi A, Creed A. An international review of environmental initiatives in the construction sector. *Journal of cleaner production*. 2015;98:92-106.
- [36] Ying Liu J, Pheng Low S, He X. Green practices in the Chinese building industry: drivers and impediments. *Journal of Technology Management in China*. 2012;7(1):50-63.
- [37] Zhang X, Shen L, Wu Y. Green strategy for gaining competitive advantage in housing development: a China study. *Journal of Cleaner Production*. 2011;19(2-3):157-67.
- [38] Qi G, Shen LY, Zeng S, Jorge OJ. The drivers for contractors' green innovation: an industry perspective. *Journal of cleaner production*. 2010;18(14):1358-65.
- [39] Carris J, Epstein D, Thornback J, Simon S, Bonfield P. *The role of the construction supply chain in delivering sustainable solutions on The Olympic Park.*; 2012.
- [40] Vanpoucke E, Quintens L, Van Engelshoven M. The role of motivation in relating green supply chain management to performance. *Supply Chain Management: An International Journal*. 2016.
- [41] Shi Q, Zuo J, Huang R, Huang J, Pullen S. Identifying the critical factors for green construction—an empirical study in China. *Habitat international*. 2013;40:1-8.
- [42] Bag S, Anand N. Modeling green supply chain management framework using ISM and MICMAC analysis. *African Journal of Business Management*. 2014;8(22):1053.