UNDERSTANDING THE DRIVING FACTORS FOR ECO-INNOVATION (EI) ADOPTION IN CONTRACTOR FIRMS

Siti Sarah Mat Isa
School of Housing, Building and Planning
Universiti Sains Malaysia, 11800 USM Penang, Malaysia
Faculty of Architecture, Planning and Surveying
UiTM Perak Branch, Seri Iskandar Campus, 32610 Seri Iskandar, Perak, Malaysia
Email: ctsarahmatisa@gmail.com

Associate Professor Dr Nazirah Zainul Abidin
School of Housing, Building and Planning
Universiti Sains Malaysia, 11800 USM Penang, Malaysia
Email: nazirah_za@usm.my

ABSTRACT

Realising that environmental sustainability in the construction sector had become a part of Malaysia's national agenda, awareness of project stakeholders had increased due to environmental degradation triggered by rapid development and unsustainable approach of past construction. Innovation had proved able to mitigate the negative impact of construction activities. However, innovation and eco-movement usually viewed as having an opposite direction. The dynamics of innovation should be intertwined with sustainable growth and environmental improvement, thus enter eco-innovation (EI). EI offers the construction industry an opportunity to innovate greener and reach governments' green obligation. The growing trend towards sustainable and green buildings has led all contractor firms to adapt and transform how they provide their services and deliver their projects, i.e. become more eco-innovative. However, EI concepts are still infancy to the Malaysian context. While EI widely applied in the manufacturing sector, its adoption in the construction sector is still scarcely discussed. Therefore, this paper aims to identify the driving factors influencing the adoption of eco-innovative practices in contractor firms in the Malaysian construction industry. The driving factors represent the primary motivations for the initiation of EI practices. A literature review is performed using content analysis to define the critical driving factors to shift from conservative construction toward eco-practices. EI's main components classify as products, process, and organisation from the review of previous studies. The study unveils four key aspects that drive contractors to eco-innovate, i.e., firm-specific factors, technology, environmental regulation, and market factors are capable of encouraging EI's adoption within the firms. This study contributes to a more comprehensive understanding of the driving factors that initiate and accelerate EI's adoption at the firms' level. Uncovering the contractor's role in stimulating EI would open avenue to other project stakeholders to realise the importance of eco-innovating in the construction industry.

Key words: Eco-innovation, contractor firms, driving factors, construction, Malaysia.

INTRODUCTION

The construction industry is one of the fastest-growing sectors contributing significantly to economic growth by supporting other sectors' expansion. Unfortunately, the Malaysian construction industry's current scenario is still taking the lead in environmental degradation due to rapid development and unsustainable construction practices (Qi et al., 2010; Bohari et al., 2015; Yusof et al., 2017). Thus, under Construction Industry Transformation Programmes (CITP) (2016-2020), the need for environmental sustainability (ES) within the construction industry has, therefore, been recognised by the government as part of the national agenda. Furthermore, the Malaysian government has set a target of increasing the number of green buildings from 550 in 2020 to 1,750 within the year 2030 (KeTTHA, 2017). The primary imperative is to embark on a greener path to ensure a more sustainable future. Since 2009, Malaysia has developed its green building rating tools to encourage sustainability in the built environment and raise awareness of these issues among relevant project stakeholders. The specific set of guidelines were employed to measure the success criteria that contractors need to attain in constructing building projects by fulfilling the green requirements (Tabassi et al., 2016). All these had led to rising demand for innovation to improve project performance without compromising the natural environment due to construction activities. The dynamics of innovation to produce products or services should be intertwined with the responsibility towards sustainable growth and environmental improvement, categorised as eco-innovation (EI). As the result of the green revolution over the years, the emerging trend towards constructing more sustainable and green buildings (Samari et al., 2013; Hamid et al., 2014), had prompted the need for all construction players to adapt and transform the way they provide their services and deliver their projects, i.e. become more eco-innovative. Many researchers highlighted that EI is the key for green transformation in the industry which increases firm efficiency, productivity and environmental sustainability (Cai and Zhou, 2014; Horbach et al., 2012; Garcia-Granero et al., 2018; He et al., 2018). In response to greater environmental awareness among the government and project stakeholders, many firms have become increasingly interested in adopting EI in their business strategy. Carillo-Hermosilla et al. (2010) mention that EI goes beyond traditional innovation involves broader organisation liability towards environment and society by creating the ability to engage in sustainability-oriented approaches in management and production process. As a new paradigm of innovation, EI refers to the production, assimilation or exploitation of a product, production process, services, management or business method that is novel to the organisation (developing or adopting it) and which results, throughout its life-cycle lead in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy) as compared to relevant alternatives (Kemp and Pearson, 2007).

In Malaysia, the focus on innovation and eco-movement concerns has the opposite direction where the environmental impacts often neglected (Xue et al., 2014; Zhiwei et al., 2014; Bamgbade et al., 2017). Most of the innovation in the construction industry unaligned with the green requirement. This situation is partly due to ineffective innovation action and process (Gambatese and Hallowell, 2011). Innovation and green must be assimilated and focused on critical environmental concern. A firm needs to move towards environmental management, i.e. from pollution control to pollution prevention from the beginning. Urgent changes are necessary to merge these two principles and integrate them into the firm's practices. Thus, the contractor firms, who manage the construction site and responsible for transforming design on paper into a real building, hold a strategic position to promote and adopt EI into their firm's strategy and improve their project management and development to enhance environmental sustainability in the industry. Developing an understanding on the factors that drive the contractor firms to eco-innovate is crucial to ensure that they don't continue to interpret that innovation and green to be an added burden and not an expected and manageable requirement (Qi et al., 2010; Cheng et al., 2014). However, EI concepts are still infancy to the Malaysian context and its adoption in the construction industry is still scarcely discussed. A study on the driving factors of EI adoption at contractor firm's level has not paid much attention. This paper tries to fill this gap. In order to improve the construction industry's current construction practices, the contractors are liable to take a holistic approach to develop and support its EI adoption to excel in their environmental endeavour. Therefore, looking at the micro-level, the eco-movement in this industry can be stimulated by adopting EI at the firm level when they can understand the driving factors that influenced the initiation and boosting of EI at the contractor firms' level.

ECO-INNOVATION (EI) CONCEPTS

In this paper, EI has been conceptualised by using the definition given by Organisation for Economic Cooperation, and Development (OECD) (2009), which looks at the ability of a contractor firm to adopt or implement a new or significantly improved, products (goods and services), processes, marketing methods, organisational structures and institutional arrangements which - with or without intent - lead to environmental improvements compared to relevant alternatives. This definition provided apparent reference to a firm as a specific typology of EI. EI offers means to increase efficiency and productivity while minimising the negative impacts on the environment (Doran and Ryan, 2012; Fernando and Wah, 2017). The EI concept differs from general innovations. EI practices in the construction industry contributed to both economic and environmental benefits in delivering quality and sustainable building and infrastructure. The positive effect of innovation on the environment is the key elements of its definition.

The project contractor has a substantial responsibility and plays a critical part in the construction of the project. Various project stakeholders were involved in a construction project. The contractor plays its roles as a mediator between client or local authority which adopt these innovations in their project and the organisations that produce many new design, products and processes such as consultants and construction suppliers (Xue et al., 2014). EI practices are critical to implant within the contractor firm as they are accountable for delivering the construction project within the specified contract. Their decision to improve the construction processes' efficiency with advanced technology, conserving energy, water and other resources during construction, effective waste management and pollutions prevention. Lead to how they perform their work on-site that do not adversely affect the project budget or schedule, and significantly reduce cost and improve productivity (Qi et al., 2010; Yusof et al., 2017). Thus, EI provides an opportunity for contractor firms to innovate in a greener way. The key emphasis of EI as a whole is, therefore, on improving the efficiency of resources usage and at the same time protecting the environment. The EI performance of firms depends on their capacity to combine their product quality, production efficiency and management effectiveness. Many previous researchers had highlighted that these three types of EI; process, product and organisational is essential in the EI implementation (Cheng and Shiu, 2012; Cheng et al., 2014; Hojnik and Ruzzier, 2016; Peng and Liu, 2016; Singh, 2017; García-Granero et al., 2017). Thus, further clarification of EI components will be elaborate further.

CONTRACTORS' ECO-INNOVATION ADOPTION

In order to identify what triggers the adoptions of EI in contractor firms, it is necessary to clearly define the relevant components of EI in the construction industry. Tatum (1988) and Suprun and Stewart (2015) observe that process EI are the improvements in construction methods and technologies that are designed or developed to accomplish general construction operations or the enhancement in the efficiency of the construction process increase the resources utilisation. These can be achieved when the firm has improved its technological capabilities and effective management. Process EI's objectives are to decrease operation costs, stimulate energy and water efficiency, time-saving, and improve the quality by establishing an acceptable tolerance. EI also aims to reduce the overall impact on the natural environment by reducing carbon emissions, lowering pollution levels, and reducing waste throughout all the construction process stages (Kibert, 2012). Horbach et al. (2012) and Lee and Min (2015) state that EI practices are positively related to firm investment in research and development (R&D) at a firm level. The firms need to make a long-term commitment to R&D investment to transform the existing technology into cleaner technology to reduce or eliminate any harmful waste and emissions to the environment.

Meanwhile, product EI introduces new or significantly improved products (regarding their characteristics), such as improvements in technical components and materials (Carrillo-Hermosilla et al., 2010). In the construction industry, product EI's environmental impact stems from their usage throughout building life-cycle and disposal rather than their production. Thus, the contractors are liable to advise and propose to client and consultants to use eco-innovative products and materials that will increase the durability and quality, energy efficiency, reduce the pace of replacement, and lower carbon emissions during the operation of the building (Qi et al., 2010). This will be able to protect the environment and provide a better quality of life for end-users. Meanwhile, the organisational EI refers to upgrading the organisation's management processes through a new and eco-method in business practices. Organisational EI involved in facilitating and aligning technical knowledge to eco-innovate and transforming the

organisational structure and coordination of the entire infrastructure to promote green practices. Several researchers (Triguero et al., 2013; Kesidou and Demirel, 2012) have identified organisational EI has positively facilitated the implementation of product and process EI. The focus mainly on organisational green management practices is to adhere to environmental regulation, comply with green rating tools, develop good relationships and collaboration in the supply chain, and improve the firm's capabilities to enhance EI adoption. Thus, based on EI's importance, it's crucial to understand the driving factors of EI adoption to enable more contractor firms to be an eco-innovative firm.

DRIVING FACTORS OF ECO-INNOVATION (EI) ADOPTION IN CONTRACTOR FIRMS

The driving factors represent the primary motivations for the EI practice to initiate. A considerable number of studies had been published from the field of EI concerning the factors that drive the EI implementation. The previous researcher on this topic such as Kesidou and Demirel (2012); Horbach et al. (2012); Triguero et al. (2013); Cai and Zhou (2014); Bossle et al. (2016); Hojnik and Ruzzier (2016); Fernando and Wah (2017); Cai and Li (2018), have shown that a firm's decision to introduce EI is influenced by a variety of factors, including firm-specific factors, technology, environmental regulations, and market factors. The firm-specific factors refer to the firm's need to improve its resources capabilities and knowledge in implementing new and advanced EI practices. Sanni (2017) stress that the process EI is stimulated internally at the firm-level, where the firm's technological capabilities within the firm are crucial determinants of process EI to initiate. Thus, top management's commitment is essential in motivating their employees to practice EI as part of the firm policy and standard (Zailani et al., 2015). Furthermore, the firm with sufficient physical assets such as suitable plants and equipment can encourage further EI adoption to minimise environmental impacts (Horbach et al., 2012; Gambatese and Hallowell, 2011). Employees account as the most valuable resources in an organisation. Thus, having skills and competent employees who can cope with EI's technological sophistication and complexity will drive them to excel in the environmental endeavour (Xue et al., 2014).

Technology factors are linked to the development of technological capabilities of a firm to eco-innovate to compete and survive in the construction industry. Technological capabilities usually enhance environmental and non-environmental process innovations (Triguero et al., 2013). The essential factors in building up such technological capabilities are an investment in R&D, including having qualified and technology-savvy employees contributing to the advancement of EI practices (Cainelli et al., 2015; Horbach et al., 2012). Based on Horbach (2008) empirical analysis of German firms, the enhancement of technological capabilities measured in terms of R&D and the competent of employees is critical in favouring EI. Cainelli et al. (2015) and Del Río et al. (2015) find that the presence of an R&D structure is positively correlated with the introduction of EI in a firm. Hence, the government's available grants and funding sources for R&D able to encourage the firm to spearhead in new green technology in a construction project (Bohari et al., 2015). In adopting EI, the literature highlighted that EI activities required access to external knowledge which can be achieved by collaboration with research institutes, external sources and partners (Triguero et al., 2013; Cainelli et al., 2015). Thus, a firm with vital networking as a source of learning a new technological knowledge capable of supporting EI implementation effectively (Ben Arfi et al., 2018). Hence, all these technological factors, including tangible and intangible assets, skills, knowledge, and networking with other firms, had driven the contractor firms to adopt EI.

Environmental regulations refer to the government's general rules and policies to control pollutions and protect the natural resources towards development. Regulation identified as significant factors that drive the EI adoption in several empirical studies (Horbach et al., 2012; Triguero et al., 2013; Cai and Zhou, 2014). The famous Porter hypothesis (cited by Cai and Li, 2018; Bossle et al., 2016) assumes that the more stringent and properly designed environmental regulation may encourage firms to develop green technology, processes or products, improve management methods, and partially or entirely avoid unnecessary economic loss due to non-compliance of environmental regulation. Therefore, Kesidou and Demirel (2012) anticipate that the enforcement of environmental regulations can stimulate EI. The firms that exceed minimum compliance could enjoy first-mover advantages by pioneering the innovation (Cai and Li, 2018). The study by Horbach et al. (2012) statistically resulted in a positive and significant influence of subsidies on EI. Similar results found by Del Río et al. (2015) and Cainelli et al. (2015). In Malaysia, the government placed severe efforts in providing subsidies and incentives to drive green implementation (Bohari et al., 2015; Greentech Malaysia, 2018). Long et al. (2017) also reveal that a firm that consistently adheres to environmental regulation and policy can enhance its reputation and image while improving their economic performance.

Meanwhile, market factors can also drive the adoption of product EI in contractor firms as end-users or business customers are now concerned about the environment and demand for green end-products or green buildings. Kammerer (2009) claims that understanding and integrating customer benefits in product development will generate more robust demand for green products, which, in turn, motivate firms to engage in EI. Triguero et al. (2013) had empirical evidence using a sample of 27 European countries that market share and market demand for green products have a significant positive influence on product EI and organisational EI. Market pressure mainly stems from competitors, clients, and end-users. Market pressure is external factors that stimulate firm initiatives to eco-innovate (Triguero et al., 2013; Del Río et al., 2016). Increasing green awareness and education is the prime reason that exaggerated the pressure among them to demand greener products (Triguero et al., 2013). Thus, the summary of the literature reviews of four drivers as the main driving factors that influenced the EI adoption in contractor firms is presented in Table 1.

Table 1: Details of driving factors of EI adoption in the construction industry at the contractor firm level

Driving factors	Items description	Sources
Firm specified factors:		
Technological capability	• Accessibility of advanced green technologies and knowledge capabilities • Availability of plants and equipment for EI implementation	Rennings, 2000; Gambatese and Hallowell, 2011
Quality of human resources	• Qualified and competent employees to cope with the technological sophistication and complexity of EI	Triguero et al., 2013; Xue et al., 2014 and Tariq et al., 2017.
Organisational direction	• The organisational approach toward embracing eco-innovative practices (as part of a firm policy or standard) • Support and commitment from top management that encourage the implementation of EI as norms practice in the firm	Zailani et al. 2015; Tariq et al. 2017; Ozorhon and Oral, 2017.
Technology factors:		
Technology-driven	• To have better R&D for technological advancement • To be the pioneer in applying new technologies • To produce technology-savvy employees • To adopt and spearhead new innovative technology for green project development	Cainelli et al. 2015; Horbach et al. 2012; Del Río et al., 2015
Technology resources	• To build vital networking with external vendors to continuously improve a firm's technological knowledge and implementation • To optimise available resources (grants and funding) provided by the government for R&D in green technology	Triguero et al. 2013 Ben Arfi et al., 2018; Rennings, 2000. Hashim, 2018
Environmental factors:		
Regulatory pressure	• Compliance to stringency and enforcement of environmental regulations • To avoid unnecessary economic loss due to non-compliance of environmental regulations • To be the pioneer in complying with the environmental standard, both local and international level (e.g., EMS, EIA, etc.)	Rennings, 2000; Fernando and Wah, 2017; Bossle et al. 2016
Government initiatives	• To optimise available subsidies and incentives provided by the government for environmental regulations compliance	Horbach et al., 2012; Cainelli et al., 2015
Firm reputation and image	• To build an excellent firm reputation as a contractor that always adhere to environmental regulations and policy	Kiefer et al., 2018; Long et al., 2017; Bohari et al., 2015
Market factors		
Customer pressure	• The rising of market demands and customers' awareness and expectation towards environmental-friendly end-products	Kesidou and Demiral, 2012, Cai and Li, 2018, Kammerer, 2009
Client pressure	• Demand from the clients to incorporate innovative practices/ technologies/ processes in the green project.	Triguero et al. 2013; Del Río et al. 2016

CONCLUSION

Malaysia's vision of a green future in the construction industry is bright. However, it also depends on all parties involved to collaborate and work together to ensure the national target of transforming the construction industry toward green requirement is achievable. Factors that influence the green/eco practices are prominent in current construction scenario coupled with post-covid-19 challenges. Undoubtedly, the contractor firms need to change their conventional construction practices towards eco-practices. From the review, the government has played its role in enhancing and motivating the construction players toward green with the enforcement of environmental regulations, new policies, incentives, and financial schemes to accelerate the green revolution. Environmental regulations mostly cited having a massive effect on EI's successful adoption, which helps contractor firms enhance their environmental performance. The availability of advanced green technology had driven and changed the way the contractors' operation in the construction of buildings and infrastructures, aims to reduce or eliminate construction waste and carbon emissions, including efficient used of resources. It is gradually impossible to deny that the current construction landscape is complicated and uncertain with increasing demand for environmental sustainability as the construction activities directly affect environmental degradation. This paper's significant contribution is to develop an understanding of EI adoption's driving factors, which expected to encourage more contractor firms to maximise value through innovation that has positive environmental impacts. The influence of firm-specific factors, technology factors, environmental regulations, and market factors to stimulate the adoption of EI practices from the contractors' perspective has been highlighted in this study. This study also expected to increase awareness and understanding among construction professionals' firms on EI adoption in the construction industry. This knowledge may contribute to better decision-making in contractor firms towards implementing eco-innovative practices at the firm level. Moving from an

understanding of the driving factors for the adoption of EI; enabled us to advance theoretically in the knowledge of this field and develop a framework for firm strategies to enhance EI adoption effectively. Again, this study enriches the literature of EI within the construction industry, which currently dominated by the manufacturing industry.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the financial support provided by the Ministry of Education (MOE) Malaysia and physical support by Universiti Sains Malaysia under the Fundamental Research Grant Scheme (FRGS) No. 203.PPBGN.6711651.

REFERENCES

Bamgbade, J. A., Kamaruddeen, A. M., & Nawi, M. N. M. (2017). Towards environmental sustainability adoption in construction fi rms : An empirical analysis of market orientation and organisational innovativeness impacts. *Sustainable Cities and Society*, 32, 486–495.

Ben Arfi, W., Hikkerova, L., & Sahut, J. M. (2018) External knowledge sources, green innovation and performance. *Technological Forecasting and Social Change*, 129, 210-220.

Bohari, A. A. M., Skitmore, M., Xia, B., Teo, M., Zhang, X., & Adham, K. N. (2015). The path towards greening the Malaysian construction industry. *Renewable and Sustainable Energy Reviews*, 52, 1742-1748.

Bossle, M. B., Dutra De Barcellos, M., Vieira, L. M., & Sauvée, L. (2016). The drivers for adoption of eco-innovation. *Journal of Cleaner Production*, 113, 861-872.

Cai, W. G., & Zhou, X. L. (2014) On the drivers of eco-innovation: Empirical evidence from China. *Journal of Cleaner Production*, 79, 239-248

Cai, W., & Li, G. (2018). The drivers of eco-innovation and its impact on performance: Evidence from China. *Journal of Cleaner Production*, 176, 110–118.

Cainelli, G., Marchi, V. De, & Grandinetti, R. (2015). Does the development of environmental innovation require different resources ? Evidence from Spanish manufacturing firms. *Journal of Cleaner Production*, 94, 211-220.

Carrillo-Hermosilla, J., Del Río, P., & Könnölä, T. (2010). Diversity of eco-innovations: Reflections from selected case studies. *Journal of Cleaner Production*, 18, 1073-1083.

Cheng, C. C. J., Yang, C. L. & Sheu, C. (2014). The link between eco-innovation and business performance: a Taiwanese industry context. *Journal of Cleaner Production*, 64, 81-90.

Cheng, C. C., and Shiu, E. C. (2012). Validation of a proposed instrument for measuring eco-innovation: An implementation perspective. *Technovation*, 32(6), 329-344.

Del Río, P., Peñasco, C., & Romero-Jordán, D. (2016). What drives eco-innovators? A critical review of the empirical literature based on econometric methods. *Journal of Cleaner Production*, 112, 2158-2170.

Doran, J. & Ryan, G. (2012). Regulation and firm perception, eco-Innovation and firm performance. *European Journal Innovation Management*, 15(4), 421-441.

Fernando, Y. & Wah, W. X. (2017). The impact of eco-innovation drivers on environmental performance : empirical results from the green technology sector in Malaysia. *Sustainable Prod. Consumption*, 12, 27-43.

García-granero, E. M., Piedra-mu, L., & Galdeano-Gomez, E. (2018). Eco-innovation measurement : A review of firm performance indicators. *Journal of Cleaner Production*, 191, 304-317.

Gambatese, J. A., & Hallowell, M. (2011). Enabling and measuring innovation in the construction industry. *Construction Management and Economics*, 29(6), 553–567.

Greentech Malaysia (2018) Malaysia National Green Technology Policy. http://www.greentech.malaysia.my, last accessed (19/07/2019)

Hamid, Z. A., Zain, M. Z. M., Hung, F. C., Noor, M. S. M., Roslan, A. F., Kilau, N. M., & Ali, M. C. (2014). Towards a national green building rating system for Malaysia. *Malaysian Construction Research Journal*, 14(1), 1–16.

Hashim, R. (2018). *Green Innovation Adoption in the Construction Sector : The role of Absorptive Capacity and the Effect of Environmental Requirements.* The University of Edinburgh.

He, F., Miao, X., Wong, C. W. Y. and Lee, S. (2018). Contemporary corporate eco-innovation research : A systematic review. *Journal of Cleaner Production*, 174, 502-526.

Hojnik, J., & Ruzzier, M. (2016). The driving forces of process eco-innovation and its impact on performance : Insights from Slovenia. *Journal of Cleaner Production*, 133.

Horbach, J. (2008). Determinants of environmental innovation-New evidence from German panel data sources. *Research Policy*, 37(1), 163–173.

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact - The role of regulatory push/pull, technology push and market pull. *Ecological Economics*, 78, 112-122.

Kammerer, D. (2009). The effects of customer benefit and regulation on environmental product innovation. Empirical evidence from appliance manufacturers in Germany. *Ecological Economics*, 68, 2285-2295.

Kemp, R., & Pearson, P. (2007). *Final report MEI project about measuring eco- innovation.* Retrieved from http://www.merit.unu.edu/MEI

Kesidou, E. & Demirel, P. (2012). On the drivers of eco-innovations: Empirical evidence from the UK. *Research Policy*, 41(5), 862-870.

Kibert, C. J. (2012). *Sustainable construction: green building design and delivery*, Hoboken, New Jersey: John Wiley & Sons.

Lam, P. T., Chan, E. H., Ann, T. W., Cam, W. C. and Jack, S. Y. (2015). Applicability of clean development mechanism to the Hong Kong building sector. *Journal of Cleaner Production*, 109, 271-283

Lee, K. H. & Min, B (2015). Green R&D for eco-innovation and its impact on carbon emissions and firm performance. *Journal of Cleaner Production*, 108, 534-542

Long, X., Chen, Y., Du, J., Oh, K., & Han, I. (2017). Environmental innovation and its impact on economic and environmental performance : Evidence from Korean-owned firms in China. *Energy Policy*, 107, 131-137.

Ministry of Energy, Green Technology and Water Malaysia (KeTTHA) (2017*). Green Technology Master Plan Malaysia 2017-2030*.

Miroshnychenko, I., Barontini, R., & Testa, F. (2017). Green practices and financial performance : A global outlook. *Journal of Cleaner Production*, 147, 340-351.

Organisation for Economic Cooperation, and Development (OECD) (2009). *Eco-Innovation in Industry: Enabling Green Growth*, OECD, Paris

Ozorhon, B., & Oral, K. (2017). Drivers of Innovation in Construction Projects. *Journal of Construction Engineering and Management*, 143(4), 1–9

Peng, X., & Liu, Y. (2016). Behind eco-innovation: Managerial environmental awareness and external resource acquisition. *Journal of Cleaner Production*, 139, 347-360.

Qi, G. Y., Shen, L. Y., Zeng, S. X., & Jorge, O. J. (2010). The drivers for contractors' green innovation: An industry perspective. *Journal of Cleaner Production*, 18(14), 1358-1365

Rennings, K. (2000). Redefining innovation - Eco-innovation research and the contribution from ecological economics. *Ecological Economics*, 32(2), 319-332.

Samari, M., Godrati, N., Esmaeilifar, R., Olfat, P., & Shafiei, M. W. M. (2013). The investigation of the barriers in developing green building in Malaysia. *Modern Applied Science*, 7(2),1–10

Sanni, M. (2017). Drivers of eco-innovation in the manufacturing sector of Nigeria. *Technological Forecasting & Social Change*, (October), 0–1.

Singh, K. S. J. (2017). *Eco-Innovation in the Chemical Manufacturing Industry : Status and Its Determinants,* Unpublished PhD Thesis, University Malaya.

Suprun, E. V., & Stewart, R. A. (2015). Construction innovation diffusion in the Russian Federation. *Construction Innovation*, 15(3), 278-312.

Tabassi, A. A., Argyropoulou, M., Roufechaei, K. M., & Argyropoulou, R. (2016). Leadership Behavior of Project Managers in Sustainable Construction Projects. *Procedia Computer Science*, 100, 724–730.

Tariq, A., Badir, Y. F., Tariq, W., & Bhutta, U. S. (2017). Drivers and consequences of green product and process innovation: A systematic review, conceptual framework, and future outlook. Technology in Society, 51, 8–23

Tatum, C. B. (1988). Process of innovation in construction firm. *Journal of Construction Engineering and Management*, 113(4), 648–663.

Triguero, A., Moreno-Mondéjar, L., & Davia, M. A. (2013) Drivers of different types of eco-innovation in European SMEs. *Ecological Economics*, 92, 25–33.

Xue, X., Zhang, R., Yang, R. & Dai, J. (2014). Innovation in Construction: A Critical Review and Future Research. *International Journal Innovation Science*, 6(2), 111–126.

Yan, H., Shen, Q., Fan, L. C. H., Wang, Y, & Zhang, L (2010) Greenhouse gas emissions in building construction: A case study of One Peking in Hong Kong. *Building and Environment*, 45(4), 949-955

Yusof, N. A., Kamal, E. M., Kong-Seng, L., & Iranmanesh, M. (2014). Are innovations being created or adopted in the construction industry? Exploring innovation in the construction industry. *SAGE Open*, 4(3), 1-9

Yusof, N., Awang, H. & Iranmanesh, M. (2017). Determinants and outcomes of environmental practices in Malaysian construction projects. *Journal of Cleaner Production*, 156, 345–354.

Zailani, S., Govindan, K., & Iranmanesh, M. (2015). Green innovation adoption in automotive supply chain : the Malaysian case. *Journal of Cleaner Production*, 108, 1115–1122.

Zhiwei, Y., Chen, L. & Bingbing, S. (2014). Application of green construction technology in construction projects. ICCREM 2014. *Smart Construction and Management in the Context of New Technology*, 389-397