

A Framework of Eco-innovation Strategies and Competitive Advantages in Contractor Firms

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Abstract— Eco-innovation (EI) is vital for the contractor firm in order to reduce all the negative impacts of construction activities on the environment and reach governments' green requirement. EI strategies refer to the capabilities of a firm to build an environment that supports innovation and green practices. The contribution of the construction industry to environmental degradation as a result of rapid development in the urban area and unsustainable approach of past construction had increased awareness of EI. However, the study on EI in the construction industry has received much less attention although EI is capable of improving the competitiveness of contractor firm and sustaining business endeavour. Thus, this paper aims to identify appropriate strategies which drive and enhance implementation of EI in the contractor firms. A literature review is carried out using content analysis to determine the EI strategies that crucial to improve the conservative construction practices toward green. The study unveils five EI strategies which are human resources development, technology advancement, collaboration and networking, knowledge empowerment and management proactiveness. A framework representing the EI strategies to become eco-innovative and competitive will be presented. The formulation of the framework on strategies supporting EI for contractor firms which can later be adapted to any service-based firms to achieve competitive advantages and environmental sustainability simultaneously.

Keywords— *Eco-innovation, eco-innovation strategies, competitive advantages, contractor firm, environmental sustainability.*

1. Introduction

Malaysia is anticipated to become a high-income developed country with national construction development is expected to change significantly through the implementation of sustainable development [1]-[3]. The existing scenario of the construction industry, which deficiency of sustainability-rated construction; buildings and infrastructure that are unaccountable to the natural environment, high carbon emissions, inefficient energy and water usage, a high volume of construction and demolition waste dumping were due to unsustainable way of past construction [4]-[7]. Continuing to deliver construction projects in an existing way will create more environmental degradation. Hence, the government are committed to address these issues. Thus, under Construction Industry Transformation Programmes (CITP) (2016-2020) and Green Technology Master Plan (GTMP) (2017-2030), the government had taken actions and believed that a positive changeable can be realised.

Furthermore, government also place serious effort in increasing the national awareness and spur production of green technology, escalation potential green market, introducing policies, financial scheme, green investment tax incentive, green procurement and others initiatives towards achieving sustainable development goals [8].

Green revolution over the years has transformed the construction landscape with green building, which has placed greater accentuate on green building construction. Hence, firms need to innovate in response to the changes in market demand and government requirement in pursuing green goal. Innovation is well known as a key to resolving these issues, at the same time able to improve productivity and economic of a firm for strengthening competitiveness within the construction industry [1], [9]. However, innovation alone is insignificant as it may create pressure towards the environment. Hence, the need to transform the construction process into a greener mode of overall operations and management through enhancement the level of innovation has become the most significant discussion in Malaysia among academic and industrial practitioners [4], [3], [10], [11]. With the increasing awareness of sustainability in the construction industry had influenced business firms to improve their environmental performance and efficiency. One of the way, the firms incorporate environmental issues into their business strategy while reinforcing their competitive advantage through innovations that can have positive environmental effects. The new environmental-friendly project development, as well as enhancement in the construction and management approach, are required to achieve higher environmental respect. These objectives can be accomplished through the implementation of eco-innovation (EI). EI is acknowledged as the key activities to build core competitive advantages for an organisation's long term-development [12], [13]. EI has the potential to be implemented in the construction industry, especially for contractor firm that motivated to shift from conservative building practices toward better green practices. [3], [14], [15].

With the emerging importance of EI recently, researchers have addressed EI from different perspectives. The first category those researches are identifying the drivers of EI and the performance outcomes arising from EI implementation, with [14], [16]-[21], being the more recent examples of this category. Second are those that identify the dimensions of eco-innovation, with [22] and [23] in this category. Third, is related to the measurement

of EI, with [24]-[26] in this category. Forth, is related to the EI strategies that enable firms to integrate environmental issues into their business operation, with ref. [12], [27]-[34] being the more examples of this category. However, most of this study had been carried out in the manufacturing industry and SMEs. Study on the fourth category which specific to the construction industry is barely limited. Thus, this study is being carried out in order to fill the gap. Previously, innovation and green have been focused as separate issues in the construction industry. Urgent changes are necessary to merge these two concepts and integrate them into a firm's business operation. In addition, the need to innovate has become part of the assessment requirement in the Green Building Index and other green rating tools. As a result, the need for EI to be implemented by the contractor firm in management and processes of green development is unavoidable. Hence, the research question in this study is; what are the appropriate strategies which drive and enhance the EI implementation in contractor firm? This study will focus on determining the EI strategies that crucial to contractor firms to become eco-innovative and competitive as a result to advance the environmental sustainability in the construction industry. As absence of effective strategies, EI will continue to be an added burden and not an expected and manageable requirement.

2. Theoretical Background

The dynamic capability is adopted in this study as a fundamental theory that conceptualising EI strategies which contribute to enhancing the firm performance and competitiveness. According to the dynamic capability approach, a firm can achieve its highest performance if it can quickly respond to the dynamic changes in the environment [35], [36]. Today, when worldwide competitive pressure is altering the construction industry landscapes, the dynamic capabilities are particularly important. Therefore, firms in this sector need to have appropriate strategies, suitable infrastructures, and the capacity to innovatively use their capabilities and resources [37]. The efficient usage of a firm's capabilities describes the general performance of the firm [38]. In practising EI, [39] claim that a firm needs guidance on how to systematically apply its capabilities to attain environmental objective and sustain continuous improvement of services, products, and processes performance. Managing innovation alone without a firm's dynamic capability to generate, expand and alter its resources base is obviously inadequate to generate success [40]. Consistent with [35] and [36], the concept of dynamic capability theory comprises, the ability to sense external opportunities and challenges, seize them accordingly and sustain competitiveness by reconfiguring or transforming the intangible and tangible capabilities of the firm towards the advancement of firm performance. The contractor firm needs to have the right capabilities in order to strengthen their EI strategies to achieve competitive advantages within the industry. In line with the strategic management process of a firm, the research of [36], [41] allows a firm to delineate strategic factors and prioritise that need to be tailored to improve firm performance.

3. Literature Review

3.2 Definition of eco-innovation

Different scholars refer to EI term interchangeably with green innovation, environmental innovation or sustainable innovation [22], [39], [42]. There are numbers of distinct definitions for EI, but they have meanings and values that are quite comparable. The Organisation for Economic Cooperation, and Development (OECD) elucidated EI as *"the creation or implementation of 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"* [43]. While, the Eco-Innovation Observatory defined EI as *"the introduction of any new or significantly improved product, process, organisational change or marketing solution that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle."* [44]. Thus, this innovation varies from the definition of general innovation as EI results in economic and environmental benefits in delivering quality building and infrastructure. The key aspect of the EI definition is focused on the positive effect of innovation activities on the environment.

3.2 Eco-innovation in the construction industry

EI is a reflection of two broad concepts: environmental management and innovation [10]. Environmental management and innovation literature are both progressively emphasising on EI as a means of advancing a firm's competitiveness while preserving the environment and its valuable resources for future generation. Especially when a firm more focuses on maintaining or improving the natural environment while engaging in innovation-based activities. Generally, EI practice aims to improve current environmental performance and gain firms' competitive advantage depends on their capacity to improve process EI (productive efficiency), product EI (product quality), and organisational EI (organisational efficiency) [34], [45], [46].

Whereas in the construction industry, process EI reflects improving the current construction processes or the addition of new processes that able to decrease the environmental impact [45]. Product EI refers to the introduction and application of new or significantly improved products (regarding their characteristics) in technical components and materials that reduce environmental impact throughout its life-cycle [22], [25]. Meanwhile, organisational EI involved in facilitating and aligning technical knowledge to eco-innovate as well as transforms the organisational structure and coordinates the entire infrastructure aimed at minimising environmental impacts [17]. The focus largely on organisational management on environmental innovation practices, for instance, Environmental Management System (EMS), Total Quality Management (TQM), etc. [17], [47]-[49].

EI was observed as an efficient manner for contractor firms to prevent or decrease destruction to the environment while remaining sufficient lucrative [50]. The adoption of EI strategies is important for contractor firms as they can not only be environmentally friendly but also gain a competitive advantage. EI practices are critical to embedding within the contractor firm as they are accountable for delivering the construction project within the stipulated contract. Various project stakeholders were involved in a development project, where, the contractor needs to play its roles as a mediator between the organisations that produce many of the new products and processes such as consultants, suppliers, and those (client, regulator and professional bodies) which adopt these innovations in their project [51]. Therefore, it becomes the responsibility of the contractor to deliver an understanding of the EI practices between the client, the suppliers, consultants and other project stakeholders to decrease and mitigate the adverse environmental impact of a construction project. Thus, the contractor firm needs to find the edge in how to control the waste and pollution, learning and improve continuously in green practices, sense and seize opportunities and reconfigure their management and operation in minimising the environmental impact, create social value, and to surpass its competitors. From this, contractor firm can comprehensively advance their firm's capabilities to eco-innovate by focusing on the strategies that need to be strengthened to compete successfully in complex, large scale green development project.

3.3 Eco-innovation strategies and competitive advantages

From the review of the literature, strongly agree that innovation is the main sources of competitive advantages, and this can be achieved with proper strategies. As support by [52], a firm obtains competitive advantages when it implements a value-creating strategy. Thus, EI strategy refers to the capabilities of a firm to build an environment that supports innovation and enables it to distinguish itself from competitors on the basis of the unique products or services that can offer to clients and end-users [53]. The benefits of EI are not limited to improve environmental performance, but it also enables firms to attain numerous monetary and economic advantages [54]. EI help contractor firm insert environmental issues into their business strategy in order to create or consolidate their competitive advantages. Indeed, it has been demonstrated by [45], [55] that the performances of EI are positively correlated to firm competitive advantage.

Table 1. Eco-innovation strategies

Eco-innovation strategies	Sources
Human resources development strategy	[10],[12],[51],[56]-[58],[81],[61],[62].
Technology advancement strategy	[10],[13],[59],[60],[81][63],[64].
Knowledge Empowerment Strategy	[58],[65],[66],[68],[81]
Collaboration and Networking Strategy	[10],[17],[58],[69]-[74],[81].
Management Proactiveness Strategy	[13],[14],[47],[58],[64]

Establishing an effective EI strategy requires the firms to embrace changes and adapt to a dynamic environment, thus contributing to a competitive advantage [48]. Thus, a contractor firm able to use its capabilities and resources in different combinations to create EI strategies, from which it can develop and apply this innovation to achieve its goals and enhance its environmental performance. As changes in the environment represent the changes in competition, regulation, market pressure and other stakeholder demands. Therefore, understanding the strategies to eco-innovate is critical. The dynamic capabilities are recognised to impact the process of structuring and restructuring the firm status quo, studying this topic will have important research value for the implementation of the EI in the construction industry at the firm level. As a result, five strategies had been reviewed as vital in EI implementation (refer Table 1), for instance, human resources development, technology advancement, collaboration and networking, knowledge empowerment and management proactiveness.

3.3.1 Human Resources Development Strategy

The construction industry is a highly complex industry that requires solid coordination of resources and material within the completion period of the project. Undisputable, the development of building and infrastructures with proper environmental management requires the support of human resources [56], [57]. Thus, human resources are an essential asset for firms in carrying business operation effectively towards achieving a firm's competitive advantages. The recruitment of well experienced and competent employees to be in charge of environmental management in the firm is vital [12]. Some studies [12], [51], [57], [58] prove that prudent management of human resources is an essential factor that influences the adoption of more advanced EI practices. This can be achieved by providing the employees with proper environmental education and training to increase their knowledge and awareness of environmental innovation and issues [12], [59]. According to [60], firms who are pioneers in environmental innovation widely involve their employees in environmental training and incentive programs to support innovation. The employees were able to undertake their duties and decision with full awareness

of its effect on the environment [61]. This awareness and knowledge will be more significant when the employees are authorised to initiate environmental practices, hence result in EI implemented in the firms [62]. In addition, employees with environmental oriented have potential in solving environmental issues during the construction process with less polluting practices. In addition, the use of reward system and recognition, pay increases and incentives able to motivate employees to be eco-innovate [48]. Taking into account that the adoption of environmental practices has become part of a contractor firm goal, the human resource development strategy is considered fundamental for adopting EI practices.

3.3.2 *Technology Advancement Strategy*

Technology is the key source of innovation in construction. The advancement of technology to embrace EI, changes the way firms operate in constructing building and infrastructure. Ref. [43] defines innovation as the implementation of new products and processes involving technological advancement. Furthermore, the firm which advances in technology and invests in research and development (R&D) able to encourage further in EI adoption [13]. As supported by [63], EI is strongly related to firms' investment in R&D. Adopting EI at a firm level, the firms need to make a long-term commitment in R&D investment to transform the existing technology with new cleaner technology to reduce or eliminate solid waste, liquid waste and polluting emissions [12]. Ref. [63] employs the term green R&D, which focuses on R&D activities for EI. Moreover, the firm's technological capabilities are emphasised the physical and knowledge capabilities of a firm to develop new product EI and process EI with inputs such as R&D investment or further education of the employees [64]. Technology advancement strategy includes substituting or transforming the existing technologies or equipment used with a greener alternative in order to reduce or eliminate construction waste and polluting emissions while undertaking construction activities [59], [64]. Thus, green technology advancement plays an important strategy in adopting EI practices for the improvement of productivity, energy efficiency, minimising construction costs, lowering carbon emission and environmental impacts.

3.3.3 *Knowledge Empowerment Strategy*

The emerging role of green knowledge has made knowledge a valuable property to firms. Thus, firms that have the capability to leverage and manipulate existing knowledge and to search for new relevant knowledge to improve their business are at an advantage. Involvement of contractor firm in EI activities requires new knowledge to be sensed, seized and transformed within the firm level. Knowledge sharing is the fundamental means through which employees can mutually exchange their knowledge and contribute to knowledge application, innovation, and ultimately to the competitive advantage of the firm [65]. Improving the sources and flow of knowledge in environmental-related issues or practices within the firm is vital [59]. Previous literature highlight that environmental knowledge is embodied in the technology and R&D obtained from external sources [47]. EI

activities required greater external sources of knowledge as compared to innovation in general [64]. EI initiatives likely depend on the firm's relationships with external partners are a source of learning and allow new knowledge creation [66]. The success of the EI is strongly impacted by the access to the knowledge base and the combination of internal and external knowledge sources in each phase of the construction process. The green knowledge is critical resources that enhance a firm's internal conditions to promote EI and coordinating the latest cleaner and greener technology to facilitate the in-house process of creation or adoption of EI [67]. The firm capability to leverage the expertise of the employees and add new value by making them collaborate on new knowledge and information, extract vital data and process it is appropriate in EI implementation [68]. According to [65], knowledge empowerment strategy is directly influenced successful innovation and improve firm performance. Hence, knowledge empowerment appears to be the basis for stimulus eco-innovative capabilities thus gaining the firm's competitive advantage.

3.3.4 *Collaboration and Networking Strategy*

The way firms collaborate with its external stakeholders in the construction industry able to influence their environmental initiatives. According to [17], collaboration and networking had a positive influence on EI practices. Ref. [47] states that environmental collaboration and networking occur when more than two organisations join forces to share information, make a joint decision and share their best practices to mitigate adverse environmental effects of human activity towards the environment. Thus, successful EI requires effective cooperation, coordination, and integration among contractors, sub-contractors, suppliers, consultants, government agencies, research institutes, universities and clients in construction projects to promote EI practices [69]-[72]. Among previous researchers, had a mutual understanding that resources sharing and knowledge transfer through collaboration and networking with external partners for learning and exchange of green knowledge and information are important for adoption of EI product and EI process [73]. Technology transfer also promotes the creation of a technological alliance with key stakeholder for environmental best practices [74]. In addition, developing a good relationship and collaboration in green supply chain able to improve innovation and environmental performance of the industry. A study by [75], revealed that innovation performance mediates positively the association between green supply chain skills and the firm's environmental performance. Therefore, moving towards greener the construction industry requires support and participation from the various project stakeholders.

3.3.5 *Management Proactiveness Strategy*

The enforcement of environmental regulation by the government would trigger firms to eco-innovate, thus enhancing firms' performance [3], [13]. In Malaysia, the implementation of EI is inseparable from the government's role in promoting green technology programs to the industry [14]. This can be seen from the

environmental regulation that been made mandatory by the government for the contractor firms venturing in a large construction project such as Environmental Quality Act, EMS, TQM, Uniform Building By-Laws (UBBL) including compliance with Green Building Rating Tools. The firm generates innovation with environmental benefits in response to the existing environmental regulations or taxes on pollution [47], [64]. In addition, the implementation of EMS which accelerates EI is seen as the reflection of the strong firm capabilities in environmental management [76], [64]. Recently, the government is committed towards the green industry by introducing new green schemes and amendments to current policies in development project [3], [14], [58]. Firms that comply with environmental regulation will perform better and become favourable firm to be selected in a green development project in the future.

4. Methodology

In this study, exploratory research is adopted. It is intended to examine the appropriate strategies to be implemented by contractor firms to eco-innovate to enhance EI practices in the construction industry. This industry is very relevant in the transition towards sustainable development and green practices, given its weight in the economy and its high historic and current environmental impacts. Thus, in-depth literature review is conducted which reflected the key concepts employed in this study. The literature review is considered essential in any scientific research. In reviewing the previous literature, content analysis is employed to determine the EI strategies for successful EI execution at the firm level. Ref. [77] defined content analysis as “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” cited in [78], [79]. In this study, content analysis is described as a research method for subjective interpretation of text information content through the coding and identification of themes or patterns from the systematic classification process. Content analysis able to provide knowledge and understanding of the phenomenon under study [78]. Based on relevant literature, e.g., [10] – [14], [17], [47], [51], [56] – [66], [68] – [74], [81] the domain of eco-innovation strategies was created and an initial list of items was generated. It reviews five appropriate EI strategies (human resources development, technology advancement, knowledge empowerment, collaboration and networking, and management proactiveness) to be employed by the contractor firms in achieving competitive advantages and meeting the environmental performance.

5. Findings and Discussion

The growing construction industry awareness on reducing waste, energy efficiency, water efficiency, reducing carbon emission and constructing more green building has resulted in the need for contractor firm to adopt suitable EI strategies. Thus, in individual contractor firms, these strategies have the potential to be introduced and adopted to promote EI implementation. Indeed, many developed countries have incorporated the EI concept into every stage of project development [15], [43], [44]. The

contribution of EI on firm performance has also been recognised (e.g., [12], [13], [63]). Hence, the framework of EI strategies for contractor firms (refer figure 1) is developed which consists of EI strategies, EI components (process, product and organisation) and the firm performance (competitive advantages and environmental performance) as the outcome (refer figure 1.).

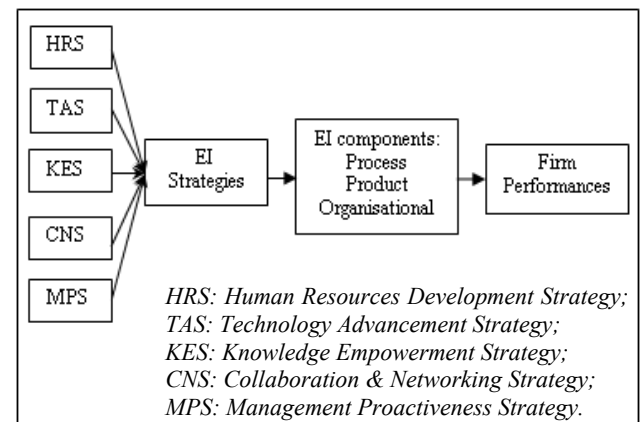


Figure 1. A conceptual framework of eco-innovation strategies in contractor firms; adapted and modified from [25], [40], [47], [52], [81].

First of all, understanding a firm’s current status is the first key steps. Ref. [12] and [81] indicate that, in order to understand how the capabilities of the firm can be developed or altered to resolve changes, it becomes mandatory to look at the firm’s history and how the past behaviour may have affected its present practice. Therefore, as this study looks into a contractor firm, it is technically essential to determine the level of execution of EI within the firm. To efficiently fulfil the environmental and economic performance, there is a need for a vibrant comprehension of EI components (process, product and organisation) and their inclusion in the construction process. Next, the contractor firm needs to redefine its strategies towards EI implementation. As a result, human resources development, technology advancement, knowledge empowerment, collaboration and networking, and management proactiveness had been reviewed as an appropriate EI strategies for contractor firm. The implementation of these strategies is strengthened through the application of dynamic capability theory. Therefore, based on dynamic capability perspective, the capacity of sensing refers to the identification and assessment of an opportunity and establishing the direction of the strategies based on the relevant EI components and firm’s current performance [36]. For instance, green technologies advancement and knowledge empowerment require investments in R&D works in order to advance the process, product and management of construction project, improve technical knowledge of technological operations including other related innovation activities. Meanwhile, seizing refers to the optimisation on firm’s capabilities and other external factors to support the accomplishment of the EI strategies which are recognised as favourable toward competitive advantages [36], [81], which consists of organising resources in order to address an opportunity and capture its value. Lastly, transforming is the activity by which the firms continuously reconfigures and improve its resource base by changing status quo and

operating capabilities as needed to transform the firm's strategies to achieve fruitful implementation of EI at firm level [33], [82]. Pushing EI at contractor firm level can enhance a firm's competitive advantages to meet the firm's goal to reduce the negative impacts of construction activities on the environment. Indirectly, the industry able to transform and embrace green practices in total. As such, the strategies within the firm context shall be investigated first to understand how the firm eco-innovate efficiently.

6. Conclusion

Nowadays, it is increasingly impossible to deny that the current construction landscape is complex and uncertain coupled with client green requirements, customer pressure toward better building performance and government regulations target toward environmental sustainability. Thus, this study facilitates the contractor firms to comprehend the innovation that has environmental benefits in their business strategy that can improve present construction practices by enhancing firms' capabilities and learning the advantages of the EI practices, which is linked to firm competitiveness and environmental performance. For that reason, based on the literature review that had been conducted, five strategies (human resources, technology, knowledge, collaboration and networking, and management proactiveness) had been examined able to reduce environmental degradations and advance EI implementation in products, processes and organisational in contractor firm. From this study, it is anticipated that understanding these strategies will encourage more contractor firms to be eco-innovative and lead the internal and external environmental changes to become competitive and survive in a local and global competition in an invincible situation. In addition, this study enriches the literature of EI within the construction industry which currently dominated by the manufacturing industry. Positively, the formulation of the framework on strategies supporting EI for contractor firms which can later be tailored to any service-based firms to achieve competitive advantages and environmental sustainability simultaneously.

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