Ummu Raihanah Hashim · Ahmad Kamil Arshad ·
Nor Hayati Abdul Hamid · Rohana Hassan ·
Ekarizan Shaffie · Anizahyati Alisibramulisi ·
Norshariza Mohamad Bhkari ·
Muhd Norhasri Muhd Sidek *Editors*

Green Infrastructure

Materials and Sustainable Management

Springer

Green Infrastructure

Ummu Raihanah Hashim · Ahmad Kamil Arshad ·
Nor Hayati Abdul Hamid · Rohana Hassan ·
Ekarizan Shaffie · Anizahyati Alisibramulisi ·
Norshariza Mohamad Bhkari ·
Muhd Norhasri Muhd Sidek
Editors

Green Infrastructure

Materials and Sustainable Management

Springer

Editors
Ummu Raihanah Hashim
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Ahmad Kamil Arshad
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Nor Hayati Abdul Hamid
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Rohana Hassan
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Ekarizan Shaffie
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Anizahyati Alisibramulisi
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Norshariza Mohamad Bhkari
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

Muhd Norhasri Muhd Sidek
Institute for Infrastructure Engineering
and Sustainable Management (IIESM)
Universiti Teknologi MARA
Shah Alam, Selangor, Malaysia

ISBN 978-981-99-7002-5 ISBN 978-981-99-7003-2 (eBook)
https://doi.org/10.1007/978-981-99-7003-2

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Paper in this product is recyclable.

Preface

The book *Green Infrastructure: Materials and Sustainable Management* is part of a sub-series Green Infrastructure. Materials and Sustainable Management offers comprehensive research-based practices highlighting the advanced and developed materials related to green infrastructure as well the sustainable approaches specifically for construction management, transportation, pavement, environment, timber, and seismicity.

This book covers chapters including Chapter "Assessment of Entry Timing Decisions (AoETD) Towards Sustainable Operations of Malaysian Construction Firms in International Markets" identifies the key and associated determinants for international ETD for Malaysian construction firms; Chapter "Pre-construction Complexity Factors Affecting Cost Performance of Infrastructure Projects"—identifies the most significant complexity factors contributing to project performance and develops a complexity assessment model for infrastructure projects; Chapter "Performance Measurement Criteria: Conceptual Framework for Subcontracting Management in the Malaysian Construction Supply Chain"—focuses on the identification of performance measurement criteria that contribute to successful subcontracting management in Malaysian construction projects; Chapter "Building Information Modelling Implementation Framework (BIMIF) for Government Building Construction Among Civil and Structural Engineering Consultants in Malaysia"—presents the initial stage of establishing a BIM implementation framework (BIMIF) for government building construction projects based on the conventional contract approach and focuses on developing the BIM process from a chosen case study; Chapter "Integrating Value Management: Determine Project Management Knowledge—Addressing Theory–Practice Gap"—identifies the Project Management (PM) knowledge areas that can be adopted in value management methodology; Chapter "Strategies of Carbon Reduction Management in Construction Operations"—investigates the current carbon emissions management practices and key strategies in reducing emissions effectively; Chapter "Green Infrastructure Development in Malaysia: A Review"—explains Malaysia's progress towards constructing green infrastructure and becoming a climate-resilient nation which holistically assessed as a result of the detailed study of incorporating green techniques into current assessments; Chapter "Why Current Procurement Systems Require Modifications to Suit the Natures of Malaysian Pre-fabricated Construction"—highlights the necessity and natures of the prefabricated projects in Malaysia, and why current procurement system needs to be adjusted so that it can help the projects to reap maximised benefits from prefabricated concept; Chapter "A Review of Green Open Space Implementation Towards Green City Development in Developing Countries"—understands the advantages and implementation of green open space (GOS) in green city development (GCD) in Malaysia and Indonesia; Chapter "Environmental Impacts of a Forensic Unit Construction at a Teaching Hospital in Malaysia"—educates on the material waste generation, energy and water consumption, and total carbon emissions from constructing a forensic unit at a teaching hospital in Malaysia before the COVID-19 pandemic; Chapter "Mechanical Properties of Concrete Containing Palm Oil Fuel Ash (POFA) as Cement and Sand Replacement"—analyses the mechanical properties of POFA in concrete as a partial replacement for cement and sand; Chapter "A Review of Graphene Research and Its Outputs: Waste Carbon Source and Synthesis Technique"—describes and reviews the potential of natural and synthetic waste to be converted to high-quality graphene; Chapter "Influence of Waste Paper Sludge Ash (WPSA) on Mechanical and Durability Properties of Self-consolidating Lightweight Foamed Concrete (SCLFC)"—investigates the effect of WPSA addition on workability, strength, ultrasonic pulse velocity, porosity, and water absorption characteristics of SCLFC; Chapter "The Effect of Tendon Directions to The Analysis and Design of Transfer Slab—A Case Study"—to analyse and design post-tensioned transfer slab by using RAM Concept as finite element analysis tool; Chapter "Perception on Impact Land Reclamation from Pan Borneo Highway Project-Pilot Study"—presents some of the effects of land reclamation resulting from the Pan Borneo Highway Project based on survey; Chapter "Challenges, Characteristics and Success Factors in Implementing Green Highway Using Structural Equation Modelling-Partial Least Squares (SEM-PLS)"—a study using triangulation research to obtain the primary data using unstructured interviews and questionnaire surveys, in which the data were analysed using SEM-PLS; Chapter "Proposed Development of an Integrated Framework for Public-Private Partnership (PPP) and Value for Money (VFM) Evaluation System of Urban Rail Transit in China"—proposes a study towards developing a framework integrating the public–private partnership (PPP) model and the VFM evaluation system for urban rail transit projects in China; Chapter "Pavement Maintenance in Malaysia: The Key to Pavement Sustainability"—presents various pavement maintenance techniques used in Malaysia to preserve the condition of road pavements so that the road can be continuously operated without disruption due to major road rehabilitation activities; Chapter "Evaluation on Volumetric Properties of Stone Mastic Asphalt Mix Containing Steel Fibre Using Response Surface Method"—studies the effects of different amounts of steel fibre on the volumetric properties of stone mastic asphalt (SMA) mixtures; Chapter "Envisaging the Potential Use of Resistance Micro Drilling On Wood Density (WD) Assessment: A Review"—provides an insightful review of the research methodologies on Resistograph, and discusses the use of a micro-drilling device measuring WD in standing trees; Chapter "Phytochemical Research for the Sustainability of Moringa Species Using Different Extraction Methods"—employs both maceration and ultrasonic-assisted techniques, followed by the phytochemical screening of the extracts by using thin-layer chromatography (TLC) and High-Performance Liquid Chromatography (HPLC); Chapter "Performance of Kapok Fibres and Kapok Ash Wood as Oil Absorption Materials"—examines the absorption capacity of kapok fibre and kapok wood ash as well as a combination of both materials into waste cooking oil; Chapter "Physical and Chemical Characteristics of Podo Wood-Xylem Filtered Water"—focuses on filtering water using wood-xylem of tropical timber, i.e. Podo species; Chapter "Effect of Tunnel Form Building (TFB) Under 10 Past Earthquake Records Analysed Using Ruaumoko 2D"—used historical earthquake records to analyse and forecast how TFB will behave in Malaysia during unpredictable earthquake; Chapter "Experimental Analysis of Seismic Responses Interior Beam-Column Joint with and Without Fuse Bars Under In-Plane Lateral Cyclic Loading"—presents two full scale super assemblage of interior beam-column joints with and without fuse bars; designed, constructed, analysed, modelled, and compared their performances under in-plane lateral cyclic loading.

The editors would like to thank all authors who are experts in green infrastructure and sustainable management for contributing their ideas and providing their knowledge and valuable insights. We are also grateful to Springer Nature for their support, especially Loyola D'Silva and Rajesh Manohar for helping us to finalise this book.

Shah Alam, Malaysia

Ummu Raihanah Hashim
Ahmad Kamil Arshad
Nor Hayati Abdul Hamid
Rohana Hassan
Ekarizan Shaffie
Anizahyati Alisibramulisi
Norshariza Mohamad Bhkari
Muhd Norhasri Muhd Sidek

Summary

The book *Green Infrastructure: Materials and Sustainable Management* is part of a sub-series that provides research-based practices highlighting advanced and sustainable materials for green infrastructure, specifically for construction management, transportation, pavement, environment, timber, and seismicity. The book includes various chapters covering different topics, such as assessment of entry timing decisions for Malaysian construction firms, pre-construction complexity factors affecting the cost performance of infrastructure projects, performance measurement criteria for subcontracting management in Malaysian construction projects, green infrastructure development in Malaysia, mechanical properties of concrete containing palm oil fuel ash, and many others.

Contents

Assessment of Entry Timing Decisions (AoETD) Towards Sustainable Operations of Malaysian Construction Firms in International Markets

Norizzati Ibrahim, Che Maznah Mat Isa, Nur Kamaliah Mustaffa, and Nur Izzati Ab Rani

Abstract Malaysian construction firms were found to have an in-depth grasp of the international market experience and cross-border networks. In line with the Construction 4.0 Strategic Plan (2021–2025), previous research indicates insufficient studies focused on developing a systematic assessment to measure entry timing decisions (ETD). This flaw was discovered because of low educational readiness and a lack of data from local researchers. Accordingly, the number of successful local construction firms competing in the global market has decreased. Therefore, the current study provides construction firms with exposure to the importance of entering foreign markets through an Assessment of Entry Timing Decisions (AoETD). The ETD for this study were divided into pioneer (Pi), early follower (EF), and late follower (LF). The study identifies the key and associated determinants for international ETD for Malaysian construction firms. In addition, this paper establishes appropriate decisional level scales for each key determinant, ranging from poor to excellent decision-making. Analysis of data and discussion of study findings were obtained from Smart PLS analysis. Correspondingly, AoETD measurement found that Pi sustained in the international market followed by LF and EF. As such, the development of AoETD

N. Ibrahim
School of Civil Engineering, Universiti Teknologi MARA Johor Baharu Branch, Pasir Gudang Campus, Johor, Malaysia
e-mail: izzati6752@uitm.edu.my

C. M. Mat Isa (✉)
Center of Civil Engineering Studies, Universiti Teknologi MARA Pulau Pinang Branch, Permatang Pauh Campus, 13500 Pulau Pinang, Malaysia
e-mail: chema982@uitm.edu.my

N. K. Mustaffa · N. I. Ab Rani
School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia
e-mail: nurkamaliah@uitm.edu.my

N. I. Ab Rani
e-mail: izzati.rani@uitm.edu.my

U. R. Hashim et al. (eds.), *Green Infrastructure*,
https://doi.org/10.1007/978-981-99-7003-2_1

can help firms implement strategic entry decisions into the global market. Furthermore, AoETD is developed in line with the Malaysian government's aims to create collaborations between academicians, government, industry, and society.

Keywords Assessment · Entry timing · Entry decisions · Construction · Sustainable decisions

1 Research Background

A firm considering entering a new global market must decide when to enter that market (Al Sadi & Dulaimi, 2019; Lo & Kletsova, 2018; Utama et al., 2019). Decision-making entails the integration of information from various perspectives and is critical to making good decisions before entering a foreign market (Low et al., 2004; Preece et al., 2016; Kaffash et al., 2012). The target of internationalisation is to expand the company's ideas, products, funds, and investment opportunities. However, this study only focuses on entry timing decisions (ETD). Construction firms confront significant obstacles in selecting strategic business ETD for the international market. According to Lilien and Yoon (1990), identifying the best time for companies to enter emerging industries has long been a major concern. Researchers are still struggling to develop a theoretical foundation that can fully integrate empirical findings in this field (Lo & Kletsova, 2018; Suarez et al., 2013). According to Lo and Kletsova (2018), pioneer firms have significant advantages over late-entry firms, but they also face greater risks and disadvantages. As a result, entry timing has become a popular research topic. The following questions must be addressed: (1) When is the best time to enter? (2) Is it better to be a pioneer or to wait and enter later, avoiding risk but sharing a more congested foreign market? Late entrants may provide adequate engineering support and investment for designing a better product or developing an effective marketing programme, lowering the risk of failure. As a result, the decision to enter the market should be timed to balance the risks of being a pioneer (Pi) and the problems associated with missed opportunities (late follower). According to Kalyanaram and Gurumurthy (1998), market pioneers generate the most revenue in the international market, followed by early and late followers. However, the findings of that study are restricted to industrial and consumer goods businesses. Consequently, ETD for this study consists of Pi, early follower (EF), and late follower (LF) used in the development of AoETD. Final findings of this study produce empirical findings to show the relationship between determinants that include firm-specific (FS), firm-resource commitment (FRC), project-specific (PS), target country (TC), home country (HC), and market-specific (MS) with ETD that need to be considered by construction firms to enter the international market. These determinants are used in AoETD and measured using scales based on empirical data.

2 Entry Timing Decisions (ETD)

The term "pioneer" refers to the first mover to commercialise an innovation. Pioneer entered a market supported by significant investments in the product's production, marketing, and distribution, as well as the elapsed time between its entry. Meanwhile, the terms "early follower" or "early entrant" refer to multiple firms entering a market in quick succession with significant investments in product production and distribution and the ability to achieve advantageous resource positions (García-Villaverde et al., 2017). Firms that enter after several other players have arrived are referred to as late entrants (Cleff & Rennings, 2011; García-Villaverde et al., 2017).

Previous research has shown that being the first to market in most cases provides a significant and sustained market-share advantage over later entrants (Lo & Kletsova, 2018; Kalyanaram & Gurumurthy, 1998). Later entrants, on the other hand, can succeed by using distinct positioning and marketing strategies. Pioneers in most industries are powerful once they have attained the status of incumbent. Numerous studies have found that later market entrants (pioneers or early followers) achieve a lower market share than earlier entrants (pioneers or early followers), and that this holds true across a wide range of product categories and industries, including consumer packaged goods and industrial goods. Even after accounting for a company's tangible (e.g., financial) and intangible (e.g., brand equity) resources and business skills, early entrants maintain a market-share advantage (Kalyanaram & Gurumurthy, 1998).

The entry timing market decision is one of the key determinants of new product success or failure (Lo & Kletsova, 2018; Lilien & Yoon, 1990). However, despite the fact that defining the optimal timing for businesses to enter new industries has long been a priority in the plan, researchers are still struggling to develop a theoretical foundation that can fully integrate empirical findings in this field (Suarez et al., 2013). The research and design and marketing investments will alter the level of the new product's opportunities and risks. A late entry, for example, may provide appropriate engineering support and investments for designing a better product or developing an effective marketing programme, reducing the risk of failure. As a result, the decision to enter the market should be timed to balance the risks of early entry (entry too soon) and the problems associated with missed opportunities (entry too late).

Lilien and Yoon (1990) identified several determinants, including R&D competition, entry competition, product competition, demand potential, and market evolution. As a result of the research and design, as well as marketing investments, the new product's prospects and risks will be altered. A late entry, for example, may provide sufficient engineering assistance and investment to develop a superior product or a successful marketing programme, lowering the risk of failure (Lo & Kletsova, 2018). As a result, market entry decisions should be made at a time that balances the risks of premature entry (over-entry) with the issues of missed opportunities (entry too late). Lilien and Yoon (1990) identify several drivers, including R&D competition, entry competition, product rivalry, demand potential, and market evolution. Contractors must consider various aspects of each entry decision before entering the international market in terms of risk exposure, resource commitment and investment risk control, and flexibility (Al Sadi & Dulaimi, 2019; Utama et al., 2019).

2.1 The Determinants of Entry Timing Decisions

Construction companies face significant challenges in selecting strategic business ETDs for the international market. According to Zander (2015), firm-specific (FS) advantages towards internationalisation that aim to reveal something new, such as a firm establishing a design centre in a new location known as a new resource or introducing technologies, capabilities, and products that offer different and better growth. Meanwhile, the need for firms to manage innovation across organisational boundaries and within an interdependent network of suppliers, customers, and regulatory bodies is referred to as project-specific (PS). The development of a firm's commitment to internationalisation in order to ensure effective decisions and profitable actions in the international market is referred to as firm-resource commitment (Bianchi et al., 2018) or refers to the extent to which organisations and managerial resources are devoted to internationalisation (Lages et al., 2008). Abdul-Talib et al. (2011) cited that larger firms with greater resources and competencies will be able to compete more efficiently and effectively in foreign markets than smaller firms. In addition, the target country (TC) also influences construction firms' decisions to enter the international market. Before entering a country, the legal environment of the target country (including legal issues such as foreign exchange rates, jurisdiction, corruption, the existence of strict time limits, strict quality requirements, etc.) must be considered (Zeqiri & Angelova, 2011). Firms that rely solely on the domestic market do not have the right sensible strategy (Durmaz & Tasdemir, 2014). Therefore, a firm needs to go abroad and look for opportunities to move forward. As a consequence, expanding into foreign markets is one of the most effective ways for a company to grow (Greening et al., 1996). There is a plethora of research demonstrating that firms that implement effective strategies are able to reap the competitive and profitable benefits of internationalisation. This means that businesses can choose to collaborate with others in foreign markets as a means of expanding and becoming more successful. Furthermore, the presence of domestic competitors or barriers to market entry in the home country causes firms to enter the international market due to demand in the host country (Asgari & Ahmad, 2010). As a result, key independent determinants are divided into six categories: firm-specific, firm-resource commitment, project-specific, target country, home country, and market-specific. Next, a total of 41 significant independent determinants have been identified in the development of AoETD, as shown in Fig. 1.

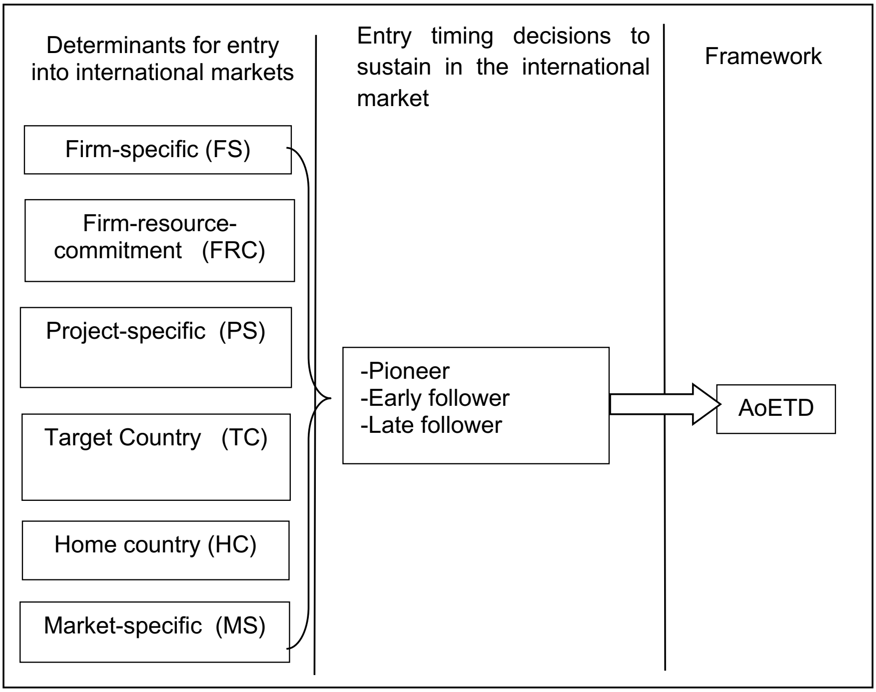
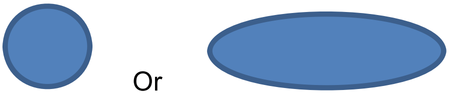
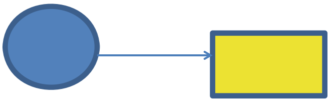


Fig. 1 Conceptual framework of classification of the entry timing decisions

3 Methodology

A quantitative approach was used as the selection was based on CIDB's (2020) record of 132 firms registered as global players operating internationally. The data for this study is focused on managers from construction firms to enquire about their opinions and perceptions of the international market ETDs adopted by their firms in international markets as recommended by Creswell (2009). Next, this study used the Smart PLS 2.0 M3 software to obtain the AoETD. PLS is a programme designed to strengthen the study's theory early, either through minor consolidation or limited data (Ringle et al., 2014). Furthermore, this model (Smart PLS) aids in the resolution of complex data (observed variables) and models with limited theoretical support (Ringle et al., 2014). Thus, this PLS model is helpful for this study. Accordingly, this model can relate a large number of linear equations at the same time. Notably, the model can connect the dependent and independent determinants, as well as measured items and structural models. As a result, this model is appropriate for this study because it can build complex models using more minor data (Ringle et al., 2014).

Table 1 The symbols used in the structural equation models

Symbol	Definition
	Construct or variable lantent (LV)
	Variable observed or measured or indicated (OV)
	Correlation between LV and OV (measuring model)
	Causal relation-coefficient of the path between an independent LV to dependent variable (structural model)

3.1 Mounting the Measuring Models on the Smart PLS

Smart PLS software is used to obtain multiple simultaneous regressions and to construct linear regressions between models (Henseler et al., 2009). This software is also used to determine the relationship between constructs and items or determinants that can be measured or observed. Based on the research of Henseler et al. (2009), Hair et al. (2014), and Cohen, five (5) major steps were taken to structure AoEMD: convergent validity analysis, discriminant validity analysis, composite reliability analysis, T-test analysis, and finally the path coefficient (1988). To begin, the Smart PLS considers several symbols (see Table 1) to obtain the Structural Equation Modeling (SEM).

3.2 The Steps of Analysis by Using Smart PLS

Measurement of AoETD implicated six (6) main analyses, including convergent validity, discriminant validity, model reliability, T-test, Pearson closure coefficient (R2) evaluation, and path coefficient) highlighted during data analysis using Smart PLS, as shown in Table 2, referring to previous researchers' statements or studies.

The T-ratio tests for evaluating the significance of correlations and regressions are critical for this study because they ensure that the threshold values are +1.96.

Table 2 Summary of the steps of analysis by using smart PLS

No.	Indicator/analysis	Purpose	Referential values/criteria	References
1	AVE measurement	Convergent validity	AVE > 0.50	Henseler et al. (2009)
2	Criteria of Fornell and Larcker	Discriminant validity	Compare the R^2 of the AVE values of each item construct with the correlation between the construct (latent variables). Next, the R^2 of AVE values should be > correlation of the construct	Fornell and Larcker (1981)
3	Cronbach Alpha and composite reliability	Model reliability	CA > 0.70 CR > 0.70	Hair et. al. (2014)
4	T-Test or T-analysis	Evaluation of significance of the correlations and regressions	Beta Coefficient, $\beta >\pm 1.96$	Hair et. al. (2014), Kock (2016)
5	Evaluation of the coefficient of the Pearson's determination (R^2)	Evaluate the range of R^2	$R^2 = 2\%$ (small effect) $R^2 = 13\%$ (median effect) $R^2 = 26\%$ (large effect)	Cohen (1988)
6	Path coefficient/ P-value analysis	Evaluation of relation	Value interpretation. The P-value test is used to examine the hypothesis that 0. We compute the one-tailed P-value associated with the path coefficient at the 0.05 significance level (i.e., 1–95%). In general, this quantity can be interpreted as the likelihood of belonging to a distribution with a mean of zero. If P 0.05, the hypothesis is accepted; otherwise, it is rejected	Cohen (1988), Kock (2016)

3.3 Measurement of AoETD

AoETD models are designed to rank the most important determinants of success in the international market, increasing a company's ability to enter the international market. To begin, a questionnaire survey is used to test the ET used by firms to enter the international market. The Rasch Model was used to identify fit items for each determinant or item. Then, based on the beta coefficient value (ß), only fit items were used for Smart PLS analysis to identify the relationship between determinants and ET decisions. Each determinant is labelled on a scale of one to six to represent poor to excellent entry decisions made to the international market, ensuring the firms' long-term sustainability in the international market. The higher the ß value, the more significant the ET decision that allows firms to stay in the international market for an extended period of time. Equation (1) presents the AoETD calculation, where the X label represents each ET decision (Awang et al., 2018).

$$\text{AoETD} = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots \beta_4 X_n \quad (1)$$

Following that, AoETD are labelled using the grade scores obtained by the firm, which are labelled from A to E as shown below:

A = can extremely sustain, B = high potential to sustain, C = moderately sustain, D = high risk to sustain, and E = very high risk to sustain

To determine the best ETD, 5 distinct scales are used. Scales are frequently used to evaluate behaviours, feelings, or actions using multiple variables or items (Boateng et al., 2018). As a result, item measurements were taken in order to obtain more accurate results. Data are organised in a matrix in the best ETD for entering the international market, from top to bottom or from A to E. In other words, the highest rank represents the best entry decision that the firm must consider when entering the international market, as shown in Table 3. The grid arrangement, as depicted in Table 3, should be carefully observed, where entry decisions to the international market are measured.

Although the firm's score is low, it has the potential to enter the international market because all these key determinants are important for entry. If the obtained

Table 3 A preference matrix of entry decision to international market

Level of the firm's score to sustain in the international market		Entry decision				
		Can extremely sustain	High potential to sustain	Moderately sustain	High risk to sustain	Very high risk to sustain
	Grade score	A	B	C	D	E
		100–81	61–80	41–60	21–40	0–20
Can extremely sustain	A					
(100–81)	√					
High potential to sustain	B					
(61–80)		√				
Moderately sustain	C					
(41–60)			√			
High risk to sustain	D					
(21–40)				√		
Very high risk to sustain	E					
(0–20)					√	

score is low, the company must find a way to elevate it. Finally, based on a combination of critical determinants and ET decisions, the firm must determine the best ET decision.

4 Results and Analysis

AoETD was developed as a result of a combination of analysis using Smart PLS software. AoETD is divided into three phases, namely: the relationship between ETDs and the sustainability of Malaysian construction firms in the international market; significant determinants influencing ETDs; and measurement of ETDs.

4.1 Phase 1: The Relationship Between ET Decisions and the Sustainability of Malaysian Construction Firms in International Market

The following are three (3) hypotheses to be achieved in this study, which test the relationship between the three items. For example, such items are pioneers (Pi), early followers (EF), late followers (LF), and sustainability by Malaysian construction firms in the international market. The hypotheses are as follows:

H1: Pioneer (Pi) has the significance of firms' ability to sustain in the international market

H2: Early follower (EF) has the significance of firms' ability to sustain in the international market

H3: Late follower (LF) has the significance of firms' ability to sustain in the international market

First, convergent validity analysis was performed to test all three hypotheses (H1, H2, and H3) and identify all determinants as valid (AVE > 0.5). Thus, the results of the convergent validity analysis are as follows:

Surprisingly, according to Smart PLS analysis (shown in Fig. 2), all items are valid (>0.50). All items under all independent determinants have a significant impact on firms' ability to sustain themselves in international markets. Since the value average (AVE) for all items was greater than 0.5, the data are reliable (Fornell & Larcker, 1981). Next, all of the CR values are greater than 0.70, while the CA value is greater than 0.70 (Hair et al., 2014). Table 4 then displays the results of the beta coefficient (β) of Pearson's determination (R2) and the P-value analysis.

Based on Table 4, the P-values for all items are significant ($P \leq 0.05$). As a result, the hypothesis is accepted based on Kock (2016). The path (arrow) and its coefficients, which measure the correlation significance of each item construct, are also shown in the table. As a result, the findings show that all items have a significant impact

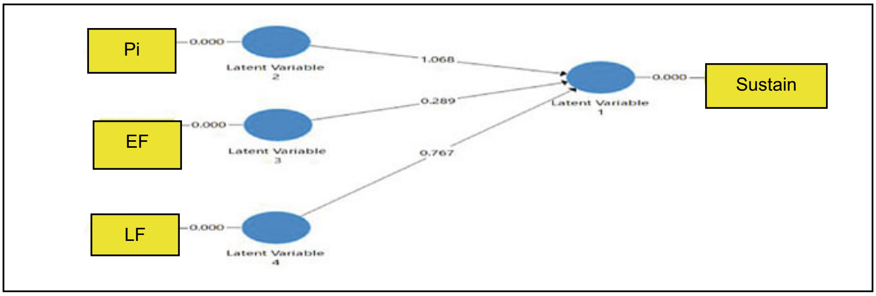


Fig. 2 The standardised regression weights. The relationship between ET decisions and the sustainability of Malaysian construction firms in the international market

Table 4 Testing the causes of sustainability of Malaysian construction firms on entry timing decisions

	Beta coefficient, β	P-value	Result
The relationship between Pi and the sustainability of firms in international markets	1.068	0.000	Significant
The relationship between EF and the sustainability of firms in international markets	0.289	0.024	Significant
The relationship between LF and the sustainability of firms in international markets	0.767	0.050	Significant

on firms' sustainability in international markets, with beta (β) equal to +1.96 (Hair et al., 2014; Kock, 2016). As shown in Table 5, all hypotheses are supported in this case.

Finally, the regression Eq. (2) constructed from the above findings is as follows:

$$\text{AoETD (ET decisions)} = 1.068\ \text{Pi} + 0.767\ \text{LF} + 0.289\ \text{EF} \tag{2}$$

Table 5 Results of hypotheses on the relationship between ET decisions and the sustainability of Malaysian construction firms in the international market

Hypotheses	Result of hypotheses
H1: Pioneer (Pi) has the significance of firms' ability to sustain in the international market	Supported
H2: Early follower (EF) has the significance of firms' ability to sustain in the international market	Supported
H3: Late follower (LF) has the significance of firms' ability to sustain in the international market	Supported

Overall, the Pis exhibited the most significant beta coefficient, 1.068, influencing firms' sustainability in international markets. The value also means that Pi is an effective primary ET, influencing the firm's success internationally compared to LF and EF.

4.2 Phase 2: Significant Determinants Influencing ET Decisions

The following are six (6) hypotheses to be achieved in this study to test the relationship between the six (6) determinants and ET decisions of Malaysian construction firms in international markets. These determinants include firm-specific (FSP), firm-resources commitments (FRC), project-specific (PS), home country (HC), target country (TC), and market-specific (MS) affecting ET decisions. The hypotheses are shown below:

H1: Firm-specific (FS) has significant effect on entry timing (ET) decision
H2: Firm-resources commitments (FRC) has significant effect on entry timing (ET) decision
H3: Project-specific (PS) has significant effect on entry timing (ET) decision
H4: Home country (HC) has significant effect on entry timing (ET) decision
H5: Target country (TC) has significant effect on entry timing (ET) decision
H6: Market-specific (MS) has significant effect on entry timing (ET) decision.

Notably, all items under the FRC are not valid (<0.50), and thus hypothesis 2 is rejected because the item does not influence the firm in its ET decision. Next, FRC items are eliminated in this analysis. Figure 3 indicates the fit or valid determinants (FS, PS, HC, TC, and MS) results from the Smart PLS analysis. Smart analysis shows all determinants are valid as they exceed 0.50.

The findings from Smart PLS in Fig. 3 show that all items (TC, FSP, PS, HF and MF) significantly influence the ET decisions (>0.50). Next, Table 6 shows the findings on the relationship between determinants and ETDs by Malaysian construction firms in the international market using analyses of convergent validity, T-test, Cronbach alpha, composite reliability, and P-value.

The P-value in Table 6 indicated that all variables had significant values of less than 0.05 (Hair et al., 2014). Meanwhile, according to Hair et al., all of the CR and CA values are valid because they exceed 0.70 (2014). Furthermore, bootstrapping modules are used to identify T-values in order to determine the significance of the correlation and P-value, as shown in Table 7.

The results in Table 7 show that all the P-values are significant (0.000) for all items and the t-values are greater than ±1.96. Significantly, the results showed that all items significantly affected the ET decisions. In this case, the hypotheses (H1, H3, H4, H5, and H6) that significantly affect ET decisions are supported. Furthermore, the results of every hypothesis are presented in Table 8.

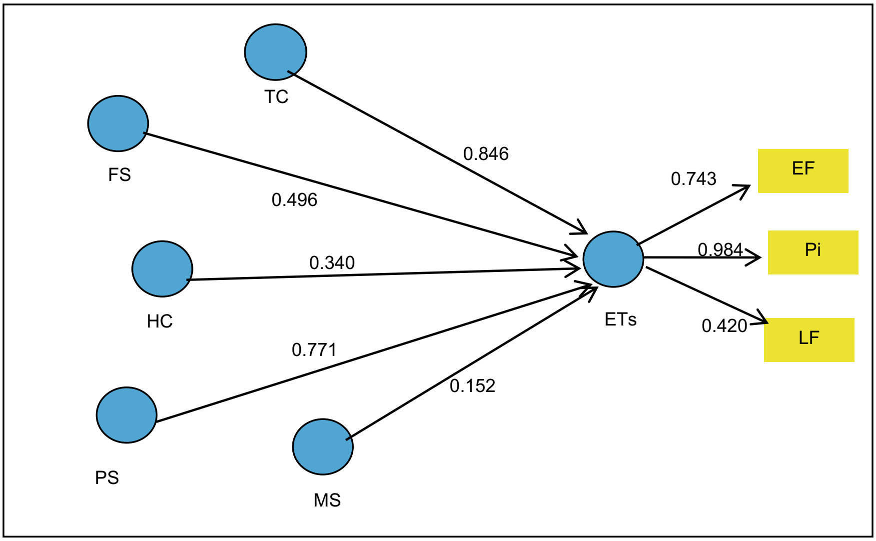


Fig. 3 The relationship between the determinants and ET decisions of Malaysian construction firms in international markets using standardised regression weights

Table 6 Findings on the relationship between determinants and entry timing decisions by Malaysian construction firms into the international market

Construct or variable lantent (LV)	Beta Coefficient, β	AVE	CR	CA	P-value	Result
FS	0.496	0.686	0.824	0.851	0.014	Significant
PS	0.771	0.687	0.820	0.779	0.018	Significant
HC	0.340	0.757	0.855	0.834	0.004	Significant
TC	0.846	0.676	0.811	0.764	0.025	Significant
MS	0.152	0.743	0.898	0.886	0.001	Significant

Finally, the regression Eq. (3) constructed from the above findings are:

$$\text{AoETD (determinants)} = 0.85\,\text{TC} + 0.77\,\text{PS} + 0.50\,\text{FS} + 0.34\,\text{HC} + 0.15\,\text{MS} \quad (3)$$

The TC significantly presented the most significant beta coefficient, 0.85, influencing ETDs. The value also means that TC is a critical determinant influencing the firm's ET decision to enter the international market. The second determinant influencing the ET decision was the PS (0.77), followed by FSP (0.50), HC (0.34), and MS (0.15).

Table 7 Results of hypotheses on the relationship between determinants and entry timing decisions by Malaysian construction firms into the international market

	Beta coefficient	T-value	P-value after bootstrapping	Result
FS ⟶ ET	0.496	23.150	0.000	Significant
PS ⟶ ET	0.771	16.642	0.000	Significant
HC ⟶ ET	0.340	18.518	0.000	Significant
TC ⟶ ET	0.846	12.640	0.000	Significant
MS ⟶ ET	0.152	32.196	0.000	Significant

Table 8 Results of hypotheses on the relationship between determinants and entry timing decisions by Malaysian construction firms into the international market after bootstrapping

Hypotheses	Results on hypotheses
H1: Firm-specific (FS) has significant effect on entry timing (ET) decision	Supported
H2: Firm-resources commitments (FRC) has significant effect on entry timing (ET) decision	Rejected
H3: Project-specific (PS) has significant effect on entry timing (ET) decision	Supported
H4: Home country (HC) has significant effect on entry timing (ET) decision	Supported
H5: Target country (TC) has significant effect on entry timing (ET) decision	Supported
H6: Market-specific (MS) has significant effect on entry timing (ET) decision	Supported

4.3 Phase 3: Measurement of ET Decisions

ET is estimated using the relationship of critical determinants (MS, HC, TC, FS, and PS). As ET decisions, other determinants include Pi, EF, and LF. The evaluation of ET decisions is broken down into three stages.

4.3.1 Stage 1: Measurement of the Key Determinants of ET Decisions to Analyse the Firm's Ability to Enter the International Market

In Stage 1, the firm can determine whether it has the potential or ability to sustain itself in the international market. Firm capabilities can be tested using the Eq. (4)

derived from Smart PLS analysis:

$$\text{AoETD (determinants)} = 0.85\,\text{TC} + 0.77\,\text{PS} + 0.50\,\text{FS} + 0.34\,\text{HC} + 0.15\,\text{MS} \tag{4}$$

Based on Eq. (4), the firm needs to choose key determinants that the firm considers to enter the international market. The firm must mark (√) if "yes" and (x) if "not applicable." An example of the assessment (AoETD) is shown in Table 9.

Based on Table 9, a value of 1 will be given if the firm chooses (√) and 0 if otherwise. The arrangement of independent determinants is arranged on a scale of 1 to 5, i.e., the larger the value of the scale, the greater the influence the determinant has on the firm's ET decision to enter the international market. In this case, scale 5 refers to TC, followed by PS, FS, HC, and MS.

Hence, AoETD measurements are based on the previous Eq. 4. Measurements for AoETD are as follows:

$$\text{AoETD (determinants)} = 0.85\,\text{TC} + 0.77\,\text{PS} + 0.50\,\text{FSP} + 0.34\,\text{HC} + 0.15\,\text{MS}$$

Hence,

$$\begin{aligned}\text{Final score, Y} &= 0.85(5) + 0.77(4) + 0.50(3) + 0.34(2) + 0.15(1)\\ &= 4.25 + 3.08 + 1.5 + 0.68 + 0.15\\ &= 9.66\end{aligned}$$

$$\begin{aligned}\text{Y in percentage} &= (9.66/9.66) * 100\\ &= 100\end{aligned}$$

An example of the measurement results in Table 9, the firm obtains a total score (100%). This score indicates that the firm will be extremely sustained in the international market if it successfully meets these critical determinants.

Table 9 Measurement of the key determinants of entry timing decision to analyse the firm's ability to enter the international market

Scale					Final score (Y)	Y (%)	Grade score	Potential of entry decisions
5	4	3	2	1				
TC	PS	FS	HC	MS				
0.85	0.77	0.5	0.34	0.15				
√	√	√	√	√				
1	1	1	1	1				
4.25	3.08	1.5	0.68	0.15	9.66	100	A	Can extremely sustain

4.3.2 Stage 2: Measurement of AoETD Based on the Relationship Between the Dependent Determinants and ET Decisions

Firstly, measurements for all ET are made based on Eq. (5):

$$\text{AoETD (determinants)} = 1.068\ \text{Pi} + 0.767\ \text{LF} + 0.289\ \text{EF} \tag{5}$$

Next, the measurements of AoETD were made, and an example of the calculation is shown in Table 10. Option 1 refers to all ET decisions, while Option 2 applies if the firm chooses one of the ET decisions. In this case, the firm chooses pioneer (Pi) as the ET decision to go to the international market.

Based on Table 10, a value of 1 will be given if the firm chooses (√) and 0 if otherwise. The arrangement of independent determinants is arranged on a scale of 1 to 3, i.e., the larger the value of the scale, the greater the influence the determinant has on the firm's ET decision to enter the international market. In this case, scale 3 refers to Pi, followed by LF, and EF.

Hence, AoETD measurements are based on the previous Eq. (5). Measurements for AoETD are as follows:

$$\text{AoETD (ET decisions)} = 1.068\,\text{Pi} + 0.767\,\text{LF} + 0.289\,\text{EF}$$

Hence, for Option 1:

Table 10 Measurement of the ET decisions (Option 1)

Opt	Scale			Final score, X	Score for each option	Total score, Z	Grade	Level of sustainability
Opt1	1	2	3					
	EF	LF	Pi					
	0.289	0.767	1.068					
	√	√	√					
	1	1	1					
	0.289	1.534	3.204	5.027	100	100.00	A	Can extremely sustain
	Scale							
	1	2	3					
	EF	LF	Pi					
	0.289	0.767	1.068					
	x	x	√					
	0	0	1					
	0	0	3.204	3.204	63.74	81.87	A	Can extremely sustain

$$\begin{aligned}\text{Final score, X} &= 1.068(3) + 0.767(2) + 0.289(1)\\ &= 3.204 + 1.534 + 0.289\\ &= 5.027\end{aligned}$$

$$\begin{aligned}\text{X in percentage} &= (5.027/5.027) * 100\\ &= 100\end{aligned}$$

Y refers to the score for the independent determinant (refer to Stage 1). For example, if score Y is 100%.

Hence,

$$\begin{aligned}\text{Total Score Z} &= ((\text{Y} + \text{X})/200) * 100\\ &= ((100 + 100)/200) * 100\\ &= 100\end{aligned}$$

For Option 2, the firm acts as a Pi to go to the international market. Hence,

$$\begin{aligned}\text{Final score, X} &= 1.068(3) + 0.767(0) + 0.289(0)\\ &= 3.204\\ \text{X in percentage} &= (3.204/5.027) * 100\\ &= 63.74\end{aligned}$$

Y refers to the score for the determinants (refer to Stage 1). For example, if score Y is 100%,

Hence,

$$\begin{aligned}\text{Total Score Z} &= ((\text{Y} + \text{X})/200) * 100\\ &= ((100 + 63.74)/200) * 100\\ &= 81.87\end{aligned}$$

Based on the assessment (AoETD), Pi is the best ET to enter the international market with an ET decision score of 81.87, or an A score, which ensures the firm's sustainability in the global market. It is followed by LF and EF. Pi also showed that the firm's extreme sustainability in foreign markets was evident.

4.3.3 Stage 3: Final Measurement of AoETD

The last stage is to combine the measurement of independent determinants with the ET decisions. Based on ranking, top managers must look at the level of ET decisions in helping firms sustain internationally before entering the global market. The same steps are taken for Option 3 and Option 4 (refer to the measurement examples in

Table 11 Overall outcome based on ETAC

	ET decisions	Score of ET decision	Grade score	Rank	Level of sustainability of firms in the international market
Option 1	All ET decisions	100.00	A	1	The firm can extremely sustain
Option 2	Pi	81.87	A	2	The firm can extremely sustain
Option 3	LF	65.26	B	3	High potential of firm to sustain
Option 4	EF	52.87	C	4	The firm moderately can sustain

Option 1 and Option 2), and the comparison for each option is illustrated based on the firm's score and level of sustainability in the international market. Finally, a total of four (4) decisions on ET were made as shown in Table 11.

Accordingly, it is relatively impossible for firms to apply all ET decisions (refer to Option 1). Therefore, the second option is to choose Option 2, which is Pi. These findings are made based on the most significant ET decision scale referring to AoETD. Thus, the result of the Pi shows that a firm can extremely sustain itself in the international market, followed by LF (Option 3) and EF (Option 4). This is similar to the study by Kalyanaram and Gurumurthy (1998). As cited by Kalyanaram and Gurumurthy (1998), late entrants can then be successful by adopting their own marketing positions and strategies, which proved findings of the AoETD.

5 Conclusions

MEDIF is developed to provide guidelines to local contractors in making strategic decisions in making the right ET (Pi, EL, and LF) decisions. Thus, AoETD highlighted six (6) key independent determinants to enter the international market arranged by scale; the key determinants chosen by firms to enter the global market were the TC, followed by PS, FS, HC, and MS. Hence, AoETD facilitates firms to decide on entry according to the firm's capabilities through the scale. AoETD measurements were made based on the scale with coefficient values from Smart PLS analysis. Based on the overall measurement of AoETD, firms can sustain in the international market and AoETD measurement could provide indicators or guidelines for local firms to operate globally from poor to excellent decision-making. According to AoETD measurements, Pi was found to be the most sustainable in the international market, followed by LF and EF.

Acknowledgements The authors gratefully acknowledge the Ministry of Higher Education Malaysia for providing the Fundamental Research Grant Scheme (600-IRMI/FRGS 5/3 (025/2019) and also to the School of Civil Engineering, College of Engineering, UiTM Shah Alam for their support in carrying out this research. We would like to thank all the managers who have participated in this study.

References

Abdul-Talib, A.-N., Salleh, M. F. M., Shamsuddin, F. M., & Ashari, H. (2011). The effects of firm size and international business experience on export attitudes. *American College of Radiology, 19*(1&2), 312–347.

Al Sadi, O., & Dulaimi, M. (2019). Choice of GCC construction market entry mode. In The international council for research and innovation in building and construction (CIB) world building congress 2019—constructing smart cities, 17 June 2019–21 June 2019, Hong Kong.

Asgari, M., & Ahmad, S. Z. (2010). Internationalization of Malaysian service firms: Business strategy and choice of foreign market entry mode. In *International conference on business, economics and tourism management (CBETM 2010)* (Vol. 1, pp. 1–6).

Awang, Z., Hui, L. S., & Zainudin, N. F. S. (2018). *Pendekatan Mudah structural equation modelling*. MPWS Rich Publication.

Bianchi, C., Carneiro, J., & Wickramasekera, R. (2018). Internationalisation commitment of emerging market firms. *Journal of Small Business and Enterprise Development*, *25*(2), 201–221. https://doi.org/10.1108/jsbed-07-2017-0221

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Frontiers in Public Health*, *6*(149). https://doi.org/10.3389/fpubh.2018.00149

Cleff, T., & Rennings, K. (2011). *Theoretical and empirical evidence of timing-to-market and lead market strategies for successful environmental innovation.* Simon Fraser University.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates, Publishers. Construction Industry Development Board Malaysia (2020). List of construction firm operating internationally.

Construction Industry Development Board Malaysia Report. (2020). Construction industry development board Malaysia record. http://international.cidb.gov.my/international

Creswell, J. W.(2009). Research design: Qualitative,quantitative,and mixed methods approaches (3rd.ed). Sage Publications, Inc.

Durmaz, Y., & Taşdemir, A. (2014). A theoretical approach to the methods introduction to international markets. *International Journal of Business and Social Science*, *5*(6(1)), 47–54.

Lo, F.-Y., & Kletsova, A. (2018). Entry timing into international markets: Evidence from the Taiwanese service industry. *Economic Research-Ekonomska Istraživanja*, *31*(1), 1059–1077. https://doi.org/10.1080/1331677X.2018.1436456

Fornell, C., & Larcker, D.F. (1981). Evaluating SEM models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50.

García-Villaverde, P. M., Parra-Requena, G., & Ruiz-Ortega, M. J. (2017). From pioneering orientation to new product performance through competitive tactics in Smes. *BRQ Business Research Quarterly, 20*(4), 275–290. https://doi.org/10.1016/j.brq.2017.05.002

Greening, D. W., Barringer, B. R., & Macy, G. (1996). A qualitative study of managerial challenges facing small business geographic expansion. *Journal of Business Venturing II, 11*(4), 233–256.

Hair, J. F., Hult, T. M., Ringle, C.M., & Sarstedt, M. A. (2014). *Primer on partial least squares structural equation modeling (PLS-SEM).* Sage

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing, 20*, 277–319.