ECO-INNOVATION IMPLEMENTATION FRAMEWORK FOR MALAYSIAN CONTRACTING FIRMS

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ECO-INNOVATION IMPLEMENTATION FRAMEWORK FOR MALAYSIAN CONTRACTING FIRMS

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LIST OF ABBREVIATIONS

BIM	Building Information Modelling
CIDB	Construction Industry Development Board
CITP	Construction Industry Transformational Programme
DC	Dynamic Capability
EIA	Environmental Impact Assessment
EI	Eco-innovation
EMP	Environmental Management Plan
EPU	Economic Planning Unit
EQA	Environmental Quality Act
GBI	Green Building Index
GDP	Gross Domestic Product
GHG	Greenhouse gas
GTMP	Green Technology Master Plan
KASA	Ministry of Environment and Water
MGTC	Malaysian Green Technology & Climate Change Corporation
MCO	Movement Control Order
MPC	Malaysia Productivity Corporation
NGTP	National Green Technology Policy
SDG	Sustainable Development Goal
SPSS	Statistical Package for the Social Science
UBBL	Uniform Building by Law
UiTM	Universiti Teknologi MARA
USM	Universiti Sains Malaysia

LIST OF APPENDICES

RANGKAKERJA IMPLEMENTASI EKO-INNOVASI UNTUK FIRMA KONTRAKTOR MALAYSIA

ABSTRAK

Industri pembinaan dijangka cemerlang dalam inovasi dan pada masa yang sama alam sekitar terpelihara menjadikan konsep eko-inovasi (EI) sebagai hala tuju penting bagi firma dan industri. Namun begitu, aplikasi tersebut masih ketinggalan berbanding industri yang lain. Penyelidikan ini memberi tumpuan kepada pembangunan rangka kerja pelaksanaan EI dengan mengadaptasi Teori Keupayaan Dinamik. Dengan 5 objektif yang perlu dicapai, kaedah campuran (QUAN-QUAL) yang terdiri daripada tinjauan soal selidik dan temu bual separa berstruktur telah digunakan. Data kajian ini diperoleh daripada firma kontraktor gred G7 yang berdaftar dengan Lembaga Pembangunan Industri Pembinaan (CIDB). Berdasarkan keputusan 103 respons tinjauan dan 14 temu bual, didapati terdapat 10 komponen EI yang relevan dengan firma kontraktor, dikategorikan di bawah proses, produk dan organisasi EI (Objektif 1); tahap penggunaan EI kekal sederhana (Objektif 2); firma kontraktor didorong oleh faktor alam sekitar, teknologi, pasaran dan kriteria khusus firma kontraktor (Objektif 3); terdapat 6 cabaran utama dan 2 faktor sokongan utama yang mempengaruhi pelaksanaan EI (Objektif 4); dan akhir sekali, 4 strategi utama (pembangunan kakitangan, pengoptimuman teknologi, mengukuhkan rangkaian, dan pengurusan firma yang proaktif) dalam melaksanakan EI (Objektif 5). Penemuan ini membolehkan pembangunan rangka kerja pelaksanaan EI. Kajian kualitatif mengesahkan perkaitan penting antara komponen EI dan faktor-faktor yang mempengaruhi pelaksanaan EI dengan strategi EI untuk membolehkan pembangunan rangka kerja pelaksanaan EI. Rangka kerja ini membantu firma kontraktor untuk menjadi lebih prihatin dalam usaha EI dengan menyediakan pemahaman yang jelas dan menyeluruh tentang pelaksanaan

EI untuk memastikan komitmen berterusan terhadap kelebihan daya saing yang mampan dan kelestarian alam sekitar.

ECO-INNOVATION IMPLEMENTATION FRAMEWORK FOR MALAYSIAN CONTRACTING FIRMS

ABSTRACT

The construction industry is expected to excel in innovation while at the same time care for the environment, which makes the concept of eco-innovation (EI) an important direction for firms and the industry. Nonetheless, this application is still lagging compared to other industries. This research focuses on developing EI implementation framework by adapting the Dynamic Capability Theory. With 5 objectives to be achieved, a mixed method (QUAN-QUAL) comprising a questionnaire survey and semi-structured interview was employed. The data for this study was obtained from G7 contractor firms registered with the Construction Industry Development Board (CIDB). Based on the results of 103 survey responses and 14 interviews, it was discovered that there are 10 components of EI relevant to contractor firms that can be parked under process, product and organisational EI (Objective 1); the level of EI adoption remained moderate (Objective 2); the contractor firms are mainly driven by environment, technology, market, and firm-specific factors (Objective 3); there are 6 main challenges and 2 main supporting factors that influence EI implementation (Objective 4); and lastly, there are 4 key strategies (staff enrichment, technology optimisation, strengthen networking, and firm management proactiveness) to implement EI (Objective 5). The qualitative study validates the crucial connection of EI components and the influencing factors of EI implementation with EI strategy, enabling the development of the EI implementation framework. This framework facilitates the contracting firms to be more attentive in EI endeavour by providing a clear and comprehensive understanding of EI implementation to ensure continuous commitment to sustainable competitive advantages and environmental sustainability.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter focuses on the research background and research problems, highlighting the current issues of the construction industry in Malaysia. This chapter presents the research questions, aim and objectives. The scope of research, the significance of the study and brief research methodology are also being explained before providing the general guide on the outline of the thesis chapters.

1.2 Background of Research

Over the last few decades, environmental sustainability has attracted growing interest from industrial practitioners and academia in response to global warming, depletion of natural resources, and extreme environmental deterioration due to rapid growth in urban areas and unsustainable development approaches (Goi, 2017; Kamar & Hamid, 2011; Lai et al., 2017; Bamgbade et al., 2017; Dong et al., 2014). Globally, countries face the same conflict between the need for development and the need to mitigate adverse environmental impacts (Long et al., 2017). Based on this trend, García-Granero et al., (2018) claim that these environmental issues had increased awareness to pursue new ways of utilising the scarcity resources more efficiently to balance consumption and sustainability requirements to cope with the increasing demand for development. Although the construction sector is vital to achieve national socio-economic development goals such as providing employment, buildings, and infrastructure, it also has significant negative environmental consequences. The construction industry is mainly responsible for environmental degradation because the construction activities are considered a substantial contributor to environmental

pollution, waste generation, greenhouse gas (GHGs) emissions, unsustainable consumption of energy and natural resources (Hamid et al., 2014; Zutshi & Creed, 2015; Yusof et al., 2017). In addition, all buildings and infrastructures have extensive direct and indirect adverse effects on the environment, irrespective during their construction, occupancy, renovation, and demolition (Manley & Rose, 2017). According to Ministry of Energy, Green Technology and Water (KeTTHA, 2017) throughout a building's life cycle, 15% of its GHGs emissions occur during the construction phase, while the remaining 85% is produced during buildings occupation.

In this context, the construction industry received special attention as they are considered to contribute most to perpetuating these problems, yet they can provide appropriate solutions instead (Lai et al., 2017). Many studies highlighted that innovation is a key to improving the industry, enhancing productivity and sustainable economic growth (Kamal et al., 2016; Davis et al., 2016; Ozorhon & Oral, 2017). Innovation is widely regarded as the foundation of business change, growth, and effectiveness. It derives from the Latin word 'innovare', which means *"to create something new"* (Chen et al., 2018). Mention (2011) stated that innovation is an interactive process between the firm and its environment, resulting from the collaboration between various actors, operating both inside and outside of the firm. Thus, innovation is essential to keep up with evolving demand and remaining relevant, acquiring a competitive advantage, and maintaining business survival in a turbulent environment (Perez-Luno et al., 2014).

Many believe that innovation is an approach that allows firms to leverage their core competencies and transform them into better performance outcomes (Doran & Ryan, 2014). It is widely acknowledged that construction firms can create and exploit new solutions in response to many environmental challenges through innovation (Shaw, 2010; Ozorhon et al., 2016). Furthermore, failing to meet an excellent environmental

performance can provoke client and public discontent, compromising the project's success and creating bad images for all firms involved (Liao et al., 2018). However, continuous increases in construction costs, high complexity of building design with rising buildings demand, shorter project duration and higher construction quality are obstacles to increased productivity and competitiveness (Bamgbade et al., 2017). Thus, innovation is crucial in modern construction practices to increase efficiency, improve productivity, and strengthen the firm's competence and competitiveness.

Innovation becomes irrelevant when it negatively impacts the environment. Thus, any firm that intends to be ecologically conscious and competitive must encourage innovation that allows for new ways of tackling environmental challenges while promoting sustainable economic growth (Dogaru, 2020). According to Sim et al. (2014), the best way to accomplish sustainability in the construction sector is to actively pursue a holistic approach that balances the environment and economy while maintaining a healthy consideration for the social needs of humanity. Hence, firms need to innovate in response to the changes in market demand and clients' requirements in pursuing environmental sustainability. Combining environmental sustainability with innovative concepts would stimulate innovation-driven actions that prioritise environmental demands and promote new changes and improvements in how building and infrastructure projects are designed and developed (Hazarika & Zhang, 2019; Bamgbade et al., 2017). Urgent changes are crucial to merge and integrate these two concepts into the firm's practices to improve environmental performance. With the growing concern about detrimental environmental consequences, the dynamics of innovation should be intertwined with the responsibility towards green growth and environmental improvement. This innovative concept is termed eco-innovation (EI).

EI is usually used interchangeably with other terms, such as sustainable innovation, environmental innovation, and green innovation (Schiederig et al., 2011; Bossle et al., 2016; Xavier et al., 2017). He et al. (2018) and Pacheco et al. (2017) highlighted that EI is the most frequently used and best represents innovation that is highly beneficial to environmental and economic performance. EI generates new business prospects and competitive advantages by decreasing negative impacts and efficiently utilising natural resources (Hazarika & Zhang, 2019). EI has emerged as an essential ingredient in a firm's innovative business strategy by creating value, competitive advantages and increasing the firm's performance without compromising the natural environment (Arranz et al., 2020; Singh, 2017).

Kuo and Smith (2018) claimed that EI is a pivotal avenue toward sustainable development in business strategy. EI is a broad concept; Rennings (2000) defined EI as *'All actions of relevant actors that develop, apply or introduce new ideas, behaviour, products and processes, which contribute to reducing environmental burdens or ecologically specified sustainability target'*. Thus, EI has become an inevitable choice for firms as it is key to green transformation, increasing their competitive advantages and enhancing their environmental performance. This view has been supported by Cai and Li (2018), Horbach, (2016), and He et al. (2018). EI is broadly seen as an essential component of competitiveness that needs to be embedded in a firm's organisational structures, processes, products, and services to induce business intention towards environmental improvements compared to other relevant alternatives (Kesidou & Demirel, 2012; Fernández et al., 2021). Recently published literature described EI as a specific type of innovation that can potentially lessen the direct ecological impact of businesses operating negatively on the environment (Sumrin et al., 2021). Hence, this study focused on EI that can provide the firms with a means of creating a sustainable

competitive advantage in today's turbulent environment. Thus, in this study, the term EI is embedded in business strategy towards changes in new innovative environmental-friendly construction processes, improvement in product quality, increased organisational capabilities and efficient management approaches that significantly improve firm's environmental performance and concurrently improved its economic growth (García-Granero et al., 2018; Arranz et al., 2019; Bamgbade et al., 2017; Demirel & Kesidou, 2019). Furthermore, mitigating environmental consequences applied at the end of a construction phase is inefficient, as the remedial procedure is time-consuming and costly (Hazarika & Zhang, 2019). Therefore, as EI is crucial to improve firm and project performance while environmental concerns are embraced, research on EI practices in the construction industry should be encouraged.

Malaysia, one of the developing countries with rapid urbanisation growth, also faced various challenges in satisfying the demand for more and better buildings and infrastructure (Hamid et al., 2014; Bohari et al., 2015). According to the Department of Statistics Malaysia (DoS), Malaysia's population was 32.7 million in 2021, with slight growth from 2020's estimation of 32.6 million (DoS Malaysia, 2021). Hence, the construction industry is essential in providing physical facilities and infrastructure to meet demand and stimulate social and economic growth. With the construction sector experiencing significant expansion, it will negatively impact the natural environment. According to Zaid et al. (2015), the construction industry ranked third in GHG emissions after the transportation and manufacturing industries. The construction activities generate waste and pollution and consume vast amounts of energy and resources, contributing to the sector's highest portion of total adverse environmental effects (Bohari et al., 2015). According to Yusof et al. (2016), the construction industry has made minimal progress in terms of environmental performance, with a small

number of projects embracing environmental sustainability. Thus, the significant adverse impacts of construction activities on the environment have triggered a greater need for the prominence of environmental awareness in any construction agenda (Bamgbade et al., 2017; Bohari et al., 2015, KeTTHA, 2017). The unparalleled carbon emission growth and business-as-usual practices will potentially lock Malaysia in for an unsustainable development path. The construction industry has a crucial role in assisting the government's efforts to achieve sustainable development, where there is a balance between economic growth, social expansion, and environmental protection (Bohari et al., 2015; KeTTHA, 2017). To pursue sustainable development, the construction industry itself must be sustainable.

Therefore, an urgent shift to a greener mode of overall operational and management in all stages of development is crucial to ensure the sustainability of growth that conserving the natural environment for future generations is achievable (Bossle et al., 2016; Munodawafa & Johl, 2019). This situation has caused a shift in the construction industry to focus on innovative advances to overcome challenging environmental goals. Thus, the Malaysian government through Construction Industry Development Board (CIDB) had been committed to supporting economic growth by driving innovation in sustainable construction practices, reducing irresponsible waste during the construction process, facilitating the industry with the adoption of sustainable practices, and forcing compliance to environmental sustainability ratings and requirements (CIDB Malaysia, 2015; KeTTHA, 2017). In addition, an increase in Malaysia's awareness of protecting the environment and natural resources has contributed to the growth of innovation in construction (Yusof et al., 2014; Bamgbade et al., 2017).

A construction project involves a diverse range of project stakeholders, temporarily organised, and coordinated to complete a specific project (Gann & Salter, 2000; Yusof et al., 2017). The various stakeholders in construction, such as clients, contractors, and consultants, have diverse perspectives on innovation, either design and product-oriented or project-oriented. Each multidisciplinary player in the construction project performs a crucial role within their sphere of responsibilities to ensure project success. According to Ozorhon (2013), innovation in the construction industry is co-created by multiple parties at the firm level and is shaped at the project level. To move forward and be more competitive, each stakeholder must innovate within their scope of work. However, each stakeholder has a different scope of work, and the way to innovate may differ from one category of stakeholder to another. Besides, they seem unable to balance the need to construct buildings and infrastructures while protecting the environment and humanity (Bohari et al., 2015; Darko et al. 2017). Unfortunately, the reported environmental issues caused by construction activities of various scales and types demonstrate that construction practices in Malaysia are still not sustainable (Yahaya, 2017). Therefore, the construction industry must focus on EI in any innovation efforts at the firm and project levels.

Based on the current scenario, all firms operating within the construction industry urgently need practical innovation approaches such as EI as a unique way to satisfy future demands toward sustainable development and environmental sustainability (Hazarika & Zhang, 2019). Thus, EI in the construction industry aims to find new or better ways to attain higher functionality with lesser resources, new technological designs, and overall systematic changes in construction processes and management. Although all project stakeholders cooperated to deliver the construction project, the contractors were accountable for converting the design into reality.

Furthermore, they are responsible for implementing the construction works that directly impact the environment (Ogunbiyi et al., 2014). Therefore, contractors must ensure their business operations do not endanger the environment and communities (Yahaya & Abidin, 2020). As a result, a positive changeable within the industry through eco-innovative practices can be materialised. This study is anticipated to assist contractor firms in understanding the implementation of EI in improving the current construction practices linked to sustainable firm performance. Thus, it has become apparent that implementing EI practices is crucial to contractors at the firm level and needs to be addressed accordingly.

1.3 Problem Statement

Complex and dynamic changes in business operations in the construction industry are necessary to align with the flow of technological evolution, environmental concerns, and ecological challenges. This situation calls for an eco-innovative approach to integrating innovation and environmental sustainability to pursue competitiveness and sustainable performance of a firm (Hazarika & Zhang, 2019; Sanni, 2018). Many previous studies from developed countries have almost exclusively focused on EI implementation in the manufacturing industry (Munodawafa & Johl, 2019). A similar scenario is applied in the Malaysian context, where the manufacturing industry leads in EI research (Fernando & Wah, 2017; Fernando et al., 2016; Salim et al., 2018; Singh, 2017; and Zailani et al., 2015). Contradictory, the construction industry has been criticised for its low innovation level. The industry is perceived to lag compared to other industries because of its low productivity, poor quality, and high pressure on the environment (Gambatese & Hallowell, 2011; Lim et al., 2010; Paraschiv et al., 2011; Wang et al., 2021) For a long time, the construction industry's activities have posed a

threat to community health and safety; and the environment due to uncontrolled pollutants, excessive waste generation, and discharges (Hazarika & Zhang, 2019; Bamgbade et al., 2017; Bohari et al., 2015), coupled with more complex construction projects due to new design concepts, larger-scale projects, and critical time limitations (Ozorhon & Oral, 2017). Dealing with such complexity and challenges is impossible with the traditional view of innovation (Cai & Li, 2018; Hazarika & Zhang, 2019). Thus, firms implementing EI engaged in new activities in processes, products, and organisational structures to improve construction efficiency, better resource consumption, improve productivity and reduction of waste and carbon emissions. EI had a potential supports environmental sustainability and the long-term viability of the construction industry.

In construction projects, the clients and consultants hold contractors accountable for the environmental and social consequences of their services, including the activities of their subcontractors and suppliers. The contractor firms are responsible for delivering the project to the client within the stipulated terms in the contract and have a dominant influence over environmental impacts due to the construction process (Yusof et al., 2017). Furthermore, the contractors act as the primary interface between the client, consultants, and other organisations involved in the construction projects (i.e., suppliers, subcontractors, etc.). Contractor firms engaged in EI primarily function as implementers, focusing on enhancing their services, productivity, and environmental performance. These measures or actions are undertaken voluntarily by their firms (Hazarika & Zhang, 2019; Suprun & Stewart, 2015). Furthermore, the contractors hold a strategic position to promote and adopt EI into project management and development.

In recent years, environmentally friendly practices have been one of the most significant needs of clients to contractors. Failure to meet these requirements may create

a poor image of the concerned contractors (Hashim et al, 2022). Hence, understanding the relevant EI components to contractors at the firm level is crucial. However, previous studies on EI components were dominated by the manufacturing industry. Due to the diverse nature of work between the manufacturing and construction industry, the EI components in the manufacturing industry may be deemed unsuitable for construction landscapes due to the unique structures and peculiarities posed by the industry (Sanni, 2018; Walker et al., 2015). Moreover, Hojnik et al. (2018) highlighted that various industries have different components due to the varying work activities and business outputs. In addressing these issues, they need to sufficiently understand the relevant components of eco-innovative practices to ensure that their business activities and decisions can reduce the overall environmental impacts. Thus, it is essential to identify the relevant EI components to ensure that a firm's management takes the appropriate initiative to enhance EI and achieve economic and environmental performance in delivering their services.

Many prior studies on the field of EI are done at the firm level (Cai & Li, 2018; Kiefer et al., 2017; Hazarika & Zhang, 2019). However, research on EI focuses on contractor firms' perspectives in the Malaysian construction industry are limited. Tajuddin et al. (2015) claimed that the industry's innovation performance is currently reported to be the lowest compared to the others. Although there is an increasing awareness of the importance of innovation, studies on it in Malaysia are very scarce. The Malaysian government and non-governmental organisations have initiated various actions to raise awareness of eco-innovative practices, but contractor firms' involvement in adopting them within their business operations and projects remains insufficient (Bamgbade et al., 2017; Bohari et al., 2015). In addition, the focus on construction innovation and eco-movement concerns has the opposite effect, whereby

the environmental impact is often neglected (Bohari et al., 2015; Dahan & Yusof, 2019; Xue et al., 2014; Zhiwei et al., 2014). EI emphasises both economic and environmental priorities when doing business. To remain competitive and relevant, the contractors must change their business routines to become more eco-innovative. Hence, contractor firms play an essential role in integrating innovation and environmental practices in their business strategy to achieve tremendous respect for the environment. Thus, from the micro-level perspective, the eco-movement within the construction industry can be efficiently expedited by contractors when EI adoption begins at their firm level.

For contractor firms to venture into and enhance EI practices, they need motivation. Environmental awareness in delivering the construction project may not be adequate to push them towards EI practices (Hashim et al., 2022). Ideally, clients stimulate green demand, and contractors execute the construction works according to the client's designs and specifications and take full responsibility for completing the project according to the contract (Hashim, 2018; Ozorhon & Oral, 2017; Setiawan et al., 2017). The clients' and customers' requirements can drive change across the construction supply chain; however, the demand for green design, green buildings, and eco-products is still unsatisfactory (Chua & Oh, 2011; Hamid et al., 2012; Sabar et al., 2018). According to Abidin (2010), the widespread awareness and agreement on green approaches by clients in Malaysia do not indicate extensive implementation in the industry. In addition, fostering changes to old routines and mindsets is a challenge in greening construction practices (Bamgbade et al., 2017; Bohari et al., 2015; Hazarika & Zhang, 2019). In addition, many studies have highlighted the construction approaches to accomplish environmental sustainability in the construction industry; however, the implementation is still at a moderate pace (Yahaya, 2017; Yusof et al., 2017). Besides, in delivering their services, the contractors always apply the minimum requirement for

environmental consideration stated in the contract. In this context, determining the driving factors is crucial to divert the interest of contractor firms from conventional to implementing eco-innovative practices.

Contractor firms that embrace new green technologies, eco-innovative products and processes, better environmental management, and collaborative partnering will have significant advantages in achieving sustainable action plans over those that continue with old practices (Hazarika & Zhang, 2019; Huang & Li, 2016). However, the influencing factors that hinder and support the achievement of EI at the firm level have been disregarded (Souto & Rodriguez, 2015; Szilagyi et al., 2018) despite the fact that EI is becoming increasingly essential for achieving competitive advantages (Almeida & Wasim, 2022; Buhl et al., 2016; Ge et al., 2018). In other words, firms experiencing impediments to EI implementation at the firm level within the construction industry have not yet received the appropriate attention. In addition, the construction industry frequently faces many challenges in introducing new ideas and technologies and comprehending the innovation implementation process (Suprun & Stewart, 2015). Nevertheless, there is a knowledge gap in studies specifically advocating barriers to eco-innovation and supporting factors in the implementation experienced by contractor firms (Ghisetti et al., 2015; Kiefer et al., 2018; Ozorhon et al., 2016; Marin et al., 2015; Villavicencio-Carbajal et al., 2017; Xavier et al., 2020). However, if these barriers are regarded as a chance to gain advantages in competition, they require changes in delivering their construction services (Ghisetti et al., 2015). Thus, understanding the influencing factors is important to strengthen and integrate EI at the firm level. If the commitment for EI is not initiated within the firms, without the right policies, sufficient resources, and capabilities there would not be strong bases to leverage it to the project level. Having a clear mindset of what to expect when implementing EI at firm level and

anticipating the potential challenges and support factors would prepare the contractors with proactive and reactive strategies.

Strategy is essential in ensuring an effective action plan that outlines how a firm will achieve its objectives and goals. Xavier et al. (2020) clarified EI potential as a management strategy due to the pressing need for sustainable changes in product performance and organisational processes. Contractor firms that can incorporate and support EI as a business strategy thus attain sustainable competitive advantage. All project innovations undergo constant changes and evolution, differing between projects (Ozorhon, 2013). These circumstances make it challenging to apply innovation effectively and explain the proper strategies and well-planned systems needed to enable contractor firms to excel in their EI attempt (Yusof & Iranmanesh, 2017). Integrating EI in creating core business strategies and management systems is essential in meeting the needs of clients and stakeholders towards embracing environmental sustainability. Formulating EI strategies to coordinate contractor firms' resources and capabilities is vital to enhance the EI performance in contractor firms. To address this issue, many researchers have searched for strategies to help firms be eco-innovative (Garcés-Ayerbe et al., 2016; Tsai & Liao, 2017; Ge et al., 2018). However, most of these studies were dominated by manufacturing and SMEs, focusing less on the construction industry (Ge et al., 2018; Tsai & Liao, 2017). Therefore, EI that are embedded in firms' business strategies lead to changes in the firm's product, process, and organisational structure may result in significantly lower environmental burdens but concurrent improvements in economic performance (García-Granero et al., 2018; Arranz et al., 2020). Environmental sustainability should be integrated into how a firm conducts business rather than being viewed as an add-on to its usual business practices and procedures (Roscoe et al., 2016). In addition, most of the proposed EI implementation schemes are

non-binding and based on a voluntary approach. Hence, it would be intriguing to determine which strategy successfully enhances the contractor firms to be eco-innovative in the Malaysian construction industry.

Therefore, this study aims to develop a framework for EI implementation for contractor firms to achieve sustainable competitive advantages and environmental sustainability. The contractor firms should adapt and lead the internal and external environment changes to make themselves strong through eco-innovative practices to be competitive and survive local and global competition. Contractor firms that ignore these eco-innovative strategies will be left behind in facing new complexities and challenges in environmental and economic conditions. Thus, this study facilitates the contractor firms to comprehend EI in their business strategy that can improve existing construction practices at the firm level by enhancing capabilities and resources to overcome the challenges to strengthen firm competitiveness and environmental performance.

With the above arguments, several questions have come to light to form research questions, such as below:

1. What are the components of EI that are relevant to contractor firms?
2. To what extent has EI been practiced at the contractors' firms?
3. What are the significant drivers in pursuing EI in contractor firms?
4. What are the factors influencing contractor firms to implement EI?
5. How can the contractors enhance the EI practices at their firms?

1.4 Research Aim and Objectives

This research aim is to develop the eco-innovation (EI) implementation framework for Malaysian contractor firms. To achieve this aim, five objectives are outlined below:

1. To identify EI components relevant to contractor firms
2. To determine the level of EI practices in the contractor firms
3. To investigate the driving factors motivating EI implementation by contractor firms
4. To explore the factors influencing EI implementation at the contractor firms
5. To examine the strategies for implementing EI in the contractor firms

1.5 Scope of the Research

This study only focuses on EI practices within the construction industry based on contractor firms' perspectives registered under Grade G7 with CIDB. The relevant components of EI are defined in this study based on the contractor's scope of services. The ability of the contractors to leverage EI at the project level will not be realised if they do not adopt EI within their firm. Thus, from the micro-level perspective, the eco-movement within the construction industry can be efficiently expedited by contractors when EI adoption begins at their firm level. In this study, EI is embedded in contractor firms' business management and strategies. As a result, changes can occur in the firm's product, process, and organisational structure, significantly enhancing the firm's environmental performance and concurrently improving economic performance. This study adopted the Dynamic Capability (DC) theory in developing the EI implementation framework. The firm's ability to integrate, build, and reconfigure internal and external resources and capabilities to address rapidly changing environments within the firm is an advantage that can facilitate the implementation of EI practices.

In Malaysia, all contractor firms must be registered under CIDB. Over 100,000 registered contractor firms with CIDB, ranging from grade G1 to G7. Only grade G7 contractor firms with unlimited tendering capacity were selected for this study. The reason was that grade G7 contractor firms undertake most large-scale development projects because they are licensed to be involved in such projects. EI is not limited to green developments but extends to all construction projects. Thus, innovation is usually present in any project. In any large project, environmental concerns cannot be neglected. Large-scale construction projects have more significant environmental impacts compared to small projects. In addition, as supported by Chang et al. (2016), based on advice gained from industrial experts, large firms in the construction industry have the resources and capabilities to undertake practical innovation activities.

Meanwhile, only G7 contractor firms with experience of more than 15 years in the construction industry will be selected for a semi-structured interview. The study will only cover the contractor firms operating within Peninsular Malaysia. The distribution of primary survey was distributed to the targeted respondents as firm representatives in top management to middle management positions. They were selected as firm representatives because they were directly involved in the development process, making them knowledgeable, experienced in all operations, and engaged in firm management issues and decision-making.

1.6 Significant of the Research

This research significantly contributes to the existing knowledge regarding academics and professional industry practices. The expansion of general innovation combined with environmental concern, which promoted EI practices, is a relatively new concept in the construction industry in Malaysia. From a theoretical point of view, this

research is significant and expected to enrich the existing studies and knowledge on EI, specifically in contractor firms in the Malaysian construction industry. Drawing from DC theory, this research framework proposed in the study will improve the EI implementation in the context of contractor firms by strengthening their firms with an appropriate strategy toward eco-consciousness within their firms. This study demonstrates the contractor firm's ability to integrate, build and reconfigure its capabilities and resources to accomplish the environmental goal in its business strategy. This research delves into the components of EI adoption in contractor firms and its level of practice at the firm level. In developing the contractor's ability to engage in sustainability-oriented approaches in management and services, the factors that drive EI adoption need to be investigated further. Understanding the influencing factors is vital to develop an appropriate strategy to enhance EI implementation in Malaysian contractor firms. Hojnik et al. (2018) mentioned that different industries have different components due to the varying work activities and business outputs. Thus, this research enriched the existing knowledge in EI in the context of construction firms.

Besides, the contractor is responsible for constructing the building and infrastructure in the construction industry. They are becoming the first to implement and introduce eco-innovative approaches in the construction industry. Thus, this study assists contractor firms in understanding the concept of EI in improving the current construction practices by enhancing resource efficiency by learning the implications of the EI in delivering their services, which is linked to sustainable firm performance. Recognising and appreciating the contractor's role in stimulating EI will create opportunities for other project stakeholders to acknowledge and understand the significance of EI in the construction sector. The contractor can respond effectively to factors that motivate their growing adoption of eco-innovative practices at the firm level

and further extended to the project level. Implementing EI is inseparable from the firm's target to achieve sustainable competitive advantages and environmental sustainability.

Moreover, this framework will eventually overcome the challenges and significantly improve construction practices into a more innovative way of achieving fruitful low-carbon and green growth. Also, this research will anticipate contributing to a better knowledge and understanding of the EI implementation by the contractor's firms in Malaysia. Exploring the EI implementation specifically in the development projects can increase the competitiveness of the contractor's firm in general, improve environmental sustainability, and overcome other negative impacts during the project development. At the same time, it can enhance clients' confidence in their investment in environmental sustainability by maximising the project's value. EI is one of the effective ways for contractor firms to evolve in the construction industry. The current construction environment is complex and uncertain, coupled with client and customer pressure and government regulation towards embracing environmental sustainability. This study can be significantly crucial to the construction industry regarding fostering more green growth mainly in the areas of economics growth that positively impact the environment, in the long run.

This research will also support the CIDB in meeting the CITP and Green Technology Master Plan (GTMP) goals, including future planning to move up the level of environmental innovation and value creation strategy to achieve sustainable development and environmental sustainability. Besides, recognising the EI driving factors from the contractor firms' perspectives would help policymakers and governments develop economic instruments that encourage eco-innovative practices in the Malaysian construction industry. Also, this research will significantly promote various sectors to adopt EI practices and increase green and sustainable buildings and

facilities in Malaysia. These will increase productivity indirectly, increase the value of the investment, lower the carbon emission and waste significantly and reduce the maintenance cost of the building in the future. At the same time, improve the competitiveness of contractor firms through eco-innovative practices with the generation of new knowledge and technology to achieve sustainable development goals.

1.7 Brief Research Methodology

A mixed method approach (quantitative and qualitative) is employed to achieve the research aim and objectives. The two-phase investigation is needed to increase understanding, expand knowledge, and explore the commitment phenomenon for EI implementation in contractor firms, particularly in the context of the construction industry in Malaysia. The first phase involves a survey with registered G7 contractor firms in Peninsular Malaysia. The intention is to identify EI components relevant to contractor firms and the level of EI practices, including the factors that drive EI implementation in their firms. The findings are analysed and tested through statistical software, i.e., SPSS 25.

The second phase involves interviews with respondents from contractors that held middle and top management positions in the firms. The interview aims to explore the factors influencing EI implementation they encountered and to examine the strategies to enhance EI implementation at the firm level. The interview findings are analysed via Thematic Analysis using ATLAS.ti software. Based on this research approach, the findings from this study are integrated to develop a framework of EI implementation for Malaysian contractor firms.

1.8 Thesis Outline

The thesis outline of this research was organised into 7 chapters as follows:

Chapter one introduces the research by describing the outline of the research and presents the background of the study, problem statements, research questions, research aim and objectives, scope and limitations of the research, research framework, contribution to the body of knowledge, the definition of terms used in this study and the structure of the thesis.

Chapter two presents a comprehensive review of the literature related to the fundamental concepts employed in this study. The dynamic capabilities theory acts as a foundation of this study. In detail, this chapter will review, discuss, and critique the existing literature specifically on EI, such as the introduction to the EI concept and practices, the types and components of EI, the drivers of EI, including the influencing factors for contractor firms to initiate EI within their firms. Next, the study discusses and elaborates on the firm's strategies to enhance EI implementation. Finally, the theoretical framework adopted for this research is presented.

Chapter three described the research methodologies and procedures employed to answer the research questions accordingly and achieve the aim and objectives of this research. The chapter also presents the research paradigm and provides the rationales and justifications for selecting the sampling frame and methodological approach. The development of the instruments for the quantitative and qualitative aspects of this research is elaborate, including the validation process.

Chapter four presents the results and analysis of the questionnaire survey. The survey carried out in the study focused on the contractor firms from G7 that had experience developing a construction project. The subjects' response rate and profile will be analysed and discussed. The analyses on descriptive analysis of the constructs and overall data analysis are described.

Chapter five explains the implementation of semi-structured interviews from contractor firms G7. This chapter presents, evaluates, and discusses the qualitative data analysis thoroughly.

Chapter six provides a discussion of the research findings from the outcome of the results attained from the survey and the interview. The research findings were discussed in detail with the results obtained from the previous literature. The development of the EI implementation framework and its interpretation and explanations are given in this chapter.

Chapter seven records concluding remarks on the study. The chapter begins with presenting the general findings in achieving the aim and each research objective outlined in this study. The contribution of the study and the limitations of the research are presented. The limitations will be continued by suggesting corresponding recommendations for future studies.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents a comprehensive review of the literature relevant to the knowledge and concepts applied in this study. The flow of discussion begins with the background of the Malaysian construction industry and examines the environmental concerns, including an overview of sustainable development in Malaysia. This is followed by a discussion of sustainable construction and an introduction to the eco-innovation (EI) concept and practices. The types and components of EI include the driving factors for contractor firms to initiate EI within their firms. Next, the study discusses the influencing factors of EI implementation and elaborates on the firm's strategies to enhance EI implementation. Finally, the theoretical framework adopted for this research is also described. This study employs the Dynamic Capabilities (DC) theory as a guide to developing an EI implementation framework to assist contractor firms in enhancing competitiveness and environmental sustainability.

2.2 The Malaysian Construction Industry

The construction sector contributes significantly to a country's overall economic development by producing wealth and providing a better quality of life for people, essential for the nation's development, by translating the government's socio-economic policies into infrastructures and buildings. Furthermore, the construction industry creates a multiplier effect on other sectors, including manufacturing of construction materials, plants and machinery suppliers, financial services, and professional services. Construction is the largest industrial sector in Europe, with 10-11% of Gross Domestic Product (GDP) and the United States with 12% of GDP (Al-Sunaid et al., 2003). While

it represents 2-3% of GDP in most developing countries, Malaysia has steadily contributed around 3% to 5% of the country's GDP annually over the last decade (DoS Malaysia, 2020).

Even though the construction industry contributes a small percentage to the Malaysian economy compared to services, manufacturing, tourism, and agriculture, it remains the country's most vital sector due to its spillover effect, including its backward and forward connections to other industries. The construction industry experienced a contraction of 19.4% in 2020 due to the impact of Covid-19 pandemic and nationwide lockdown. However, with the various efforts from the government such as investment in transportation and energy projects, it is forecasted to have an annual average growth of 6.8% between 2022 to 2025 (Research & Markets, 2021). The growth of the industry has also been part of the national agenda under 12th Malaysia Plan in which various residential, industrial and infrastructure projects are in plan in line with the country commitment to achieve sustainable development goals in 2025 (Economic Planning Unit, 2021)

The construction sector offers massive employment opportunities by providing an average of 1.5 million jobs from 2015 to 2020 for professionals, supervisors, skilled and unskilled workers, which basically covers 10% of the overall labour workforce (CIDB, 2018). However, this number decreased by 0.67% in 2020 due to the pandemic effect 2020 (DoS Malaysia, 2020). This has also contributed to the increase in the national unemployment rate of 4.8% in the fourth quarter of 2020 (DoS Malaysia, 2020). The contribution made by the construction industry to the progress of the economy is, without a doubt, significant.

Throughout the years, the demand for development from both the public and private sectors has contributed to major ongoing construction projects in various

locations throughout Malaysia each year (CIDB Malaysia, 2019). The private sector also contributes significantly to economic growth and meets the demand for residential and non-residential projects to help the government achieve its development goals. In 2019 (prior to Covid-19), the public sector's share of the value of construction work done was 43.9% (RM16.3 billion), while the private sector propels the construction activity with 56.1% (RM20.7 billion) of the value of construction work done (DoS Malaysia, 2019). The trends continue with the private sector taking a slightly more percentage in the value of work done. Even with the effect of the pandemic, in 2021, the private sector continues to contribute 58.7% (RM16.2 billion), while the public sector is 41.3% (RM11.4 billion), although the amount in RM has decreased due to the contracted economy (DoS Malaysia, 2021). Although this industry is crucial for economic growth, the challenges within the industry never cease. This gives rise to various new concepts and greater expectations for better construction performance, pushing the need for an innovative approach while ensuring the industry minimises potential detrimental effects on the environment and society.

2.2.1 Progressing Innovation in the Malaysian Construction Industry

Malaysia goal of becoming a developed country with a high-income economy status can be accomplished by focusing on improving and increasing industrial performance through innovation. The transformation of the Malaysian construction industry through innovation is becoming essential in delivering value throughout the supply chain and satisfying the clients and end-users with the final products. The demand for projects is predicted to become more complex and interconnected; the construction industry needs to leverage new technologies and innovative processes to deliver better value (CIDB Malaysia, 2020). Construction firms have increasingly relied upon innovations and improvements in rapidly changing markets, technologies, and