ENVIRONMENTAL TECHNOLOGICAL INNOVATION IMPLEMENTATION AND MARKET DEMAND IN MALAYSIAN MANUFACTURING INDUSTRY

By

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ABSTRACT

Sustainable development is an international agenda accepted by all stakeholders, namely policy- makers, industry practitioners and the communities, to resolve current and future development problems. The interdependence relationship between economy, social and environment is an important pillar of sustainable development. Environmental technological innovation (ET-innovation) is the key factor that connects those three pillars. Hence, this study's original contribution to knowledge was the evaluation of the extent of market demand effects on ET-innovation implementation from the perspective of the demand-based view. This study also proposed market orientation as the mediator on the above relationship while the moderating effect of environmental turbulence and managerial ties were also determined. The investigation was done within the scope of the manufacturing industry in Malaysia. The single cross-sectional web-based survey was used to collect the data while the analysis was executed using PLS-SEM. The response rate for the study was 5.6 percent with 186 usable data. Interestingly, the result shows that customer demand has an insignificant direct relationship with ET-innovation, whereas only competitor pressure has direct relationships with ET-innovation implementation as hypothesised. Furthermore, the effect of market orientation as a mediating factor can only be found on the eco-process innovation implementation, while no interaction effects have been found for both environmental turbulence and managerial ties as moderating factors. In conclusion, despite several limitations, this study has proposed and validated a model to better explain ET-innovation implementation in the Malaysian manufacturing industry. This study has also compiled empirical evidence for new and existing theoretical propositions surrounding ET-innovation and environmental innovation. Several practical implications have been derived to further assist stakeholders in implementing ET-innovation. It is hoped that the inputs that originated in this study form the basis for future scholarly research. Recommendations are also outlined in this study.

Keywords: environmental technological innovation, demand-based view, market orientation, sustainable development, environmental innovation

ABSTRAK

Pembangunan lestari adalah agenda antarabangsa yang diterima oleh semua pihak yang berkepentingan iaitu pembuat dasar, pengamal industri dan masyarakat untuk menyelesaikan masalah pembangunan semasa dan pada masa hadapan. Hubungan saling bergantungan antara ekonomi, sosial dan alam sekitar merupakan tunggak yang penting dalam pembangunan lestari. Inovasi teknologi alam sekitar *(ET-innovation)* adalah faktor utama yang menghubungkan ketiga-tiga tunggak pembangunan lestari tersebut. Oleh itu, sumbangan sebenar kajian ini dalam ilmu pengetahuan adalah untuk menilai sejauh mana kesan permintaan pasaran terhadap pelaksanaan *ET-innovation* dari perspektif pandangan berasaskan permintaan *(demand-based view)*. Kajian ini turut mencadangkan orientasi pasaran *(market orientation)* sebagai faktor perantara dalam hubungan di atas, manakala kesan pengantaraan pergolakan persekitaran *(environmental turbulence)* dan pertalian pengurusan *(managerial ties)* juga ditentukan. Penyelidikan dibuat dalam skop industri pembuatan di Malaysia. Tinjauan keratan rentas tunggal berasaskan sesawang (web) digunakan untuk mengumpul data, manakala analisis dilakukan dengan menggunakan PLS-SEM. Kadar maklum balas kajian adalah sebanyak 5.6 peratus dengan 186 data boleh digunakan. Menariknya, keputusan kajian menunjukkan bahawa hubungan langsung permintaan pelanggan dengan *ET-innovation* adalah tidak signifikan, sedangkan hanya tekanan pesaing mempunyai hubungan langsung dengan pelaksanaan *ET-innovation* sebagaimana hipotesis asal. Tambahan pula, kesan orientasi pasaran sebagai faktor perantara hanya boleh didapati pada pelaksanaan inovasi proses alam sekitar *(eco-process innovation)*, manakala tiada kesan interaksi didapati pada pergolakan alam sekitar dan hubungan pengurusan sebagai faktor perantara. Kesimpulannya, walaupun terdapat beberapa kekangan, kajian ini telah mencadangkan sebuah model yang terbukti boleh menerangkan *ET-innovation* dengan lebih jelas dalam industri pembuatan di Malaysia. Kajian ini juga telah mengumpulkan bukti empirik untuk cadangan teori baharu dan teori sedia ada yang berkaitan dengan *ET-innovation* dan inovasi alam sekitar *(environmental innovation)*. Beberapa implikasi praktikal telah diperolehi untuk membantu pihak-pihak berkepentingan ke arah pelaksanaan *ET-innovation*. Diharapkan agar input daripada kajian ini dapat membentuk asas penyelidikan ilmiah pada masa hadapan. Beberapa cadangan juga digariskan dalam kajian ini.

Kata kunci: inovasi teknologi alam sekitar, pandangan berasaskan permintaan, orientasi pasaran, pembangunan lestari, inovasi alam sekitar

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AIC	Akaike's Information Criterion
AIC_3	Modified AIC with Factor 3
AIC_4	Modified AIC with Factor 4
AIM	Malaysian Innovation Agency *(Agensi Inovasi Malaysia)*
ASEIC	ASEM SMEs Eco-innovation Center
ASEM	Asia-Europe Meeting
AVE	Average Variance Extracted
BCSDM	Business Council for Sustainable Development in Malaysia
BIC	Bayesian Information Criteria
CAIC	Consistent AIC
CB-SEM	Covariance Based - Structural Equation Modelling
CO_2	Carbon Dioxide
CR	Composite Reliability
Eco-	Environmental
Eco-process Innovation	Environmental Process Innovation
Eco-product Innovation	Environmental Product Innovation
EMS	Environmental Management System
EN	Entropy Statistic (Normed)
ENGO	Environmentally Oriented NGO
ENPD	Environmental New Product Development
ENSEARCH	Environmental Management and Research Association of Malaysia
EPU	Economic Planning Unit
ET-innovation	Environmental Technological Innovation
FIMIX-PLS	Finite Mixture PLS
FMM	Federation of Malaysian Manufacturers
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIS	Geographical Information System
GLC	Government Linked Company
GoF	Goodness-of-Fit Index
GreenTech Malaysia	Malaysia Green Technology Corporation

GTFS	Green Technology Funding Scheme
HTMT	Heterotrait-Monotrait Ratio of Correlations
IPMA	Importance-Performance Matrix Analysis
ISO	International Organization for Standardization
KeTTHA	Ministry of Energy, Green Technology, and Water *(Kementerian Tenaga, Teknologi Hijau dan Air)*
LnL	Log Likelihood
MaGIC	Malaysian Global Innovation and Creativity Centre
MASTIC	Malaysian Science and Technology Information Centre
MATRADE	Malaysia External Trade Development Corporation
MDL_5	Minimum Description Length with Factor 5
MGA	Multi-Group Analysis
MICCI	Malaysian International Chamber of Commerce & Industry
MOSTI	Ministry of Science, Technology, and Innovation *(Kementerian Sains, Teknologi and Inovasi)*
NFI	Normal Fit Index
NRBV	Natural-resource-based View
OECD	Organisation for Economic Co-operation and Development
PLC	Product Life Cycle
PLS-GAS	Genetic Algorithm Segmentation in PLS-SEM
PLS-IRRS	Iterative Reweighted Regressions Segmentation Method
PLS-MGA	PLS-Multi Group Analysis
PLS-POS	PLS-SEM Prediction-Oriented Segmentation Approach
PLS-SEM	Partial Least Squares – Structural Equation Modelling
R&D	Research and Development
RBV	Resource-based View
REBUS-PLS	Response-Based Procedure For Detecting Unit Segments
SME	Small Medium Entreprise
SRMR	Standardized Root Mean Residual
TIM	Texas Instruments Malaysia Sdn Bhd
UN	United Nations
UNFCC-COP 15	United Nations Framework Convention on Climate Change - Conference of the Parties 15
VIF	Variance Inflation Factor
WCED	World Commission on Environment and Development

LIST OF APPENDICES

CHAPTER ONE

INTRODUCTION

This chapter begins with the background of the study, the problem statement, the research objectives and the research questions. Subsequent sections discuss the significance of this study, the scope and the limitations of this study, and also the definition of terms. Finally, the chapter concludes with the organisation of the report and the summary of the chapter.

1.1 Background of the Study

The background of this study first gives a big picture overview of the sustainable development concept in the world and in Malaysia. It will then narrow down to describe the environmental technological innovation (ET-innovation) concept within the sustainable development. Finally, it ends with a brief explanation of the current situation on market demand and the ET-innovation in Malaysian manufacturing industry as the focus of this study.

1.1.1 Sustainable Development

The Honorary U Thant (Secretary-General of the United Nations, 1969) has stated that the arms race, the environment deterioration, the population explosion, and economic development stagnation are major long-term problems of the new world (Meadows, Meadows, Randers, & Behrens, 1972, p. 17). Sustainable development is an important agenda to resolve most of these critical modern man problems. Sustainable development is a process of developing land, businesses, social, and cities that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, para. 27).

The sustainable development definition above was originally published by the United Nations World Commission on Environment and Development (WCED) called the Brundtland Report signed by the then Chairman, The Honorary Mr Gro Harlem Brundtland, in 1987. The report is committed to the interdependency between economics, social and environment, inclusive development for current population and the next decades, impartiality, social equity and justice between and within generation and species, responsibility at all levels to take precaution and prevention, and safety and security against chronic threat and harmful disturbance (Birkin, Polesie, & Lewis, 2009; Elkington, 1994; Gladwin, Kennelly, & Krause, 1995; Kinnear & Ogden, 2014; Mirata & Emtairah, 2005; Oreský, 2009).

Subsequent to the idea of sustainable development and its continuous action by the UN, Malaysia as member also has to be responsible and take action. In fact, Malaysia as part of Southeast Asia, contribute to the emission of about 4% of global energy-related emissions (or a little over 1 billion metric tonnes (bt) of carbon dioxide (CO^2)) in 2008 (A. Amran, Zainuddin, & Zailani, 2013). Currently, Malaysia contributes slightly above 0.6% of the world's total carbon emissions (Clean Malaysia, 2016; UNFCC, 2015). Hence, at United Nations Framework Convention on Climate Change - Conference of the Parties – 15th session (UNFCCC - COP-15; 2009) in Copenhagen, the Prime Minister's of Malaysia while giving his remarks, has pledged that Malaysia will strive to reduce carbon emission up to 40% in terms of emission intensity of GDP by 2020 compared to its 2005 levels (A. Z. Ismail, 2010; C. S. Khor & Lalchand, 2014; MATRADE, 2015; Silivarajoo, 2011).

1.1.2 Environmental Technological Innovation

The above challenges of sustainable development can be overcome with a balanced integrated development among economy, environment and society (Yang, 2013) and using technology as an instrument to solve the human problem (Pansera, 2012). Existing technologies and production methods would not be enough for economic development to be ecologically sustainable (Hart, 1995). Thus, it's important to have new innovation in technology that can reduce environmental impact and also natural resources usage. Innovation that leads to this target is term as environmental technological innovation (ET-innovation) (Ekins, 2010; Hart, 1995).

ET-innovation is an important subcategory of environmental innovation (Arundel & Kemp, 2009; OECD, 2009; N. Rashid, Jabar, Yahya, & Shami, 2014). The other subcategory of environmental innovation is a non-technological environmental innovation which includes environmental innovation in marketing, organisation, social and institution (C. C. Cheng & Shiu, 2012; Klewitz & Hansen, 2014; Noor Aslinda et al., 2014) (refer Section 2.2 for details).

Whereas, the typology of ET-innovation are the environmental product (eco-product) innovation and the environmental process (eco-process) innovation with both innovations engage with important and specific activities of ET-innovation implementation (C. C. Cheng & Shiu, 2012). This study will focus on ET-innovation and its typology, which being defined earlier by K. Green, McMeekin, & Irwin (1994) as,

> *[...] "inventing, innovating and diffusing new sets of products and processes which somehow or other are inherently more environmentally friendly than the sets we currently make and use" (p. 1048).*

Studies on environmental innovation are relatively quite young with research span less than 25 years and an upsurge only after 2009 with researches focusing on ET-innovation are even more scarce (Díaz-García, González-Moreno, & Sáez-Martínez, 2015). Instead of ET-innovation (Carraro, 2000; K. Green et al., 1994), other researchers use different terminology such as technological environmental innovation (Brunnermeier & Cohen, 2003; Carrillo-Hermosilla, Del Río, & Könnölä, 2010; Huber, 2004), technological (technical) eco-innovation (Rennings, 1998; Rennings, Ziegler, Ankele, & Hoffmann, 2006), green technological innovation (Norberg-Bohm, 1999; Tseng, Wang, Chiu, Geng, & Hsu, 2013), or sustainable technological innovation (White, 2002).

1.1.3 Market Demand and ET-innovation in the Manufacturing Industry

In the event to fulfil the promise in UNFCCC-COP 15 in 2009, the government of Malaysia has undergone a cabinet reshuffling with new ministry being established. The new ministry replacing Ministry of Energy, Water and Communications was renamed as Ministry of Energy, Green Technology and Water (*Kementerian Tenaga, Teknologi Hijau dan Air, KeTTHA*) with new portfolios (A. Z. Ismail, 2010; Silivarajoo, 2011). The ministry does not take long to produce their first and very important statute towards achieving sustainability target, which is the National Green Technology Policy. The initiative was launched on the 24th of July 2009 by the Prime Minister of Malaysia (KeTTHA, 2010). The above action is part of Malaysian government strategic thrusts towards strengthening the institutional frameworks. Other thrusts include to provide a conducive environment, economic instruments, hubs and funding mechanism, intensify human capital development and intensifying green technology research and innovations (KeTTHA, 2010).

At the same time, innovation management in Malaysia becomes the country important agenda when the Malaysian Innovation Agency (*Agensi Inovasi Malaysia* (AIM)) Act was approved in 2010. AIM Act defined;

> *"Innovation means any idea or knowledge in whatever form which brings about changes in the form of product, service or process resulting in positive impact to the economy, business, public service delivery system, social well being or the environment".* (Laws of Malaysia, 2010)

Since then, policy, regulation, program and fund allocation was introduced to promote innovation at federal's and states' level. One example was the establishment of Malaysian Global Innovation & Creativity Centre (MaGIC) in October 2013 as one stop centre for financial support linkages and pre-development fund assistance for new and potential firms (H. Amran, 2013; Mat Zuki, 2014). As the environment is also part of innovation as mention in the definition of innovation by AIM Act, hence, this current development in policy and government initiatives is a positive drive for firms to be involved in ET-innovation in Malaysia (AIM, 2015b).

While policy makers have been introducing innovation and technology policies based on supply-side perspective, the demand-side view has been neglected (Frenkel, Maital, Leck, & Israel, 2015). Supply side perspective policies include public research & development (R&D) programs, government-funded demonstrations, and educational and training investment. Whereas, demand-side policy approach include intellectual property protection, public procurement, technology standard and tariffs with objectives to increase payoff for successful investment by measures such as expanding the market possibilities (L. Xu & Su, 2016). The Malaysian government has begun to consider market demand approach when designing innovation initiatives especially in the major industries; the manufacturing and the mining sector. For example, PlaTCOM Ventures Sdn Bhd was developed with objectives to addresses the innovation gaps through a holistic market-driven approach in supports of innovation and industrial competitiveness (AIM, 2015b; Platcom Ventures, 2015). The AIM also has launched the Steinbeis Malaysia Foundation in August 2014 to provides an industry-focused platform to stimulate industry-academia collaboration from a market-driven perspective (AIM, 2015a).

Turning now to the manufacturing industry where the focus of government initiative and policies are. The industry is the key driver of Malaysian economy because most products such as food industry, rubber industry, petroleum products, heavy industry and chemical industry are produced in industrial manufacturing (Harun & Ishak, 2014), it is the second largest contributor to national GDP with its share of 23% GDP in 2015 (National Productivity Council, 2014; OECD, 2016), it have nearly 2.2 million people on their pay list which comprise of 16.8% of the country's total employment (National Productivity Council, 2014), and the productivity growth in the manufacturing sector rose 38% in 2014 (Bernama, 2015).

Hence, the relationship of market demand with ET-innovation within the manufacturing industry in Malaysia has been selected as the key research scope for this study. In the context of the above relationship, further studies on market orientation as mediating factor and environmental turbulence and managerial ties as moderating factors also appears to be important and worthy of investigation (Cai & Zhou, 2014; Han, Kim, & Srivastava, 1998; Wang & Chung, 2013; Zhou, Brown, & Dev, 2009).

1.2 Problem Statement

Sustainable development is a concept where a development must consider the effect of social, economic, and environmental factors on the current needs and future needs of the living and non-living things while also make an effort to compare its advantages and the disadvantages against the alternative option (Dalal-Clayton & Bass, 2000; WCED, 1987). Therefore, as a nation of the world, the government of Malaysia has pledged to reduce carbon emission and save the earth as an important diplomatic action and moral obligation in the best interest of the nation and its population (A. Z. Ismail, 2010; C. S. Khor & Lalchand, 2014; MATRADE, 2015; Silivarajoo, 2011). In addition, the government introduces Green Technology Financing Scheme (GTFS) in excess of RM3.5 billion between 2010-2017 for the first phase and RM5 billion for the second phase (2018-2022) (GreenTech Malaysia, 2017). This scheme is a soft loan supported by the government intended for firms that use green technology in their process set-up or for firms that develop ET-innovation.

On the other hand, the Malaysian government has shifted focus from agricultural to knowledge base to an innovation-centered economy where innovation becomes the drivers of economic growth (Abdul Halim, Ahmad, Ramayah, & Taghizadeh, 2014, 2016). This new direction started of with the AIM Act in 2010, the introduction of MaGIC with RM70 million funding scheme, and the establishment PlaTCOM Ventures and Steinbeis Malaysia Foundation to assist collaboration between industries, academia and the policy makers (AIM, 2015a, 2015b; H. Amran, 2013; Mat Zuki, 2014; Platcom Ventures, 2015).

The government policies direction on green technology and innovation as mentioned above is a positive drive for firms to be involved in ET-innovation in Malaysia (AIM, 2015b). Besides, Malaysia contributes more than 0.6% of the world's total carbon emissions (Clean Malaysia, 2016; UNFCC, 2015), and the GDP for green business was forecasted at about RM60 billion by 2030 and green technology investments is estimated at RM86 billion by the same year to Malaysia (Spykerman, 2015). Whereas if action is overlooked, according to ADB, Malaysia may risk losing GDP between 7-8% (A. Amran et al., 2013).

Looking at global setting, implementing environmental innovation towards sustainable development has now become an ethical part in companies' strategy (Dangelico & Pujari, 2010) in reducing environmental damage (Triguero, Moreno-Mondéjar, & Davia, 2013). But in the event that companies chose or required by regulation to adopt environment-friendly policies, the goal is also to grasp opportunities to reduce costs, enjoy a better reputation and gain new markets (Dangelico & Pujari, 2010; Laperche & Picard, 2013; R.-J. Lin, Chen, & Huang, 2014; Seebode, Jeanrenaud, & Bessant, 2012). This action also must bring profits (Dangelico & Pujari, 2010; R.-J. Lin et al., 2014; Triguero et al., 2013) and give the firm competitive advantage (Y.-S. Chen, Lai, & Wen, 2006; Sambasivan, Bah, & Jo-Ann, 2013), albeit in the form of expectation in future performance against competitors (Hart, 1995; Triguero et al., 2013). The study by Dangelico and Pujari (2010) beside confirming the findings above, emphasise that these different motivations often co-exist within the same firm. This is in line with Porter's hypothesis that emphasises environmental innovation as solutions to economic competitiveness in response to strict environment regulation and standard (Porter & van der Linde, 1995b).

Highly renowned researchers have contributed their concept and model, such as Porter (1991) on applying environmental innovation to be competitive, Kemp (1994) on the problems encountered by technological firms when shifting to environmentally sustainable innovation, Hart (1995) with the concept of the Natural-Resource-Based view, and Rennings (1998, 2000) with three specialties of environmental innovation. Several international researchers have also devoted considerable attention to the concept of environmental innovation and its application with most active researchers are from Europe especially Germany, the Netherlands and Italy (Martin, 2016; Schiederig, Tietze, & Herstatt, 2012).

Previous empirical research on ET-innovation has focused primarily on regulatory effect (Anex, 2000; Norberg-Bohm, 1999; Sun, Lu, Wang, Ma, & He, 2008; Taylor, Rubin, & Hounshell, 2003), antecedents of ET-innovation (Sharfman, Meo, & Ellington, 2000; Zailani, Iranmanesh, Nikbin, & Jumadi, 2014) and the issues in the implementation of ET-innovation (Inoue, Arimura, & Nakano, 2013; Ke-xin & Meng, 2013). The study of market demand on innovation (Schmookler 1966 in Scherer 1982), environmental innovation (Rennings, 1998) and even ET-innovation (K. Green, Morton, & New, 2000; R.-J. Lin et al., 2014) was also not new. However, the effect of market demand on ET-innovation from the demand-based view which can be classified as customer demand and competitive pressure, is new and worthy to study for the following reasons; (1) knowledge on demand-based view is less explored, unknown and overlooked on its importance, (2) regulators prefer supply side and neglect demand-side, (3) fluctuation in demand for green technology need for better understanding, and (4) competitive pressure in demand-based view is not common in innovation study but important to improve competitive advantage

(Adner & Levinthal, 2001; Frenkel et al., 2015; Malaman, 1996; Priem, Li, & Carr, 2011; Stanko, Bohlmann, & Molina-Castillo, 2013; Yalabik & Fairchild, 2011).

In addition, the study of market demand relationship with ET-innovation encompasses unexplored dimension of market orientation as a mediating factor, that also have attracted research attention in other disciplines (Wang & Chung, 2013). Among gaps that encourage market orientation to be introduced as mediating factor are; the importance of market data in pushing for rising in demand, firms need to understand current and latent need cause by demand heterogeneity, firms need to understand competitor strategy when customers' functional requirement is achieved, firms need to have relationship with customer until end of product lifecycle, demand fluctuation need for organisational change, and the exact mechanism when demand signal for environmental product received at a firm is still underexplored (Adner & Levinthal, 2001; Azzone & Noci, 1998; de Medeiros, Ribeiro, & Cortimiglia, 2014; K. Green et al., 2000; Lemke & Luzio, 2014; Muzamil Naqshbandi & Kaur, 2014; Rehfeld, Rennings, & Ziegler, 2007).

Environmental turbulence and managerial ties as moderating factors also appeared to be important and worthy of investigation in the context of their interaction on market orientation relations with ET-innovation (Cai & Zhou, 2014; Norberg-Bohm, 1999; Triguero et al., 2013; Weng & Lin, 2011). Although environmental turbulence study as moderator is not new in the technological innovation literature, it is still scarce with limited theoretical and empirical in ET-innovation study (Hernández-Espallardo & Delgado-Ballester, 2009; Zailani et al., 2014). It was important because a study by Han et al. (1998) showed that market orientation components interact differently with various environmental turbulence variables in facilitating innovations. Furthermore, Norberg-Bohm (1999) wrote for any introduction of the environmental policy, firms must consider each industry characteristics and environmental turbulence to be successful.

While the study by Wang & Chung (2013) emphasised the role of managerial ties between market orientation and innovation relationship which is especially important from the Asian perspective since many Asian countries have communities and relational cultures where networks have some role in firms' business activities for growth. Understanding managerial ties as moderating factor will also assist foreign firms that want to invest in Asian countries to appropriately design their market orientation strategies towards enhancing innovation activities (Heidreich & Koschatzky, 2011).

This study attempted to investigate the impact of (1) market demand, (2) market orientation, (3) environmental turbulence, and (4) managerial ties towards ET-innovation implementation body of knowledge. The study sought to extend the ET-innovation knowledge by addressing the gaps in market demand relationship with ET-innovation implementation through demand-based perspective. In addition, interrelationships among market orientation as a mediator between market demand and ET-innovation implementation, environmental turbulence as a moderator between market orientation and ET-innovation implementation, and managerial ties as a moderator between market orientation and ET-innovation implementation were examined.

1.3 Research Questions

Specifically, this study was asking the following questions:

a) To what extent market demand relates to environmental technological innovation implementation?

b) Does market orientation mediate the relationship between market demand and environmental technological innovation implementation?

c) Is there a moderating effect of environmental turbulence on the relationship between market orientation and environmental technological innovation implementation?

d) Is there a moderating effect of managerial ties on the relationship between market orientation and environmental technological innovation implementation?

1.4 Research Objectives

Based on the above research questions, this study was designed to accomplish the following specific objectives:

a) To evaluate the extensiveness of the relationship between market demand and environmental technological innovation implementation.

b) To propose the mediating role of market orientation in the relationship between market demand and environmental technological innovation implementation.

c) To determine the moderating role of environmental turbulence in the relationship between market orientation and environmental technological innovation implementation.

d) To determine the moderating role of managerial ties in the relationship between market orientation and environmental technological innovation implementation

1.5 Significance of the Study

The outcome of this study will have the following benefits. First, this study serves as an important source of reference for future discussions and a starting point for further researches in ET-innovation implementation and its dimensions, namely eco-product innovation and eco-process innovation. Second, it contributes to extending discussion on market demand as the driver of ET-innovation implementation from the view of demand-based. Third, it further expands the literature on market orientation in the innovation management field by examining its mediating effect on market demand and ET-innovation implementation linkage. Fourth, this study also contributes to the understanding of environmental turbulence and managerial ties as moderator in the above relationship.

Fifth, this study has significance contributions to policymakers, business owners, managers, and communities by enhancing the understanding of ET-innovation relationship with sustainable development and also the implementation in Malaysian manufacturing firms and industry. Sixth, the present study further strengthens the understanding of the dimensions of ET-innovation, its drivers and its relationships effect. Seventh, it provides added evidence to the existing concept of environmental turbulence and its interaction effect on ET-innovation. Finally, this study provides empirical evidence that supports or counters previous researches findings in respect to managerial ties interaction effect on the market orientation and ET-innovation relationship.

1.6 Scope and Limitations of the Study

The specific scope of this study was within the boundary of ET-innovation implementation as explained in the definition of the terms. This study has focused on the market demand from the demand-based view, market orientation, environmental turbulence and managerial ties effect on ET-innovation implementation. Some data on size, age and firm-specific characteristics has been recorded. All these data was gathered from industries that implement ET-innovation within Malaysian manufacturing industry.

1.7 Definition of Terms

Key terms are defined to establish the positions of this study. Refer Table 1.1.

Table 1.1
Definition of key terms

Key terms	Definitions
Environmental Technological Innovation (ET-innovation) Implementation	**ET-innovation implementation** is define as inventing, innovating and diffusing of a product or production process that is novel to the firm (developing or adopting it) which integrate consideration throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (Charter & Clark, 2007; K. Green et al., 1994; Kemp & Pearson, 2007). The main dimensions for ET-innovation implementation for this study are eco-process innovation implementation and eco-product innovation implementation. **(i) Eco-process innovation implementation** is define as the introduction of an improvement to existing production processes or the addition of new processes with the aim of producing environmentally friendly products capable of meeting eco-targets, such as energy savings, pollution prevention, waste recycling, no toxicity, low energy consumption, recycle, reuse and remanufacture material and use of cleaner technology to make savings and prevent pollution (C. C. J. Cheng, Yang, & Sheu, 2014; C. C. Cheng & Shiu, 2012; Conding, Mohd Zubir, Adwini Hashim, & Sri Lanang, 2012; R.-J. Lin et al., 2014; Relich, 2015) **(ii) Eco-product innovation implementation** involves the development of new or improved products that inflicts no or less negative impact on the environment than a conventional product through different stages of the product's physical life cycle (manufacturing process, product use, and disposal) (C. C. J. Cheng et al., 2014; C. C. Cheng & Shiu, 2012; Dangelico & Pujari, 2010; de Medeiros et al., 2014; S. K.-S. Wong, 2013)

Table 1.1 (Continued)

Key terms	Definitions
Market Demand	**Market demand** from demand-side view means works that look downstream from the focal firm, toward product markets and consumers (Priem et al., 2011). **Demand-based view** explained that in the early technological development, firms technological innovation is guided by the customer need and requirement while in the latter stage after market price and performance are met, technological innovation is driven by competition to attract satisfied customer (Adner & Levinthal, 2001). Market demand for this study is classified as customer demand and competitive pressure. **(i) Customer demand** analysis focuses on identifying, understanding and responding to customer (end user or buyer firms) needs and creating products capable of meeting their expectations (R.-J. Lin et al., 2014; Powpaka, 2006). **(ii) Competitor pressure**, on the other hand, force firms to understand the strengths, weaknesses, capabilities and strategies of the key competitors and identify their technologies capable of satisfying the target consumers' demand (Y. Li, 2014; Narver & Slater, 1990).
Market Orientation	**Market orientation** is the organisationwide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organisationwide responsiveness to it (Kohli & Jaworski, 1990). Market intelligence can be summarised as an act of understanding customer's current and future needs and preferences; it also includes an analysis of how they may be affected by exogenous factors. Responding to the market need requires the participation of virtually all departments in a firm, thus effective dissemination of market intelligence, either formally or informally, is important to provide a platform for concentrated actions by different departments. While, responsiveness is the action taken in response to intelligence that is generated and disseminated. Without responding to market needs, market orientation objectives would not be achieved (Kohli & Jaworski, 1990).
Environmental Turbulence	**Environment turbulence** is the rates of change in the market, technology and/or competitive behaviour within an industry (C.-Y. Lin & Ho, 2011; K. H. Tsai & Yang, 2013; Weng & Lin, 2011). In this study, market turbulence, technological turbulence and competitive intensity will be used to explain environmental turbulence (Baker & Sinkula, 2005; Kohli & Jaworski, 1990). **(i)** Jaworski and Kohli (1993) define the term **market turbulence** as the rate of change in the composition of customers and their preference. **(ii) Technological turbulence** can be defined as the rate of technological change within an industry (Jaworski & Kohli, 1993; Zhou, 2006). **(iii) Competitive intensity** reflects the competition between firms in an industry (K. H. Tsai & Yang, 2013).

Table 1.1 (Continued)

Key terms	Definitions
Managerial Ties	Peng and Luo (2000) explains the **managerial ties** as micro interpersonal ties of a firm's top management with top executives at other firms, universities, and with government officials. Cai and Zhou (2014) emphasises the external ties strength as the frequency of connection between firms and other stakeholders, which reflects cooperation in social networks. For this study the managerial ties will look for explanations from three angles; political ties, business ties and university ties. **(i)** Wang and Chung (2013) denote **political ties** as managers' connections with government officials, or personnel, in various government agencies. **(ii) Business ties** refer to managers' connections with other firms such as ties with their suppliers, buyers, distributors and competitors (Wang & Chung, 2013). **(iii)** K. Xu, Huang, and Gao (2011) define **university ties** as the personal relationships between members of a firm and university staff.
Environmental Innovation	**Environmental innovation** can be summarised as the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organisation (developing or adopting it). Environmental innovation also integrate considerations for sustainability (environmental, social, financial) during idea generation, research, development and commercial phases and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (Charter & Clark, 2007; Kemp & Pearson, 2007)
Environmental Product (Eco-product)	An **environmental product (eco-product)** is not a product that has zero environmental impact. It is a product that strives to protect or enhance the natural environment by conserving energy and/or resources and reducing or eliminating the use of toxic agents, pollution, and waste during its whole life-cycle (Driessen, Hillebrand, Kok, & Verhallen, 2013; Ottman, Stafford, & Hartman, 2006)
Green Technology	**Green technology, eco-technology, or environmental technology** is the output of ET-innovation. **Green technology** is the development and application of product and process that efficiently use natural resources while reducing/recycling wastes, to control/minimise the risks of chemical substances, and to reduce pollution (Glavič & Lukman, 2007; KeTTHA, 2010; Shrivastava, 1995).
Green Industry	The core **green industries** are "those [identifiable] sectors within which the main – or a substantial part of – activities are undertaken with the primary purpose of the production of goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems" (Kim, Park, Lee, & Youm, 2013)
Green Business	**Green business** is defined as "business models which support the development of products and services (systems) with environmental benefits, reduce resource use/waste and which are economic viable. These business models have a lower environmental impact than traditional business models" (Machiba, 2012)
Green Purchasing	**Green purchasing** is defined as an environmentally-conscious purchasing initiative that tries to ensure that purchased products or materials meet environmental objectives set by the purchasing firm, such as reducing sources of waste, promoting recycling, reuse, resource reduction, and substitution of materials (Eltayeb & Zailani, 2010)

Table 1.1 (Continued)

Key terms	Definitions
Green Consumer	A consumer whose purchasing behaviour is persuaded by environmental concerns is known as a **green consumer** (Shrum, McCarty, & Lowrey, 1995; Suki, 2013a)
Sustainable Development	**Sustainable development** is a concept where a development must consider the effect of social, economic, and environmental factors on the current needs and future needs of the living and non-living things while also make an effort to compare its advantages and the disadvantages against the alternative option (Dalal-Clayton & Bass, 2000; WCED, 1987)
Environmental or Green or Eco- or Sustainable	The term **environmental** is used in this study interchangeably with **green** or **eco-**, or **sustainable**. The author try to consistently use the same phrase for specific concept as much as he can, but in general, the term **environmental, green, eco-**, or **sustainable** indicate concern with any activities that makes progress towards the goal of sustainable development by reducing impacts on the environment, increasing resilience to environmental pressures or using natural resources more efficiently and responsibly (European Commission, 2017)

1.8 Organisation of the Thesis

This study is divided into several chapters. Chapter 1 contains a discussion of the background of the study, the problem statement, research objectives, research questions, limitations, the scope of the study and the significance of the study.

Chapter 2 focus on literature reviews while Chapter 3 detail out the framework and hypotheses. Chapter 4 explains the methodology which consists of research design, survey instrument and data collection and analysis method. Whereas, Chapter 5 showed the complete analyses and results. Finally, Chapter 6 discussed the results and Chapter 7 concludes the whole study.

1.9 Chapter Summary

This chapter laid the foundations for the study. It provided the introduction and the background to and detailed the justification and rationale for this study. The research problem, objectives, and questions were introduced that are examined during the research process. The study contributions and implications were offered. It outlined the limitations and the definition of terms.

Finally, the overview of the thesis structure was presented. The next chapter, Chapter 2, proceeds with a detailed description of the parent disciplines and some relationship research for this study.

CHAPTER TWO

LITERATURE REVIEW

This literature begins with explanations on this study dependent variable, ET-innovation implementation relationship with sustainable development, and its relationship with environmental innovation and also innovation. The discussions continue with a review on ET-innovation implementation which focuses on its definition, typology, and its relationship.

Subsequent sections then examine and explain the market demand as an independent variable, market orientation as a mediator and also inspect the concepts of environmental turbulence and managerial ties as moderating factors. Finally, the chapter concludes with the summary of the chapter.

2.1 ET-innovation Relationship with Sustainable Development

Initially, the United Nations (UN) was the organisation that promoted sustainable development. For example, in 1992, as a result of the Brundtland report, the Earth Summit (also known as the United Nations Conference on Environment and Development) was held in Rio de Janeiro (Oreský, 2009; Wee & A. Quazi, 2005). The Rio summit influenced all subsequent UN conferences, which have examined the relationship between human rights, population, social development, women and human settlements and the need for sustainable development. In 2012, at the United Nations Conference on Sustainable Development (also known as Rio+20 due to its commencement 20 years after 1992 in Rio), they again repledged to work together for a prosperous, secure and sustainable future of the earth and its citizens.

The head of states and governments agreed that actions should fill the implementation gaps and achieve greater integration among the three pillars of sustainable development –economic, social and the environment (refer Figure 2.1) (United Nations, 2012).

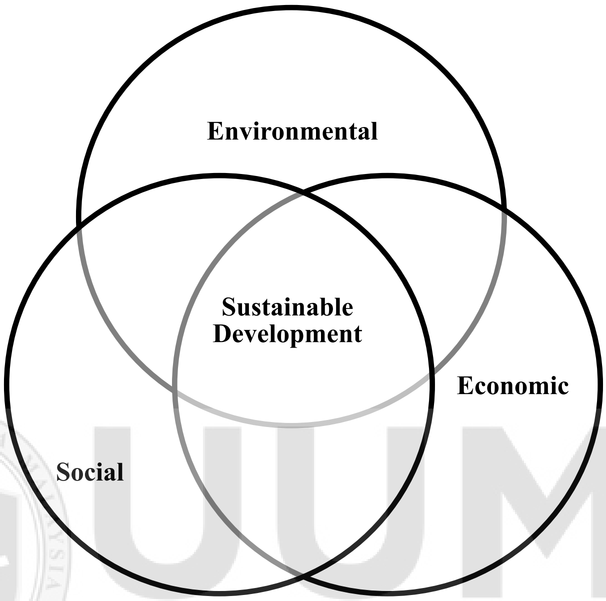

Figure 2.1
Pillar of Sustainable Development
Source: Giddings, Hopwood, and O'Brien (2002)

There are major underlying causes and effects that make sustainable development an important concept for the world. The causes are factors that elevate the concept of sustainable development such as population growth, urban development and increasing energy usage, while the underlying effects are the outcome of the causes that need for sustainable development intervention. Major underlying effects include environmental deterioration and urban related issues (Roosa, 2008; Yanarella, Levine, & Lancaster, 2009).

First major cause, the rapid rise of population numbers in the world drives increasing demand for resources and different consumption patterns (Mariadoss, Tansuhaj, & Mouri, 2011; Roosa, 2008). The world urban population were growing at the rate of 4.5% per year since 1990 (Roosa, 2008, p. 3). To put into perspective, the world's urban population in 1950 was about 730 million, after less than 60 years, in 2005 the population were 3.18 billion of a total 6.46 billion world's population (Roosa, 2008, pp. 3–4). Population in Malaysian since 1994 has been increasing at a rate of 2.4% per year or about 600,000 per year. In 2002, Malaysian population has reached more than 17 million, increased more than 1.5 million from the year 2000 (Manaf, Samah, & Zukki, 2009). Currently, Malaysian citizens stand at more than 30 million (Department of Statistics Malaysia, 2015).

The second cause, growth in urban population directly causing changes in urban development (Roosa, 2008, p. 8). With all the growth in population especially urban population, human-being need to find more resources to support the new inhabitants, thus it is expected by 2040 natural resources usage of the Earth's bio-capacity will increase up to 170% (Mariadoss et al., 2011). Need for urban development cannot be stopped since the global economy has grown over 15-fold since the end of World War II while manufacturing industry has increased by a factor of 40 (Hart, 1995).

Third major cause, the energy usage will increase through the years; the world reliant on fossil fuel is part of the reason sustainable development is important for earth survival. In 2006, the combined total of petroleum, natural gas and coal represented more than 83% of the world total primary energy production, while for Malaysia, the percentage is higher at 95% (Lim & Teong, 2010). Energy usage for transportation sector in Malaysia also showed noticeable data with 32.7% increment within an eight-year span from the year 2000. For the year 2000 alone, demand for energy for transportation was approximately 41% out of 29.70 MTOE (Million Tonne of Oil Equivalent) total energy demand (Lim & Lee, 2012). This demand trend is expected to continue until the year 2030 for Malaysia as a rapidly developing country (Lim & Teong, 2010).

On the other hand, the environmental deterioration is one of the effect that is happening to the world that pushes for sustainable development concept (Roosa, 2008, p. 22). Environmental impact due to development includes global climate changes such as deforestation (Demirbas & Dincer, 2008; T. N. H. T. Ismail, Don, Diman, & Wijeyesekera, 2013), loss of wetlands (Rennings & Wiggering, 1997), damage to ozone layers (Mont, Neuvonen, & Lähteenoja, 2014), increase of temperature hikes (A. Amran et al., 2013), and greenhouse effect (Beltran, Carrese, Cipriani, & Petrelli, 2009; Mont et al., 2014). Impact at regional level includes air and water pollution (Rennings & Wiggering, 1997), acid gas emission causing acid rain (Mont et al., 2014), destruction of local climates due to urban expansion (Hart, 1995; Tinch, 2001), and local health impact resulting from disseminations of toxic waste (K. S. Khor & Mohamed Udin, 2013).

For example, majority of European countries suffered in an increment of greenhouse gases (-or GHG in Earth's atmosphere include water vapor with three atoms, carbon dioxide, methane, nitrous oxide, and ozone) emissions from transport by more than 27% between 1990 and 2005 although environmental innovation such as that related to alternative fuels and engine systems have been initiated (Beltran et al., 2009). In Malaysia, Kuala Lumpur has recorded the highest percentage of temperature increase compared to other Malaysian cities with a hike of between 0.5 to 1.5 percent. This phenomenon, if prolonged, will effect the current flora and fauna ecosystem and also local climate pattern (A. Amran et al., 2013).

The second major effect is the urban issue such as related to municipal waste. Solid wastes are already a significant problem for Malaysian municipal organisation. In 2005 for example, it has been reported that each resident of Klang Valley produced at least 1.5kg solid waste every day. These solid waste includes waste from products purchased by the general public for household use, such as garbage, refuse, sludge and other discarded solid materials (Haron, Paim, & Yahaya, 2005). Electronic waste is another cause of concern as uncontained environmental toxic from electrical and electronic equipment could threaten the environment and the human health. According to Kammerer (2009), electronic waste already accounts for 8% of total waste and forecasted as the fastest growing waste category. Across developed and developing countries, e.g., Japan, Korea, Taiwan and China, and Malaysia, regulations related to extended producer responsibility were introduced to make producers accountable for collecting and recycling used products. Only a few multinational companies operating in Malaysia such as, Motorola, Nokia, Dell, HP and Apple, that accept equipment end-of-life return policy (K. S. Khor & Mohamed Udin, 2013). These major causes and effects are driving the need for sustainable development and become the focus for public policy by international organisations and states governments (Roosa, 2008).

ET-innovation has a direct relationship with all the cause and effect of sustainable development explained above through technology (Kemp & Arundel, 1998; Mata-Lima, Alvino-Borba, Pinheiro, Mata-Lima, & Almeida, 2013) as shown in Figure 2.2. According to Brundtland Commision (1987), new technology is capable of proposing a new method for saving resources and reduce consumptions (WCED, 1987, para. 14). New technology also is the key to economic growth and competitive advantage (Porter, 1990; WCED, 1987, para. 14); which make it very important in the fight against poverty which threatens environment through the unsustainable use of resources (WCED, 1987, para. 20).

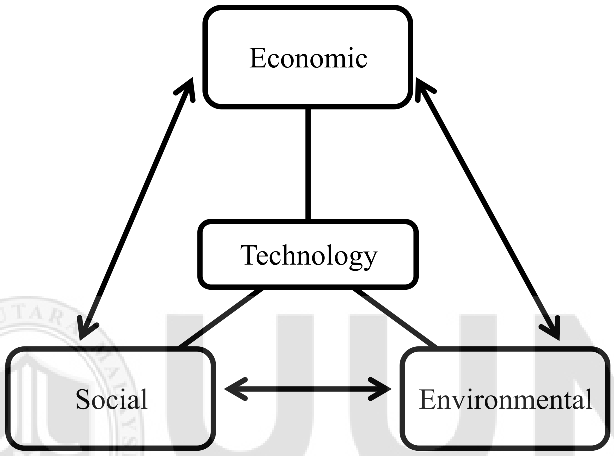

Figure 2.2
Dimensions of the sustainability triangle
Source: Mata-Lima et al. (2013)

Technology as the key relationship within the sustainable development is in line with several in-depth issues in sustainable development that has been in focus after the Brundtland Commision (1987). These issues include, firstly, the inclusiveness of development for current and future human well-being (Birkin et al., 2009; Gladwin et al., 1995). Secondly, embracing the interdependence of ecological, social and economic (Figure 2.1) (Elkington, 1994; Giddings et al., 2002; Gladwin et al., 1995). Thirdly, impartiality at all level; intergenerational, intra-generation and inter-species (Elkington, 1994; Gladwin et al., 1995). The fourth issue is the responsibilities of each area, technology, sciences and politics, to take precaution and prevention. For example, certain development must be aware of regenerative and absorptive capacities of material or energy, thus output growth must be below the threshold (Gladwin et al., 1995; Mirata & Emtairah, 2005). Finally, safety and security against chronic threats and harmful disturbance. These includes major earthquake, coronavirus infectious diseases and political stability (Gladwin et al., 1995; Kinnear & Ogden, 2014).

However, new technology can also produce new ways to pollute and change earth natural evolutionary progress (WCED, 1987, para. 14). Hence, it is important for the technological and scientific study to be responsible and take precaution against these possibilities (Gladwin et al., 1995). It is fundamental for the new technology or technological innovation to be balanced, integrated, and interdependence of social, economics and environment (as shown in Figure 2.1) (Elkington, 1994; Gladwin et al., 1995; Yang, 2013). To be used as the sustainable development tool, this kind of technology is infused with environmentally driven focus and known as ET-innovation (Ekins, 2010; K. Green et al., 1994).

2.2 ET-innovation Relationship with Environmental Innovation and Innovation

Environmental innovation can be categorised base on technological or non-technological ways (Arundel & Kemp, 2009; OECD, 2009; L. Rashid et al., 2014; N. Rashid et al., 2014). ET-innovation is a subcategory of environmental innovation as shown in Figure 2.3 (Abdullah, Zailani, Iranmanesh, & Jayaraman, 2016; Arundel & Kemp, 2009; OECD, 2009). Therefore, it is crucial to understand the concept of environmental innovation.

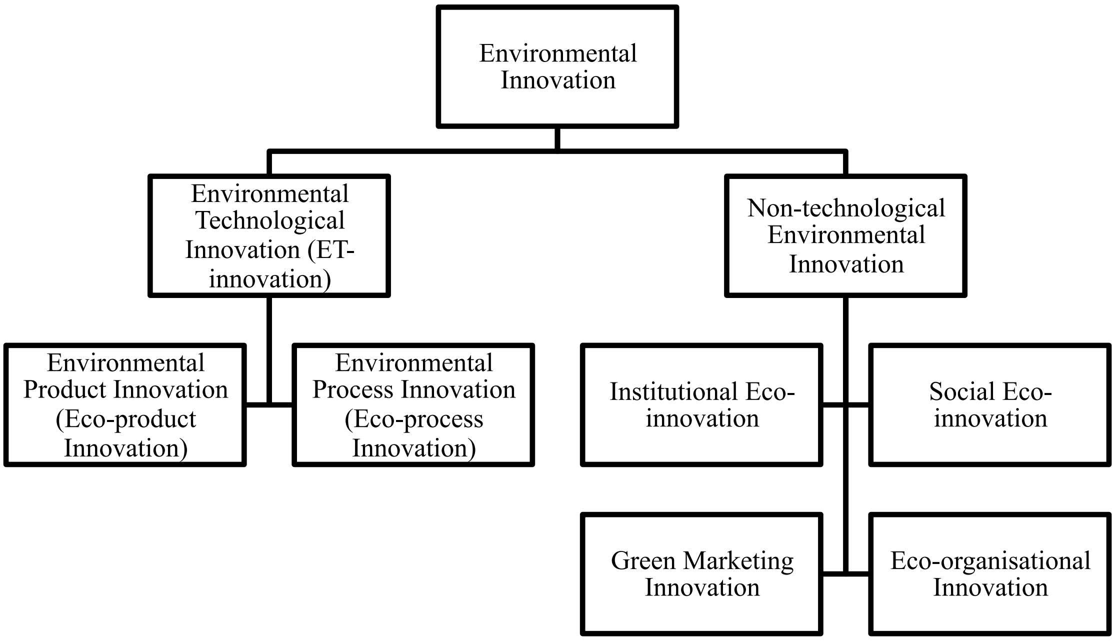

Figure 2.3
Typology of Environmental Innovation
Source: Hemmelskamp (1996); Reid and Miedzinski (2008); Rennings et al. (2006); and Triebswetter and Wackerbauer (2008)

Research on environmental innovation is relatively quite young with research span less than 25 years and an upsurge only after 2009 (Díaz-García et al., 2015). There are at least another seven terms that being used synonymously as environmental innovation. Among earlier notions as reviewed by Schiederig et al. (2012) and Díaz-García et al. (2015) includes eco-innovation (Fussler & James, 1996), ecological innovation (Blättel-Mink, 1998), sustainable innovation (Larson, 2000), environmental innovation (Ramus, 2001) and green innovation (Driessen & Hillebrand, 2002). More recent terms include sustainability-driven innovation (Keeble, Lyon, Vassallo, Hedstrom, & Sanchez, 2005), environmentally sustainable innovation (Hellström, 2007) and sustainability-oriented innovation (Hansen, Grosse-Dunker, & Reichwald, 2009).

Despite the differences in terms and definition, it can be concluded that they are often used interchangeably (Schiederig et al., 2012) because they emphasised on the environment and activities that reduce the negative impact on the environment (de Carvalho, 2014). Hence, environmental innovation can be summarised as the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organisation (developing or adopting it). Environmental innovation also integrate considerations for sustainability (environmental, social, financial) during idea generation, research, development and commercial phases and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (Charter & Clark, 2007; Kemp & Pearson, 2007).

One important question when explaining environmental innovation is whether the concept is different from innovation. One major difference between environmental innovation and innovation is that environmental innovation can be traced directly to sustainable development concept, and conventional innovation is not. However, many concept and model in innovation may be adapted in environmental innovation (Driessen et al., 2013) because both are generally correlated (Cuerva, Triguero-Cano, & Córcoles, 2014). Since ET-innovation and technological innovation are subcategories of environmental innovation and innovation respectively, the above conditions are applicable for ET-innovation and technological innovation too, hence, it is necessary to understand the prime similarities and differences.

There are a few major similarities between environmental innovation and innovation which also highlighted the major differences between both concepts. Firstly, the spillover effect of innovation and R&D effort can be found in both innovations. Jaffe (1986) and Cuerva et al. (2014) in their studies, substantiate the spillover phenomenon. In a further study, Belin, Horbach, and Oltra (2011) found that generally, environmental innovation requires more external sources of information and knowledge than conventional innovation. Compared to general innovation, environmental innovation also creates positive impacts on the environment (Kammerer, 2009; Triebswetter & Wackerbauer, 2008). Thus, for example, introducing environmental innovation policy can be seen as introducing environmental policy and innovation policy simultaneously. These will help cut cost at an institutional and firm level and increase eco-efficiency (Rennings, 1998, 2000).

Secondly, regulations play an important role in environmental innovations than for other kinds of innovation (Cleff & Rennings, 1999; Horbach, Rammer, & Rennings, 2012). Whereas, market demand and science and technology factors, precede innovation (Mowery & Rosenberg, 1979; Pavitt, 1984), and also environmental innovation (Cleff & Rennings, 1999; Rennings, 1998).

Finally, environmental innovation also focuses on social and institutional innovation where all innovation activities would consider the impact towards the society and whether it will give benefits to the human institution (socially and economically) and its relationship with the environment (Rennings, 1998).

For record, as shown in Figure 2.3, the other subcategory of environmental innovation is a non-technological environmental innovation which comprises marketing (Noor Aslinda et al., 2014; OECD, 2009; Reid & Miedzinski, 2008), social (Rennings, 1998, 2000), organisational (C. C. J. Cheng et al., 2014; OECD, 2009; Reid & Miedzinski, 2008; Tseng et al., 2013), and institutional (OECD, 2009; L. Rashid et al., 2014; Rennings, 1998, 2000).

The term environmental marketing innovation is often used to refer to “a development of environmentally friendly marketing procedure (e.g. voluntary eco-labelling, franchising, licensing and pricing) in a company” (Noor Aslinda et al., 2014; Reid & Miedzinski, 2008), while Rennings (1998, 2000) defined social environmental innovation as “changes of lifestyles and consumer behavior towards environment conscious product and system”.

Eco-organisational innovation refers to “a firm’s ability to upgrade the organization’s management processes to ensure internal efficiencies that can help to implement production processes green supply chain management, and re-design and improve products or services to obtain new environmental criteria or directives” (C. C. J. Cheng et al., 2014; Tseng et al., 2013).

Institutional environmental innovativeness includes the broader societal area beyond a single organisation’s control, such as institutional arrangements, social norms and cultural values. According to Rennings (1998, 2000), innovative institutions will make improved decision making through new ways of scientific assessment and public participation. L. Rashid et al. (2014) distinct the term in two ways: (1) formally: new or improved decision, roles, and ways on legal enforcement (laws, rules and regulation), international agreement or voluntary public participants to integrate in environmental concerns, and (2) informally; change in social behavior and cultural values towards perception on environmental awareness.

2.3 ET-innovation Implementation

This section discussed the dependent variable of the study which is ET-innovation implementation. The definition will then be derived, followed by its typology and the outcome.

As stated earlier, ET-innovation is an important subcategory of environmental innovation. Instead of environmental technological innovation (ET-innovation) (Carraro, 2000; K. Green et al., 1994), some researchers use different terminology such as technological environmental innovation (Brunnermeier & Cohen, 2003; Carrillo-Hermosilla et al., 2010; Huber, 2004), technological (technical) eco-innovation (Rennings, 1998; Rennings et al., 2006), green technological innovation (Norberg-Bohm, 1999; Tseng et al., 2013), or sustainable technological innovation (White, 2002).

Whereas, the definition of implementation is generally being accepted as putting something into effect. Implementation can be summarised as a process of a manager directing targeted employees' to appropriately and committedly install planned activities related to developing a new product until its first introduced in the market or a new process until its first used within the firm (Klein & Sorra, 1996; Nutt, 1986; Utterback, 1971).

ET-innovation implementation can be described as when ET-innovation is in its phase of action-taking mode (C. C. Cheng & Shiu, 2012), which is similar to ET-innovation because all literature on ET-innovation also focuses on an active concept (in implementation/ in practice). Thus, it is crucial to understand the concept of ET-innovation to understand the implementation. The above statement also applicable to both eco-product innovation implementation and eco-process innovation implementation which are parts of ET-innovation implementation and also within the scope of this study (refer Subsection 2.3.2 for details on ET-innovation and subcategories).

Conventional technological innovations and ET-innovations have an indirect relation. Although both concepts are sub categorised into product and process, there are a number of important differences between both concepts. Firstly, ET-innovations contribute to the reduction or avoidance of environmental burdens (Triebswetter & Wackerbauer, 2008). Secondly, ET-innovations can be costlier than conventional innovation in a short run, however, in mid to long-term, a firm can have cost savings through reduction of material causing environmental damages and also achieve green business goals (Triguero et al., 2013). Thirdly, according to Kammerer (2009), a major environmental impact was caused by the product used (e.g. CO_2 emissions from diesel machinery) and product disposal (e.g. chipboards in electronic devices) rather than during production. Hence, it is in ET-innovation purpose to tackle this issue in contrast with traditional innovation. Finally, for ET-innovation, besides knowledge of customers and competitors, understanding regulation and environmental laws are also crucial (de Medeiros et al., 2014).

2.3.1 ET-innovation Definition

K. Green et al. (1994) define ET-innovation as "inventing, innovating and diffusing new sets of products and processes which somehow or other are inherently more environmentally friendly than the sets we currently make and use". Norberg-Bohm (1999) explains ET-innovation through regulators eyesight which focuses on "policy to promote innovation that reduces environmental impacts through waste minimization, thus moving towards the goal of minimal waste society".

Brunnermeier and Cohen (2003) used environmental innovation term but actually focus on technologically related environmental innovation and defined it as "developing new methods of reducing or treating air or water emissions, recycling or reusing waste, finding cleaner energy sources and other methods of environmental protection".

For Huber (2004) technological environmental innovations are about using new and different technologies to "reduce the quantities of resources and sinks used, be they measured as specific environmental intensity per unit of output, or as average consumption per capita, or even in absolute volumes" by prioritising implementing new structures. Rennings et al. (2006) also emphasise the uniqueness of ET-innovation as they define it as "specific kinds of innovations consist of new or modified products and processes to avoid or reduce the environmental burden". Huber (2008) simply describes ET-innovation as a technical innovation that has some specific environmental advantage compared to previous like-technologies.

Three important aspects of ET-innovation definitions includes (1) must base on new technological knowledge, (2) must be at least new to the firm, and (3) must incorporate the reduction of environmental impact compared to existing technologies (Rennings et al., 2006). Referring to past definitions, ET-innovation implementation is define as inventing, innovating and diffusing of a product or production processes that is novel to the firm (developing or adopting it) which integrate consideration throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (Charter & Clark, 2007; K. Green et al., 1994; Kemp & Pearson, 2007).

2.3.2 ET-innovation Typology

Tseng et al. (2013) argued that ET-innovation is different from the eco-process innovation and eco-product innovation. However, when a closer looks into the article, the authors intentionally include ET-innovation while studying eco-product and eco-process innovation, despite ET-innovation also contribute to process and product innovation. Furthermore, the articles that they referred didn't mention any differentiation between ET-innovation and eco-process innovation or eco-product innovation (refer Klassen and Whybark (1999) and Shrivastava (1995)). Thus, it could be recognised, referring to other prevalent literatures, that ET-innovation can be classified into eco-process innovation and eco-product innovation (Chang, 2011; Green et al., 1994; Guoyou, Saixing, Chiming, Haitao, & Hailiang, 2013; Horbach et al., 2012; Rennings et al., 2006) (refer Figure 2.4).

Turning now to the eco-product innovation, more popular terms which are being used alternately are, environmental product innovation (Cleff & Rennings, 1999; Kammerer, 2009; Rehfeld et al., 2007; Triebswetter & Wackerbauer, 2008) and green product innovation (Abdullah et al., 2016; Conding, Mohd Zubir, et al., 2012; Dangelico & Pujari, 2010; R.-J. Lin et al., 2014). Whereas, relatively few studies in comparison with the above use the terms eco-product innovation (C. C. J. Cheng et al., 2014; L. Rashid et al., 2014), sustainable product innovation (Dewulf, 2013), sustainability-oriented product innovation (Grosse-Dunker & Hansen, 2012; Klewitz & Hansen, 2011; Klewitz, Zeyen, & Hansen, 2012), sustainability-driven product innovation (Hallstedt, Thompson, & Lindahl, 2013) or environmentally sustainable product innovation (de Medeiros et al., 2014).

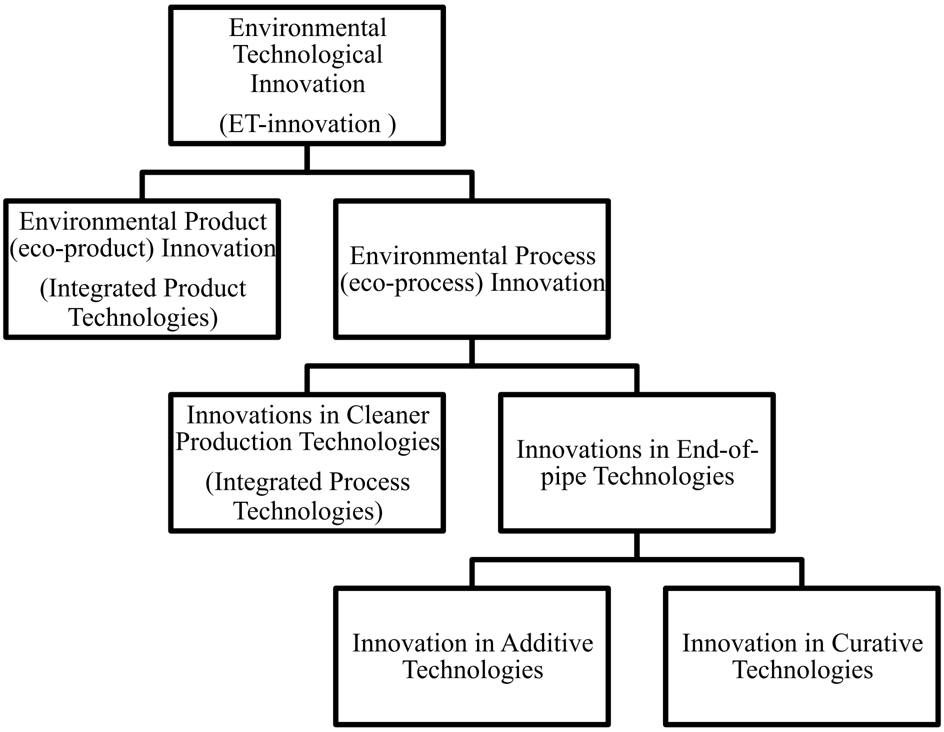

Figure 2.4
Types of ET-innovation
Source: Hemmelskamp (1996); Reid and Miedzinski (2008); Rennings et al. (2006); and Triebswetter and Wackerbauer (2008)

The term product is generally understood to mean something that is made, grown or produced by a process for the purpose of to be sold or used. Formally, a product is defined by International Organization for Standardisation/British Standards Institution (ISO/BSI) 9000:2005 as a "result of a set of interrelated or interacting activities which transforms inputs into outputs" (BSI, 2005). Whereas, in the field of consumer products, a few terms for an environmental product are commonly used. Among others are environmental product (Ottman et al., 2006), green product (Albino, Balice, & Dangelico, 2009; Driessen et al., 2013; S. K.-S. Wong, 2013), sustainable product (Seuring & Müller, 2008), environmentally sustainable product (de Medeiros et al., 2014) and eco-product (de Medeiros et al., 2014).

An environmental product (eco-product) is not a product that has zero environmental impact. It is a product that strives to protect or enhance the natural environment by conserving energy and/or resources and reducing or eliminating the use of toxic agents, pollution, and waste during its whole life-cycle (Driessen et al., 2013; Ottman et al., 2006). Due to its lifecycle impact on the environment, an eco-product has a direct relationship not only to eco-product innovation but also eco-process innovation. In fact, according to S.K.-S. Wong (2013) eco-process innovation can be the leverage where success in a new eco-product can be secured.

Taken the literature above, eco-product innovation can simply be explained as an innovation of transforming input to output with environment consideration. Eco-product innovation implementation involves the development of new or improved products that inflicts no or less negative impact on the environment than a conventional product through different stages of the product's physical life cycle (manufacturing process, product use, and disposal) (C. C. J. Cheng et al., 2014; C. C. Cheng & Shiu, 2012; Dangelico & Pujari, 2010; de Medeiros et al., 2014; S. K.-S. Wong, 2013). Listed in Table 2.1 are other definitions of eco-product innovation in the past literature.

Table 2.1
Eco-product Innovation Definitions

Terms	Definition
Environmental product innovation	Kammerer (2009) writes that an environmental product innovation is "an innovation that reduce the impact along a product's total life cycle for different environmental issues, such as reduction of encouraged and materials in products, improved power consumption and emission output in use phase, as well as extended use phase or recycling schemes for obsolete products regardless of whether this was the main objective of the innovation".
Eco-product innovation	C. C. J. Cheng et al. (2014) refers eco-product innovation as an "introduction of new or significantly improved products (regarding their characteristics), such as improvements in technical components and materials" where advanced eco technologies, shortening product life cycles, and increasing competition are involved.

Table 2.1 (Continued)

Terms	Definition
Green product innovation	For Dangelico and Pujari (2010), green product innovation is “a multi-faceted process wherein three key types of environmental focus (material, energy, and pollution) are highlighted based on their major impact on the environment at different stages of the product’s physical life cycle (manufacturing process, product use, and disposal)”.
	Conding, Mohd Zubir, et al. (2012) explained that product that is related to environmental innovation is considered as green product innovation. The innovation includes a product that are new or that offer a significant improvement on the basic characteristic, technical specification, incorporated software or any components or materials. The innovation “must involve energy-saving, pollution prevention, waste recycling, no toxicity, or green product design, using less or non-polluting/ toxic materials, improving and designing environmentally friendly packaging for existing and new products, recovery of company’s end-of-life products and recycling”.
	S. K.-S. Wong (2012) defines green product innovation as “an application of innovative ideas leading to the design, manufacturing and marketing of new products whose newness and greenness significantly outperform conventional or competing products”.
	The term "green product innovation" is used by R.-J. Lin et al. (2014) to refer to “the introduction of new or significantly improved products in response to environmental concerns such as non-toxic raw materials, green design, energy savings, pollution prevention, waste recycling and waste minimization”.
	According to R.-H. Chen (2014) green product innovation is defined as “product innovation closely associated with environmental concerns, including energy saving, pollution prevention, waste recycling, not producing toxicity, and green product designs”.
	For S. K.-S. Wong (2013) green product innovation “creates value by producing a new product or service that inflicts no or less negative impact on the environment than a conventional or competing product”.
Environmentally sustainable product innovation	de Medeiros et al. (2014) define from a business point of view. According to them, environmentally sustainable product innovation involves “the development of products or technologies that are both market-oriented and cause the minimal environmental impact possible”.
Eco-product implementation	C. C. Cheng and Shiu (2012) mention that eco-product implementation focus mainly on a product’s lifecycle in order to reduce environmental impact for improved existing products or new product during their use until disposal

The other dimension of ET-innovation is the eco-process innovation (C. C. J. Cheng et al., 2014; Klewitz & Hansen, 2014; Sezen & Çankaya, 2013), green process innovation (Y.-S. Chen et al., 2006; Conding, Mohd Zubir, et al., 2012; Tseng et al., 2013; S. K.-S. Wong, 2013) or environmental process innovation (Wagner, 2007).

This study has compiled a list of definitions for eco-process innovation in Table 2.2. However, for this study, the eco-process innovation implementation is define as the introduction of an improvement to existing production processes or the addition of new processes with the aim of producing environmentally friendly products capable of meeting eco-targets, such as energy savings, pollution prevention, waste recycling, no toxicity, low energy consumption, recycle, reuse and remanufacture material and use of cleaner technology to make savings and prevent pollution (C. C. J. Cheng et al., 2014; C. C. Cheng & Shiu, 2012; Conding, Habidin, Zubir, Hashim, & Seri Lanang Jaya, 2012; Conding, Mohd Zubir, et al., 2012; R.-J. Lin et al., 2014; Relich, 2015).

Table 2.2
Eco-process Innovation Definitions

Terms	Definition
Eco-process innovation	An eco-process innovation refers to "the improvement of existing production processes or the addition of new processes to reduce environmental impact" (C. C. J. Cheng et al., 2014).
	Klewitz and Hansen (2014) emphasise that eco-process innovations relate to "the production of goods and services with the aim of increasing eco-efficiency or eco-effectiveness". Eco-efficiency is delivering competitively priced goods and services that satisfy human needs and bring a quality of life, while progressively reducing ecological impacts (Fernández-viñé, Gómez-navarro, & Capuz-rizo, 2013), while eco-effectiveness can be defined as the systematic derivation and usage of goals to improve environmental performance (Frei, 1998).
Green process innovation	Green process innovation is a "process that assumed to happen when it has implemented new or significantly improved production processes, distribution new methods or support activities for its good and services and the process is related to energy- saving, pollution- prevention, waste recycling, or no toxicity, low energy consumption, recycle, reuse and remanufacture material and use of cleaner technology to make savings and prevent pollution" (Conding, Habidin, et al., 2012; Conding, Mohd Zubir, et al., 2012).
	S. K.-S. Wong (2013) defines green process innovation as "the use of environmentally friendly technologies and manufacturing processes to produce goods and provide services that impose no or less negative impact on the people and the environment".
	While R.-J. Lin et al. (2014) describe it as "modifications in manufacturing processes and systems with the aim of producing environmentally friendly products capable of meeting eco-targets, such as energy savings, pollution prevention, and waste recycling".
	For R.-H. Chen (2014) green process innovation refers to "the modification of current operating processes and systems, aiming at producing new or significantly improved green products with a reduced environmental impact".

Table 2.2 (Continued)

Terms	Definition
Eco-process implementation	C. C. Cheng and Shiu (2012) and Relich (2015) uses the term eco-process implementation to refer to "the introduction of manufacturing processes that lead to reduced environmental impact, such as closed loops for solvents, material recycling, or filters".

Eco-process innovations are commonly subdivided into innovation in integrated technologies (or cleaner production technologies) and innovations in end-of-pipe technologies (Rennings et al., 2006; Triebswetter & Wackerbauer, 2008). End-of-pipe technologies include the preventive measure which is the additive technologies such as pollution control and reclaiming (Hemmelskamp, 1996). The other part of end-of-pipe technologies is the curative technologies (eg repair contaminated water) (Reid & Miedzinski, 2008). The typology of eco-innovation can be summarised as Figure 2.4.

From the point of view of Reid and Miedzinski (2008), end-of-pipe/curative technologies are the least efficient solutions in reducing environmental impact. Rennings (1998) also wrote that integrated or cleaner technologies are preferred than additive or end-of-pipe-solutions in using technologies as tools to achieve sustainable development. Whereas, Huber (2004) characterised ET-innovation as being upstream rather than downstream. In this context, upstream in the manufacturing chain, the product chain and in the life cycle of a technology (Carrillo-Hermosilla et al., 2010).

In addition, an empirical research by Rennings and Thomas (2002) concludes that innovations in cleaner production, especially towards product and service innovations instead of end-of-pipe technologies would better benefit the environment and employment sectors. Rehfeld et al. (2007) found that firms that implement environmental product innovations also apply changes in the production process. C. C. Cheng and Shiu (2012) added that process and product involves many precise and critical activities that contribute to overall environmental innovation implementation. Although the curative/end-of-pipe technology was not the focus in many western origin types of research, Malaysia, as a developing country and rather new in ET-innovation, should not focus primarily on specific technology in this initial stage, but broadly accept all kind of ET-innovation technologies (Fernando, Wah, & Shaharudin, 2016). Thus, this study has included all innovations on integrated product and process technological innovation and also end-of-pipe technological innovations within the scope of ET-innovation implementation.

2.3.3 Other ET-Innovation Relationship

The terms below are included in this review as these terms have some relationship with ET-innovation and also have been used as keywords in the literature search.

2.3.3.1 Green Engineering, Green Design and Green Technology

The relationship of green engineering, green design and green technology can be summarised in respect to ET-innovation as the tool (green engineering), green design as the practice and green technology as the output. Green engineering is the study of product and process design with an intention to identify, develop, and exploit sciences and technologies that can bolster productivity without costing the environment (Anastas & Zimmerman, 2003; Navinchandra, 1990). While, green design is a segment of green engineering with an intention of yielding a product that totalled a very minimum environmental impact (Li Wei, Mat Saman, & Meng Chiao, 2008).

Green technology (KeTTHA, 2010), eco-technology (Sarkar, 2013), or environmental technology (European Parliament, 2005; Glavič & Lukman, 2007; Shrivastava, 1995) is the output of ET-innovation. Green technology is the development and application of product and process that efficiently use natural resources while reducing/recycling wastes, to control/minimise the risks of chemical substances, and to reduce pollution (Glavič & Lukman, 2007; KeTTHA, 2010; Shrivastava, 1995).

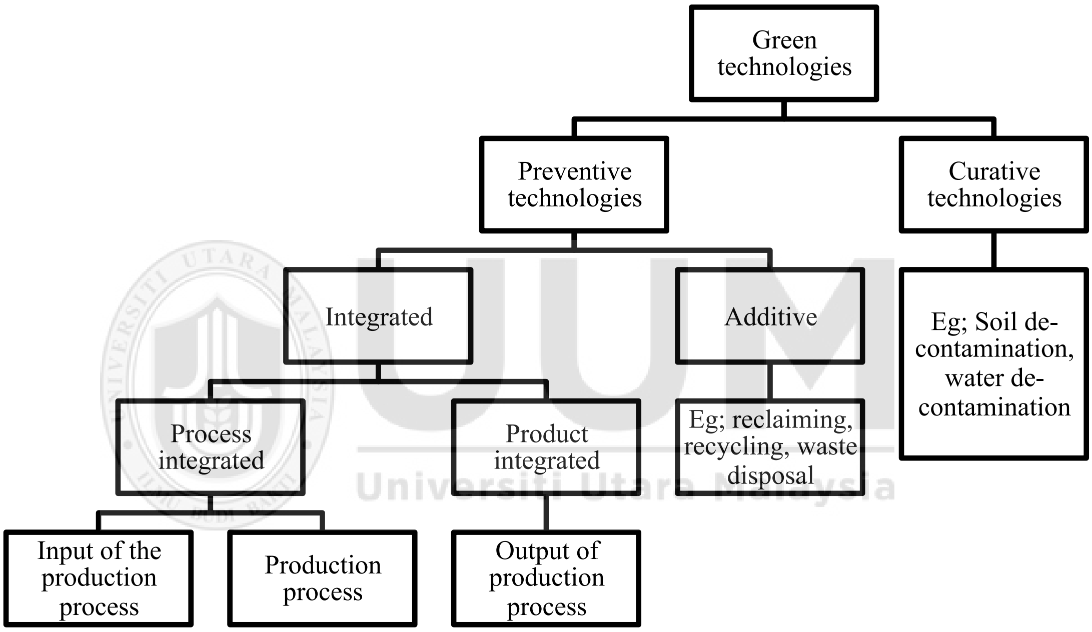

Figure 2.5
Green Technologies Classification
Adapted from Hemmelskamp (1996) and Rennings (1998, 2000), originally from Hohmeyer and Koschel (1995)

Several researchers have proposed a classification for green technology (Klassen & Whybark, 1999; Shrivastava, 1995). In this research, the classification suggested by Rennings (1998, 2000) is followed. This taxonomy generally classified green technology into two technical methods (refer Figure 2.5): repairing damages or also known as curative technologies (e.g. soil decontamination), and trying to avoid damages from happening in the first place or preventive technologies (Rennings, 1998, 2000). Preventive measures can be separated to integrated and additive protection. The latter also called end-of-pipe technology, which includes reclaiming, recycling and waste disposal (Hemmelskamp, 1996). Following Hohmeyer and Koschel (1995), Hemmelskamp (1996) subdivided integrated green technology into product and process integrated measures.

2.3.3.2 Environmental New Product Development and Green Product Design

Eco-product innovation has some relationship with environmental new product development (ENPD) and green product design. ENPD is the process of developing an improved sustainable product or service for the market with not just environmental issues are explicitly integrated to create a least environmentally harmful products during it life cycle (materials, manufacture, use, or disposal) but also ecologically sustainable while providing functions that meet basic human needs (Gmelin & Seuring, 2014; Pujari, Wright, & Peattie, 2003).

In 1998, Michael Frei introduced the term sustainable product design to describe a socio-technical system, with the results are perceived by internal and external stakeholders. Product design defines the physical product system which may cause environmental impacts or contribute to environmental problems. Thus, if a sustainable product is a result aimed by stakeholder, subsequently sustainable product design becomes a requirement for product design. K. S. Khor and Mohamed Udin (2013) added that green product design would not compromise product's function and quality, while also recovers product value throughout its lifecycle prior to disposal.

2.3.4 Outcomes of ET-innovation

In 1999, a theoretical paper by Norberg-Bohm stated that to achieve closed-loop zero waste society will require a lot of contribution from the industrial sector which will rely heavily on radical ET-innovation. Otherwise, an environmental innovation is just an innovation. The empirical evidence by Zailani et al. (2014) and R.-H. Chen (2014) confirmed that ET-innovation adoption positively related to the environmental outcome which includes performance in environmental management and environmental operation.

Furthermore, environmental innovation aim is to reduce the impact on the environment at all the physical life cycle stages while maintaining economical viability (Triguero et al., 2013). The major environmental impact mostly comes from the product usage and its disposal, less from production (Kammerer, 2009). Examples of impact during products use are materials of the product, material use per unit of output, energy use per unit of output, electromagnetic fields, CO_2 emission, water pollution, air pollution, soil pollution and noise pollution (Horbach et al., 2012; Kammerer, 2009; L. Rashid et al., 2014). Whereas, disposal of products will impact air, water, soil or noise emissions and energy use (Horbach et al., 2012; Kammerer, 2009; L. Rashid et al., 2014). Whereas, the magnitude of impact from an environmental innovation will determine the effect on the environment (OECD, 2009). For example, an environmental innovation that develops new product generally embody higher potential environmental benefits compared to an environmental innovation that adopts other firm's product (OECD, 2009).

On the other hand, the empirical research by Sezen and Çankaya (2013) in Turkey report that eco-process innovation had positive effects on corporate sustainability performance (economic, environmental, social). The duo added that for new industry eco-process innovation could be more effective when environmental applications are introduced. Zailani et al. (2015) also concurred the above result from the context of Malaysian industry. Findings by Y. Li (2014) and R.-J. Lin, Tan, and Geng (2013) show that by adopting environmental innovation practices, firm's environmental performance will enhance, and consequently indirectly enhance financial performance. If a firm invests more on environmental innovation practices, the financial performance will be better. Thus, firms must recognise that any effort on environmental improvement is an economic and competitive opportunity, not an additional cost to their operations.

Competitive advantage is one of the reason environmental innovation being implemented in firms (Triebswetter & Wackerbauer, 2008). In their analysis of eco-innovation implementation in automotive industry, Tseng et al. (2013) pointed out that due to the short lifecycle of products and constantly change green technology, firms has to improve environmental innovations to increase their competitive ability against rival firms (R.-J. Lin et al., 2014). Chang (2011) reports that eco-product innovation mediates the positive relationship between corporate environmental ethics and competitive advantage, but eco-process innovation does not. This is because an eco-product can be seen in the market but it is difficult for consumers to value how much effort that a firm devotes in the process improvement. However, Y.-S. Chen et al. (2006) found that firms could not only meet the demand and trend of the environmental protection through environmental innovation and eventually achieve a corporate competitive advantage, they must also create win–win situations between the firms, consumers and stakeholders (communities, ENGOs and government).

Firms develop eco-product for business advantage. In general, customers do not have a natural desire or need for unsustainable products (Lemke & Luzio, 2014; Ottman, 2011). Therefore, firms need to pay high attention in fulfilling customer satisfaction towards their eco-product and gain the advantage in the market (R.-H. Chen, 2014). According to Cuerva et al. (2014), firms also want their product to be different from existing products. Hence, firms will get the advantage over their competition and lead to a better position in the market (Kammerer, 2009; Pujari, 2006; Reinhardt, 1998). The differences include; improved environmental performance (Kammerer, 2009), reduce environmental impact with a same or better quality (Rehfeld et al., 2007; Tseng et al., 2013), has better or equivalent aesthetical quality to conventional product, inclusive with high technology, and high reliability (Tseng et al., 2013).

However, for an eco-product to be successful, firms must choose the best trade-off between a market demand, product's environmental compatibility and its contribution to profitability when designing (Wagner & Llerena, 2011). Azzone & Noci (1998) propose eco-product design guideline as follow: (1) Product structure must minimise the variety of materials, reduce the number of items in the bill of materials, and make valuable and hazardous materials easily accessible, (2) avoid individual components that are incompatible with standard recycling processes, (3) disassembly operations means that product designers are required to use joining elements that can be easily disassembled, reduce the number of fasteners, and reduce the need for destructive disassembly techniques, and (4) finally, logistics issues in particular, need the design team to consider the possibility of marking the material with a number indicating its nature and whether it can be recycled which might provide all the necessary information to make the recycling process easier, and product design should consider transportation after usage.

Being competitive in the marketplace will open doors for new business opportunity for firms that implementing the environmental innovation strategy (Triebswetter & Wackerbauer, 2008). In her study, de Carvalho (2014) recorded 23 percent of firms that implement environmental innovation strategy has new business creation as the main determinant. The numbers should be higher just because environmental innovation is different from general innovation, thus means new potential business area. However, the numbers are still comparatively low, as firms cannot grasp the idea of environmental innovation potential. In their major article, Porter & van der Linde (1995b) explained that the situation happens because of firms inability to creatively deal with environmental issues.

Cost saving was found as one determinant that motivates firms to implement environmental innovation (de Carvalho, 2014; Frondel, Horbach, & Rennings, 2008; Horbach, 2008; Ishak & Ahmad, 2011; Triebswetter & Wackerbauer, 2008). These can be achieved with a more efficient process (Ishak & Ahmad, 2011). However, saving must come later as environmental innovation's economic success will emphasise by internal R&D and high investment intensity (Horbach et al., 2012; Triguero et al., 2013). In her study, Y. Li (2014) cannot find a significant positive effect of environmental innovation on financial performance. C. C. J. Cheng et al. (2014) also found eco-process innovation has more influence on business performance than eco-product innovation. The insignificant relationships may cause by the delay effect due to high initial capital and long payback period. However, the positive relationship between environmental innovation on financial performance can be stronger by the effect of allocated valuable resources (Y. Li, 2014).

Brand reputation and image improvement also drive environmental innovation implementation (de Carvalho, 2014; Ishak & Ahmad, 2011). According to Driessen et al. (2013), if a product is greener, the reputation of green leadership will be more significant and the reputation as technology leaders will go up too. The reason for this is because the greener a product is will require advanced levels of technological development, thus the reputation of the company in green and technology. The article by R.-J. Lin et al. (2014) however reported that eco-product innovation has a significantly small impact on reputation. The sharp increases in product prices, which prevent the inclusion of the features and preferences desired by consumers may have triggered the result.

2.4 Market Demand

Main determinants of ET-innovation can be summarized to firm-specific factor (Horbach et al., 2012; Triguero et al., 2013), market demand (Cleff & Rennings, 1999; K. Green et al., 2000; Kammerer, 2009; R.-J. Lin et al., 2014; Rehfeld et al., 2007), technology push (Bi, Ma, & Li, 2011; K. Green et al., 2000; Norberg-Bohm, 1999; Triebswetter & Wackerbauer, 2008), and regulation and incentives (K. Green et al., 2000; Kammerer, 2009; Y. Li, 2014; Norberg-Bohm, 1999; Triguero et al., 2013; Zailani et al., 2014).

However, the focus of this study will be on market demand. Market demand study is not new, it is one of the main determinants of conventional innovation and also for environmental innovation and ET-innovation. Market demand study in innovation has been discussed since the late 1960s (Mowery & Rosenberg, 1979) while the study of demand on environmental innovation started in 1990s (Rennings, 1998), tailing the 1987 Brundtland Commission report on sustainable development.

This study also will take a closer look into market demand effect on ET-innovation from the demand-based view (Adner & Levinthal, 2001). Demand-based view means works that look downstream from the focal firm, toward product markets and consumers (Priem et al., 2011) rather than upstream views that look into activities and internal capabilities of firms as the primary drivers of innovation (Barney, 1991; Dosi, 1982). Adner and Levinthal (2001) demand-based view simulation model found that in the early technological development, firms technological innovation is guided by the customer need and requirement; and when the market price and performance are met, technological innovation is driven by competition to attract the technologically satisfied customer.

Understanding the above, market demand for this study is classified as customer demand and competitive pressure. Customer demand analysis focuses on identifying, understanding and responding to customer needs and creating products capable of meeting their expectations (R.-J. Lin et al., 2014; Powpaka, 2006). Competitor pressure, on the other hand, force firms to understand the strengths, weaknesses, capabilities and strategies of the key competitors and identify their technologies capable of satisfying the target consumers' demand (Y. Li, 2014; Narver & Slater, 1990).

2.4.1 Why Market Demand: Demand-based View Study?

The study on demand-side factors as an emerging new research direction (Priem et al., 2011) and its effect on ET-innovation are important because of a few reasons. First, the body of knowledge of the demand-based view is relatively underexplored (Adner & Levinthal, 2001), has received noticeably less attention (Stanko et al., 2013), the researches are dispersed and relatively less-known (Priem et al., 2011). Many scholars may have overlooked the extent and importance of this research perspective since it is spanning wide across innovation, entrepreneurship, and strategy studies (Priem et al., 2011).

Second, regulators also have been designing many innovation and technology policies based on supply-side perspective while neglecting demand-side view for so long (Frenkel et al., 2015). The government of Malaysia, for example, has started to recognise this concept by assisting innovative firms through Platcom Ventures Sdn Bhd (a subsidiary of AIM) where they focus on innovation gaps and market-driven approach during their facilitation process from concept to commercialization (AIM, 2015b). Another example was MaGIC, which was allocated with RM 70 million funds for its program which include one stop centre for entrepreneurs and innovators, financial support linkages and pre-development fund assistance for new and potential firms (H. Amran, 2013; Mat Zuki, 2014).

Third, Malaman (1996) wrote that market demand for cleaner technology innovations is generally difficult to predict. Tseng et al. (2013) have shown in their study that market demand can vary due to disturbances that may occur in actual operations. Demand fluctuations may have caused by green consumers due to their difficulty to please attitude (Lemke & Luzio, 2014). This issue is important since according to R.-J. Lin et al. (2014), the demand fluctuations due to changes in market variables can affect firm's performance.

Fourth, the demand-based view includes competitive pressure which was not a common theme in an environmental innovation study. Yalabik and Fairchild (2011) theoretical formulation final result confirmed the competitive pressure to attract environmentally concern customers increase the effectiveness of innovation within firms, and added that an empirical result is needed to support the generalizability of the result.

Fifth, the study of competitor pressure in demand-based view is crucial as more competitors enter the market, competition will be intense and some competitors will resort to an imitation of successful companies. Therefore, firms need to innovate to survive (C. Xu, Wang, & Wang, 2008), and maintain the competitive advantage by being different (F. Ye, Zhao, Prahinski, & Li, 2013). While, at the same time give more attention to competitors' environmental strategies to remain relevant (Y. Li, 2014; F. Ye et al., 2013).

Sixth, although according to Rehfeld et al. (2007), market factors are generally accepted as important during diffusion phase while technological factors stimulate the initial stage of innovation. Articles review by de Medeiros et al. (2014) however, concluded that action on technological investment only occur when firm understand market factors, hence market factors are significant throughout the lifecycle.

Seventh, while the study of science and technology (supply-side) provide trajectories of innovation, demand factors is crucial to direct the trajectory towards having the competitive advantage in the market (Di Stefano, Gambardella, & Verona, 2012). This is because, the demand-pull innovation research does not assume that customers' needs are constant as in technology-based innovation research, instead demand-based innovation research emphasise market change and market heterogeneity (Priem et al., 2011).

Finally, new technological development won't be able to provide the necessary change as earlier as expected (K. Green et al., 2000; Porter & van der Linde, 1995a, 1995b). As K. Green et al. (2000) reviewed, researches have shown that eco-product and eco-process innovation need other drivers such as market demand and government regulations.

2.5 Market Orientation

In this study, market orientation is proposed to be the mediator in increasing the market demand effect towards the implementation of ET-innovation. Hence, the review of market orientation is listed starting with the introduction, the definitions, the dimensions of market orientation, the existing relationship, and why the concept is introduced.

Market orientation has been a marketing concept for a long time. It becomes popular in the 1990s with seminal papers by Narver and Slater (1990) and Kohli and Jaworski (1990). Deshpandé and Farley (1998) claim that market orientation is a pillar of modern marketing study due to its significant managerial relevance. Its influence is not limited to specific organisational activities but widespread to any kind of activities in an organisation (Atuahene-Gima, 1996). Market orientation also is an important aspect in many innovation management literatures as an important driver for a successful innovation implementation (Calantone, Harmancioglu, & Droge, 2010; Ingenbleek, Frambach, & Verhallen, 2010; Liao, Chang, Wu, & Katrichis, 2011).

Previous studies have approached the term market orientation from two perspectives, either as philosophy or behaviour. Market orientation as philosophy can be described as when a firm develop organisational characteristic such as goals, strategies and activities influenced by personal factors while having powerful reasoning culture (Cadogan & Diamantopoulos, 1995).

Whereas, from a behavioristic viewpoint, behaviour and activities represent the orientation elements itself (Cadogan & Diamantopoulos, 1995). According to Hsu, Tsai, Hsieh, and Wang (2014), most studies have discussed market orientation through behavioristic perspective using two approaches. The first approach emphasises on culture integration within firms (Narver & Slater, 1990); while the second adopt an operational approach (Kohli & Jaworski, 1990).

Narver and Slater (1990) defines market orientation as the "organisation culture (i.e., culture and climate) that most effectively and efficiently creates the necessary behaviours for the creation of superior value for buyers and, thus, continuous superior performance for the business" (p. 21). Present researches also offered their version of the definition. For example, R. Lin et al. (2012) defined market orientation as an "organisational culture and strategic support that primarily focuses on customer needs, competitors' strategies and inter-functional information to create distinguished organisational performance" (p. 44). Driessen et al. (2013) simply wrote market orientation as processing information about customers and competitors.

In this study, the definition by Kohli and Jaworski (1990) is being used. The duo describes market orientation as the "organizationwide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organizationwide responsiveness to it" (p. 6).

Most prevalent studies on dimensions of market orientation were introduced by Narver and Slater (1990) and Kohli and Jaworski (1990). Narver and Slater (1990) proposed three behavioural components for market orientation; customer orientation, competitor orientation and interfunctional coordination. They inferred customer orientation as “the sufficient understanding of one’s target buyers to be able to create superior value for them continuously”, while competitor orientation means “that a seller understands the short-term strengths and weaknesses and long-term capabilities and strategies of both the key current and the key potential competitors”. Interfunctional coordination is defined as “the coordinated utilisation of company resources in creating superior value for target customers”.

Whereas, Kohli and Jaworski (1990) suggest three organisation-wide activities for market orientation: (1) market intelligence generation, (2) the dissemination of the acquired intelligence data across departments and (3) responsiveness to the intelligence. Market intelligence can be summarised as an act of understanding customer's current and future needs and preferences; it also includes an analysis of how they may be affected by exogenous factors. Responding to the market need requires the participation of virtually all departments in a firm, thus effective dissemination of market intelligence, either formally or informally, is important to provide a platform for concentrated actions by different departments. Responsiveness is the action taken in response to intelligence that is generated and disseminated. Without responding to market needs, market orientation objectives would not be achieved.

The cultural and operative approach by Narver and Slater (1990) and Kohli and Jaworski (1990) are not mutually exclusive (Hsu et al., 2014), there is similarities and relationship between the two approaches (Cadogan & Diamantopoulos, 1995). Both approaches of market orientation focus on current needs and future needs. Therefore, to cater researchers debate on narrow perspective of market orientation performance, some researchers has divided market orientation to two complementary part; responsive and proactive (Narver, Slater, & MacLachlan, 2004). Companies that implement responsive market orientation (RMO) focus on understanding current customer needs and put an effort in response to the requirement. Whereas, in the case of proactive market orientation (PMO), the firm try to understand customers' underlying needs, which probably they don't even notice yet (Narver et al., 2004; Zhang & Duan, 2010).

In this study, definition and dimensions of market orientation by Kohli and Jaworski (1990) is believed to be more suitable since it does not just focus on customer and competitor in gathering intelligence but other stakeholders. Factors that affecting ET-innovation also includes regulation and incentives and other stakeholders too. Kohli and Jaworski (1990) also stress the latent need in their definition which also being expressed in MARKOR, their empirically tested market orientation scale (Kohli, Jaworski, & Kumar, 1993).

2.5.1 Market Orientation as Mediating Factor

There is very limited study so far that use market orientation as the mediator in the relationship with ET-innovation implementation. However, there are several researches that are relevant to this study (Cai & Zhou, 2014; Y. Chen, Tang, Jin, Li, & Paillé, 2015; Driessen et al., 2013; Lemke & Luzio, 2014; M.-T. Tsai, Chuang, Chao, & Chang, 2012; Zhou et al., 2009). Listed below are possible reasons for the use of market orientation concept as the mediating factor in the relationship of market demand and ET-innovation implementation.

Firstly, K. Green et al. (2000) highlighted the issue of actions that should have been taken when signal/information demanding for eco-products is receive at a firm. According to them, the exact mechanism of these actions is still underexplored. It looks like in one hand there are consumers who need clarity in their green approach, while on the other hand, firms are experimenting with environmental innovations (Narula & Desore, 2016). K. Green et al. (2000) suggested three market-orientated-like approaches in handling this gap. The firm needs to have a sales team that attune to customer demand and make sense to consider a product or process innovation, have a good inter-department relationship where the related department can discuss and relay information, and finally, have the ability to respond to a request from the market. Even though K. Green et al. (2000) analysis is not recent, current literatures also suggests that many organisations still have not adopted the market-oriented approach in dealing with customer needs and requirement (Lemke & Luzio, 2014; Sandhu, Ozanne, Smallman, & Cullen, 2010).

Secondly, as market demand drive ET-innovation (de Medeiros et al., 2014; K. Green et al., 2000; Rehfeld et al., 2007), the lack of market demand becomes a barrier to ET-innovation implementation (Abdullah et al., 2016). However, according to Lemke and Luzio (2014) and Ottman (2011), it is unnatural for the consumer to choose an unnatural (non-environmental) product. Therefore, it is important to understand current and latent needs and push for a rise in market demand. For example, the private household has an impact on environmental economy estimated between 30-40% (Grunert, 1993). Thus, market orientation implementation on consumer market must consider nurturing and facilitating green consumer market through supplying information truthfully, providing choices and good prices, increasing confidence and developing innovative products (Peattie, 2001). Rehfeld et al. (2007) added that by issuing the right price, demand for eco-products would rise.

Thirdly, the demand-based view emphasised on demand heterogeneity where customers have different functional requirement (Adner & Levinthal, 2001). Firm-specific factors and different industry will have a different functional need, budget and capability too (Muzamil Naqshbandi & Kaur, 2014). Heterogeneous concept and nature of firm highlight the need to generate intelligence on customer current demand, disseminate the data within the firms and response with ET-innovation.

The fourth reason, at a certain level where a customer is satisfied with function and price, competition will kick in, firm need to innovate to reduce the price or increase performance through eco-product innovation and eco-process innovation (Adner & Levinthal, 2001). For example, Huo and Shan (2013) study on PV market in twenty countries resulted in an insignificant market pull effect towards eco-product when the market grew steeply. According to the demand-based view, the above happen because the functionality threshold has been reached. Hence, it is important for a firm to gather competitors' intelligence to maintain stable market share and also stabilise between investing in eco-product innovation and pursuing eco-process innovation.

Next reason, base on Dangelico and Pujari (2010), consumers are still low on awareness on benefits of the environmental product. They are also highly concerned with competitive price, product quality, esthetic and credibility of environmental claims. Firms thus need to have a relationship with customers to implement innovation until products' end-of-life (Azzone & Noci, 1998). Bhattacharya, Krishnan, and Mahajan (1998) also found that in a highly volatile market, an early product definition and specification is not always possible. Firms need to continuously engage with customers during new product development process and tune the product definition according to market preferences. Relationship with customers will increase market share, making the market more competitive. Hence, market orientation is important for firms that develop and market eco-products since they need to integrate an eco-product with conventional product characters to achieve customer demands and requirements.

Sixth, although market orientation effect may become uneconomic in some environment such as low competition industry, a steady market, technologically turbulent industry and a booming economy (Kohli & Jaworski, 1990). According to Malaman (1996), market demand for cleaner technology innovations is generally difficult to predict. Tseng et al. (2013) have shown in his study that market demand can vary due to disturbances that may occur in actual operations. Demand fluctuations may cause by customers due to their difficulty to please attitude (Lemke & Luzio, 2014). Among reasons for the difficulty to predict demand fluctuations are a lack of knowledge which causes information problems at demand level and the need for more changes at the management level (Malaman, 1996; Markusson, 2001). Market orientation in environmentally sustainable product innovation has a wider scope than traditional product innovation. Besides knowledge of customers and competitors, market orientation in eco-product innovation stressed the need of knowing regulation and environmental laws and policies concerning financial and information incentives oriented to environmental innovation practices (de Medeiros et al., 2014). Also critical are, collaboration with internal departments and external stakeholders during eco-product innovation which will lead to the introduction of new eco-products to the marketplace (de Medeiros et al., 2014). Thus, in this case, the market orientation was a possible solution.

The seventh reason, Kuo (2003) emphasised the importance of understanding the market before developing new eco-products. He also draws our attention to the criticality of understanding the possibility of manufacturing these eco-products from cost, material, and marketability perspectives. This consensus issue between customers and manufacturers push for responsive action when intelligence data gathered and disseminated (market-oriented approach). An example of a case study on an international consultancy firm in the service industry, DCE consulting identifies a model for new concept development in the firm. Since the firm demand for a new concept for their business, Heusinkveld, Benders, and van den Berg (2009) argue that new concept development is not just an internal process, but requires a continuous contact with the market. Hence, it is important to translate market preference using market-oriented approach.

The subsequent reason, Kanchanapibul et al. (2014) stressed the need for business to focus on delivering satisfaction. They are confident if consumers' environmental belief is consistent, market demand will increase. Although to achieve business success, firms still need to understand customers, competitors, and regulation and response to this intelligence. The customer demand for solutions to environment problems and they also understand the impact of business toward the environment. Therefore, it is critical for firms to understand this needs and apply market orientation, not only for business success, but also for survival (Y. Chen et al., 2015; Crittenden, Crittenden, Ferrell, Ferrell, & Pinney, 2011).

The ninth reason, a case study by Brook and Pagnanelli (2014) propose a list of criteria which includes customer orientation to reprioritize sustainability-driven innovation selection, thus ensure competitiveness. Customer orientation was important since firms with cross-functional management capability able to act quicker than firm without, thus implies the firm's ability to coordinate internal department and external stakeholders (environmentalist, media, community leaders and government department) in making environmental product design and innovation decision (Hart, 1995).

Finally, several studies on market demand relationship with environmental innovation/ET-innovation use other factors as mediator. Thus, it is possible to use market orientation as mediator. For instance, (a) The study by S. K.-S. Wong (2013) underscored the mediating role played by knowledge sharing in the environmental requirements and new eco-product success, and also for the relationship between environmental requirements and eco-product and eco-process innovations and (b) Cai and Zhou (2014) observed a mediation effect of integrative capability between internal drivers (technological capabilities, organisational capabilities, and CSR) and external drivers (environmental regulations, competitors and customers' green demands) against eco-innovation performance.

2.6 Environmental Turbulence

Environmental turbulence was reviewed as one of the most relevant considered factors before a firm continues with decision-making process (H. Li &

Atuahene-Gima, 2002; Zailani et al., 2014). Thus, this study proposes the concept as moderating factor in the relationship between market orientation and ET-innovation.

Although inclusion of environmental moderators in the market orientation and product innovation relationship is not completely new and also environmental uncertainty variable were discussed in the literature of technical innovation (García-Zamora, González-Benito, & Muñoz-Gallego, 2013; Nadkarni & Chen, 2014), it is still scarce (Hernández-Espallardo & Delgado-Ballester, 2009). Whereas, the environmental effect on environmental innovation relationship barely developed from a theoretical point of view with limited empirical applications (C.-Y. Lin & Ho, 2011; Zailani et al., 2014).

In an uncertain market situation, D.-Y. Li and Liu (2014) mentioned that environmental turbulence would reduce firms' advantage against their competitors and the value of their existing capabilities. Thus, firms need to be more innovative to meet customer requirement and maintain market share from being encroach by competitors (García-Zamora et al., 2013; Story, Boso, & Cadogan, 2015). Although learning curve, cost and resources will increase, the trade off is better because, during uncertainty, firms can generate high product trials, support customer variety-seeking and lead to repeat purchases (Story et al., 2015). Even the government of Malaysia is concerned with the market stability and has encouraged the industry to embrace innovation as their surviving strategy for their firms' sustainability (AIM, 2015c).

Story et al. (2015) compared the effect of environmental uncertainty in the developed nation (United Kingdom) and the emerging market (Ghana). According to them, emerging markets (unlike developed markets) often suffer from greater political instability, corruption, and unstable macroeconomic environments causing the ability to create the structural changes required (relative to developed market counterparts) in dynamic environments ineffective. They added, emerging markets often lack the skills and capabilities, thus, firms need to redesign administrative functions and marketing operations, and also implement new technologies. Consequently, might further overstress emerging market firms' capabilities in dynamic markets. In the end, will reduce the overall effectiveness of their innovation activities relative to developed market firms.

In spite of the above, the government of Malaysia emphasized the importance of innovation by having *Agensi Inovasi Malaysia*, Malaysian Global Innovation & Creativity Centre (MaGIC) and *Agensi Inovasi Malaysia* Act to enhance the productivity of the nation in dynamic and uncertain time (AIM, 2014; Laws of Malaysia, 2010; Mat Zuki, 2014). The government also published the National Green Technology Policy to spearhead Malaysia towards reducing the environmental impact (KeTTHA, 2010). Hence, it is important to understand the actual effect of environmental turbulence in the relationship of market orientation and ET-innovation in the Malaysian industry.

Some researchers use environmental uncertainty or environmental dynamism to explain environmental turbulence. Some available definitions are as in Table 2.3. Instead, for this study, we define environment turbulence as the rates of change in the market, technology and/or competitive behaviour within an industry (C.-Y. Lin & Ho, 2011; K. H. Tsai & Yang, 2013; Weng & Lin, 2011).

Table 2.3
Environmental Turbulence Dimensions and Definitions

Terms	**Definitions**
Environmental turbulence	K. H. Tsai & Yang (2013) definition of environmental turbulence also refers to the rates of change in the market and/or technology within an industry.
Environmental uncertainty	Naranjo-Gil (2009) define environmental uncertainty as an organisation's perceived inability to predict accurately the actions of customers and situations that comprise the external environment, due to a lack of information or an inability to discriminate between relevant and irrelevant information.
	G.-C. Wu (2013) summarises environmental uncertainty as effects of imprecise predictions about environmental change on firms' normal operational efficiency, which according to Maletič, Maletič, Dahlgaard, Dahlgaard-Park, & Gomišček (2014) due to the decision makers lack information about environmental factors, thus having difficulty in forecasting changes in the environment.
	Environmental uncertainty refers to frequent and unpredictable changes in customer preferences, technological development and competitive behaviour perceived by the managers (C.-Y. Lin & Ho, 2011; Weng & Lin, 2011)
Environmental dynamism	For Maletič et al. (2014), environmental dynamism refers to the rate of change and the level of instability factors within the environment.
	D.-Y. Li and Liu (2014) interpreted dynamism as unpredictability and detail out the environment as technological innovation in the industry and actions by customers.
	Environmental dynamism, which is defined as the rate and unpredictability of change in environmental variables (Nadkarni & Chen, 2014)
Market turbulence	Jaworski and Kohli (1993) define the term market turbulence as the rate of change in the composition of customers and their preference.
	For K. H. Tsai & Yang (2013), market turbulence reflects the degree of change in customer preferences for products in an industry.
Demand uncertainty	Zheng Zhou (2006) rephrases market turbulence as demand uncertainty and added that firms are required to adapt to changing customers needs and expectations by offering preferred products and realign their strategy.
	Sheng, Zhou, and Lessassy (2013) focus on the instability and the extent of difficulty in predicting changes in consumer preferences and expectations in defining demand uncertainty.
	G.-C. Wu (2013) summarises demand uncertainty as; (1) difficulties in assessing customer needs, (2) accurately anticipating demand and finally, predicting the evolution of customer preferences.
Technological turbulence	Technological turbulence can be defined as the rate of technological change within an industry (Jaworski & Kohli, 1993; Zhou, 2006).
	Sheng, Zhou, and Li (2011) explain the rate of change as a speed of transition and unpredictability of technology in a specific industry.
Technological dynamism	D.-Y. Li and Liu (2014) interpret technological dynamism as the unpredictability rate of change and innovation in an industry.
	While G.-C. Wu (2013) summarises technological uncertainty as (1) the unpredictability of technological development including rapid changes in technology, (2) the technological complexity and difficulty, and the constant creation of new technologies.
Competitive intensity	Competitive intensity reflects the competition between firms in an industry (K. H. Tsai & Yang, 2013).

In 1990, Kohli and Jaworski introduce three environmental characteristics that influence the relationship between market orientation and business performance. They are market turbulence, technological turbulence and competitive intensity. Baker and Sinkula (2005) use market turbulence instead of environmental turbulence to explain the changes in technology and industry and the intensity of competition. In the study, all three concepts will be used to explain environmental turbulence as a moderator to the relationship of market orientation and ET-innovation implementation.

Jaworski and Kohli (1993) was apparently the first to define the term market turbulence, and they explain it as the rate of change in the composition of customers and their preference. Whereas, technological turbulence can be defined as the rate of technological change within an industry (Jaworski & Kohli, 1993; Zhou, 2006). Competitive intensity, on the other hand, reflects the competition between firms in an industry (K. H. Tsai & Yang, 2013). According to Auh and Menguc (2005), it is a situation where the market is crowded with similar firms making an intense competition and limited opportunities for further growth.

The study on the relationship of environmental turbulence and its dimension on ET-innovation are scarce with limited empirical applications as far as the scope of this study reviewed (Hernández-Espallardo & Delgado-Ballester, 2009; C.-Y. Lin & Ho, 2011; Zailani et al., 2014), therefore the theoretical and empirical study on the relationship between environmental turbulence and innovation are listed in Chapter 3.

2.7 Managerial Ties

According to Wang and Chung (2013), the moderating role of managerial ties in the linkage of market orientation and innovation is exceptionally important from the Asian perspective. Hence, in this study, the concept of managerial ties is suggested as a moderating factor in the relationship between market orientation and ET-innovation.

Most Asian countries (including Malaysia) is rich with relational cultures where network ties play important role in business growth (Wang & Chung, 2013). In fact, even relational ties are included in *Agensi Inovasi Malaysia* long-term innovation strategy (AIM, 2014). Understanding managerial ties also will assist foreign firms investing in Asian countries by appropriately design their market orientation strategies towards enhancing innovation activities (Heidreich & Koschatzky, 2011).

Geletkanycz and Hambrick (1997) was apparently the first to describe "managerial ties as executives' boundary-spanning activities and their associated interactions with external entities". Throughout this study, the term managerial ties will use the definition by M. W. Peng and Luo (2000). Their seminal work explains the managerial ties as micro interpersonal ties of a firm's top management with top executives at other firms, the universities, and with government officials. Cai and Zhou (2014) emphasises the external ties strength as the frequency of connection between firms and other stakeholders, which reflects cooperation in social networks.

Consequently, for this study, the managerial ties will look for explanations from three angles; political ties, business ties and university ties. For J. Wu (2011), political ties refer to the firm–government relationship when governments own partially or fully a firm. Nevertheless, we prefer definition by Wang and Chung (2013) who denote political ties as managers' connections with government officials, or personnel, in various government agencies.

M. W. Peng and Luo (2000) highlighted the more ubiquitous nature of political ties in transitional economies. In emerging economy, political network contact can help firms during regulation enforcement (Wang & Chung, 2013) and in understanding government information, rules and incentives (Muzamil Naqshbandi & Kaur, 2014).

Established political contact also can help make it easier for firms to procure scarce resources such as human resources capital and land (J. J. Li & Zhou, 2010), help firms achieve institutional support (M. W. Peng & Luo, 2000), help a firm by shaping an advantageous environment (Wang & Chung, 2013) and create secure and trustworthy relationships where firms can use to tap into knowledge outside the firms or optimally commercialize innovation that incompatible with its current business model (Muzamil Naqshbandi & Kaur, 2014).

Business ties refer to managers' connections with other firms such as ties with their suppliers, buyers, distributors and competitors. Connections with customers will help firms understand needs and requirement better and for longer term (Wang & Chung, 2013). The aim of the inter-firm ties is to access a broad scope of knowledge, resources, and complementary capabilities of partners to perform innovation activities (J. Wu, 2011). J. J. Li and Zhou (2010) added that through these linkages, there are also opportunities for scarce insider information.

Apparently, Muzamil Naqshbandi and Kaur (2014) is the first that separated the ties with an institute of higher learning as one of the external entity. Precedent articles mostly include university ties in business ties or explain university-business relationship from a different angle. In this study, the term university ties are used to refer to the personal relationships between members of a firm and university staff (K. Xu et al., 2011).

A major (2457 alliances undertaken by 147 biotechnology firms) analysis by George, Zahra, and Wood (2002) shows that companies with university linkages have lower research and development (R&D) expenses while having higher levels of innovative output. While, according to review by J. Wu (2011), ties with a university can improve a firm's product innovation by offering an opportunity to enter into alliances with other firms in order to expose to diverse management, marketing, managerial, and innovation systems. Firms could also find support from the incubators that universities have established to capitalise on the growth of new technologies.

2.8 Underpinning Theory

2.8.1 Natural-resource-based View

The root of the resource-based view (RBV) of the firm is that competitive advantage is created and sustained through the judicious and inimitable use of the resources of the firm (Barney, 1991). Under the resource-based model, the firm uses its distinctive competence to sustain its competitive advantage (Barney, 1991, 2001). A sustained competitive advantage occurs when the firm implements a value-creating strategy that is not easily reproduced - this strategy results in a sustained advantage. For a firm to exploit its resources for a sustained competitive advantage, the resource must have four attributes: it must be valuable, rare, imperfectly inimitable and there cannot be substitutes that are not valuable, rare or inimitable (Barney, 2001; Barney, Wright, & Ketchen, 2001).

When used by a firm to sustain its competitive advantage, these resources are termed the firm's core competencies and are the collective use of the firm's resources that allow it to attain competitive advantage (Carbonell & Rodriguez, 2006). The core competencies of a firm refer to the firm's capabilities in using these resources which cannot easily duplicate by competitors (S. K.-S. Wong, 2012).

Building upon RBV, Hart (1995) proposed natural-resource-based view (NRBV) where future strategy and competitive advantage will be grounded on firm environmentally oriented capabilities that facilitate economic performance. The NRBV perspective states that the firm operates in a manner that minimises its impact on the environment via an environmentally sustainable economic activity that has the distinctive characteristics of being valuable, nonsubstitutable, rare, and costly to imitate (casually ambiguous or socially complex), (Barney, 1991; Hart, 1995). When a firm behaves in this manner, it can create a sustainable competitive advantage against it competitors (Shrivastava, 2006).

Hart further suggested three interconnected steps for achieving this target: pollution prevention, product stewardship and clean technology (1997). Pollution prevention focuses on preventing waste and emission rather than curative technology activities. Product stewardship considers the product's impact on the environment throughout its life cycle from concept, design, manufacturing, distribution, usage until disposal (Hart, 1995; N. A. Yahya, Arshad, & Kamaluddin, 2014). Clean technology seeks to preserve ecosystem resources and reorients energy use and industry in ecologically sustainable directions (Cristina De Stefano, Montes-Sancho, & Busch, 2016; Hart, 1997).

In the NRBV, intangibles like employee involvement, shared vision, tacit skills and firm capabilities including environmental innovation are connected to the firm's environmental strategy (Delgado-Verde, Amores-Salvadó, Martín-de Castro, & Navas-López, 2014). Thus, when focusing on the NRBV steps, technology in pollution prevention and clean technology can be related to eco-process innovation while product stewardship is an eco-product innovation because it links to product design and development (refer also Subsection 2.3.2).

Taking the above theory propositions, eco-product innovation and eco-process innovation are firms' heterogeneous resources and capabilities that contribute to the firm competitive advantage and performance (K.-H. Lee & Min, 2015). As discussed earlier in the literature section, both were part of ET-innovation and the focus endogenous variable in this study.

2.8.2 Demand-based View

Schmookler (1966) suggested that innovation is driven by the external requirements of the market (Adner & Levinthal, 2001). In 1976, Gerstenfeld reported that successful innovation projects are related to demand pull while pursuing a project related to technology push has a higher risk of failure. However, Cooper (1979) analysis explained that technology-push ideas are as likely to succeed as market-pull products.

Hence, base on the demand-pull model and considering technological progress, Adner and Levinthal (2001) proposed the demand-based view and proved this with their simulation model. Researchers on demand-based view also use other terms such as demand-based perspective (Adner, 2004), demand-side approach (Priem et al., 2011), demand-side strategy (G. Ye & Mukhopadhyay, 2013) and demand-side perspective (Siqueira, Priem, & Parente, 2015). While those that focus on innovation management field use phrases as follows; demand-induced innovation (Fabrizio & Thomas, 2012), demand-driven innovation (Frenkel & Maital, 2015), market-driven technological innovation (J. Lee & Kim, 2016), demand for innovation, demand-side innovation and demand-pull innovation (Priem & Li, 2016).

The focus on this area of the body of knowledge although introduced as early as the end of the last century (Adner, 2002; Adner & Levinthal, 2001; von Hippel, 1994), it grows steadily with an upsurge only in the last five years. This is because of several reasons: in the early years of introduction, the body of knowledge on demand-based view is relatively underexplored, received noticeably less attention and relatively less-known, but in the later years, the literature disperse and span wide across many fields of studies causing scholars to overlook the extent and importance of this research perspective (Adner & Levinthal, 2001; Priem et al., 2011; Stanko et al., 2013). But, in the last seven years, demand-based perspective has permeated in fields such as innovation, entrepreneurship, strategy studies, and policymaking (AIM, 2015a, 2015b; Huo & Shan, 2013; Priem et al., 2011).

While, the demand-based view generally talks about the interaction between demand environment and technology development in which the technology is evaluated (Adner & Levinthal, 2001). The demand-based view in innovation focuses on innovation that is driven by existing or latent market-based need or unsatisfied demand (Frenkel et al., 2015; Priem & Li, 2016). In addition, the demand-based view emphasises on value creation rather than value capture. Value creation is determining customers' perception on final product or service where economic value can be gained, whereas value capture concern on internal primary activities such as purchasing, logistic, operation and sales that capture value for the firm (G. Ye & Mukhopadhyay, 2013).

From the perspective of demand-based view, consumer demand is considered as follows; (1) customer preferences are dynamic such that preference trajectories, cycles of incremental, and discontinuous change in preferences have possibility in triggering transitions in technology (Tripsas, 2008); (2) knowledge in the pattern of local demand can predict the pattern of innovation (Fabrizio & Thomas, 2012); and (3) finally, firms request for customer involvement in their innovation process (Priem & Li, 2016).

The demand-based view also explains the dynamic of market demand on technological innovation. In the early technological development, firms technological innovation are guided by the customer need and requirement, then when the market price and performance are met, technological innovation is driven by the competition to attract satisfied customer (Adner & Levinthal, 2001; Horbach et al., 2012). Priem et al. (2011) added that the demand-based perspective view consumers and competitors from the firm as the focal point.

The theory suggested that the customer demand and competitor pressure as key dimensions of market demand from the perspective of demand-based, thus for this study both variables were used as dimensions of market demand.

2.9 Chapter Summary

Based on the reviews of literature, several gaps were identified in the field of market demand relationship with ET-innovation implementation, and the interaction with market orientation, environmental turbulence and managerial ties concepts. This study is conducted with the aim to fill these gaps. A detailed explanation of the theoretical framework and development of hypotheses for the current research are presented in the next chapter.

CHAPTER THREE

CONCEPTUAL FRAMEWORK AND DEVELOPMENT OF HYPOTHESES

This chapter discusses the conceptual framework and the development of hypotheses. It begins with an overview of the conceptual framework for the study. The subsequent section covers the reviews on the relationship between variables and the development of hypotheses. Finally, the chapter ends with a summary.

3.1 Conceptual Framework

Following to the problem statement, research questions, research objectives and literature review, this section presents conceptual framework. The conceptual framework provides a foundation for hypotheses development (Sekaran, 2003). It guides the study towards objective and keeps it within research boundary (Perry, 1995; Summers, 2001). Based on the literature review discussed in Chapter 2, Figure 3.1 illustrates the theoretical association for this study.

This study proposes market orientation as the mediator in the relationship between market demand and environmental technological innovation (ET-innovation) implementation. According to Hair, Black, Babin, and Anderson (2010), mediating variable is created when a third variable or construct intervenes between two other related constructs and most application of mediation is to explain why a relationship between two constructs exists and this will assist in clarifying the influence of an independent variable on the dependent variable. Additionally, in this study, the interaction effect of environmental turbulence and managerial ties towards market orientation and ET-innovation implementation linkage is investigated.

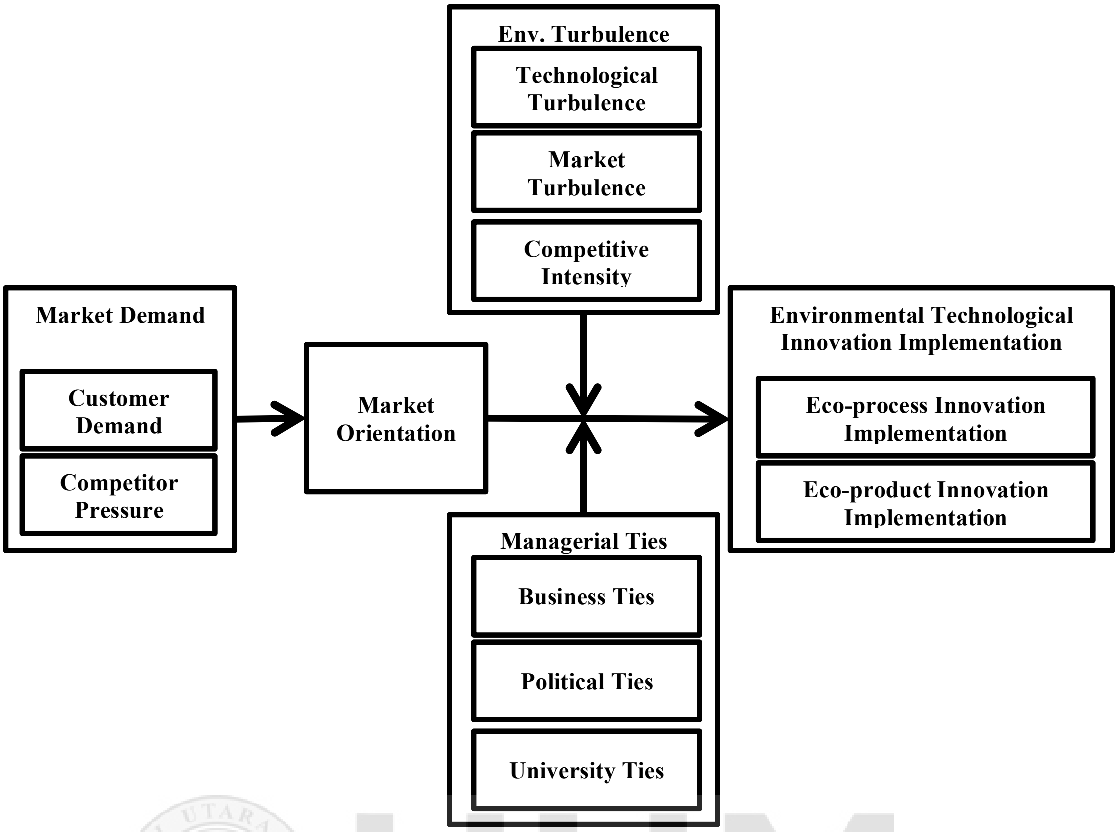

Figure 3.1
Conceptual framework

3.2 Development of Framework and Hypotheses

A hypothesis is a formal unproven statement or proposition about a factor or phenomenon (Malhotra & Birks, 2006; Zikmund & Babin, 2010). Using the conceptual model as the basis, hypotheses were developed as the following sections.

3.2.1 Market Demand Relationship with ET-innovation Implementation

Rennings (1998) apparently one of the first that implemented the demand-pull and technology-push model in the area of environmental innovation. He also came out with three specialities of environmental innovation. The first speciality is the double externality effect where environmental innovation not just create spill over in terms of innovation but create external benefits for the environment. The second speciality is the importance of regulatory as the determinant of environmental innovation besides the market demand and technology push factors (as in conventional innovation). He stated that eco-product innovation is significantly driven by the strategic market behaviour of firms (market pull) while eco-process innovation is more driven by regulation (regulatory push/pull). The third speciality is the increasing importance of social and institutional innovation. Cleff and Rennings (1999) issued the framework for environmental innovation with technology push, market pull, and regulatory push/pull as the main determinants. The late Dr. Rennings and his team upgraded their works by adding firms' specific factors as another major factor in 2012 as Figure 3.2 below (Horbach et al., 2012).

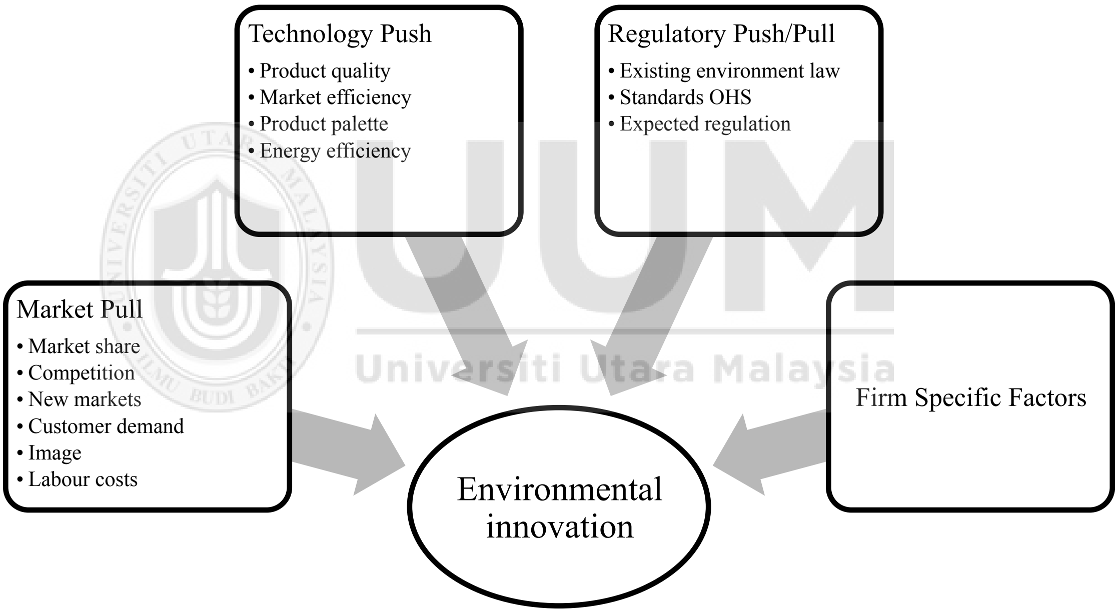

Figure 3.2
Determinants of Environmental Innovation
Source: Cleff & Rennings (1999) and Horbach et al. (2012)

According to a review by K. Green et al. (2000), previous researches show that market demand and government regulations are two main drivers of environmentally driven product and process innovation. Whereas, Horbach et al.

(2012) empirically explained that some green technology fields are more market orientated than the others while end-of-pipe technologies, in particular, are more regulation driven. Hence, this study adapted the above framework and focused on market demand as the determinant of ET-innovation. The analysis of this study is done from the perspective of demand-based. As explained in Section 2.3, base on the above model, the dimensions for market demand in this study are customer demand and competitor pressure.

One critical element in the demand-based view is the demand heterogeneity (Adner & Levinthal, 2001). Studies have reported that customer pressure is the main motive (Triebswetter & Wackerbauer, 2004) and significantly influenced (Weng & Lin, 2011) the adoption of eco-product innovations. Previous studies proof that characteristics of eco-product consumers have shown an inherent diversity in market demand. Among others, they are enforcing higher requirements on eco-products (product quality and esthetic; Dangelico & Pujari, 2010; Lewis & Harvey, 2001), concern on perceived benefit on environment against cost (Dangelico & Pujari, 2010; Peattie, 2001; Rehfeld et al., 2007), ask for customer benefit besides the environmental benefits (Kammerer, 2009), prefer high degree of new-to-market features (Halila & Rundquist, 2011), have value of their own since they are aware of environmental impact through knowledge and study, and demanding and sensitive when making purchasing decision (Kanchanapibul et al., 2014; Lemke & Luzio, 2014).

Whereas, study on younger generation (18-30 years old) found that they have extremely positive attitude toward eco-products, actually purchase and utilise eco-products, higher awareness in social and environmentally conscious, well connected and are more skeptical (demand for more rational explanation; Kanchanapibul et al., 2014; Ottman et al., 2006). This study shows the future trend of eco-product in the market, as these young samples will become a major consumer in years to come.

Horbach (2008) has confirmed the positive effect of market demands in the implementation of eco-product innovations. While a recent study by Triguero et al. (2013) stated that firms that have high value for market demand are shown to have more innovations in eco-products. R.-J. Lin et al. (2013) empirical findings showed that market demand had significant effects on both eco-product innovation performance and firm performance. R.-J. Lin et al. (2013) also observed that market demand is positively associated with economic performance, where, economic performance in their study includes the increase of investment for environmentally friendly technology, the decrease of cost for hazardous materials purchasing and zero customer complaints or returns. In addition, Guoyou et al. (2013) reported that foreign customers play a significant role in both firms' eco-process innovation and eco-product innovation, whereas, only eco-process innovation respond to domestic-orientated firms which explain the nature of competition that is stiffer in the international market than in the domestic market.

If a key competitor has implemented ET-innovation to attract consumers and gain comparative competitive advantages, other companies will also follow the same strategy (Narver & Slater, 1990). Firms tend to imitate other firms that they perceived more successful (F. Ye et al., 2013). When facing competition like this, firms need to innovate to be relevant in the market, if they survive, they will be more ready to face further competition (C. Xu et al., 2008). Cleff and Rennings (1999) also have reported that strategic market goals are especially important for eco-product innovations. Furthermore, they should also pay more attention to the changes in the competitors' environmental strategies to be a successful competitor in the green market (Lewis & Harvey, 2001; Y. Li, 2014; F. Ye et al., 2013).

The threats to market share also encourage eco-product innovations as statistical analysis by K. Green et al. (1994) showed significant correlation within a sample of 169 UK firms. The threat to market share indirectly shows that demand has shifted towards eco-product and competitor has taken some action. For example, Brunnermeier and Cohen (2003) empirical study on environment patent in the US found that there is a positive relationship between industries with higher levels of foreign competition and its innovative activity. Kuik (2006) observes the findings of his study on the automotive industry in Europe, the US and Japan, which showed that international competition drives the implementation of environmental innovation. The analysis by Dechezleprêtre and Glachant (2014) on domestic and foreign demand for wind power within 28 OECD countries over the period 1991–2008 concurred the above findings. The above situations which also a prospect for market share expansion, consequently drive firms to implement eco-product innovation (Triguero et al., 2013).

However, Rehfeld et al. (2007) earlier study have shown that market pull has no significant effect on eco-product innovation. While an empirical study by C.-Y. Lin and Ho (2011) within Chinese logistics companies observed an insignificant effect of customer pressure on eco-process innovation practices. Test results by Huo and Shan (2013) also showed that 70% of photovoltaic (PV) market in twenty countries has insignificant market pull factor. They suggested that in order to encourage demand, demand-pull policy making is suggested to lead the market until it achieved stable growth.

Although, several researchers have shown that market demand has mix relationship with ET-innovation, but the positive relationship between market demands and ET-innovation showed far more convincing arguments. Therefore, it is proposed:

H1a. Customer demand is positively related to eco-process innovation implementation

H1b. Customer demand is positively related to eco-product innovation implementation

H1c. Competitor pressure is positively related to eco-process innovation implementation

H1d. Competitor pressure is positively related to eco-product innovation implementation

3.2.2 Market Orientation in The Relationship Between Market Demand and ET-innovation Implementation

Market orientation is a fundamental of modern marketing study (Deshpandé & Farley, 1998) and an important aspect in innovation management discussions that drives product innovation success (Driessen et al., 2013). An empirical paper by Atuahene-Gima (1996) was the first in a long line of discussions that study the relationship between market orientation and innovation. The result of his study showed a mixed relationship between market orientation and different dimensions of innovation.

The subsequent articles since then also delivered mix results. Some studies showed significant result, for example, several literature showed that, market orientation foster innovation in their firms in all market condition (Hernández-Espallardo & Delgado-Ballester, 2009), market orientation influence the success of technological product innovation implementation (Mat & Razak, 2011), market orientation provide significant relationship between proactive market orientation and new product success (Narver et al., 2004), responsive and proactive market orientation have positive impact on product innovation (Zhang & Duan, 2010) and market orientation has a partial mediation interaction between absorptive capacity and technological innovation capabilities (Aljanabi & Noor, 2015).

Whereas other papers observed an insignificant relationship between responsive market orientation and new product success (Narver et al., 2004), market orientation has no significant relation with product innovation performance (R.-J. Lin et al., 2012) and competitor orientation specifically can cause product innovation constraint with firms trap in developing me-too product instead of new to world products (Lukas & Ferrell, 2000).

Despite the amalgam and indirect result, market orientation is still relevant in all market environment (Narver & Slater, 1990), although the result will not be the same. For example, research by Powpaka (2006) in Thailand's service industry proof that market orientation can contribute a different result between industry in the western and non-western world. An empirical study by Story et al. (2015) on developed and emerging market also stated that while market orientation is important in both markets, the utilisation of mechanisms to achieve the objectives differ.

In this study, the market orientation factor will be introduced as the mediating factor for market demand and ET-innovation relationship. This is a novel contribution since very limited research has attempted a study in this area of the body of knowledge. Among gaps that encourage market orientation to be introduced as mediating factor are; the importance of market data in pushing for rising in demand, firms need to understand current and latent need cause by demand heterogeneity, firms need to understand competitor strategy when customers' functional requirement has achieved, firms need to have relationship with customer until end of product lifecycle, demand fluctuation need for organisational change, and the exact mechanism when market request for eco-product from a firm is still underexplored. The full reasons are listed in Section 2.5.3.

Although previous studies on market orientation effect on innovation have shown inconsistent result, the factor is still relevant as many studies have identified a positive relationship between market orientation and innovation (Liao et al., 2011) and current works of literature also propose market orientation as an important driver of product innovation strategies (Driessen et al., 2013). Plus, although market orientation by itself is not sufficient to guarantee business performance (T. Lee & Tsai, 2005) but the introduction of market orientation as the mediator between market demand and ET-innovation will help (Atuahene-Gima, 1996).

In summary, as the demand for ET-innovation product increase; without understanding of customer needs, information on competitors strategy and actions towards the collected data, a firm cannot survive in the green technology industry, thus market orientation as mediating factor can be summarised in hypotheses as below;

H2a. Market orientation mediate the relationship between customer demand and eco-process innovation implementation

H2b. Market orientation mediate the relationship between customer demand and eco-product innovation implementation

H2c. Market orientation mediate the relationship between competitor pressure and eco-process innovation implementation

H2d. Market orientation mediate the relationship between competitor pressure and eco-product innovation implementation

3.2.3 Environmental Turbulence Interaction with Market Orientation and ET-innovation Implementation Relationship

Articles that use environmental turbulence as moderator for market orientation – performance relationship has increased over the years (Liao et al., 2011), tenet article by Kohli and Jaworski (1990) is one of the first that propose the relationship. The use of environment factor as moderator for the market orientation – product innovation relationship, although not completely new but still scarce (Hernández-Espallardo & Delgado-Ballester, 2009).

Studies on the effect of environmental uncertainty on environmental innovation relationship barely developed from a theoretical point of view with limited empirical applications (C.-Y. Lin & Ho, 2011; Zailani et al., 2014). For example, Norberg-Bohm (1999) wrote for any introduction environmental policy must consider each industry characteristics, environmental turbulence, and stakeholders requirements to be successful. Furthermore, according to C.-Y. Lin and Ho (2011) review, managers in higher turbulence industry inclines to use more innovative strategies to address rapid changes in the environment and increase the rate of technical innovation to be competitive. As ET-innovation is a technical innovation activity, the environmental uncertainty can be positively associated with ET-innovation (Weng & Lin, 2011). The use of environment turbulence factor as moderator for market orientation and ET-innovation relationship in this study is new and a novel contribution to the body of knowledge.

Kohli and Jaworski (1990) introduce three environmental characteristics that explain his environmental turbulence concept, which are market turbulence, technological turbulence and competitive intensity. Although each factor is interrelated environmental variables, researchers and managers tend to evaluate each factor differently (Atuahene-Gima & Li, 2004). Extant articles showed that each variable give different effect to innovation, hence, in this study, each factor will be analysed independently.

3.2.3.1 Technological Turbulence

R.-J. Lin et al. (2014) pointed out that firms enhanced their environmental innovations implementation to have the advantage over their competitors in a green industry where green technology constantly developing and lifecycle of products are short. The finding is in line with Jean, Sinkovics, and Hiebaum (2014), they argued that in technological turbulence environment, unpredictable changes can cause some existing technology perceivably old and obsolete for some customers, hence shorten a product lifecycle.

García-Zamora et al. (2013) emphasised that technological dynamism might exert a positive effect if companies are oriented strategically toward innovation and take advantage of such changes to: (1) exploit their capabilities and organizational characteristics; (2) adjust their offers and expand their commercial efforts to meet market needs; and (3) strengthen their support for R&D and adopt a continuous innovation approach.

Several empirical studies reported a positive moderating effect by technological turbulence. For example; Zhang and Duan (2010) for the proactive market orientation - product development relationship (the moderating effect of responsive market orientation is insignificant), Gao et al. (2007) found that technological turbulence moderate interaction between technology orientation profitability and product performance, Sheng et al. (2011) stated that in rapid technological changes, business ties encourage performance, García-Zamora et al. (2013) observed positive moderating effect by technological turbulence on the relationship between product and process innovation and new product success, and Yu et al. (2013) declared technological turbulence enhances the performance effects of network competence and technological capability.

Several other studies reported different results. For instance, Atuahene-Gima and Li (2004) identified technology uncertainty negatively moderate the relationship between strategic decision comprehensiveness and new product performance and K. B. Lee and Wong (2012) showed that technological change weakens the impact of cross-functional integration on NPD timeliness. The negative impact might have caused by a slow and ineffective reaction by firms in a technologically hostile environment, and delays in the implementation of innovative activities (García-Zamora et al., 2013).

Hence, there remains major debate on the effect of technological turbulence on market orientation and ET-innovation implementation link. Despite the argument, technological turbulence as moderator is not a question, therefore;

H3a: Technological turbulence moderates the relationship between market orientation and eco-process innovation implementation

H3b: Technological turbulence moderates the relationship between market orientation and eco-product innovation implementation

3.2.3.2 Market Turbulence

Utterback and Abernathy (1975) are among the first that consider market turbulence in the technological manufacturing industry. They explained that manufacturing firms, which focus on maximising performances, rely on market information to innovate, and their innovation was base on the uncertainties of external market sources. Rehfeld et al. (2007) also found that economic aspects are the major obstacles to the commercial exploitation of environmental products.

Several studies have explained positive moderating factor of market turbulence, for example in the relationship of strategic decision comprehensiveness and new product performance (Atuahene-Gima & Li, 2004), customer orientation and business performance (G. Y. Gao et al., 2007), proactive market orientation and new product innovation (Zhang & Duan, 2010), velocity performance of supply delivery and third party logistic (3PL) (Briggs, Landry, & Daugherty, 2010), network competence and new product performance (Yu et al., 2013), innovation and business performance (García-Zamora et al., 2013), new products introduction speed and CEOs focus (low past focus, high present focus, and high future focus) (Nadkarni & Chen, 2014) and firm-level product innovativeness and new product performance in developed market (Story et al., 2015).

While, several other studies have revealed the following; a negative moderating factor against responsive market orientation and new product innovation link (Zhang & Duan, 2010), a negative and significant moderation relationship between firm-level product innovativeness and new product performance in emerging market (Story et al., 2015), an insignificant technological capability relationship with new product development performance (Yu et al., 2013), an insignificant moderation interaction between political ties/business ties and firm performances (Sheng et al., 2011), an insignificant influences on SMEs environmental innovation adoption (Weng & Lin, 2011), a negative relationship towards green practice adoption (C.-Y. Lin & Ho, 2011), a driver for dynamic capability (D.-Y. Li & Liu, 2014) and a driver for ET-innovation adoption (Zailani et al., 2014).

Although D.-Y. Li and Liu (2014) highlight on debates of whether market turbulence is a moderator or a driver. The examples above explicitly show that market turbulence was researched more as a moderator than a driver, and especially true for the market orientation-innovation relationship (Zhang & Duan, 2010).

During market stable, a firm would not need to change the concept of their product since they know they will get the same market share from the same sets of customers. However, when a new set of customers in the name of green consumer emerged, the market will change. Eco-product consumers are demanding and sensitive when making a purchasing decision (Kanchanapibul et al., 2014; Lemke & Luzio, 2014) and they are aware of environmental impact through knowledge and study (Kanchanapibul et al., 2014). When market change, firms need to oriented strategically toward innovation and therefore take advantage of such changes and absorb the positive effect (García-Zamora et al., 2013), in this case, they have to implement ET-innovation to cater the new customers. When the demand increased steadily, ET-innovation adoption will also increase (Triguero et al., 2013). Firms also need to ensure that firms do not lose ground to competitors' changing strategies (Story et al., 2015).

Firms have to gather intelligence on customer needs and requirement, the available regulation, and the competitor situation before continuing with the ET-innovation implementation. If the company does not react quickly and effectively to market pressures or a hostile environment, it will hinder or misleads the implementation of ET-innovation initiatives, thus limits returns on the investment and profit margins (García-Zamora et al., 2013). Hence, the hypotheses are:

H3c: Market turbulence moderates the relationship between market orientation and eco-process innovation implementation

H3d: Market turbulence moderates the relationship between market orientation and eco-product innovation implementation

3.2.3.3 Competitive Intensity

Hernández-Espallardo and Delgado-Ballester (2009) stated that in a highly competitive environment, the effect of market orientation on product innovation performance is higher due to pressure from competitors, in response firms will innovate to be competitive. Yalabik and Fairchild (2011) added that competition over environmentally sensitive customers also pressures firms to effectively implement eco-products. Since the environmental industry is still new, Horbach et al. (2012) forecasted a high probability of market entries of new competitors causing unstable market positions, which encourage environmental innovation. Plus, Inoue et al. (2013) described firms with fewer (less than five) competitors can afford to allocate resources to environmental R&D activities from a long-term perspective because they do not have to fight short-term competition.

Despite the theoretical explanations and although competitive intensity might have a positive impact on innovation success because it creates opportunities (Guo & Cao, 2014) and causing positive and significant contribution to the profitability and the success of new products (García-Zamora et al., 2013), some studies suggested no moderating effect (G. Y. Gao et al., 2007; Hernández-Espallardo & Delgado-Ballester, 2009; Zhang & Duan, 2010) and other studies found negative moderating effect that hinders the outcomes (García-Zamora et al., 2013).

Studies in competitive intensity showed mix results, thus it is essential to understand the exact effect of competitive intensity towards the relationship of market orientation and ET-innovation implementation, especially in the context of the Malaysian green businesses which targeted at RM60 billion GDP in 2030 (Spykerman, 2015). As such, it is hypothesised;

H3e: Competitive intensity moderates the relationship between market orientation and eco-process innovation implementation

H3f: Competitive intensity moderates the relationship between market orientation and eco-product innovation implementation

3.2.4 Managerial Ties Interaction with Market Orientation and ET-innovation Implementation Relationship

According to Wang and Chung (2013), the moderating role of managerial ties in the linkage of market orientation and innovation is exceptionally important from the Asian perspective. The study of managerial ties played an important role in business growth since most countries in Asia have relational tradition.

Several studies investigating managerial ties effect use it as a driver (Mat & Razak, 2011; M. W. Peng & Luo, 2000; J. Wu, 2011), while more recent studies have considered a moderating relationship (Cai & Zhou, 2014; Guo & Cao, 2014; Wang & Chung, 2013). The use of managerial ties as moderator in market orientation-innovation relationship can be found in Wang and Chung (2013) article. In their study, the managerial ties variable was classified into political and business ties. However, for this study, the concept of managerial ties as a moderating factor in the relationship between market orientation and ET-innovation will be viewed from three angles; political ties, business ties and university ties. Hence, this study will add a novel contribution to the managerial ties and ET-innovation body of knowledge.

Previous studies also have reported mix impact of managerial ties dimensions on innovation (J. Wu, 2011). Triguero et al. (2013) analysis stated that demand factors had an effect on cooperation/networks thus influencing the eco-innovation dynamism. In addition, review by Guo and Cao (2014) stated that managerial ties might strengthen the relationship between strategic flexibility and firm performance in three aspects as the following, knowledge on environmental changes force firms to adjust their strategic actions to manage ahead of their competitors, close interactions with business partners provide new ideas and thus can accelerate innovations, and managerial ties also enable firms to gain access to resources supporting strategic changes.

However, Guo and Cao (2014) also emphasised that managerial ties might deter strategic flexibility from contributing to firm performance through (a) overreliance on managerial ties which will obstruct the deployment of new strategies and (b) strong managerial ties might cause a firm to let other organisation lead and hamper firm innovation. Therefore, in this study, each dimensions impact analysis will be studied individually.

3.2.4.1 Business ties

In this study, business ties refer to managers' connections with their competitors, suppliers and buyers (Wang & Chung, 2013). Ties with competitors were engaged by firm to avoid competitive disadvantage due to perceived environmental risk in a specific field unable to cater by one firm (Azzone & Noci, 1998), to avoid implicit collusion, and uncertain risk of win/loose (M. W. Peng & Luo, 2000), to increase chances for successful innovation (R.-J. Lin et al., 2013), and to improve firms performance (J. Wu, 2011).

Whereas, the basic reason for network with a supplier are for firms to acquire quality materials, good services and on time delivery (M. W. Peng & Luo, 2000), and increase the competitiveness of eco-product design (Azzone & Noci, 1998) through knowledge pool, problems solving method, and strategy combination (J. Wu, 2011).

Ties with the buyers/user will help firms understand market needs better and quicker (J. Wu, 2011), spur customer loyalty, thus increases sales volume through repeat–purchase and reliable payment (M. W. Peng & Luo, 2000), and encourage efficient response to market demand (Wang & Chung, 2013).

Different components characters in business ties have caused the analysis result related to business ties inconsistent. Among results are; positive moderation of business ties will enhance the customer orientation and interfunctional coordination impact on innovation (Wang & Chung, 2013), negative interaction effects between business ties and competitor orientation on innovation (Wang & Chung, 2013), interaction with customer/supplier and competitor influence success of technological product innovation implementation (Mat & Razak, 2011; J. Wu, 2011), business ties encourage better firms' performance during strong technological turbulence (Sheng et al., 2011), insignificant drive of external collaboration on environmental product innovations (Triguero et al., 2013) and insignificant effects of external partners against eco-product innovation initiatives (Abdullah et al., 2016). These results are mostly from extant empirical papers where the relationship with conventional innovation was studied.

Whereas according to Triguero et al. (2013), eco-innovators are more likely to cooperate with other firms and Horbach et al. (2012) found that firms that implement environmental innovation in cooperation with other firms are particularly economically successful. However, finding partners was not an easy task (Abdullah et al., 2016). Lack of partnership in eco- product innovation is mainly due to the high cost, long payback period, difficulties in protecting intellectual properties, high monitoring cost, and difficulty in accessing the viability of innovation, thus making it harder to get funding for innovation (Abdullah et al., 2016; Woolman & Veshagh, 2006). Therefore, it is crucial to confirm the moderation effect of managerial ties on market orientation - ET-innovation implementation relationship. Hence, the hypotheses are;

H4a: Business ties moderate the relationship between market orientation and eco-process innovation implementation

H4b: Business ties moderate the relationship between market orientation and eco-product innovation implementation

3.2.4.2 Political Ties

The effect of political ties as moderating factor inclined towards negative relationship against innovation. This is because, (1) innovation depend on flexible working time, creativity, and quick market response, whereas, government emphasis control which is contradicted, (2) competitor-oriented firm that relies too much on government for an advantage over their competitor would not be motivated to innovate, (3) strong political ties can influence firm to take hierarchical organizational shape which has negative association with innovation, and (4) network contact may force firm to accommodate unethical request causing loss of trust in internal collaboration which is key in innovation success (Wang & Chung, 2013).

While the above explanation, Horbach et al. (2012) emphasized that market orientated environmental technology field also need for external political support when market failures especially due to organisational, control and coordination problems and Veugelers (2012) also found that voluntary agreements between regulators and polluters are the most influential driver for all types of eco-innovations. Whereas, Mat and Razak (2011) reported a positive driving factor of interaction with government agency towards the success of technological product innovation implementation which contradicted with Sheng et al. (2011) report where political ties impede firm performance when the speed of technological change is high. J. Wu (2011) empirical research meanwhile showed an inverted U-shaped relationship between political ties and firm product innovation. This indicates the positive effect of political ties on firm product innovation would diminish as the costs of political ties outweigh the benefit. On the other hand, Sheng et al. (2011)

also found that political ties interaction with high market uncertainty insignificantly effects firm performance.

Political ties study is quite young due to its high relevance in transitional economies (M. W. Peng & Luo, 2000). Studies on the topic are rather limited causing mixed final analysis. The reality of political ties is relational and cultural in nature also explain the variance result because each country has a different culture. Hence, for this study,

H4c: Political ties moderate the relationship between market orientation and eco-process innovation implementation

H4d: Political ties moderate the relationship between market orientation and eco-product innovation implementation

3.2.4.3 University Ties

Firms that are searching for external knowledge sources have a higher probability of considering university knowledge (Muzamil Naqshbandi & Kaur, 2014). Hence, firms engaged ties with university to avoid risk of facing difficulty when implementing green practices due to wide range of technology and organisational in environmental innovation, to joint projects with universities which have accumulated knowledge in relation to specific environmental problems (Azzone & Noci, 1998), to improve a firm's product innovation due to opportunity to enter into alliances with other firms, and to find support from the incubators that universities have established and capitalized on the growth of new technologies (J. Wu, 2011).

In their research result, Triguero et al. (2013) indicate that collaboration with research institutes, agencies and universities drives eco-product innovation and have a higher probability to also implement eco-process innovations. J. Wu (2011) also confirmed positive impact of universities ties on firm product innovation. Horbach et al. (2012) however, do not find any positively significant influence of factor collaboration with universities in the decision to perform eco-product innovations. Therefore, university ties as a moderator would be a better proposition, when the networking with the university is very good, intelligence data from the market can be responded better. Customer needs and requirements and competitor's strategy can be analysed base on knowledge gathered from ties with the university, and this will enhance the ET-innovation implementation. Therefore, it is proposed;

H4e: University ties moderate the relationship between market orientation and eco-process innovation implementation

H4f: University ties moderate the relationship between market orientation and eco-product innovation implementation

3.3 Summary

To summarise, this chapter has discussed the conceptual research framework of the study. There are five components depicted in the framework and each of the components was discussed extensively to establish a direct relationship (between market demand and ET-innovation implementation), mediating relationship (market orientation as the mediating factor) and two moderating relationships (environmental turbulence and managerial ties).

This chapter has also pointed 20 testable statements (as Table 3.1) with regards to the level of ET-innovation implementation. Next chapter, Chapter 4 will extensively discuss the methodology of the study.

Table 3.1
Summary of hypotheses

Hyp. No	Statement
H1 (a-d)	Market demand is positively related to environmental technological innovation (ET-innovation) implementation.
H2 (a-d)	Market orientation mediate the relationship between market demand and environmental technological innovation (ET-innovation) implementation
H3 (a-f)	Environmental turbulence moderates the relationship between market orientation and environmental technological innovation (ET-innovation) implementation
H4 (a-f)	Managerial ties moderate the relationship between market orientation and environmental technological innovation (ET-innovation) implementation

CHAPTER FOUR

RESEARCH METHODOLOGY

This chapter focuses on the research methodology used in executing this study. It begins with the research design, which consists of the purpose of the study and the instrument use, detail of survey instrument, measurement scale, reliability and validity. The subsequent section explains the sampling design, which includes the population, the sampling frame, the sample and the units of analysis. A description of data collection, response rate and nonresponse bias analysis and method selected for data analysis is then presented. This chapter concludes with the summary of the section.

4.1 Design of The Research

The research design is a framework that guides the researcher for data collection and data analyses associated with the problem statements and objectives of the research (Zikmund & Babin, 2010, p. 56). Research design aim is to (1) grasp design issues before designing instrument and selecting population, (2) highlight the logic behind the design, (3) understand the design principles and its linkage with the statistical analysis and finally, create awareness of the design limitations and suggest ways of solving problem (de Vaus, 2002).

4.1.1 Purpose of Study

The purpose of this study is to empirically test the hypotheses that have been formulated in the previous chapter and to confirm the proposed model. In doing so, this study involves a descriptive study, hypotheses testing and examines specific relationships.

This quantitative study is a single cross-sectional in which data was gathered through a single survey on respondents in a non-contrived setting to avoid researcher's control and manipulation of the variables. This research method also avoids unrepresentative sampling of the population and bias response by respondent over time (Malhotra & Birks, 2006, p. 69).

4.1.2 Survey Instrument

This survey was executed using self-administered questionnaire method. Thus, this section deals with issues related to the measurement of concepts, which include the scales used and the development of instruments to measure the various previously described concepts.

The questionnaires consist of six parts. The first part of the questionnaire comprise the descriptive data questions such as the main industry where the firm is from, the ownership of the firm, the number of years the firm has been founded, the number of employees, the number of years respondent has been working with the firm and the respondent role in the firm. The respondent also has been asked to describe the novelty level of their eco-process innovation and/or eco-product innovation. These questions also acted as screening questions as only replies from firms that implemented ET-innovation was required.

The subsequent parts are the measurement of ET-innovation implementation, market demand, market orientation, environmental turbulence and managerial ties.

Finally, as an option, the respondent can provide their contact information if they want to have the summary of the study.

4.1.2.1 ET-innovation Implementation

ET-innovation implementation was measured using a previously established instrument that has been shown to be reliable and valid in prior research (C. C. J. Cheng et al., 2014; C. C. Cheng & Shiu, 2012). The instrument consists of seven items for eco-product innovation implementation and four items for eco-process innovation implementation. Each question was an adaptation of 7-point Likert numerical scale. Response to each option was made on a seven-point interval scale ranging from 1 (strongly disagree) to 7 (strongly agree). Refer Table 4.1 for details questions.

Table 4.1
ET-innovation Implementation Questions

Question No	Questions
	In last 3 years, relative to your competitors, please rate your firm on a scale of 1 to 7 on the following questions:
9	Our firm often emphasises developing new eco-products through new technologies to simplify their packaging
10	Our firm often emphasises developing new eco-products through new technologies to simplify their construction
11	Our firm often emphasises developing new eco-products through new technologies to easily recycle their components
12	Our firm often emphasises developing new eco-products through new technologies to easily decompose their materials
13	Our firm often emphasises developing new eco-products through new technologies to use natural materials
14	Our firm often emphasises developing new eco-products through new technologies to reduce damage by waste as much as possible
15	Our firm often emphasises developing new eco-products through new technologies to use as little energy as possible
16	Our firm often innovatively updates manufacturing processes to protect against contaminations
17	Our firm often innovatively updates manufacturing processes to meet standards of environmental law

Table 4.1 (Continued)

Question No	Questions
18	Our firm often uses innovative technologies in manufacturing processes to save energy.
19	Our firm often innovatively updates manufacturing equipment in manufacturing processes to save energy

4.1.2.2 Market Demand

There were seven questions prepared for measuring the market demand construct (Table 4.2). All questions are in the form of 7-point Likert numerical scale. All seven questions were adopted from Y. Li (2014) and has also been used by Hojnik and Ruzzier (2016). The seven-point interval scale is ranged from 1 (strongly disagree) to 7 (strongly agree).

Table 4.2
Market Demand Questions

Question No	Questions
20	Our domestic customers/business clients require our products meet the requirements of environmental regulations
21	Our domestic customers/business clients pay great attention to the green concept contained in products
22	Our overseas customers/business clients require our products meet the requirements of environmental regulations
23	Our overseas customers/business clients pay great attention to the green concept contained in products
24	We establish a company's environmental image comparing to competitors through green concept
25	We increase a company's market share through green concept
26	We improve a company's competitive advantage over competitors through green concept

4.1.2.3 Market Orientation

Ten questions were adopted from Hernández-Espallardo and Delgado-Ballester (2009) which cited Kohli et al. (1993) as their source (refer Table 4.3).

Response to each option was made on a seven-point interval scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Table 4.3
Market Orientation Questions

Question No	Questions
27	We meet regularly with customers/business clients to find out what products or services they will need in the future
28	We often poll end users/business clients to assess the quality of our products and services
29	We periodically review the likely effect of changes in our business environment (e.g. regulation on customers/business clients)
30	We are quick to detect fundamental shifts in our business environments (e.g., competition, technology, regulation)
31	When something important happens to a major customer or market, the whole firm knows about it in a short period
32	Data on customer/business clients satisfaction are disseminated at all levels in this firm on a regular basis
33	When someone finds out something important about competitors, they are quick to alert the rest of the firm
34	We are quick to respond to significant changes in our competitors' pricing structures
35	Personnel get together periodically to plan a response to changes taking place in our business environment
36	If a major competitor were to launch an intensive campaign targeted at our customers/business clients, we would implement a response immediately

4.1.2.4 Environmental Turbulence

The measurements of environmental turbulence were adopted from Kohli et al. (1993) which has been used in Zhou and Wu (2010) and Briggs et al. (2010) accordingly. Each question was in the form of the 7-point Likert numerical scale with the scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). Refer Table 4.4 for details.

Table 4.4
Environmental Turbulence Questions

Question No	Questions
37	The technology in this industry is changing rapidly

Table 4.4 (Continued)

Question No	Questions
38	Technological changes provide substantial opportunities in this industry
39	A large number of new product ideas have been made possible through technological breakthroughs in this industry
40	It is very difficult to forecast where the technology in this area will be in the next few years
41	In our kind of business, customers'/business clients' product preferences change constantly.
42	Our customers/business clients tend to look for new products all the time.
43	We are witnessing demand for our products from new customers/business clients
44	New customers tend to have product-related needs that are different from those of our existing customers/business clients
45	Competition in our industry is cutthroat.
46	Promotion wars are common in our industry
47	Anything that a competitor can offer, others can match easily
48	Price competition is common in our industry

4.1.2.5 Managerial Ties

The dimensions of managerial ties include business ties, political ties and university ties. Each dimension provides four questions to measure managerial ties through 7-point Likert numerical scale. Referring to Table 4.5, all questions were adopted from Muzamil Naqshbandi and Kaur (2014) where they referred to M. W. Peng and Luo (2000) and Ramos-Vielba, Fernández-Esquinas, and Espinosa-de-los-Monteros (2010). The seven-point interval scale is ranged from 1 (Very Little) to 7 (Very Extensive).

Table 4.5
Managerial Ties Questions

Question No	Questions
	Please mark the number best describing the extent to which managers at your firm have utilised personal ties, networks, and connection during the past three years with…
49	managers at supplier firms
50	managers at buyer firms

Table 4.5 (Continued)

Question No	Questions
51	managers at competitor firms
52	an official in industry bureaus
53	political leaders at various level of the governments
54	an official in regulatory bureaus
55	an official in supporting organisations such as tax bureaus, state banks, commercial administration bureaus and the like
56	university researchers for R&D activities and formal consulting work
57	university researchers for training and transfer of personnel
58	university researchers for commercialisation related to intellectual property rights

4.1.2.6 Measurement Scale

A Likert numerical scale was used for most of the questions. Likert scale was used because it is easy to construct, has intuitive appeal, high adaptability and usually good reliability (Malhotra & Birks, 2006; Nunnally, 1978). In a Likert scale, respondents were to choose among the given options. Thus, a researcher was able to solicit answers about the given statement through a set of response keys.

The 7-point Likert numerical scale was used in this study. The numerical scale was used so those respondents have numbers as response options, rather that semantic space or verbal descriptions to identify categories (Zikmund & Babin, 2010, p. 262). Thus, for interval scale the midpoint with categorical description existence can create an unbalances scales. Furthermore, the use of 7-point scale is common for Likert scale and with more scale than normally five-point, the interval becomes smaller, thus lower error and more reliable (Zikmund & Babin, 2010, p. 246).

To avoid unbalanced scales which may produce a skewed distribution, the scale must be symmetrical and equidistant (Hair, Hult, Ringle, & Sarstedt, 2014, p.

9; Zikmund & Babin, 2010, p. 262). Therefore, the 7-point Likert numerical scale categories were constructed as Table 4.6 below.

Table 4.6
7-point Likert Numerical Scale with Categories

Scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Categories	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
	Very little	Little	Somewhat little	Average	Somewhat extensive	Extensive	Very extensive

4.1.2.7 Validity and Reliability of the Instrument

The measure development and assessment section of this chapter describe the development of rating scales for all construct used in this study. Constructs were first subjected to purification and then assessed for their reliability, validity and generalizability using established procedures from measurement development literature (Malhotra & Birks, 2006, p. 311). Face validity test explanations can be found below and reliability test will be explained in Chapter 5.

Validity Assessment

Validity relates to whether the findings truthfully represent an actual picture of a concept. In a simple word, validity measures what it should measure. All of the questions were taken from previous studies. Content validity, or face validity, is a subjective but systematic evaluation of how well the content of a scale represents the measurement project (Malhotra & Birks, 2006).

According to Malhotra and Birks (2006), the researcher or someone else may examine whether the scale items adequately cover the entire domain of the construct being measured. For Sekaran (2003, p. 206) when researcher checks the questions on the surface and finds that those questions appear to measure the concept, it is called face validity. As all of the questions were taken from previous studies, these questions can be considered as face validated.

However, assessment by experts will further proof face and content validity (C. C. Cheng & Shiu, 2012). The sample questionnaire was sent to experts with an additional column on the right of each question for the expert to evaluate. Each expert can evaluate base on options of essential, useful but not essential or not necessary as proposed by Lawshe (1975). They could also give comment where appropriate.

Four academics and two industry experts have gone through the questions and provided their comment as in Table 4.7.

Table 4.7
Summary Comments From Experts and Action Taken

	Comments	**Action**
1	Some words need to be clarified according to industry terminology	Change to common language, e.g. firm to company
2	Language and grammar	Modified and rechecked
3	Some questions were suggested as not necessary	Questions were deleted
4	Organisation of section in questions need to be rearranged	Rearranged accordingly
5	Too many questions	Questions have been reduced where applicable

4.2 Sampling Design and Procedures

4.2.1 Population

The population targeted for this study was all manufacturing firms in Malaysia. According to the latest economic census, there are 42,024 manufacturing firms established up to 2014 (Department of Statistics Malaysia, 2014).

4.2.2 Sampling Frame

The sampling frame for this study comprised all sizes of Malaysian manufacturing firms as listed in three lists: (1) Approved list of firms that received Green Technology Funding Scheme (GTFS) from Malaysian Green Technology Corporation (GreenTech Malaysia), the non-profit organization under Ministry of Energy, Green Technology and Water Malaysia (KeTTHA), (2) List of firms that registered their product in MyHijau directory, and (3) List of firms listed in Malaysia External Trade Development Corporation's (MATRADE) directory for Malaysia exporters (MATRADE, 2016).

The GTFS approved list is used since all of the fund recipients have been thoroughly checked by the banks and funding institute as valid and are involved in research on green technology (GreenTech Malaysia, 2015b). The firms must also forward progress report to the funder, and also KeTTHA (GreenTech Malaysia, 2015a). The MyHijau directory was established by GreenTech to give a reliable option for consumers and buyers when purchasing eco-products. Each product that received MyHijau mark must go through a strict testing procedure for eco-labelling by approved third party testing lab locally or internationally (GreenTech Malaysia, 2015c). Therefore, firms with their products in the MyHijau directory are certainly are an eco-products producer. Malaysia Exporters Directory by MATRADE only include firms that have good track record in products manufacturing and looking to build a reputation among foreign investors and purchasers (MATRADE, 2014).

For this survey study, all listed manufacturing firms under the three directories were combined in a list, and then any double entry was deleted. The final number was 6,857 firms.

4.2.3 Sample

To get a census of the whole population require cost, time and man-hours, thus random sampling is used as a subset to estimate the same population characteristics (Zikmund & Babin, 2010). Hence, for this study, the table in Hair et al. (2014, p. 21) was referred. With nine arrows pointing at a construct at 5% significant level and 0.25 coefficient of determination (R^2), a sample of 88 was the minimum. Or, if we use the popular rule of thumb, a minimum sample size of ten times the maximum number of paths aiming at any construct in the outer model, the targeted minimum were at 90 samples (Hair, Sarstedt, Ringle, & Mena, 2012). However, it is important to investigate unobserved heterogeneity issues within the model (Hair, Sarstedt, Matthews, & Ringle, 2016; Matthews, Sarstedt, Hair, & Ringle, 2016), thereby, to have at least two segments for the analyses, this study targeted at least 180 samples.

On the other hand, various rate of response for web-survey has been observed, for e.g. 18.4% (Sánchez-Fernández, Muñoz-Leiva, & Montoro-Ríos, 2012), 14-20% (Zikmund & Babin, 2010, p. 177), 10-25% (Sauermann & Roach, 2013), 9% (Zillmann, Schmitz, Skopek, & Blossfeld, 2014), 8.4% (Petrovčič, Petrič, & Lozar Manfreda, 2016), 6.23% (Hikmet & Chen, 2003), 5–25% (Sarstedt & Mooi, 2014), 4.9% (De Valck, Langerak, Verhoef, & Verlegh, 2007), and 1% (Koo & Skinner, 2005). With such a variety and inconclusive response rates, to achieve at least 180 replies, the actual sample would be in a range of 1,500 to 4,500 samples (for a response rate of 4-12%). Hence, we randomly sampled 2,500 for the first round and 2,000 for the second round.

4.2.4 Sampling Plan

A sampling plan is a specific technique used to select a sample from a specific population (Zikmund & Babin, 2010). To obtain more information on ET-innovation implementation, this research applied random sampling on selected sampling frame (Al-janabi, 2016, p. 101). Firms in the sampling frame were gathered from GTFS and MyHijau directory, which confirmed their involvement in green technology. Whereas, firms in MATRADE directory was selected because they were ready to compete in the global market where ET-innovation was already common (Hojnik & Ruzzier, 2016).

Data from the directories was combined in a spreadsheet and checked for double entry. After deletion of the double entry, each data was assigned a random number. Then, the random numbers were sorted (smallest number to biggest number), and the first 4,500 data was drawn from the sorted data list as samples.

While it is often difficult to get a representative sample of busy professionals to participate in a survey research, worse are, methods such as mail surveys, telephone surveys, and face-to-face are costly and time-consuming (Dillman, 2000). Therefore, a web-based survey was chosen for this study as it is more cost effective and least time were needed than other data collection methodologies (Atif, Richards, & Bilgin, 2012; Malhotra & Birks, 2006; Zikmund & Babin, 2010).

The usage of a web-based survey in research rapidly grows in recent years (Sánchez-Fernández et al., 2012). The response rate for the survey, however, has decreased lower than other self-administered surveys (Fan & Yan, 2010; Sánchez-Fernández et al., 2012; Sauermann & Roach, 2013). There were various factors possibly affecting respondent to answer survey question which include inaccurate address lists, a lack of interest and time, people confusing market research with selling, privacy issues, unattractive questionnaire features, increasing number of viruses and spams, non-exclusivity of survey instrument due to variety of target, and over surveying due to low survey cost leading to respondent fatigue (Sánchez-Fernández et al., 2012; Sarstedt & Mooi, 2014; Sauermann & Roach, 2013; Vicente & Reis, 2010).

Among actions that can be used to increase the response rate are methods of contact such as personalization, monetary incentives, non-monetary incentives, questionnaire length, and timing of survey invitation and reminders (Fan & Yan, 2010; Sauermann & Roach, 2013). A few steps that have been taken to increase response rate and at the same time reduce non-response bias.

First, as confirmed by present researches, personalisation of messages (Sánchez-Fernández et al., 2012; Sauermann & Roach, 2013), rewording the sentences of each wave of reminders (Sauermann & Roach, 2013), and an effective cover letter which include plea for help (Petrovčič et al., 2016), clear instruction on how to fill the survey and emphasis on confidentiality of the response (Atif et al., 2012). The cover letter follows the sample by Petrovčič et al. (2016) with some modification which was checked by an expert. There were three waves of reminders with each reminder personalise and differently word (Sánchez-Fernández et al., 2012) (Refer Appendix E to H).

Second, as suggested by Dillman (2000), and Sauermann and Roach (2013), three reminders were sent after the first invitation letter. However, no concrete studies on the numbers of days between reminders (Sánchez-Fernández et al., 2012; Sauermann & Roach, 2013), days of the week, or hour of the day when reminders should be sent (Sauermann & Roach, 2013). De Valck et al. (2007) though proposed a period of seven days between each reminder, but for this study, each reminder wave was sent after waiting period of 4-5 days. In fact, according to Sánchez-Fernández et al. (2012), if time is in constraint, reminders should be sent "sooner rather than later, because it will not jeopardise retention rates” (p. 512).

Third, it is important to properly word the questionnaire and making sure it is attractive but reasonable to the type of research being done, while the length of time to answer the question is practical (Vicente & Reis, 2010). The duo also found a length of more than 30 minutes generally too long for most types of survey. For this study, mock tests have shown time length of about 15-20 minutes per response.

Finally, the duration of the whole activities being suggested to be 12 days by Petrovčič et al. (2016) or 60 days (Sauermann & Roach, 2013). The first invitation for the first round was sent on the 7th of March 2016 and ended on the 26th of March 2016. The second round started on 29th of March 2016 and ended on the 17th of April 2016. The actual total days for this study were 40 days.

The web-based survey research is rather complex with the personalise invitation, the personalise reminders, the number of reminders, the duration between reminders and sheer numbers of respondents. Therefore, third party web-based software, Questionpro.com, was used to assist in managing the project (questionpro.com, 2016).

4.2.5 Unit of Analysis

The unit of analysis was an individual plant and an executive or higher-level officer represents each individual plant since they were involved in some level of decision making. The reason for choosing individual plant was to increase generalisability because using figures from a single industry can restrict the findings generalisation (R.-J. Lin et al., 2014).

4.3 Data Collection

This study employed primary data, which will be collected through the use of survey instrument as in Section 4.2. Survey method was selected in doing this research for the following reasons: (1) the ability to accommodate larger sample sizes; thus increases generalizability of results, (2) the ability to distinguish small differences in collected data, (3) For ease of administering and recording questions and answers, (4) The capability of using advanced statistical analysis, and (5) Finally, the potential abilities of tapping into factors and relationships not directly measurable (Hair, Bush, & Ortinau, 2002).

The management of survey project was done with Questionpro.com. The software personalize each invitation and reminders according to requirement, provide tools for attractive questionnaire, send invitation and reminders to respondent at required time, provide platform for respondent to answer survey whether on Windows (PC), Macintosh (Mac) or on mobile devices, recorded all replied, non-replied, and incomplete responses, and export response data to suitable medium for analyses.

4.3.1 Response Rate

Response rate or rate of return can be calculated as the total number of returned/completed questionnaires with the total number of respondent received the invitation to participate as the denominator (Zikmund & Babin, 2010, p. 168). Table

4.8 illustrates the breakdown of the rate of return according to invitation rounds and waves. Initially, 2,500 and 2,000 emails have been selected randomly and each email address being sent an invitation to participate in the survey. However, as can be seen in the table below, only 2,015 and 1,578 respondent from the first and second round received the emails respectively. The rest were bounced due to a wrong address, change of address, or rejected by firms' centralise email administrator.

From the table below, we can see an improvement of respond from the first invitation to the second reminder, but the respond drop at the third reminder. So, the three reminders suggested by Dillman (2000) and Sauermann and Roach (2013) was rather applicable. Interestingly, the final rate of respond at 5.6% is rather expected. A single digit response was quite common as mention by Hikmet and Chen (2003) because nonresponse issue is severe in a web-based survey (Zikmund & Babin, 2010, p. 149) and getting a higher response is difficult (Atif et al., 2012). The details reasons and the actions taken to increase the response rate possibility have been explained in the earlier section.

Table 4.8
Response Rate

	1st Round			**2nd Round**		
Wave	**No of emails sent**	**No of completed reply**	**Reply percentage**	**No of emails sent**	**No of completed reply**	**Reply percentage**
First email	2015	33	1.6	1578	25	1.6
1st reminder	1954	31	1.6	1546	24	1.6
2nd reminder	1905	36	1.9	1527	26	1.7
Final reminder	1856	15	0.8	1475	11	0.7
Total by round	2015	115	5.7	1578	86	5.4
Overall result	**3593**	**201**	**5.6**	**/--**	**/--**	**/--**

4.3.2 Nonresponse Bias

As the problem of nonresponse is serious in the web-based survey, it is important to have an understanding of the issue (Zikmund & Babin, 2010, p. 149). Nonresponse bias or error is statistically a difference between a survey without nonrespondents and a survey that include nonrespondents. In another word, a bias that results when respondent differ from nonrespondents in a meaningful way (Atif et al., 2012; Zikmund & Babin, 2010). Therefore, if there is no nonresponse bias or bias close to zero, the analysis result on the sample will represent the population better.

Unfortunately, it is challenging to measure nonresponse bias since the participant, of course, did not respond. Thus, one way to measure nonresponse bias is to use wave analysis technique or extrapolation methods (Armstrong & Overton, 1977; Atif et al., 2012). The method is based on assumption that subjects who are less readily to answer are more like nonrespondents. “Less readily has been defined as answering later, or as requiring more prodding to answer” (Armstrong & Overton, 1977, p. 397). For this study, reply result of the invitation and the first reminder was considered as the early reply, while second and final reminder was considered the late reply. Therefore, after multigroup (MGA) analysis using Partial Least Squares – Structural Equation Modeling (PLS-SEM), the results is as Table 4.9. There were no significant differences for all 2 tests; (1) test between early reply and late reply and (2) 1st round and 2nd round. Thereby it can be concluded that nonresponse bias has no effect on the representation of the population.

Table 4.9
Result for Nonresponse Error Test

Wave	**Result**
Early reply vs Late reply	Not significant
1st Round vs 2nd Round	Not significant

4.4 Analytical Tools

Partial Least Squares – Structural Equation Modelling (PLS-SEM) was used in this study to find the answer for the various research questions decided earlier. PLS-SEM was selected as the analytical tool for the following reasons (Hair et al., 2014); Firstly, PLS-SEM is an alternative approach to Covariance Based - Structural Equation Modelling (CB-SEM) for a less developed concept. ET-innovation implementation is still in its early stage; literature are scarce and findings are contradicting (C. C. Cheng & Shiu, 2012; R.-J. Lin et al., 2013). Secondly, the sample size is small and/or the data are non-normally distributed. Finally, the structural model is complex. The proposed conceptual model consists of five constructs with 50 indicators.

When surveyed data received, data preparation process need to be executed (Malhotra & Birks, 2006). Since PLS-SEM was selected as the analytical tool, data preparation process was done according to steps suggested by Hair et al. (2014) as in next chapter.

4.5 Summary

This chapter elaborates the detail aspect of the approach that will be taken by this research. Four important aspects; the research design and the instruments, the sampling design and procedures, the data collection issues and the tool of analysis has been discussed at length throughout this chapter.

CHAPTER FIVE

ANALYSES AND RESULTS

This chapter offers analyses and interpretations on findings from the survey questionnaires replies. In order for proper interpretations, the analysis section begins with the descriptive analyses on the demographic profile of the data. A short description of the analysis procedure used to interpret the findings is then presented. Since the eight stages of analysis proposed by Hair et al. (2014) was used for the analysis. The subsequent eight sections reflect the analysis stages and the explanation of results. This chapter concludes with the summary of the chapter.

5.1 Demographic Profile of Respondents

The descriptive analysis involves an examination of several patterns exhibited by the variables of interest in the dataset which include firms' background, respondents' background and the novelty level of eco-product and eco-process innovation implemented by the firm.

5.1.1 Firms' Background

Four background data were collected from the respondent firms; industry, company ownership, years of service and the firms' size in terms of employees' number. A total of 186 (after cleaning) firms from 21 manufacturing subsectors replied the survey. These represent nearly all manufacturing subsectors in Malaysia (EPU, 2015).

Table 5.1 shows that top four subsectors responded to the survey are machinery and equipment industry (16.7%), electrical and electronics (14.5%), food and sustainable resources (13.4%), and concrete products (8.6%) with accumulated 53.2% of total replies. Balance 46.8% (90 firms) replies came from the balance 17 industries. Interestingly, three catalyst subsectors (machinery and equipment industry, electrical and electronics, and chemicals) and two high potential growth subsectors (aerospace and medical devices) (EPU, 2015, pts. 19-11) contribute nearly 40% of the total reply.

Most of the reply came from private companies (80.6%), with the balance from joint venture (JV) (7%), foreign owned (5.9%), public-listed (3.8%) and government-linked companies (GLC) (2.7%). The above also reflected in the size of the firms with 87.6 percent replies were received from small and medium enterprises (SME) (Central Bank of Malaysia, 2013). The balanced were from 23 big firms (≥200 employees).

According to Rosenbusch, Brinckmann, and Bausch (2013) and Sáez-Martínez, Díaz-García, and González-Moreno (2014), firms takes about eight to twelve years to mature. For this study, firms with above 12 years experience were considered as mature. As can be seen from the table (below), about half replies were from young firms (46.8%) and the other half were from mature firms (53.2%).

Table 5.1
Firms Background Statistics

Firms background		Frequency	Percentage
Industry	Aerospace	1	0.5
	Automotive industry	7	3.8
	Basic metal products	6	3.2
	Building & construction materials	3	1.6
	Chemicals	9	4.8
	Concrete products	16	8.6
	Electrical & electronics	27	14.5
	Food & sustainable resources	25	13.4
	Furniture & wood-based	10	5.4
	Jewelry	1	0.5
	Machinery & equipment industry	31	16.7
	Medical devices	6	3.2
	Non-metallic mineral industry	3	1.6
	Palm oil based	4	2.2
	Petrochemicals industry	8	4.3
	Pharmaceutical	13	7.0
	Publishing & printing	1	0.5
	Remanufacturing	6	3.2
	Rubber products	1	0.5
	Shipbuilding	1	0.5
	Textile and apparels	7	3.8
Company type	Federal owned	1	0.5
	Foreign ownership	11	5.9
	Mixed ownership/Joint Venture	13	7.0
	Privately owned	150	80.6
	Publicly owned	7	3.8
	State-owned	4	2.2
Years of operation	>0-6 years	46	24.7
	>6-12 years	41	22.1
	>12-20 years	44	23.7
	>20 years	55	29.2
Firm size	<5 employees	25	13.4
	5-74 employees	107	57.2
	75-199 employees	31	16.3
	≥200 employees	23	11.8

5.1.2 Respondent Background

Table 5.2 listed the years of experience for respondent with their respective firms are quite diversified with employment years of up to 3 years (31.2%), above 3 to 6 years (21.5%), above 6 to 12 years (23.6%) and above 12 years (23.4%). It is also apparent from this table that very nearly half of the reply came from owners/top management (47.8%), while middle management (29.6%) and executives (22.6%).

Table 5.2
Respondent Background Statistics

Respondent background		Frequency	Percentage
Years with the firm	Up to 3 years	58	31.2
	>3-6 years	40	21.5
	>6-12 years	44	23.6
	>12 years	44	23.4
Position	Lower Management/Executives	42	22.6
	Middle Management	55	29.6
	Owners/Top Management	89	47.8

Table 5.3
Environmental Technological Innovation Novelty Statistics

Innovation Novelty		Frequency	Percentage
Eco-product	New to the firm	64	34.4
	New to the Malaysian industry	76	40.9
	New to the world	44	23.7
	Implement eco-process innovation only	2	1.1
Eco-process	New to the firm	84	45.2
	New to the Malaysian industry	59	31.7
	New to the world	39	21
	Implement eco-product innovation only	4	2.2

5.1.3 Innovation Novelty

With regards to the novelty of eco-product innovation, 23.7% claimed that their products are a new invention, while newly introduce in Malaysia at 40.9% and new within the firm at 34.4%. It can be seen from the data in Table 5.3, that most eco-process innovations were adapted to their plants (45.2%), with balance were innovations that new in Malaysia (31.7%), and new to the world (21%).

5.2 Procedure of Analysis

The analysis of this study used the partial least square of structural equation modelling statistic methodology. Data management and analysis were performed using SmartPLS 3 (v3.2.4) (Ringle, Wende, & Becker, 2015). Hence, in being thorough and systematic, the stages of analysis proposed by Hair et al. (2014, p. 25) has been used.

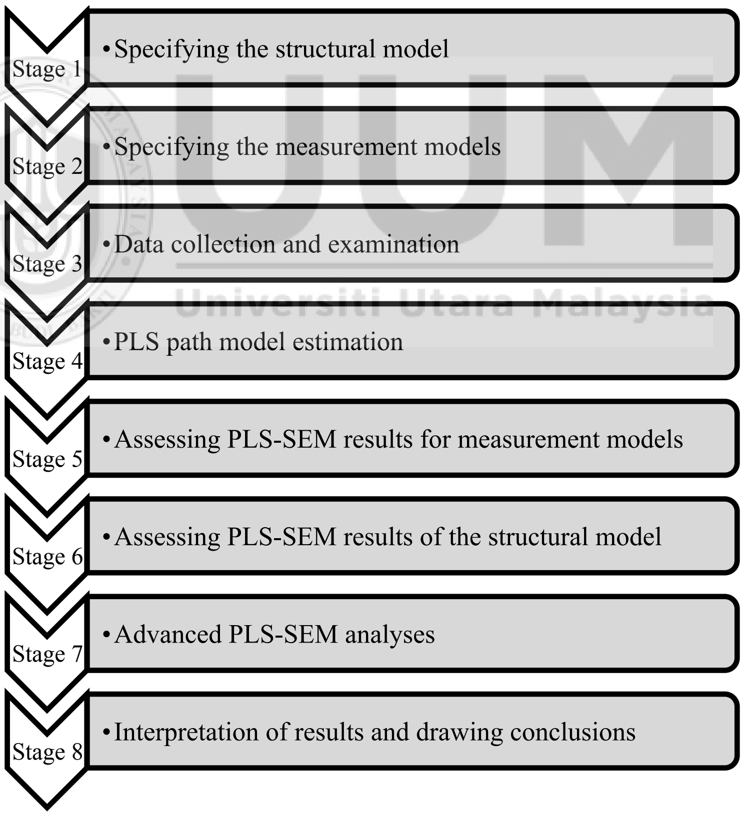

Figure 5.1
A Systematic Procedure for Applying PLS-SEM
Source: Hair et al. (2014)

As Figure 5.1 above, the analyses consist of eight stages begins with the specification of the structural model and measurement model (Stage 1 and 2) which have been explained in details in Chapter 2 and Chapter 3. Stage 3 includes data collection and data examination that also has been detailed out in Chapter 4. Nevertheless, activities done in the three stages will be summarised for easy understanding. The subsequent stage, Stage 4, is the estimation of partial least squares (PLS) model. Stage 5 and Stage 6 are important stages for evaluating the reliability and validity of measurement and structural model. These are the answers of theory versus reality where we can gauge the reflection whether the same, distorted or just plain dark. Finally, Stage 7 and Stage 8 include the process of other advanced analyses which include the mediation, moderation, multi-group analysis (MGA), unobserved heterogeneity test and importance-performance matrix analysis (IPMA), and the final interpretation of results.

5.3 Stage 1 - Structural Model Specification

Base on theory and literature review in Chapter 2, the conceptual model has been explained in Chapter 3. The structural model consists of five components (Figure 5.2). Market demand is the exogenous variable with ET-innovation implementation as the endogenous variable. The study of market demand identified two dimensions which are customer demand and competitor pressure as constructs, while the dimensions of ET-innovation implementation are eco-product innovation implementation and eco-process innovation implementation. Market orientation was hypothesised as the mediator. The structural model also included environmental turbulence and managerial ties as moderators. The former listed three constructs; technological turbulence, market turbulence and competitive intensity, while the latter consists of business ties, political ties and university ties.

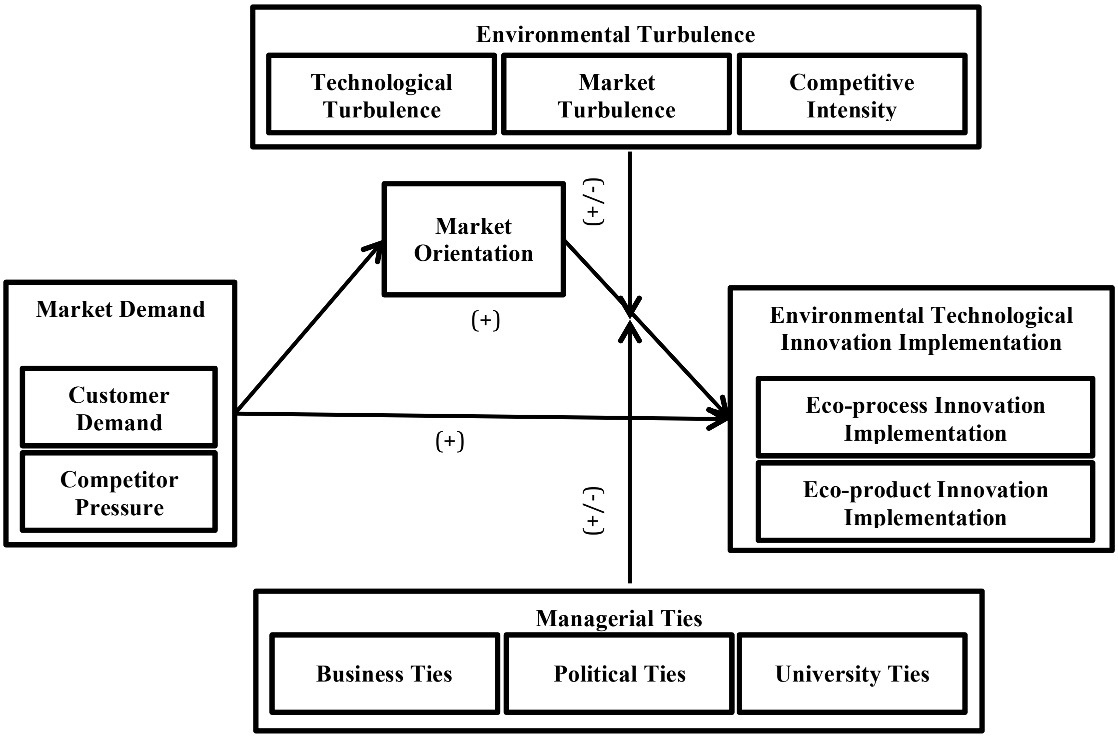

Figure 5.2
Structural Model

Table 5.4
Table of Indicators and Names

Construct	No of Indicators	Questions No.	Types of Measurement Model
Eco-product Innovation Implementation	7	9 – 15	Reflective
Eco-process Innovation Implementation	4	16 – 19	Reflective
Customer Demand	4	20 - 23	Reflective
Competitor Pressure	3	24 - 26	Reflective
Market Orientation	10	27 - 36	Reflective
Technological Turbulence	4	37 – 40	Reflective
Market Turbulence	4	41 – 44	Reflective
Competitive Intensity	4	45 – 48	Reflective
Business Ties	3	49 - 51	Reflective
Political Ties	4	52 – 55	Reflective
University Ties	3	56 – 58	Reflective

5.4 Stage 2 – Measurement Model Specification

Explanations on indicators use by each construct have been described at length in Chapter 4. In summary, please refer Table 5.4 for each construct's indicators and numbers.

5.5 Stage 3 – Data Collection and Examination

Data collection is an important step for any research but especially important for structural equation modelling (SEM) application because error within the received data need to be identified and removed (Hair et al., 2014). Hence, the research design was properly executed to get replies that are as valid and reliable as possible (Refer Chapter 4).

Data issues that contributed to error must be handled when the replied data were accepted. Primary data issues such as missing data, suspicious response pattern, outliers and data distribution were explained in the following section (Hair et al., 2010).

5.5.1 Missing Data

As the survey was done through the internet (questionpro.com, 2016), there was an added security where the system segregated complete responses and incomplete responses. A total of 252 responses were deleted due to incomplete response or double reply. Data checking function also exist within SmartPLS where missing data is recorded before any further analysis, and there were no missing data for this study (refer setting in Appendix A).

5.5.2 Suspicious Response Patterns

Hair et al. (2014) proposed a deletion for straight lining and inconsistency in answers responses. A straight lining is when respondent select one response to all questions or long straight number of questions, while inconsistent answers are when a respondent reply different answer to nearly the same question (normally one screening question). In the case of this study, the novelty questions were derived as screening questions (refer section 5.1.3). Four responses were deleted because of inconsistent answers and four responses were deleted for a straight lining. The Table 5.5 below also showed that seven responses were deleted due to changes in core businesses.

Table 5.5
Total No of Suspicious Responses

Reasons	1st Round	2nd Round	Total
Inconsistency in answers	4		4
Straight lining	1	3	4
Non-manufacturing company	4	3	7

5.5.3 Outliers

As shown in Figure 5.3, there were a number of outliers available in the response data, however, no clear explanation can be derived, thus the data were initially being retained (Sarstedt & Mooi, 2014). Then, the multi-group analysis (MGA) and unobserved heterogeneity tests were done to emerge any distinct or unique subgroup within the response data (Hair et al., 2014). The results found insignificance differences between groups in MGA analysis and an insubstantial level of unobserved heterogeneity. Hence, outliers were preserved in the analysis. (Details of MGA and unobserved heterogeneity tests can be referred in Stage 7).

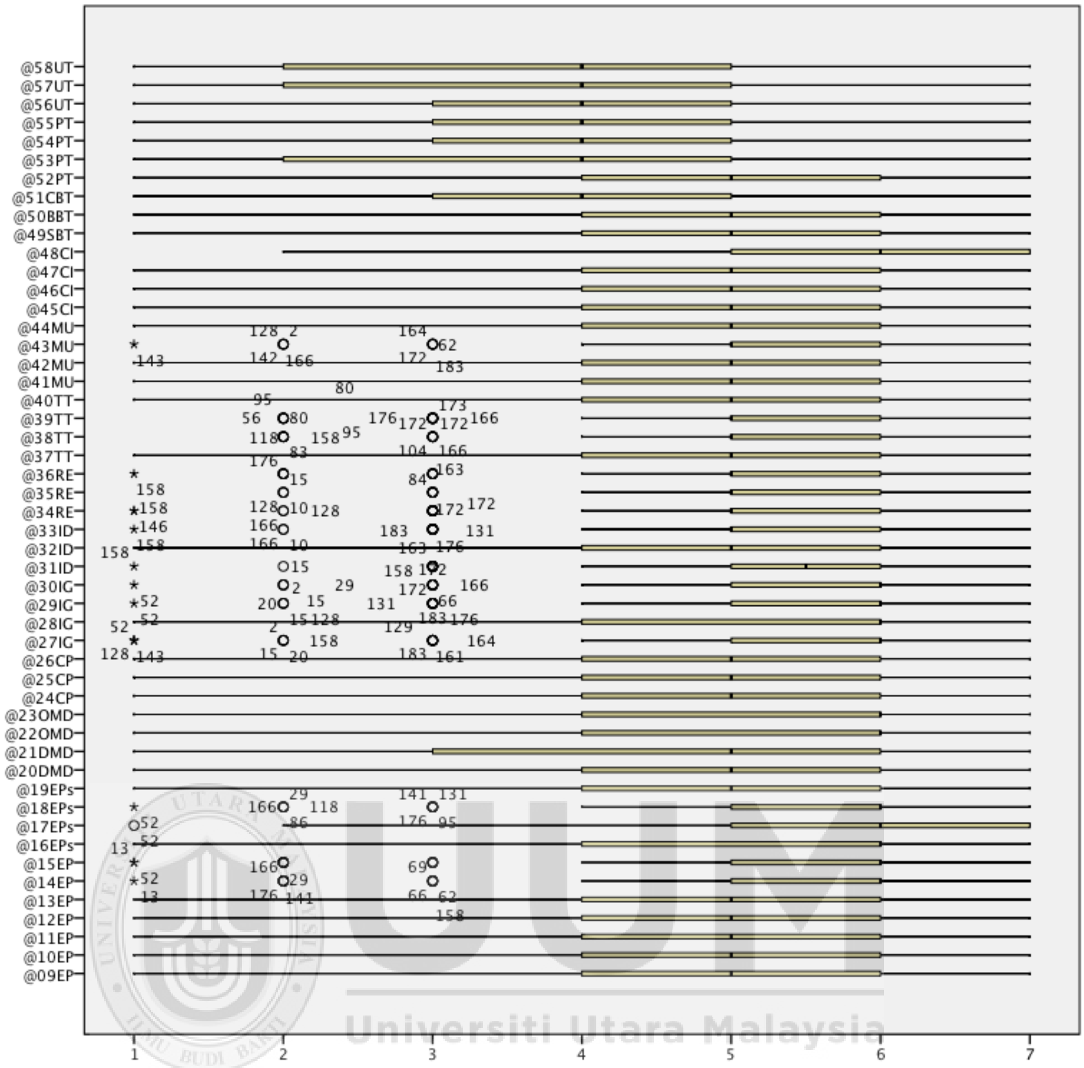

Figure 5.3
Box Plot for Indicators

5.5.4 Data Distribution

PLS-SEM is a nonparametric statistical method where it does not require data distribution to be normally distributed (Garson, 2016; Hair et al., 2014). Acceptable range values of within -1 and +1 can be considered normal. From Appendix I, we can see that there are skewness for indicator 27 (-1.048) and kurtosis for indicator 58 (-1.009) with both results below -1. The results indicate that the response data have minimal skewed and kurtosis and thus very applicable for PLS-SEM analysis (Garson, 2016).

5.6 Stage 4 - PLS Path Model Estimation

PLS-SEM algorithm was originally developed by Wold (1975) and then extended by Lohmöller (1989). As mentioned by Hair et al. (2014), the algorithm estimates the path coefficients for the structural model relationships, the outer loadings and/or outer weights for the measurement models and the R^2 values of the latent endogenous variables.

To run PLS-SEM algorithm in SmartPLS, a few parameters must be set. The setting can be referred in Appendix A. Figure 5.4 provides results when the estimation completed. The effects on eco-process innovation implementation are market orientation (0.37), competitor pressure (0.356), and customer demand (0.054) while for eco-product innovation implementations are competitor pressure (0.552), market orientation (0.127), and customer demand (0.126). Path coefficient of above 0.2, by the rule of thumb, are significant and path coefficient of below 0.1, normally not significant (Hair et al., 2014). The result of the customer demand direct path towards eco-process innovation implementation which is lower than 0.1 was a concern, thus further analysis such as multigroup analysis was planned at a later stage to understand the real phenomena against the theory.

The higher R^2 the better, but a different value can be detected for different field of study (Hair et al., 2014) and value of above 10% can be considered worthy of explanation (Nik Abdullah & Yaakub, 2015). For this study, the model explained eco-process innovation implementation at 43.8% whilst for eco-product innovation implementation at 57.9%

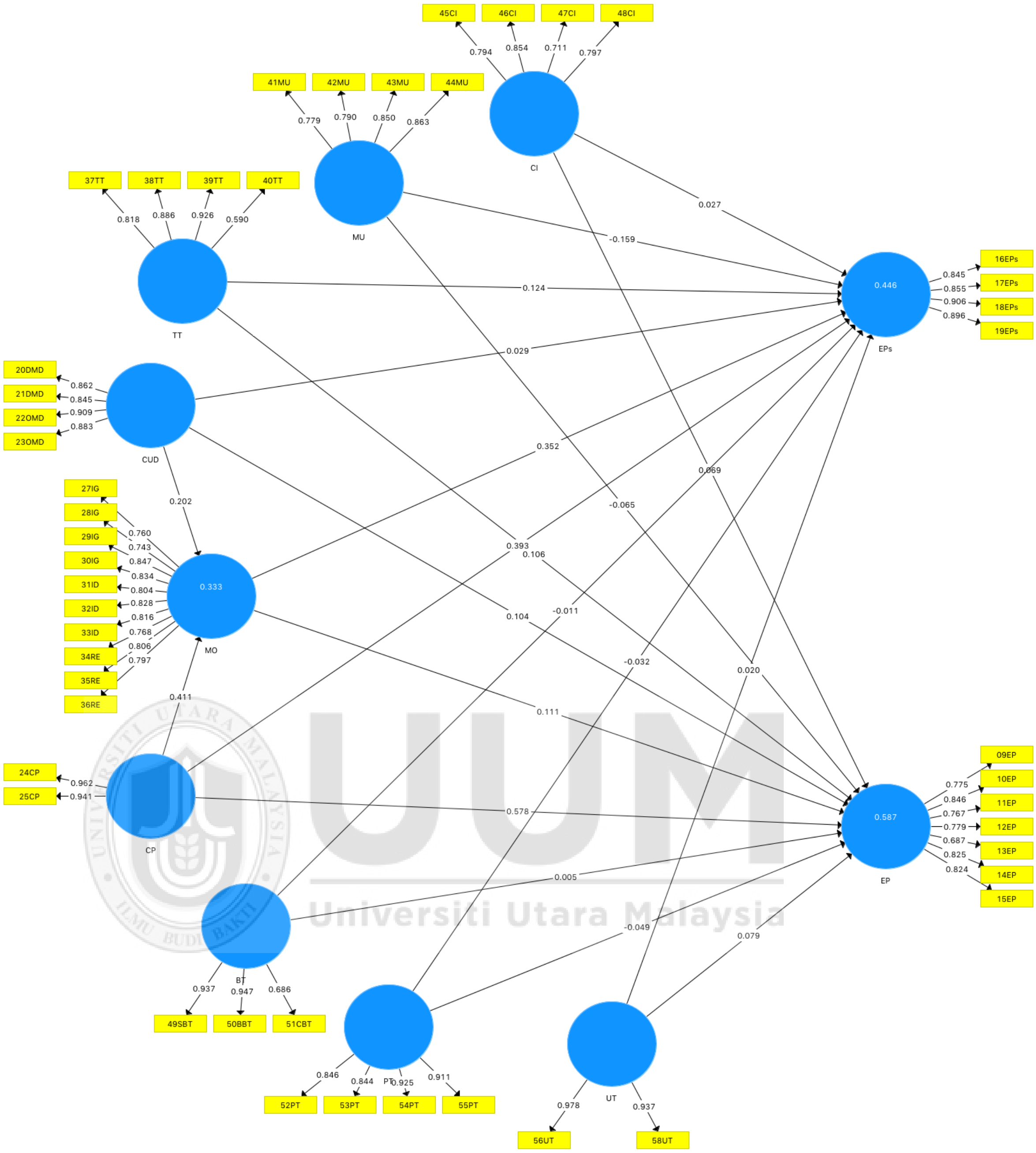

Figure 5.4
Evaluation Model in SmartPLS (after rectification in Stage 5)

5.7 Stage 5 - Evaluation of Measurement Models

A global goodness-of-fit criterion for PLS-SEM although available but not readily acceptable (Garson, 2016). Currently, PLS-SEM researchers rely on measures indicating the model's predictive capabilities to judge the model's quality (Hair et al., 2014). The systematic application for judging the models quality involve evaluating measurement model (Stage 5) and structural model (Stage 6) separately (Garson, 2016; Hair et al., 2014). The evaluation processes completed include tests on reliability and validity of both measurement and structural model as Figure 5.5.

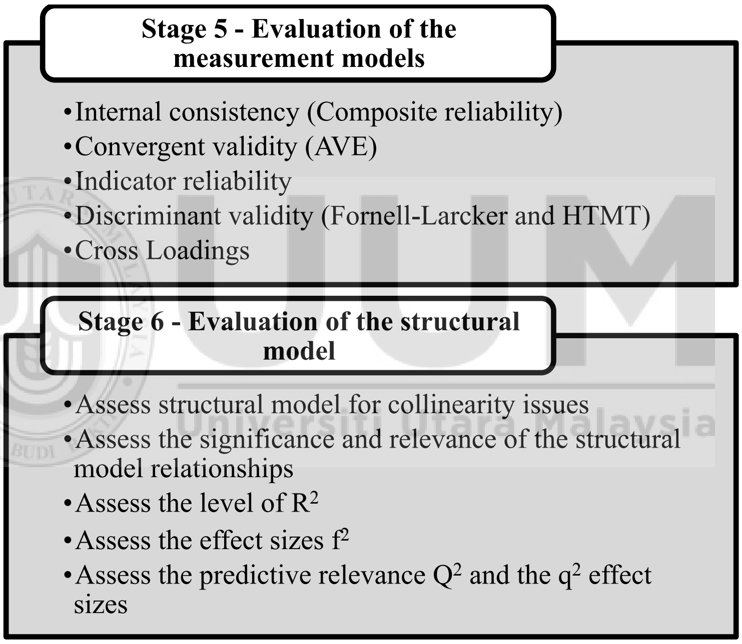

Figure 5.5
Systematic Evaluation of PLS-SEM Results
Source: Garson (2016) and Hair et al. (2014, 2012)

Assessment of reflective measurement models involves determining indicator reliability (squared standardized outer loadings), internal consistency reliability (composite reliability), convergent validity (average variance extracted or AVE), and discriminant validity (Fornell-Larcker criterion and HTMT) and cross-loadings as described by, for example, Hair, Sarstedt, Ringle, and Mena (2012) and Henseler, Hubona, and Ray (2016).

Whereas, assessments for the structural model include collinearity issue, size and significance of path coefficients, coefficients of determination (R^2), predictive relevance (Q^2), f^2 effect sizes and q^2 effect sizes (Garson, 2016; Hair et al., 2014).

5.7.1 Internal Consistency Reliability

Internal composite reliability for the model was measured using composite reliability (also known as Dillon-Goldstein's ρ, factor reliability, Jöreskog's ρ, ω, or ρ_c) (Henseler et al., 2016). Composite reliability was chosen instead of Cronbach's alpha because it does not assume tau-equivalence, making it more appropriate for PLS-SEM, which prioritises individual reliability of each indicator (Hair et al., 2012) and because Cronbach's alpha may under- or overestimate scale reliability in a reflective model (Garson, 2016).

Table 5.6
Composite Reliability of Constructs

Constructs	Composite Reliability before deletion	Composite Reliability after deletion
Business Ties	0.897	0.897
Competitive Intensity	0.869	0.869
Competitor Pressure	0.966	**0.951**
Customer Demand	0.929	0.929
Eco-process Innovation Implementation	0.929	0.929
Eco-product Innovation Implementation	0.919	0.919
Market Orientation	0.947	0.947
Market Turbulence	0.892	0.892
Political Ties	0.933	0.933
Technological Turbulence	0.885	0.885
University Ties	0.971	**0.957**

The acceptable cutoff values for exploratory research are between 0.60 to 0.70, while values between 0.70 and 0.90 would be satisfactory (Hair et al., 2014; Nunnally & Bernstein, 1994). There was a concern for values of above 0.95 reflecting design problems (minor wording variants) or just highly correlated (Garson, 2016; Hair et al., 2014). Table 5.6 presents the composite reliability for all constructs where competitor pressure (0.966) and university ties (0.971) in particular are above 0.95 respectively.

Hair et al. (2014) proposed for any indicators that probably redundant in explaining a particular construct to be deleted since it can increase correlation error. The Table 5.8 below illustrates variance inflation factor (VIF) values for indicators before deletion, which is above 5.0, and VIF after deletion, where values are acceptable (between 0.2 and 5.0; Hair et al., 2014, p. 125). Although composite reliability, in Table 5.6, for competitor pressure (0.951) and university ties (0.957) are still above 0.95, but the VIF value showed significant reduction meaning that both constructs' indicators are correlated but not redundant.

Table 5.7
VIF Value for High Correlation Indicators

Indicators for Competitor Pressure	**VIF before deletion**	**VIF after deletion**	**Indicators for University Ties**	**VIF before deletion**	**VIF after deletion**
24CP	3.320	2.959	56UT	4.866	3.471
25CP	7.702	2.959	57UT	8.035	Deleted
26CP	8.236	Deleted	58UT	5.962	3.471

5.7.2 Convergent Validity

Convergent validity is where a measure should be correlated positively with alternative measures of the same construct (S. B. Green & Salkind, 2014; Hair et al., 2014). The average variance extracted (AVE) and the outer loadings of the indicators was established to determine convergent validity of the model (Hair et al., 2014).

5.7.2.1 Average Variance Extracted (AVE)

Average variance extracted (AVE) is a leading measure of convergent validity (Fornell & Larcker, 1981). It measures unidimensional of a construct to avoid systematic measurement error (Henseler et al., 2016). Table 5.8 shows all construct produce an AVE higher than 0.5, thus can be regarded as acceptable (Henseler et al., 2016).

Table 5.8
Average Variance Extracted (AVE) of Constructs

Constructs	Average Variance Extracted (AVE)
Business Ties	0.748
Competitive Intensity	0.625
Competitor Pressure	0.906
Customer Demand	0.766
Eco-process Innovation Implementation	0.767
Eco-product Innovation Implementation	0.620
Market Orientation	0.642
Market Turbulence	0.675
Political Ties	0.778
Technological Turbulence	0.665
University Ties	0.917

5.7.2.2 Indicator Reliability

Indicator reliability is an association between the construct and its indicators where high outer loading indicate that both has a lot in common (Hair et al., 2014). Nunnally and Bernstein (1994) recommend a minimum reliability of 0.7 (Henseler et al., 2016). Hair et al. (2014) added that if outer loading below 0.70 but above 0.4, these indicators should be analysed base on its impact on AVE and composite reliability. The decision to delete or to retain must consider the threshold of a composite reliability of above 0.7 and an AVE of above 0.5 (Hair, Ringle, & Sarstedt, 2011).

Factor loadings for four indicators from this study were below that 0.7; these are 13EP (0.688), 51CBT (0.686), 40TT(0.590) and 47CI (0.691). To establish indicator reliability, the indicators were deleted in two stages, and then composite reliability and AVE were accessed as Table 5.9. As can be seen in the table, the original composite reliability (above 0.7) and AVE (above 0.5) values were already above the threshold. Therefore, to avoid deleting indicators and effect content validity of the constructs, all indicators were retained (Hair et al., 2011).

Table 5.9
CR and AVE Before and After Indicators Deletion

Constructs	**Before**		**After 13EP, 51CBT and 40TT deletion**		**After 47CI deletion**	
	Composite Reliability	**AVE**	**Composite Reliability**	**AVE**	**Composite Reliability**	**AVE**
Business Ties	0.897	0.748	0.958	0.919	0.958	0.919
Competitive Intensity	0.869	0.625	0.869	0.625	0.877	0.705
Eco-product Innovation Implementation	0.919	0.620	0.919	0.655	0.919	0.655
Technological Turbulence	0.885	0.665	0.926	0.806	0.926	0.806

5.7.3 Discriminant Validity

Discriminant validity is important to differentiate indicators of a construct from other constructs' indicators. Indicators should correlate more within the same construct than with other constructs (S. B. Green & Salkind, 2014; Henseler et al., 2016). Discriminant validity can be tested with Fornell-Larcker criterion and/or Heterotrait-Monotrait Ratio (HTMT).

The Fornell-Larcker criterion stated that a factor's AVE should be higher than its squared correlations with all other factors in the model, while the HTMT is an estimate for the factor correlation where in order to clearly discriminate between two factors, the HTMT should be significantly smaller than one (Henseler et al., 2016). As shown in Appendix J and Appendix K, both, the Fornell-Larcker criterion and the HTMT for this study pass the discriminant validity test.

5.7.4 Cross Loadings

Cross loadings are assessed to avoid an indicator from being assigned to wrong construct (Henseler et al., 2016). All cross loadings are lower than indicator loading assigned for each construct (Appendix L). Thus all indicators were retained.

5.7.5 Result Summary for Measurement Models

Table 5.10 summarises the results of the reflective measurement model assessment (rounded to three decimal places). As can be seen, most model evaluation criteria have been met and the minority that wasn't have been explained. These result, thus providing support for the measures' validity and reliability.

Table 5.10
Summary Result for Measurement Model

Latent Variable	**Internal Consistent Reliability (ρ_c>0.7)**	**Indicator Reliability (Loadings >0.7)**	**Converg ent Validity (AVE> 0.5)**	**Discriminant Validity?**		**Cross Loading s?**
				Fornell-Larcker	**HTMT**	
Business Ties	0.897	Indicator 51CBT =0.686, Retained (CR & AVE above threshold)	0.748	Yes	Yes	No
Competitive Intensity	0.869	Indicator 47CI =0.691, Retained (CR & AVE above threshold)	0.625	Yes	Yes	No

Table 5.10 (Continued)

Latent Variable	Internal Consistent Reliability (ρ_c>0.7)	Indicator Reliability (Loadings >0.7)	Convergent Validity (AVE> 0.5)	Discriminant Validity?		Cross Loadings?
				Fornell-Larcker	HTMT	
Competitor Pressure	0.951, Retained 0.2<VIF<5	>0.7	0.906	Yes	Yes	No
Customer Demand	0.929	>0.7	0.766	Yes	Yes	No
Eco-process Innovation Implementation	0.929	>0.7	0.767	Yes	Yes	No
Eco-product Innovation Implementation	0.919	Indicator 13EP =0.688, Retained (CR & AVE above threshold)	0.620	Yes	Yes	No
Market Orientation	0.947	>0.7	0.642	Yes	Yes	No
Market Turbulence	0.892	>0.7	0.675	Yes	Yes	No
Political Ties	0.933	>0.7	0.778	Yes	Yes	No
Technological Turbulence	0.885	Indicator 40TT =0.590, Retained (CR & AVE above threshold)	0.665	Yes	Yes	No
University Ties	0.957, Retained 0.2<VIF<5	>0.7	0.917	Yes	Yes	No

5.8 Stage 6 - Assessing PLS-SEM Structural Model Results

Once the assessment of measurement model was found reliable and valid, the assessment of structural model was carried out. The assessment was done according to steps proposed by Hair et al. (2014) as in Figure 5.6.

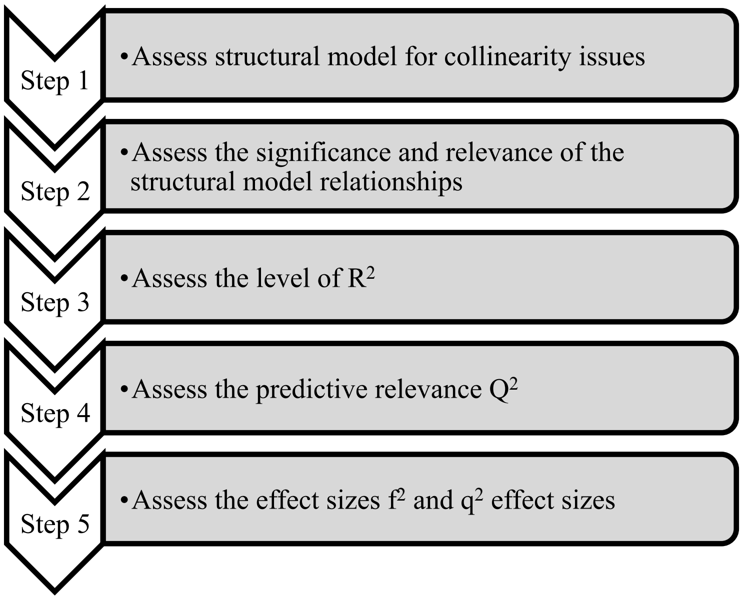

Figure 5.6
Structural Model Assessment Steps
Source: Adapted from Hair et al. (2014)

Table 5.11
Variance Inflation Factor (VIF)

Constructs	**Eco-process Innovation Implementation**	**Eco-product Innovation Implementation**	**Market Orientation**
Business Ties	1.678	1.678	
Competitive Intensity	1.383	1.383	
Competitor Pressure	2.588	2.588	2.219
Customer Demand	2.437	2.437	2.219
Market Orientation	1.967	1.967	
Market Turbulence	2.273	2.273	
Political Ties	2.533	2.533	
Technological Turbulence	1.776	1.776	
University Ties	1.901	1.901	

5.8.1 Collinearity Assessment

Collinearity is a problem when a redundant indicator is used to explain more than one construct. In this case, the indicator needs to be eliminated (Hair et al., 2011). Variance Inflation Factor (VIF) value was used to measure collinearity with a tolerance value of between 0.20 and 5 can be considered as without collinearity problem (Hair et al., 2014). The results of VIF obtained from the SmartPLS, as shown in Table 5.11 earlier, are within tolerance and thus collinearity was not an issue for further assessment.

5.8.2 Assess The Significance and Relevance of The Structural Model Relationships

The path coefficients have values of between -1 to +1 with the nearer the values to 0, the weaker is the relationship. Previous studies generally considered the strength of the relationship as strong (above 0.2), moderate (between 0.10 to 0.20) or weak (below 0.10) which also the same for negative values (Hair et al., 2014; Nik Abdullah & Yaakub, 2015).

Looking at Table 5.12, the moderate and strong relationship towards eco-process innovation implementation are competitor pressure (0.393), market orientation (0.352), market turbulence (-0.159), and technological turbulence (0.124). Whereas, for eco-product innovation implementation, the variables are competitor pressure (0.578), market orientation (0.111), technological turbulence (0.106), and customer demand (0.104).

Further look into total effects in Table 5.13, illustrates that competitor pressure strongly affects both eco-process innovation implementation (0.537) and eco-product innovation implementation (0.624) with customer demand left quite far behind with 0.1 (eco-process) and 0.126 (eco-product) respectively. This is rather surprising because it diverts away from the literature reviews and listed hypotheses. Therefore, there was a need to further access the reasons for the results.

Table 5.12
Significance Testing Results of the Structural Model Path Coefficients

Hypotheses	Relationship	Path Coefficient	t values	p Values	Significance Levels
H1a	Customer Demand -> Eco-process Innovation Implementation	0.029	0.237	0.813	NS
H1b	Customer Demand -> Eco-product Innovation Implementation	0.104	1.075	0.283	NS
H1c	Competitor Pressure -> Eco-process Innovation Implementation	0.393	3.347	0.001	***
H1d	Competitor Pressure -> Eco-product Innovation Implementation	0.578	6.225	0.000	***
-	Customer Demand -> Market Orientation	0.202	1.996	0.046	**
-	Competitor Pressure -> Market Orientation	0.411	4.165	0.000	***
-	Market Orientation -> Eco-process Innovation Implementation	0.352	4.245	0.000	***
-	Market Orientation -> Eco-product Innovation Implementation	0.111	1.439	0.150	NS
-	Technological Turbulence -> Eco-process Innovation Implementation	0.124	1.511	0.131	NS
-	Technological Turbulence -> Eco-product Innovation Implementation	0.106	1.297	0.195	NS
-	Market Turbulence -> Eco-process Innovation Implementation	-0.159	1.696	0.090	*
-	Market Turbulence -> Eco-product Innovation Implementation	-0.065	0.869	0.385	NS
-	Competitive Intensity -> Eco-process Innovation Implementation	0.027	0.373	0.709	NS
-	Competitive Intensity -> Eco-product Innovation Implementation	0.069	1.250	0.212	NS
-	Business Ties -> Eco-process Innovation Implementation	-0.011	0.139	0.889	NS

Table 5.12 (Continued)

Hypotheses	Relationship	Path Coefficient	t values	p Values	Significance Levels
-	Business Ties -> Eco-product Innovation Implementation	0.005	0.074	0.941	NS
-	Political Ties -> Eco-process Innovation Implementation	-0.032	0.292	0.770	NS
-	Political Ties -> Eco-product Innovation Implementation	-0.049	0.677	0.498	NS
-	University Ties -> Eco-process Innovation Implementation	0.020	0.225	0.822	NS
-	University Ties -> Eco-product Innovation Implementation	0.079	1.121	0.263	NS

Note: NS = not significant. *p < .10. **p < .05. ***p < .01

Table 5.13
Significance Testing Results of the Structural Model Total Effects

Hypotheses	Relationship	Path Coefficient	t values	p Values	Significance Levels
-	Customer Demand -> Eco-process Innovation Implementation	0.100	0.776	0.438	NS
-	Customer Demand -> Eco-product Innovation Implementation	0.126	1.334	0.183	NS
-	Competitor Pressure -> Eco-process Innovation Implementation	0.537	4.794	0.000	***
-	Competitor Pressure -> Eco-product Innovation Implementation	0.624	6.853	0.000	***

Note: NS = not significant. *p < .10. **p < .05. ***p < .01

In order to identify the significance of structural model relationships, bootstrapping is commonly use. It is a resampling procedure for nonparametric data which involve repeated sampling from the data set and estimating the effect of each resampled data set (Hair et al., 2011; Preacher & Hayes, 2008). According to Chin (2001, 2010), resamples of 200 to 1000 is appropriate to produce reasonable standard error estimates for hypothesis testing when performing bootstrapping. Hence, for this study, 1000 resamples was used for a statistical reason and for time and technical reason as more resamples will need more time or more advanced equipment for a faster result (refer setting in Appendix B).

From Table 5.12 and Table 5.13 above, the author can see that competitor pressure relationship with eco-process innovation implementation and eco-product innovation implementation showed significant relationships for direct and total effect. Market orientation only has a significant relationship with eco-process innovation implementation, although customer demand and competitor pressure relationship with market orientation are significance. This result showed the level of market orientation implementation in the green manufacturing industry in Malaysia is still low especially in product innovation although the awareness is high. Further discussion will be explained in next chapter.

5.8.3 Assess the Coefficient of Determination (R^2 Value)

The coefficient of determination (R^2 value) is the most common measure to evaluate the structural model. It measures model's predictive accuracy with values ranges from 0 to 1 (Hair et al., 2014, p. 174). Values closer to 1 indicate higher predictive accuracy. Using Chin (1998) cutoff value for R^2 of 0.67, 0.33 and 0.19 which represent substantial, moderate and weak, the endogenous constructs predictive accuracy can be safely considered as moderate (Garson, 2016). The R^2 value for eco-process innovation implementation and eco-product innovation implementation are 0.446 and 0.587 respectively (Table 5.18), which means that the model explains 44.6% and 58.7% of the variance in the level of eco-process innovation and eco-product innovation implementations among manufacturers in Malaysia.

Table 5.14
Results of R^2 and Q^2 Values

	R^2 Value	Q^2 Value
Eco-process Innovation Implementation	0.446	0.310
Eco-product Innovation Implementation	0.587	0.328
Market Orientation	0.333	0.192

5.8.4 Predictive Relevance Q^2

Path coefficients in a structural model may be significant, but their size may be so small to be given special attention. This is crucial for management when interpreting the importance of relationships before drawing conclusions and taking actions. Therefore, it is important to assess the relevance of significant relationships (Hair et al., 2014). Stone (1974) and Geisser (1974) is the leading figures in the development of predictive relevance Q^2 for reflective model thus also known as Stone-Geisser Q^2 (Chin, 1998). A Q^2 value of greater than 0 means that the PLS-SEM model is predictive of the particular construct, while a Q^2 with a 0 or negative value indicates the model is irrelevant to a prediction of the given endogenous factor (Garson, 2016). As can be seen in Table 5.14, Q^2 values of endogenous constructs are noticeably above 0 thus providing support for the predictive relevance of the model.

5.8.5 Effect Size (f^2)

To understand the impact of an exogenous construct gave against an endogenous construct, the exogenous construct is being omitted from the model and the change in R^2 is being measured. The result is called an effect size f^2 (Hair et al., 2014). The threshold values of f^2 are 0.02, 0.15, and 0.35 which represent small, medium, and large effects (Garson, 2016; Hair et al., 2014). Table 5.15 shows a medium effect size of competitor pressure against eco-product innovation implementation. Other small effects include the competitor pressure against eco-process innovation implementation and market orientation, market orientation and market turbulence effect against eco-process innovation implementation, and customer demand effect against market orientation.

Table 5.15
f^2 Results

Constructs	Eco-process Innovation Implementation	Eco-product Innovation Implementation	Market Orientation
Business Ties	0.000	0.000	
Competitive Intensity	0.001	0.008	
Competitor Pressure	**0.108**	**0.313**	**0.114**
Customer Demand	0.001	0.011	**0.028**
Market Orientation	**0.113**	0.015	
Market Turbulence	**0.020**	0.005	
Political Ties	0.001	0.002	
Technological Turbulence	0.016	0.015	
University Ties	0.000	0.008	

5.8.6 Effect Size (q^2)

Predictive relevance impact can also be measured similarly to effect size f^2 for coefficient determination R^2. The effect size q^2 can be indicated as small, medium, or large predictive relevance for a certain endogenous construct by cutoff values of 0.02, 0.15, and 0.35 (Hair et al., 2014). Small effect predictive relevance can be seen for competitor pressure against ET-innovation implementation and also market orientation against eco-process innovation implementation (Table 5.16).

Table 5.16
Effect Size (q^2)

Constructs	Eco-process Innovation Implementation	Eco-product Innovation Implementation	Market Orientation
Business Ties	0.000	-0.001	
Competitive Intensity	0.000	0.001	
Competitor Pressure	**0.028**	**0.048**	0.015
Customer Demand	-0.002	0.002	0.004
Market Orientation	**0.028**	0.002	
Market Turbulence	0.005	0.000	
Political Ties	0.000	-0.001	
Technological Turbulence	0.004	0.002	
University Ties	0.000	0.001	

5.8.7 Result Summary for Structural Assessment

Table 5.17 summarises the results of the f^2 and q^2 effect sizes with respect to all the relationships in the model, along with the path coefficients. It can be seen from the data in the table that path coefficients with acceptable effect sizes on predictive accuracy and relevance are competitor pressure against eco-product innovation and eco-process innovation. The path coefficient and effect sizes are 0.578 with f^2 (q^2) of 0.313 (0.048) and 0.393 with 0.108 (0.028). Correspondingly, market orientation against eco-process innovation implementation with path coefficient 0.352 and 0.113 (0.028) effect sizes.

Table 5.17
Summary of Results

Constructs	Eco-process Innovation Implementation			Eco-product Innovation Implementation			Market Orientation		
	Path Coefficients	f^2 Effect Size	q^2 Effect Size	Path Coefficients	f^2 Effect Size	q^2 Effect Size	Path Coefficients	f^2 Effect Size	q^2 Effect Size
Business Ties	-0.011	0.000	0.000	0.005	0.000	-0.001			
Competitive Intensity	0.027	0.001	0.000	0.069	0.008	0.001			
Competitor Pressure	**0.393**	**0.108**	**0.028**	**0.578**	**0.313**	**0.048**	**0.411**	**0.114**	0.015
Customer Demand	0.029	0.001	-0.002	0.104	0.011	0.002	**0.202**	**0.028**	0.004
Market Orientation	**0.352**	**0.113**	**0.028**	0.111	0.015	0.002			
Market Turbulence	**-0.159**	**0.020**	0.005	-0.065	0.005	0.000			
Political Ties	-0.033	0.001	0.000	-0.049	0.002	-0.001			
Technological Turbulence	0.124	0.016	0.004	0.106	0.015	0.002			
University Ties	0.020	0.003	0.001	0.079	0.009	0.002			

5.8.8 Model Fit

There are a few model fit suggested to be used for PLS-SEM, such are the goodness-of-fit index (GoF) (Tenenhaus, Vinzi, Chatelin, & Lauro, 2005), the tests of model fit using the geodesic discrepancy (d_G), or the unweighted least squares discrepancy (d_{ULS}) to quantify the discrepancy between two matrices (Dijkstra & Henseler, 2015), and the approximate model fit using the standardized root mean square residual (SRMR; Hu & Bentler, 1999) or normed fit index (NFI or the Bentler-Bonett index) to measure the strength of discrepancy between the model-implied and the empirical correlation matrix (Henseler et al., 2016).

Model fit was not used for this study for several reasons: firstly, GoF does not represent a goodness-of-fit criterion for PLS-SEM because it is unable to separate valid models from invalid models (Hair et al., 2014; Henseler & Sarstedt, 2012), secondly, most of the above measures' are young and their behavior across data and model constellations need for further research, thirdly, the test for model fit and approximate fit are more applicable for consistent PLS (PLSc) (Henseler et al., 2016), and finally, as standard PLS-SEM focuses on prediction rather than on explanatory modeling, "their use can even be harmful as researchers may be tempted to sacrifice predictive power to achieve better 'fit'" (smartpls, 2015).

5.9 Stage 7 - Advances PLS-SEM Analyses

5.9.1 Mediator Analysis

According to MacKinnon, Fairchild, and Fritz (2007), "mediation is one way that a researcher can explain the process or mechanism by which one variable affects another" (p. 593). The principal of mediation analysis is that it analyse a sequence of relationships where an antecedent variable affects a mediating variable, and then affects a dependent variable (Nitzl, Roldán, & Cepeda Carrión, 2016).

The most commonly used mediating tests are the Sobel test or causal steps strategy (Baron & Kenny, 1986; Sobel, 1982, 1986). Even though it is the most commonly used method, the causal steps strategy is normally used in large samples (Preacher & Hayes, 2008). Preacher and Hayes (2008) recommended the use of bootstrapping for testing mediation because it does not impose the assumption of normality of the sampling distribution (Hair et al., 2014).

Although many authors used Baron and Kenny (1986) three conditions of mediation when testing the mediation analysis, on the contrary, Hayes (2014) emphasise that "evidence that path c is different from zero is not a requirement of 21st-century mediation analysis. Correlation between X and Y is neither sufficient nor necessary to claim that X affects Y" (refer Figure 5.7). Thus for this study, the procedure of analysis by Nitzl et al. (2016) as adapted from Zhao, Lynch, and Chen (2010) was used (refer Figure 5.8).

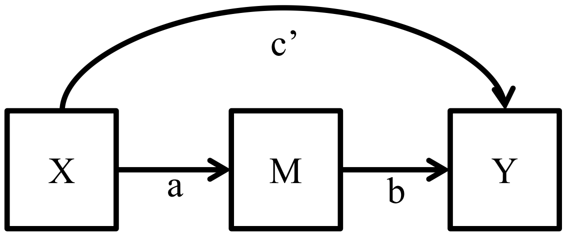

Figure 5.7
Indirect Effect

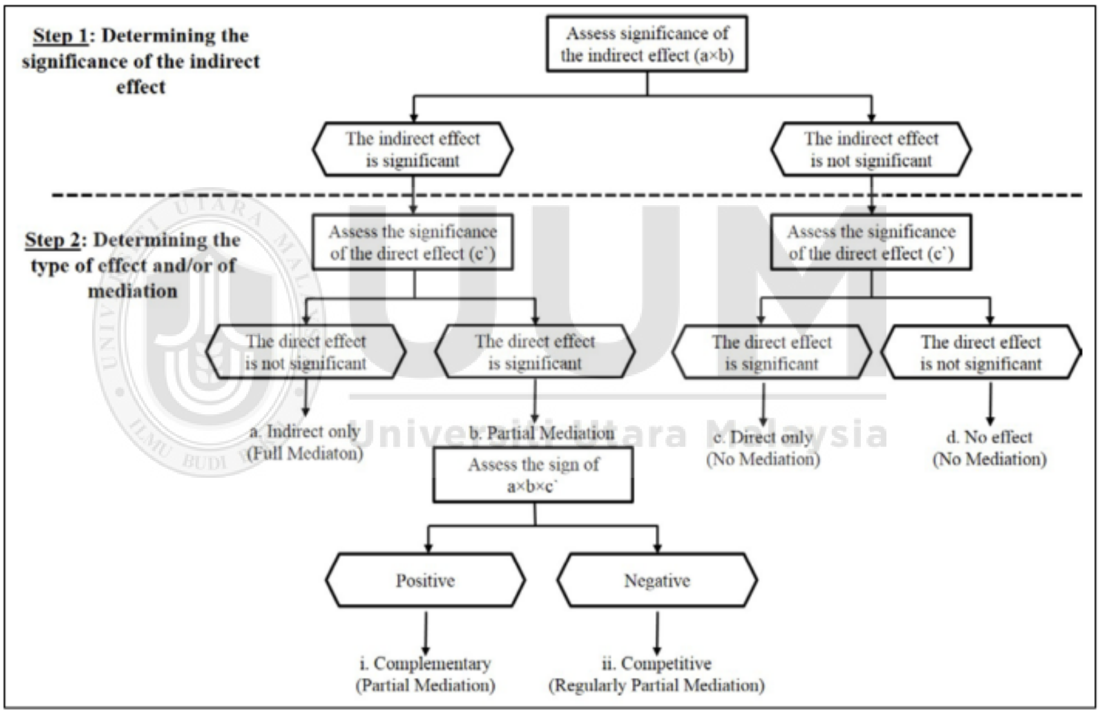

Figure 5.8
Mediator analysis procedure in PLS
Source: Nitzl et al. (2016) and Zhao et al. (2010)

The results (as Table 5.18) of the above procedure indicate that partial mediation exists in the relationship between competitor pressure and eco-process innovation implementation and a full mediation for the relationship between customer demand and eco-process innovation implementation. Whereas, there is a significant direct effect on the relationship of competitor pressure to eco-product innovation implementation. However, no relationships exist between customer demand and eco- product innovation implementation. Surprisingly, these results partially divert from the hypotheses hence will be explained in Chapter 6.

Table 5.18
Findings after Mediation Analysis

Hypo-theses	**Relationship**	**Indirect Effect**	**t Values**	**p Values**	**Significance Levels**
H2a	Customer Demand -> Eco-process Innovation Implementation	0.066	1.668	0.096	*
H2b	Customer Demand -> Eco-product Innovation Implementation	0.018	0.796	0.426	NS
H2c	Competitor Pressure -> Eco-process Innovation Implementation	0.134	2.612	0.009	**
H2d	Competitor Pressure -> Eco-product Innovation Implementation	0.036	0.955	0.340	NS

Hypo-theses	**Direct Effect**	**t Values**	**p Values**	**Significance Levels**	**Findings**
H2a	0.078	0.631	0.528	NS	Full mediation
H2b	0.129	1.378	0.168	NS	No mediation (No effect)
H2c	0.354	2.884	0.004	***	Complementary partial mediation
H2d	0.506	5.161	0.000	***	No mediation (Direct only)

Note: NS = not significant. *p < .10. **p < .05. ***p < .01

5.9.2 Continuous Moderator Effects

Moderator variable specifies the form and/or magnitude of the relationship between a predictor and a criterion variable (Sharma, Durand, & Gur-Arie, 1981). Analysis for moderator examines how its interact with the effect of an antecedent variable on the subsequent variable (Hayes, 2014).

For moderation analysis test, Chin (2010) suggested the use of product indicator approach instead of two stages approach (latent variable score method) as it produces more accurate parameter estimates in his simulation test (Garson, 2016). For the reason above and high level of composite reliabilities (refer Hair et al., 2014, p. 269), the moderation analysis was executed using product indicator approach.

The moderating hypothesis is supported if the interaction path coefficient is significant (Henseler & Fassott, 2010). As can be seen in Table 5.19, no significant moderation effect was detected for all hypotheses.

Table 5.19
Findings after Moderation Analysis

Hypo-theses	Relationship	Direct Effect	t Values	p Values	Significance Levels	Findings
H3a	Market Orientation-\Technological Turbulence/ -> Eco-process Innovation Implementation	0.076	1.588	0.113	NS	No moderation
H3b	Market Orientation-\Technological Turbulence/ -> Eco-product Innovation Implementation	0.072	1.486	0.138	NS	No moderation
H3c	Market Orientation-\Market Turbulence/ -> Eco-process Innovation Implementation	-0.040	0.534	0.594	NS	No moderation
H3d	Market Orientation-\Market Turbulence/ -> Eco-product Innovation Implementation	-0.070	1.304	0.193	NS	No moderation
H3e	Market Orientation-\Competitive Intensity/ -> Eco-process Innovation Implementation	-0.007	0.150	0.881	NS	No moderation
H3f	Market Orientation-\Competitive Intensity/ -> Eco-product Innovation Implementation	-0.011	0.317	0.751	NS	No moderation
H4a	Market Orientation-\Business Ties/ -> Eco-process Innovation Implementation	-0.017	0.347	0.729	NS	No moderation
H4b	Market Orientation-\Business Ties/ -> Eco-product Innovation Implementation	-0.077	0.971	0.332	NS	No moderation
H4c	Market Orientation-\Political Ties/ -> Eco-process Innovation Implementation	-0.087	0.996	0.319	NS	No moderation

Table 5.19 (Continued)

Hypo-theses	Relationship	Direct Effect	t Values	p Values	Significance Levels	Findings
H4d	Market Orientation-\Political Ties/ -> Eco-product Innovation Implementation	-0.050	0.837	0.403	NS	No moderation
H4e	Market Orientation-\University Ties/ -> Eco-process Innovation Implementation	0.038	0.840	0.401	NS	No moderation
H4f	Market Orientation-\University Ties/ -> Eco-product Innovation Implementation	0.027	0.703	0.482	NS	No moderation

Note: NS = not significant.

5.9.3 Multi-Group Analysis

Beside continuous moderating effect as analysed in the previous section, there are other methods that explore the existence of two or more heterogeneous groups that show significant differences across a group of data (Hair et al., 2014). The other method is generally "regarded as a special case of modelling continuous moderating effects" which is the multigroup analysis (MGA) (Sarstedt, Henseler, & Ringle, 2011, p. 198).

Since an inability to analyse the heterogeneity can lead to a wrong conclusion, it is important to test all possible angle (Becker, Rai, Ringle, & Völckner, 2013). The above two methods are quite frequently used for observed heterogeneity (Hair et al., 2014), whereas methods for unobserved heterogeneity will be analysed in the subsequent section (Section 5.9.4).

There are three methods for multigroup analysis. These are partial least square-multigroup analysis (PLS-MGA), parametric test, and Welch-Satterthwait test (Garson, 2016; Sarstedt, Henseler, et al., 2011). All three methods test the significance of path differences, but only PLS-MGA was designed for nonparametric data (Henseler, Ringle, & Sinkovics, 2009). It is used to compare differences between path coefficients in the structural model, and/or differences in loadings or weights (Hair et al., 2014). The observed variable of firms' age and firms' size was tested and explained in subsequent subsections.

5.9.3.1 Firms Maturity

Examining the p-values column in Table 5.20 and Table 5.21, the difference showed that all direct and indirect effect differences were not significant. These results are consistent with those of other studies and suggest that the model can be used for young and mature firms (Cuerva et al., 2014; Horbach, 2008).

Table 5.20
PLS-MGA Significance Test Result for Young and Mature Firms

Relationships	Path Coefficients Different	p-Values	Findings
Business Ties -> Eco-process Innovation Implementation	0.049	0.598	NS
Business Ties -> Eco-product Innovation Implementation	0.218	0.915	NS
Competitive Intensity -> Eco-process Innovation Implementation	0.179	0.159	NS
Competitive Intensity -> Eco-product Innovation Implementation	0.094	0.258	NS
Competitor Pressure -> Eco-process Innovation Implementation	0.232	0.187	NS
Competitor Pressure -> Eco-product Innovation Implementation	0.171	0.221	NS
Competitor Pressure -> Market Orientation	0.236	0.121	NS
Customer Demand -> Eco-process Innovation Implementation	0.204	0.785	NS
Customer Demand -> Eco-product Innovation Implementation	0.265	0.896	NS
Customer Demand -> Market Orientation	0.273	0.906	NS
Market Orientation -> Eco-process Innovation Implementation	0.044	0.578	NS

Table 5.20 (Continued)

Relationships	Path Coefficients Different	p-Values	Findings
Market Orientation -> Eco-product Innovation Implementation	0.204	0.877	NS
Market Orientation-\Business Ties/ -> Eco-process Innovation Implementation	0.111	0.202	NS
Market Orientation-\Business Ties/ -> Eco-product Innovation Implementation	0.016	0.564	NS
Market Orientation-\Competitive Intensity/ -> Eco-process Innovation Implementation	0.103	0.782	NS
Market Orientation-\Competitive Intensity/ -> Eco-product Innovation Implementation	0.062	0.751	NS
Market Orientation-\Market Turbulence/ -> Eco-process Innovation Implementation	0.054	0.375	NS
Market Orientation-\Market Turbulence/ -> Eco-product Innovation Implementation	0.086	0.743	NS
Market Orientation-\Political Ties/ -> Eco-process Innovation Implementation	0.009	0.432	NS
Market Orientation-\Political Ties/ -> Eco-product Innovation Implementation	0.077	0.262	NS
Market Orientation-\Technological Turbulence/ -> Eco-process Innovation Implementation	0.162	0.868	NS
Market Orientation-\Technological Turbulence/ -> Eco-product Innovation Implementation	0.015	0.552	NS
Market Orientation-\University Ties/ -> Eco-process Innovation Implementation	0.097	0.813	NS
Market Orientation-\University Ties/ -> Eco-product Innovation Implementation	0.025	0.617	NS
Market Turbulence -> Eco-process Innovation Implementation	0.359	0.946	NS
Market Turbulence -> Eco-product Innovation Implementation	0.202	0.148	NS
Political Ties -> Eco-process Innovation Implementation	0.161	0.233	NS
Political Ties -> Eco-product Innovation Implementation	0.028	0.432	NS
Technological Turbulence -> Eco-process Innovation Implementation	0.195	0.169	NS
Technological Turbulence -> Eco-product Innovation Implementation	0.000	0.502	NS
University Ties -> Eco-process Innovation Implementation	0.137	0.763	NS
University Ties -> Eco-product Innovation Implementation	0.069	0.671	NS

Note: NS = not significant. *p < .10. **p < .05. ***p < .01

Table 5.21
PLS-MGA Significance Test Result for Indirect Effects for Young and Mature Firms

Relationships	Indirect Effects Different	p-Values	Findings
Competitor Pressure -> Eco-process Innovation Implementation	0.065	0.272	NS
Competitor Pressure -> Eco-product Innovation Implementation	0.053	0.748	NS
Customer Demand -> Eco-process Innovation Implementation	0.105	0.901	NS
Customer Demand -> Eco-product Innovation Implementation	0.076	0.932	NS

Note: NS = not significant. *p < .10. **p < .05. ***p < .01

5.9.3.2 Firms Size

This PLS-MGA tests the difference for small medium industry (SME) in the collected data against all replied survey result. Total numbers of SME are 163 versus 186 total firms. As can be seen in Table 5.22 and Table 5.23, the results illustrate that the model can be generalised for SME industry. However, with a small sample size of big manufacturing firms, caution must be applied, as the findings might not be transferable to the Malaysian manufacturing industry inclusively. Nonetheless, the numbers of reply from the SME of more than 87% actually show the portion of the actual percentage of SME versus big manufacturing companies in Malaysia which is about 95% (C. K. Wong, 2013).

Table 5.22
PLS-MGA Significance Test Result for Firms Size

Relationships	Path Coefficients Different	p-Values	Findings
Business Ties -> Eco-process Innovation Implementation	0.006	0.516	NS
Business Ties -> Eco-product Innovation Implementation	0.077	0.228	NS
Competitive Intensity -> Eco-process Innovation Implementation	0.014	0.546	NS

Table 5.22 (Continued)

Relationships	Path Coefficients Different	p-Values	Findings
Competitive Intensity -> Eco-product Innovation Implementation	0.016	0.430	NS
Competitor Pressure -> Eco-process Innovation Implementation	0.003	0.504	NS
Competitor Pressure -> Eco-product Innovation Implementation	0.032	0.581	NS
Competitor Pressure -> Market Orientation	0.003	0.493	NS
Customer Demand -> Eco-process Innovation Implementation	0.015	0.538	NS
Customer Demand -> Eco-product Innovation Implementation	0.028	0.424	NS
Customer Demand -> Market Orientation	0.025	0.568	NS
Market Orientation -> Eco-process Innovation Implementation	0.012	0.530	NS
Market Orientation -> Eco-product Innovation Implementation	0.025	0.580	NS
Market Orientation-\Business Ties/ -> Eco-process Innovation Implementation	0.010	0.557	NS
Market Orientation-\Business Ties/ -> Eco-product Innovation Implementation	0.033	0.619	NS
Market Orientation-\Competitive Intensity/ -> Eco-process Innovation Implementation	0.002	0.490	NS
Market Orientation-\Competitive Intensity/ -> Eco-product Innovation Implementation	0.008	0.562	NS
Market Orientation-\Market Turbulence/ -> Eco-process Innovation Implementation	0.005	0.511	NS
Market Orientation-\Market Turbulence/ -> Eco-product Innovation Implementation	0.007	0.458	NS
Market Orientation-\Political Ties/ -> Eco-process Innovation Implementation	0.008	0.527	NS
Market Orientation-\Political Ties/ -> Eco-product Innovation Implementation	0.052	0.267	NS
Market Orientation-\Technological Turbulence/ -> Eco-process Innovation Implementation	0.005	0.471	NS
Market Orientation-\Technological Turbulence/ -> Eco-product Innovation Implementation	0.011	0.569	NS
Market Orientation-\University Ties/ -> Eco-process Innovation Implementation	0.014	0.586	NS
Market Orientation-\University Ties/ -> Eco-product Innovation Implementation	0.008	0.436	NS

Table 5.22 (Continued)

Relationships	Path Coefficients Different	p-Values	Findings
Market Turbulence -> Eco-process Innovation Implementation	0.062	0.331	NS
Market Turbulence -> Eco-product Innovation Implementation	0.028	0.595	NS
Political Ties -> Eco-process Innovation Implementation	0.026	0.432	NS
Political Ties -> Eco-product Innovation Implementation	0.069	0.718	NS
Technological Turbulence -> Eco-process Innovation Implementation	0.020	0.556	NS
Technological Turbulence -> Eco-product Innovation Implementation	0.011	0.529	NS
University Ties -> Eco-process Innovation Implementation	0.047	0.644	NS
University Ties -> Eco-product Innovation Implementation	0.037	0.370	NS

Note: NS = not significant.

Table 5.23
PLS-MGA Significance Test Result for Indirect Effects for Firms Size

Relationships	Indirect Effects Different	p-Values	Findings
Competitor Pressure -> Eco-process Innovation Implementation	0.006	0.516	NS
Competitor Pressure -> Eco-product Innovation Implementation	0.077	0.228	NS
Customer Demand -> Eco-process Innovation Implementation	0.010	0.585	NS
Customer Demand -> Eco-product Innovation Implementation	0.007	0.589	NS

Note: NS = not significant.

5.9.4 Unobserved Heterogeneity

It is unrealistic to assume the collected data as homogeneous to characterise a single population, especially in social and behavioural sciences including marketing, management and information systems (Becker, Ringle, & Völckner, 2009). As mentioned earlier, failure in detecting heterogeneity among others, can cause bias parameter estimates, which lead to Type I and Type II errors, resulting in invalid conclusions (Becker et al., 2013), it can be a threat to the validity of PLS-SEM results, leading to incorrect coalescences (Rigdon, Ringle, & Sarstedt, 2010; Rigdon, Ringle, Sarstedt, & Gudergan, 2011), and if not carefully taken into account, may involve misleading interpretations (Matthews et al., 2016).

In the preceding section, observable characters such as firms age and size have been tested with multigroup analysis method, however, there are possibilities of "significant differences in model relationships between groups of data" which cannot be traced to observable one (Hair et al., 2016, p. 63). These unobserved heterogeneity can be explored with a few differently function method within PLS, such as; the finite mixture PLS (FIMIX-PLS; Sarstedt, Becker, Ringle, & Schwaiger, 2011), the response-based procedure for detecting unit segments (REBUS-PLS; Esposito Vinzi, Ringle, Squillacciotti, & Trinchera, 2007; Esposito Vinzi, Trinchera, Squillacciotti, & Tenenhaus, 2008), the PLS-SEM prediction-oriented segmentation approach (PLS-POS; Becker et al., 2013), the genetic algorithm segmentation in PLS-SEM (PLS-GAS; Ringle, Sarstedt, & Schlittgen, 2014; Ringle, Sarstedt, Schlittgen, & Taylor, 2013), and the iterative reweighted regressions segmentation method (PLS-IRRS; Schlittgen, Ringle, Sarstedt, & Becker, 2016). As for this study, we used FIMIX-PLS technique to distinguish unobserved heterogeneity.

5.9.4.1 FIMIX-PLS

FIMIX-PLS is one of the earliest methods that can produce a result that indicate the significance of unobserved heterogeneity in collected data (Matthews et al., 2016; Sarstedt, 2008). FIMIX-PLS is rather prevalent because of several reasons: it is the best understood latent class approach to PLS-SEM (Sarstedt, 2008), it detects unobserved heterogeneity in the structural model (Becker et al., 2013), it is the only approach that proposes step-by-step techniques towards permeating segment's numbers from replied data (Matthews et al., 2016) and it has gone through more tests, thus more systematic approach existed (Hair et al., 2016). To be systematic, the four steps approach by Hair et al. (2016) as Figure 5.9 was executed.

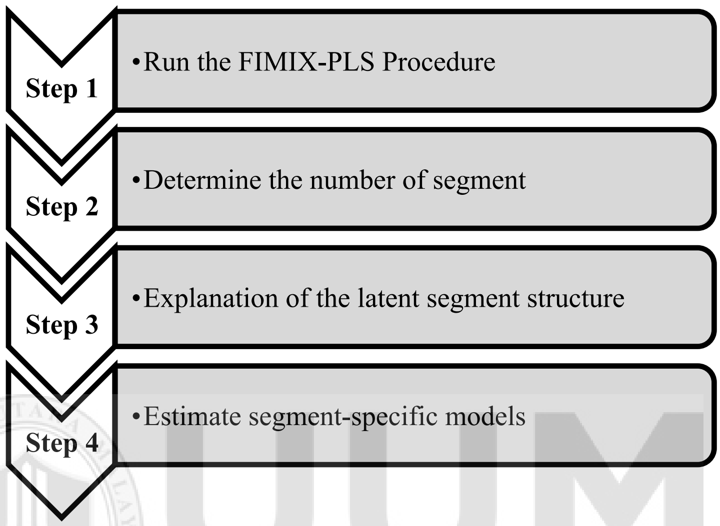

Figure 5.9
FIMIX-PLS Procedure
Source: Hair et al. (2016)

The unobserved heterogeneity began with the execution of FIMIX-PLS procedure in SmartPLS with setting as in Appendix C. The procedure begins with calculating how many segments to run. To calculate numbers of segments to be run, the sample size n is divided by the minimum sample size, nmin: (n/nmin = 186/88 = 2.1). Supposedly, a five per cent significance level was used, as well as a minimum R^2 of 0.25, also nine arrowheads pointing at any construct in the model (=eco-product innovation), 88 observations were stated as reliable to estimate a model (Hair et al., 2014). Therefore, the FIMIX-PLS procedure on SmartPLS was run for one to three segments (just to be on the safe side), and the fit indices were documented in Table 5.24.

Following Hair et al. (2016) tests in determining number of segments to retain; (1) AIC_3 and CAIC did not indicate the same number of segments; rejected, (2) AIC_3 and BIC did not indicate the same number of segments; rejected, (3) AIC_4 and BIC did not indicate the same number of segments; rejected, (4) fewer segments than indicated by AIC is two segments, (5) more segments than indicated by MDL_5 is also two segments and finally, (6) the EN for two-segment is higher that 0.5 (p. 72).

Table 5.24
Fit Indices for a One to Three Segment Solution

Criteria	**No of segments**		
	1	**2**	**3**
LnL (Log Likelihood)	-616.997	-558.522	-505.648
AIC (Akaike's Information Criterion)	1,279.995	1,211.044	**1,153.296**
AIC_3 (Modified AIC with Factor 3)	1,302.995	1,258.044	**1,224.296**
AIC_4 (Modified AIC with Factor 4)	1,325.995	1,305.044	**1,295.296**
BIC (Bayesian Information Criteria)	**1,354.187**	1,362.655	1,382.324
CAIC (Consistent AIC)	**1,377.187**	1,409.655	1,453.324
MDL_5 (Minimum Description Length with Factor 5)	**1,834.956**	2,345.095	2,866.436
EN (Entropy Statistic (Normed))	n/a	**0.583**	0.684

The lowest figure (**bold**) was selected segment for the particular criteria

The tests indicated two segments is the solution for unobserved heterogeneity grouping, however, when Table 5.25 was referred, the selection of two segments is not realistic since 44.1% (of 186 = 82 observations) is smaller than a minimum number of observations needed (88 observations) to reliably execute segment-specific model estimation. The overall result suggested that there is no substantial level of unobserved heterogeneity in the replied data thus the validity of findings are secured (Becker et al., 2013) and data level analysis is not biased (Matthews et al., 2016).

Table 5.25
Relatives segment sizes (N=186)

No of segments	Relatives Segment Sizes		
	Segment 1	Segment 2	Segment 3
2	0.559	0.441	
3	0.380	0.336	0.285

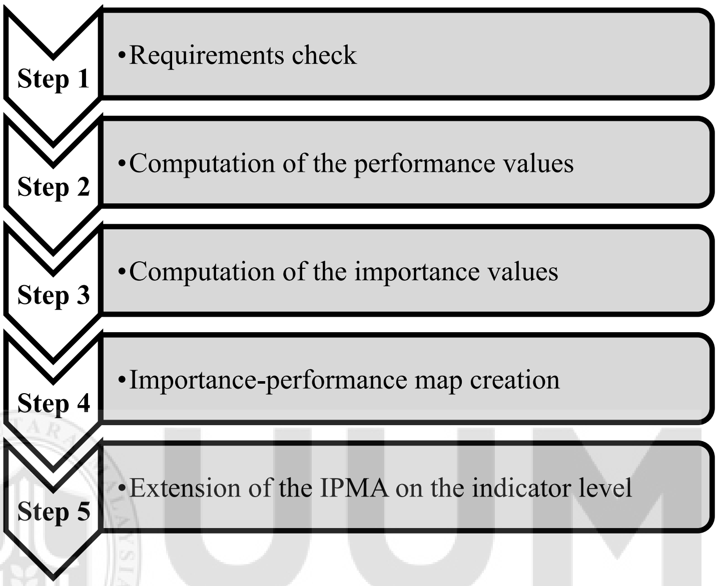

Figure 5.10
Importance-Performance Map Analysis Procedure
Source: Ringle & Sarstedt (2016)

5.9.5 Importance Performance Matrix Analysis (IPMA)

Importance Performance Matrix Analysis (IPMA; also known as importance-performance matrix, priority map analysis or impact-performance map) is an approach for extended analysis on path coefficients with total effects and average latent variable scores are used to indicate importance and performance of a variable and/or indicators respectively (Hair et al., 2014; Ringle & Sarstedt, 2016). The IPMA technique is useful for generating further findings and conclusions, highlighting constructs to improve a subsequent target construct, and also for contrasting and developing conclusions in a multigroup analysis (Ringle & Sarstedt, 2016). For this study, the IPMA five-steps procedure as proposed by Ringle & Sarstedt (2016) has been used (Figure 5.10).

The results obtained from running IPMA on PLS for both eco-process innovation and eco-product innovation implementations are shown in Figure 5.11 and Figure 5.12. It is apparent in the importance-performance map; competitor pressure is the most important construct for ET-innovation implementation. At indicator level, the competitor pressure's indicator, question no. 24, ("We establish a company's environmental image comparing to competitors through green concept") has the highest effect (>0.2), followed by also competitor pressure's indicator, question no. 25, ("We increase a company's market share through green concept") (refer Table 5.26). This shows the importance of ET-innovation implementation in capturing new market share and have the advantage against other firms.

Table 5.26
ET-innovation Implementation Important Indicators Question (Rank by Most Important)

	Question No	Important Indicator Survey Question
Eco-process innovation	24	We establish a company's environmental image comparing to competitors through green concept
	25	We increase a company's market share through green concept
	30	We are quick to detect fundamental shifts in our business environments (e.g., competition, technology, regulation)
Eco-product innovation	24	We establish a company's environmental image comparing to competitors through green concept
	25	We increase a company's market share through green concept

Turn back to Table 5.26, the next important construct for eco-process innovation implementation is the market orientation (>0.35) and the highest indicator for market orientation is the question no. 30 ("We are quick to detect fundamental shifts in our business environments") which also related to gathering external intelligence including competitors movement, technology shift and new regulation.

For preliminary analysis, in overall, firms must consider competitors action while also keep track of technology and regulation changes when implementing ET-innovation. The reason market orientation has higher importance for eco-process innovation maybe because the difficulty of a firm to show any new eco-process innovation compared to eco-product innovation which can visually be seen and touch (Ariffin, Yusof, Putit, & Shah, 2016; Cleff & Rennings, 1999, 2000). Thus, the need for market orientation approaches to understand the demand for eco-process innovation.

5.10 Stage 8 – Interpretation of Results and Drawing Conclusions

The assessment of measurement and structural model has been successfully evaluated, while the analyses have also been completed and the results have been drawn. The next step is the interpretation, the discussions of results and the drawing of conclusions. This step will be explained in Chapter 6.

5.11 Summary

This chapter explained step-by-step analyses on the recorded data. Each result was reported with some preliminary explanations provided. Further discussions on the results can be observed in the following chapter.

CHAPTER SIX

DISCUSSION

This chapter discusses and concludes the result of this research from obtained data and analyses done in preceding chapters. It starts with an overview of the research. Then, the discussions of the findings are explained.

6.1 An Overview of The Study

The concept of sustainable development was proposed as early as the 1980s. It was initially defined as an effort to compare the effect of social and ecological factors, as well as economic ones; of the living and non-living resource base; considering current needs and future needs and of the long-term as well as the short-term advantages and disadvantages of alternative development activity (Dalal-Clayton & Bass, 2000; WCED, 1987). Several in-depth issues in sustainable development involved the responsibility of nations to take precaution and prevention in the area of technology, sciences and politics. For example, each development program must aware of regenerative and absorptive capacities of material or energy, and maintain output growth below stipulated threshold (Gladwin et al., 1995).

For this matter, new technology is capable of proposing new methods in handling the prevention and precaution obligation while saving resources and reduce consumptions. New technology is also the key to economic growth and competitive advantage; which make it very important in the fight against poverty which threatens environment through the unsustainable use of resources(Porter, 1990; WCED, 1987).

However, new technology also can produce new ways to pollute and alter earth natural evolutionary progress (WCED, 1987). Hence, it is important for the technological and scientific study to be responsible and take precaution against these possibilities (Gladwin et al., 1995). In addition, it is difficult for the industry to control the technology by just adopting any technology. Firms need to innovate to assure control by implementing ET-innovation as a sustainable development tool (Kemp, 2010).

This study took a closer look into market demand effect on ET-innovation from the demand-based perspective. Demand-side view means works that look downstream from the focal firm, toward product markets and consumers (Adner & Levinthal, 2001; Priem et al., 2011). Therefore, it attempts to evaluate the answer to question of to what extent market demand related to ET-innovation implementation within the scope of manufacturing industry in Malaysia. The industry is the second largest contributor to Malaysia's gross domestic product (GDP) (National Productivity Council, 2014), a key driver of Malaysian economy (Harun & Ishak, 2014) and targeted to contribute up to RM22 billion of green business by 2020 and RM60 billion by 2030 (Spykerman, 2015).

This study propose the dimension of market orientation as a mediating factor in the study of market demand relationship with ET-innovation which has been enticing research attention in other disciplines. The interaction effects of environmental turbulence and managerial ties on market orientation and ET-innovation relationship have also been determined.

The next section presents and discusses the significance of results by examining the research hypotheses and conceptual model within the context of literature and current business practices.

6.2 Discussions of Findings

6.2.1 Overview of Findings

The overall final results obtained from the analyses of the surveyed data using the PLS-SEM technique is pictured as in Figure 6.1. Altogether, four hypotheses (H1c, H1d, H2a and H2c) were supported, while the balance 16 hypotheses (H1a, H1b, H2b, H2d, H3a-H3f and H4a-H4f) weren't supported.

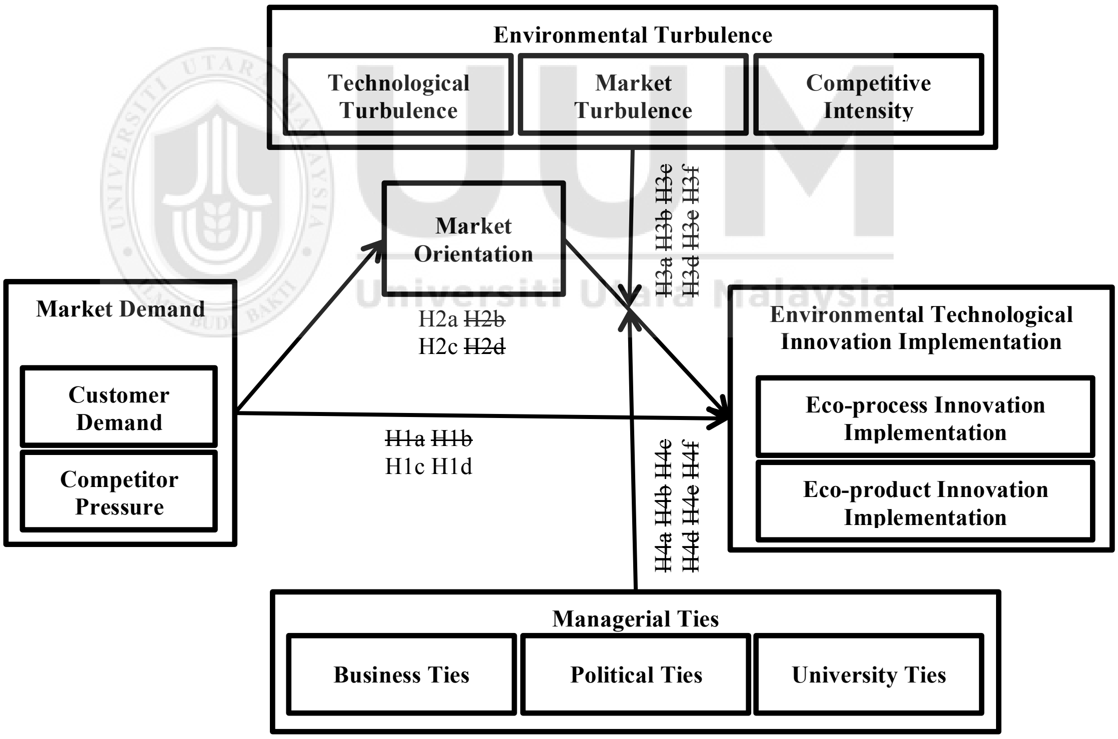

Figure 6.1
Overview of Hypothesised Structural Model Findings
(~~strikethrough~~ font indicate insignificant relationships)

For ease of interpretation, the range of seven point Likert numerical scales were categorised into equal-sized categories of low, moderate and high. Therefore, scores of less than 3 [6/3 + lowest value, 1] are considered as low; scores of 5 [highest value, 7 – 6/3] are considered high and those in between considered moderate (Noor et al., 2012). As presented in Table 6.1, market orientation, eco-process innovation implementation, eco-product innovation implementation, technological turbulence and competitive intensity can be considered highly related to survey respondent while the rest are moderately related.

Table 6.1
Latent Variable and Mean Values

Variables	Mean
Customer Demand	4.93
Competitor Pressure	4.96
Market Orientation	5.31
Eco-process Innovation Implementation	5.42
Eco-product Innovation Implementation	5.07
Technological Turbulence	5.18
Market Turbulence	4.97
Competitive Intensity	5.09
Business Ties	4.62
Political Ties	4.11
University Ties	3.87

6.2.2 Market Demand Relationship with ET-innovation Implementation

There are four hypotheses for the first research objective which tried to understand the extent of the relationship between market demand on ET-innovation implementation. Only two hypotheses as portrayed in Table 6.2, were significantly related. The results indicate that only competitor pressure have a positive relationship with ET-innovation, while customer demand has no effect on either eco-process or eco-product innovation implementation.

Table 6.2
Hypotheses H1a – H1d Results [Market Demand Relationship with ET-innovation Implementation]

No	Statement	Result
H1a	Customer demand is positively related to eco-process innovation implementation	Not significant
H1b	Customer demand is positively related to eco-product innovation implementation	Not significant
H1c	Competitor pressure is positively related to eco-process innovation implementation	Significant
H1d	Competitor pressure is positively related to eco-product innovation implementation	Significant

6.2.2.1 Customer Demand Relationship with ET-Innovation Implementation

Contrary to expectations, this study did not find a significant direct relationship between customer demand and ET-innovation implementation as mentioned in an earlier finding (Rehfeld et al., 2007). The findings also consistent with those of C.-Y. Lin and Ho (2011) who observed an insignificant effect of customer pressure on eco-process innovation practices within Chinese logistics companies, while several other researchers found customer demand plays an insignificant role in firms' eco-product innovation implementation (Guoyou et al., 2013; Huo & Shan, 2013).

This study has been unable to demonstrate that customer demand has a positive influence on green practice adoption as in the empirical study by Zailani et al. (2014) on Malaysian transportation companies or by Ramakrishnan, Haron, and Goh (2015) on green purchasing in Malaysian SMEs. Several researches reported that customer demand significantly influenced eco-product innovation (R.-J. Lin et al., 2013; Triguero et al., 2013; Weng & Lin, 2011), while Hojnik and Ruzzier (2016) empirically found that customer demand has a positive influence on eco-process innovation through their demand for eco-products that being produced in an environmentally friendly way. Plus, in an earlier research, A. Z. Yahya, Othman, Othman, Rahman, and Moen (2011) concluded that only less innovative companies consider market demand as a barrier, more innovative firms treat market demand as pushing factors.

Customer demand in the Malaysian context and the scope of this study is not limited to end-user only but included buyers' purchasing department, top management and the buyer firms itself as consumers. The above approach which also proposed by K. Green et al. (2000, 2002) was listed in the subsequent discussions.

The present findings seem to be consistent with other research which found that the level of eco-product purchase behaviour among Malaysian consumers is still low (Goh & Abdul Wahid, 2014; Noor et al., 2012) and the unwillingness of Spain consumers to pay for eco-products (Del Río, Romero-Jordán, & Peñasco, 2015). Guoyou et al. (2013) reported that environmentally oriented NGOs (ENGOs) are still at a young age due to the legal and political barrier, and are focusing on environmental management. This basically shows that green purchasing behaviour is also at its infancy stage because, with only environmental awareness, a nation will have a green purchasing community that encourages pro-environment movement (Narula & Desore, 2016). Malaysian firms also believe that customer demand is still low due to product affordability which reducing the product opportunity to grow. Thus, manufacturing firms unwilling to take the risk and implement ET-innovation in view of customer demand (Abdullah et al., 2016).

Several literatures confirmed that customer benefits such as cost, quality, product aesthetic, and product features, plays an important role in the decision to purchase eco-products (Dangelico & Pujari, 2010; Halila & Rundquist, 2011;

Kammerer, 2009; Rehfeld et al., 2007). In Malaysian context, among significant push towards buying eco-product and green purchasing are price, functionality, quality, easy to fine, and expected business benefits e.g. cost saving, marketing opportunities and financial returns (Ariffin et al., 2016; Eltayeb & Zailani, 2010; Eltayeb, Zailani, & Jayaraman, 2010; Sharaf, Isa, & Al-Qasa, 2015; Suki, 2013a; Wen & Noor, 2015). In all of the above literature, environmental concern is not the deciding factor, at least not the primary reason, for consumers and firms to purchase eco-product. It can be safely said that the purchase of an eco-product in Malaysia is not primarily for the environmental benefits, instead, consumers purchase the product because the product has reached the functional and net utility threshold they required. This threshold concept is an important element mentioned in demand-based view. The functional threshold is the minimum functionality that a product must reach if it is to be of value to a particular consumer, while net utility threshold is the maximum price a consumer willing to pay to satisfy their functional requirement (Adner & Levinthal, 2001). Questions on customer demand in this study focusing on environmental requirements by the customers, hence this factor strengthen the reason for an insignificant relationship between customer demands and ET-innovation implementation.

Inadequate level of environmental knowledge possession is also a possible reason for the insignificant relationship between customer demand and ET-innovation implementation because knowledge correlated positively with purchasing behaviour (Haron et al., 2005; Noor et al., 2012; Suki, 2013b, 2013c). Empirical result by Noor et al. (2012) stated that Malaysian green consumers only possessed a moderate level of knowledge towards the environment. Haron et al. (2005) concluded in their study that low level of complex environmental knowledge becomes an obstacle for Malaysian government in encouraging sustainable consumptions among Malaysians. Furthermore, a report by EPU on Malaysian firms that attempt to internationally market their eco-product, emphasises low knowledge possession on global environmental standards as one of the critical barrier (EPU, 2015). Mohd Noor et al. (2016) added that due to the fact that Malaysian green industry is still at the early stage of product life cycle (PLC), the learning curve on green consumption is rather slower than other countries.

Several empirical researches found that lack of knowledge on a particular issue is a major problem for Malaysian SMEs firms (Aljanabi & Noor, 2015; Noor & Aljanabi, 2016; A. Z. Yahya et al., 2011). Purchasing firms scarce internal knowledge causing these firms to rely on externally generated knowledge on customers and competitors (Aljanabi & Noor, 2015). Furthermore, Abdullah et al. (2016) emphasised that the magnitude of the issue amplifies for environmental practices as it is still at an immature stage. These above finding further support the idea of firms' lack of believed in the benefit of environmental purchasing because they tend to associate the benefits to external parties rather than on the firm itself (Zailani, Jeyaraman, Vengadasan, & Premkumar, 2012). A study on Malaysian SMEs also found that these firms perceived involvement in societal and environmental responsibility would reduce their existing profit (Ramakrishnan et al., 2015). In addition, Abdullah et al. (2016) reported that firms are unwilling to take the risk in implementing environmental initiatives when they consider there would not be positive opportunities in firms growth.

The above non-significant result may also be due to the fact that awareness of green technology is still low in the developing countries (Narula & Desore, 2016).

Customer awareness on environmental issues can increase demand for eco-products that incentivise the environmental innovation implementation (Cuerva et al., 2014; Mohd Noor et al., 2016; Singh, Chakraborty, & Roy, 2016). An earlier study in the United Kingdom found that growth of environmental innovation is dependent on consumers environmental awareness (Foster & Green, 2002). Whereas, a study in Guatemala, a developing country, concluded that an awareness-raising is important for green market realisable (van Kempen, Muradian, Sandóval, & Castañeda, 2009). A previous study in the Malaysian context has reported that the awareness on sustainable development and environmental protection is rather low in manufacturing industries (Nik Abdullah & Yaakub, 2015). Ramakrishnan et al. (2015) added that top management awareness on environmental practices also still lack especially in SMEs. The lack of awareness thus become a barrier for successful environmental innovation practices in Malaysian manufacturing industries (Abdullah et al., 2016). This is because, the lack of environmental awareness especially on risk and cost-benefit of implementing environmental practices can cause firms to lose sight on environmental issues in the industries, thus unable to react swiftly to handle the issues or proactively grab the competitive advantage of the situation (X. Peng & Liu, 2016). In fact, Economic Planning Unit (EPU) report in the 11th Malaysia Plan highlighted the awareness lacking in global environmental requirements has cause inability for Malaysian firms to export eco-product (EPU, 2015).

Even though some firms are aware of the benefits of environmental initiatives (the numbers are low), they are not ready to carry on with the implementation (Nik Abdullah & Yaakub, 2015). There are several possible explanations that can be listed as follows: although management commitment is noticeable but firmer involvement is required (Nik Abdullah & Yaakub, 2015), firms also cannot venture into environmental programs without adequate manpower capabilities (Zailani et al., 2015), financial capacities (Cuerva et al., 2014; Xie, Huo, Qi, & Zhu, 2016), and other additional resources in comparison to conventional innovation (F. Ye et al., 2013).

Consumers purchase eco-products from a certain company base on their perception of the firms' brand image reflected by the green marketing elements (Suki, 2013a), thus will refuse to purchase if the firms are known as not environmentally friendly (Mohd Noor et al., 2016). The firms' brand image includes eco-labelling which directly correlated with green purchase. In fact, Narula and Desore (2016) stated a low purchase intention for a product if it is not eco-labeled or environmentally certified in developing countries. Despite that, Hasan and Ali (2015) argued that Malaysian firms showed a slow inclination towards implementation of environmental certification.

Even though policy and incentives existed, this study found that ET-innovation is not driven directly by demand. This possibly because some studies have found that government assistance does not have relevant and justified effect on assisting environmental initiatives (Cuerva et al., 2014; Del Río et al., 2015; Xie et al., 2016). Although other studies have reported inverse result (Narula & Desore, 2016; Ramakrishnan et al., 2015), Abdullah et al. (2016) explained that, in the Malaysian manufacturing industry case, the control and pressure of these regulations and incentives are rather inconsistent.

6.2.2.2 Competitor Pressure Relationship with ET-innovation Implementation

The findings of the current study on competitor pressure (in Table 6.2) are consistent with those of Yalabik and Fairchild (2011) who found that competitive pressure is an effective driver of environmental innovation. Several other studies found an international competition directly affects the implementation of environmental innovation (Brunnermeier & Cohen, 2003; Dechezleprêtre & Glachant, 2014; Kuik, 2006). The result of this study revealed that competitor pressure exerts a highly significant positive influence on eco-product and eco-process innovation implementation ($p<0.01$), which is consistent with findings of previous research (Hojnik & Ruzzier, 2016; Y. Li, 2014; R.-J. Lin et al., 2014; Singh et al., 2016). On the other hand, one particular study shows that competition does not have significant effects on environmental innovation, especially during a highly volatile transitional period, because fierce competition may distract firms from long-term strategic consideration (H. Lin, Zeng, Ma, Qi, & Tam, 2014).

This study used data from MATRADE as respondent where most of the firms listed either have an international business or looking for overseas business (MATRADE, 2016). EPU reported that manufacturing industry total export is RM 636.7 billion compared to contribution to GDP of RM 243.9 billion in 2015 (EPU, 2015). Therefore, firms that export their products were forced to accept the norm where global companies are pursuing sustainable development (Hojnik & Ruzzier, 2016; C.-Y. Lin & Ho, 2011). The increase competition pressured firms to develop and innovate towards an environmentally friendly direction in terms of technological service, quality and reliability (Rubashkina, Galeotti, & Verdolini, 2014; Tseng et al., 2013). Firms improvement for the international market, indirectly reflect in the domestic market, because the eco-product and clean technology would also be marketed in Malaysia. This will exert pressure to the upstream suppliers and their domestic competitors to also improve their environmental practices (F. Ye et al., 2013). This view is also referred as green multiplier effect in literature (Eltayeb et al., 2010).

The rationale for the strong effect is that firms react strongly against any threat to their market share. IPMA analysis (subsection 5.9.5) showed that competitive intensity indicators are among best performs indicators for ET-innovation (both eco-product and eco-process innovation implementation). The statistical analysis by K. Green et al. (1994) showed a significant correlation between the threats to market share and eco-product innovation. The threat to market share indirectly shows that demand has shifted towards eco-product and competitor has taken some action towards implementing environmental initiatives. Either by complying with the environmental regulation and directive (Y. Lin, Tseng, Chen, & Chiu, 2011) or by understanding the market demand (R.-J. Lin et al., 2014), this situation is also a prospect for market share expansion for firms, which consequently drive firms to implement ET-innovation (Triguero et al., 2013). Because, when facing competition on their market share, firms have no choice but to be innovative to be relevant in the market, if they survive, they will be more ready to face further competition (C. Xu et al., 2008).

Firms need to practices environmental strategy, especially ET-innovation to be competitive against rival firms. ET-innovation generally needs a higher level of technological ability (Driessen et al., 2013). If a firm has technical ability in ET-innovation, industry will notice and this will enhance firms' reputation in green and technology (R.-J. Lin et al., 2014). Hence, this situation will improve their market position (Hojnik & Ruzzier, 2016), and ultimately gain competitive advantage and increase market share (Y. Li, 2014).

As proposed by Porter and van der Linde (1995a), firms that take advantage by going beyond environmentally regulated area will be more competitive than firms that are not. Firms will search business opportunities within the environmentally oriented ecosystem to differentiate themselves from their competitors (Hojnik & Ruzzier, 2016) and to outperform their rival (Zailani et al., 2015). This competitive situation pushes the firms to continue improving their eco-process by really understand the capability of their current green equipment and technology beyond normal application (Tseng et al., 2013) and to be more creative when developing their eco-product (Meutia & Ismail, 2015). For example, in this study, 23.7% of the respondents produce new-to-the-world eco-products and 21% implement new-to-the-world eco-process respectively. In addition, the number of Malaysian firms with ISO14001 Environmental Management System (EMS) increases more than 23% in average every year since its introduction in 1999 in Malaysia (ISO, 2017). According to (Triguero, Moreno-Mondéjar, & Davia, 2016), firms with EMS in the past 2 years are more likely to have more than 30% of total innovation as ET-innovation.

6.2.3 Market Orientation as Mediating Factor

To evaluate the market orientation effect on the relationship between market demand and ET-innovation implementation, four hypotheses have been derived. The result showed (Table 6.3) that market orientation fully mediates the relationship between customer demand and eco-process innovation implementation (H2a), while partially mediate the competitor pressure-eco-process innovation implementation relationship (H2c). Surprisingly, no significant results were found for the test on market orientation as the mediating factor for market demand against eco-product innovation implementation (H2b and H2d).

Table 6.3
Hypotheses H2a – H2d Results [Market Orientation in The Relationship Between Market Demand and ET-innovation Implementation]

No	Statement	Result
H2a	Market orientation mediate the relationship between customer demand and eco-process innovation implementation	Full mediation
H2b	Market orientation mediate the relationship between customer demand and eco-product innovation implementation	No mediation (No effect)
H2c	Market orientation mediate the relationship between competitor pressure and eco-process innovation implementation	Complementary partial mediation
H2d	Market orientation mediate the relationship between competitor pressure and eco-product innovation implementation	No mediation (Direct only)

The above results can be discussed from two particular angles. Firstly, through the angle of market orientation as a mediating factor in this study. As explained in Chapter 5, full mediation was achieved for customer demand - eco-process innovation implementation, but the relationship is weak (below 0.1; indirect effect = 0.066, p = 0.096*, direct effect = 0.078), while the competitor pressure - eco-process innovation implementation is only partially mediated (indirect effect = 0.134, p = 0.009**, direct effect = 0.354) with the indirect effect just above moderate strength of 0.1 (Hair et al., 2014; Nik Abdullah & Yaakub, 2015). It is apparent from the analysis results that market orientation performance as mediator is not conclusive. Hence, the possible reasons of low significance relationship between market orientation and ET-innovation implementations in Malaysia will be explained.

It seems possible that the above results are due to market orientation capabilities not fully implemented in Malaysian SME industry (A. Z. Yahya et al., 2011). Several studies within the scope of Malaysian SME industry also unable to show that market orientation strongly affect firm performance (Amin, Thurasamy, Aldakhil, & Kaswuri, 2016; Idar, Yusoff, & Mahmood, 2012). A study in Indonesia also reported an insignificant market orientation effect on firms' competitiveness

(Hayati & Rukhviyanti, 2016). Although respondent replies for this study show a high level of market orientation activities (refer Table 6.1, mean above 5), an earlier but seminal findings explained that without proper integration between market orientation and the business organisation, success in sales, profitability and new product is far fetched (Slater & Narver, 1994). T. Lee and Tsai (2005) further support the idea by empirically showed that without appropriate business operation mode, market orientation effort to promote innovation would not increase a firm performance. Business operation mode includes participative decision making and commitment by top management, sharing information, resources and influence, and top-down and cross-functional collaboration (T. Lee & Tsai, 2005). Respondent replies for managerial ties in this study illustrate the moderate to low level of top management commitment to share information on innovation (refer Subsection 6.2.5).

Another possible explanation for the first approach is that market orientation may not be useful if the cost exceeds the benefits (Kohli & Jaworski, 1990). For example, investment for market orientation resources can be too costly for SMEs (Chiun Lo, Chai Wang, Justin Wah Constance, & Ramayah, 2016). Implementing new and innovative eco-product need high capital for research and development, technology, and equipment (Abdullah et al., 2016; Meutia & Ismail, 2015), while eco-process innovation need expenditure for manpower advancement in technological know-how and understanding of current equipment (Abdullah et al., 2016; Tseng et al., 2013). As Malaysian industry is a transitional knowledge base industry, additional investment for ET-innovation is possible (Magnani & Tubb, 2012). This is because innovation will directly relate to R&D effort, a key resource of a firm that pushes management to opt for internal resource and technology know-how instead of market orientation (Paladino, 2008; Zhou & Li, 2010).

Finally, there are similarities between the market orientation characteristic in this study and those described by Paladino (2008). The research suggests that when technological innovation (product and process; H. Lin et al. (2014)) being implemented, firms will focus on development where firms will maximise the usage of internal resources to achieve the competitive advantage against their competitor. Since new technology is even new to a firm, by acquiring new technological knowledge and implementing new technological innovations, firms can become technologically superior than their competitors (Chiun Lo et al., 2016). Firms will increasingly able to develop environmentally friendly technological innovation (L. Chen & Wang, 2017) thus reduces the dependence on market orientation (Paladino, 2008). This is in line with the identity of Malaysian industry as a transitional knowledge driven industry to innovation driven industry reported in Global Competitiveness Report (GCR) 2016-2017 (Abdul Halim et al., 2016; MASTIC, 2017).

As for the second angle, several possible reasons is discussed through the lens of eco-product/eco-process innovation angle, by explaining the possible causes market orientation has a significant mediating effect against eco-process innovation implementation in contrary to eco-product innovation implementation.

In this study, the relationship between market orientation and eco-product innovation implementation was found as not significant. This finding supports previous researches into this topic by, among others, Atuahene-Gima (1996), Langerak, Hultink, and Robben (2004), T. Lee and Tsai (2005), Narver et al. (2004), and R.-J. Lin et al. (2012). Furthermore, some researchers have shown that relationship between market orientation and product innovation is indirect (Y. Chen et al., 2015; R.-J. Lin et al., 2012). As a result, market orientation by itself is not enough to have a significant effect on eco-product innovation (T. Lee & Tsai, 2005; R.-J. Lin et al., 2012).

Moreover, this inconsistency between eco-product innovation implementation and eco-process innovation implementation may be due to the direct benefit enjoyed by customers of eco-products. Firms that implement eco-product innovation generally produce an eco-product that indulges consumers with side benefit such as quality, functionality and aesthetic besides being environmentally friendly (Dangelico & Pujari, 2010; Kammerer, 2009; Lewis & Harvey, 2001). On the other hand, when eco-process innovation was implemented, environmental benefits and added benefit were difficult to be proclaimed to customers, the customers can't value the effort being put in by firms and green marketing was not properly executed (Ariffin et al., 2016; Chang, 2011; Cleff & Rennings, 2000). As a consequence, firms that implement eco-process innovation need market orientation as a link to understand customer demand and competitor strategy (Guoyou et al., 2013; S. K.-S. Wong, 2013).

Finally, Adner and Levinthal (2001) demand-based view explained that for new-to-the-firm or new-to-the-industry product where functional threshold has been acquired, the focus is on process innovation to reduce the price. This phase of maturity reflect in this study in the green manufacturing industry. This study recorded 76.9% as new-to-the-firm or new-to-the-Malaysia-industry eco-process innovation. Eco-process innovation also has a stronger effect on firm sustainable performance than eco-product innovation (Sezen & Çankaya, 2013). Thus firms that introduce new-to-the-firm/new-to-the-Malaysia-industry and also acquire sustainable performance will continue with eco-process innovation. But, they need market orientation to understand the competitor strategy and also customer requirement. S. K.-S. Wong (2013) and Guoyou et al. (2013) highlight a stronger impact of market orientation on eco-process innovation, in comparison with the effect towards eco-product innovation.

6.2.4 Environmental Turbulence as Moderating Factor

In order to assess the moderation effect of environmental turbulence against the relationship of market orientation and ET-innovation implementation, six hypotheses have been derived for testing. Interactions of each dimension of environmental turbulence, namely technological turbulence, market turbulence and competitive intensity were tested against market orientation linkage with eco-process and eco-product innovation implementation. As can be seen from Table 6.4, it is somewhat interesting that none of the moderation tests was found significant.

Table 6.4
Hypotheses H3a – H3f Results [Environmental Turbulence Interaction with Market Orientation and ET-innovation Implementation Relationship]

No	Statement	Result
H3a	Technological turbulence moderates the relationship between market orientation and eco-process innovation implementation	No moderation
H3b	Technological turbulence moderates the relationship between market orientation and eco-product innovation implementation	No moderation
H3c	Market turbulence moderates the relationship between market orientation and eco-process innovation implementation	No moderation
H3d	Market turbulence moderates the relationship between market orientation and eco-product innovation implementation	No moderation
H3e	Competitive intensity moderates the relationship between market orientation and eco-process innovation implementation	No moderation
H3f	Competitive intensity moderates the relationship between market orientation and eco-product innovation implementation	No moderation

H3a and H3b results are consistent with those described by Jaworski and Kohli (1993) and Zhang and Duan (2010) that suggest market orientation relationship against ET-innovation is not being affected by the technological change or new breakthrough. However, the findings of the current study do not support several of previous studies. For instance, technology uncertainty negative moderation on the relationship between strategic decision comprehensiveness and new product performance (Atuahene-Gima & Li, 2004), positive moderating interaction on proactive market orientation and product development relationship (Zhang & Duan, 2010), and K. B. Lee and Wong (2012) showed that technological change weakens the impact of cross-functional integration on NPD timeliness.

The above H3c and H3d findings corroborate the ideas of Jaworski and Kohli (1993), Paladino (2008), and Magnani and Tubb (2012), where they found an insignificant interaction of market turbulence on the relationship of market orientation with performance, innovation, and environmental R&D investment respectively. But, these results differ from findings by Zhang and Duan (2010), who reported a negative moderating effect on responsive market orientation and new product innovation link and a positive interaction on proactive market orientation and new product innovation relationship. Also, a positive moderating factor of market turbulence on customer orientation and business performance (G. Y. Gao et al., 2007).

Although H3e and H3f results differ from the constructed hypotheses, they are consistent with those of Hernández-Espallardo and Delgado-Ballester (2009) and Zhang and Duan (2010) where they described an insignificant interaction of competitive intensity on market orientation and product innovation link, and also

Jaworski and Kohli (1993) and G. Y. Gao et al. (2007) where they explained insignificant interaction on market orientation and performance relationship. In contrast, competitive intensity positively moderates the relationship between strategic flexibility and firm performance (Guo & Cao, 2014) and negatively moderate the relationship between innovation and business performance (García-Zamora et al., 2013).

Possible reasons for the insignificant findings can be explained by two views. Firstly, looking from the technological view, although green manufacturing firms in Malaysia are mostly adopters/adapters of technology (75.3% - 76.9% in this study) instead of creating new-to-the-world technology (EPU, 2015), 75% of the respondent firms are seven years and above and can be considered at early maturity and matured phase (Rosenbusch et al., 2013; Sáez-Martínez et al., 2014). Therefore, firms are at a phase where they balance process innovation and product innovation (Adner & Levinthal, 2001). Moreover, national R&D census recorded that investment for R&D activities from private firms achieve nearly 65% for 2012 (MASTIC, 2015). These data is in line with GCR assessment on Malaysia as a transitional knowledge-driven economy (MASTIC, 2017). Hence, when a Malaysian firm decides on implementing technological innovation to get leverage against their competitor, they will be better than their competitors in terms of technology superiority (Chiun Lo et al., 2016; Paladino, 2008). With some enhancement, these firms able to use their current technological facility and know how to implement ET-innovation (Magnani & Tubb, 2012). These technologically oriented firm have the ability to pursue knowledge diversification within their network, thus external uncertainties did not give much effect towards their operation (Choung, Hwang, & Song, 2014).

Secondly, from the view of firms that implement market orientation strategy, Jaworski and Kohli (1993) found that market orientation is robust with varying levels of technological turbulence, market turbulence and competitive intensity. This is possibly because of two reasons, (1) in the initial environment turbulence, market-oriented firms focus is to invest significantly in market orientation to perform better than their competitor (Abiodun & Mahmood, 2015). During stable environment, even when the strategy should be different, the magnitude of market orientation is already complex with substantial money, time spent, and culture and operational changes, thus changes won't be cost effective (Slater & Narver, 1994), plus difficult to be adjusted (del Brío & Junquera, 2003), and (2) market-oriented firms are prepared to sustain competitive advantage and perform in environment uncertainties (Hult, Hurley, & Knight, 2004; Slater & Narver, 1994). Hence, their stakeholders couldn't wait for firms to take action only when sales were stagnated, margins were reduced, or competitions were intensified. As action means creating the best value for their consumers, market-oriented firms' will continually be taking action in any environmental condition (Slater & Narver, 1994; Zhang & Duan, 2010). Thus, external turbulence won't significantly affect market orientation and ET-innovation linkage.

6.2.5 Managerial Ties as Moderating Factor

Six hypotheses were proposed to measure the managerial ties interaction with the relationship of market orientation and ET-innovation implementation. Each dimension of managerial ties, namely, business ties, political ties and university ties was tested against both market orientation-eco-process innovation and market orientation-eco-product innovation implementation. As shown in Table 6.5, none of these moderation effects has been statistically significant.

Table 6.5
Hypotheses H4a – H4f Results [Managerial Ties Interaction with Market Orientation and ET-innovation Implementation Relationship]

No	Statement	Result
H4a	Business ties moderate the relationship between market orientation and eco-process innovation implementation	No moderation
H4b	Business ties moderate the relationship between market orientation and eco-product innovation implementation	No moderation
H4c	Political ties moderate the relationship between market orientation and eco-process innovation implementation	No moderation
H4d	Political ties moderate the relationship between market orientation and eco-product innovation implementation	No moderation
H4e	University ties moderate the relationship between market orientation and eco-process innovation implementation	No moderation
H4f	University ties moderate the relationship between market orientation and eco-product innovation implementation	No moderation

H4a and H4b findings seem to be broadly consistent with Sheng et al. (2011) who reported business ties insignificant effect on firm performance during high market uncertainty. The findings also accord with an earlier observation, which showed an insignificant drive of external collaboration and partners against the eco-product innovation and eco-process innovation initiatives (Abdullah et al., 2016; Bönte & Dienes, 2013; Triguero et al., 2013). However, these results differ from a review by Wang and Chung (2013), which found positive moderation of business ties will enhance the customer orientation and interfunctional coordination effect on innovation, and negative interaction between business ties and competitor orientation on innovation. Also, others researches that showed business tie significant relationship as a driver against innovation and environmental innovation (Guo & Cao, 2014; Mat & Razak, 2011; J. Wu, 2011).

These insignificant result may also be explained by the fact that firms fear of losing close guarded technological secret and intellectual property (Muzamil Naqshbandi & Kaur, 2014) and they also hesitant to acquire knowledge from business ties (S. Gao, Xu, & Yang, 2008). Although, younger firms have embraced the concept of “compete on the basis of innovations but cooperate with regard to developing the necessary technological knowledge and skills” (Martin, 2012, p. 1232), but the concept was still half-heartedly accepted in Malaysian industry (Muzamil Naqshbandi & Kaur, 2014). Plus, the activities incur costs (Tseng et al., 2013). Whereas firms already have enough in-house technology for ET-innovation implementation (Cuerva et al., 2014; Triguero et al., 2016). Thus whether the ties are stronger or weaker, it did not have a direct effect on the implementation of ET-innovation.

Meanwhile, insignificant moderation of political ties (H4c and H4d) were broadly consistent with Sheng et al. (2011) who reported political ties insignificant effect on firm performance during high market uncertainty. On the other hand, however, the findings of the study differ from several researches that reported a need for political support in the interaction or as a driver towards innovation and environmental innovation implementation (Horbach et al., 2012; Mat & Razak, 2011; Veugelers, 2012; J. Wu, 2011).

One possible reason that explains the insignificant interaction of political ties on market orientation and ET-innovation implementation relationship is that political linkage between managers and their political counterparts is rather low. This study reported a moderate-to-low value (4.11 with <3 as low in Table 6.1) for the political ties. IPMA analysis (Figure 5.11 and Figure 5.12) also showed that political ties indicators were not important for ET-innovation implementation. The result also illustrates that the indicators performance achieve only about 50% (lest than other variables' constructs except university ties). This is due to managers' view of the government official as strict in implementing the regulation, thus always looking for fault in firms operation. On the other hand, managers may undervalue the actual degree of political ties to avoid scandal if known to the public (Sheng et al., 2011).

Finally, it is a relieve to compare H4e and H4f results with that found by Horbach et al. (2012) who also unable to find any significant influence of collaboration with universities effect on eco-product innovation. In contrary, other researchers found collaboration and ties with universities, research institutes, and agencies gave positive impact in the performance of product innovation, eco-process innovation, and research and development (Muzamil Naqshbandi, 2016; Salleh & Omar, 2013; Triguero et al., 2013; J. Wu, 2011).

A possible explanation that university ties insignificantly affect market orientation-ET-innovation relationship is that the ties itself were still relatively new (Muzamil Naqshbandi & Kaur, 2014; Rasiah & Govindaraju, 2009). This study also reported in Table 6.1, a moderate-to-low value (3.87 with <3 as low) for university ties strength among manufacturing firms in Malaysia. IPMA analysis (refer Figure 5.11 and Figure 5.12) also illustrates indicators for university ties have the worst performance of all indicators at average below that 50%. Firms in Malaysia have difficulty to bond with university and research institutes since they were not familiar with the environment, plus to reach the right person for their project could be confusing for them (Muzamil Naqshbandi & Kaur, 2014). Even, when a firm struck a tie with a research institution, they need to have an in-house R&D too, to support the collaboration between the two entity (Rasiah & Govindaraju, 2009). This fact only holds for a medium-sized firm, but unfortunately for small firms, this capability is not within their reach, which makes it even less possible for university ties to have any impact on market orientation-ET-innovation implementation linkage (Triguero, Moreno-Mondéjar, & Davia, 2015).

6.2.6 The Modified Model

The above combinations of findings provide support for a modified model as in Figure 6.2. This model has been updated from the proposed conceptual model in Section 3.1. This study finding indicate that the Malaysian green manufacturing industry as an export- and competitor-oriented industry where firms are involved in manufacturing products in the international arena where sustainable development is pursued. This has cause firms to implement ET-innovation to compete and directly push upstream local supplier and their competitors to follow suit. The results and findings (Subsection 6.2.2.2) have successfully proven direct relationship for competitor pressure and eco-product innovation implementation.

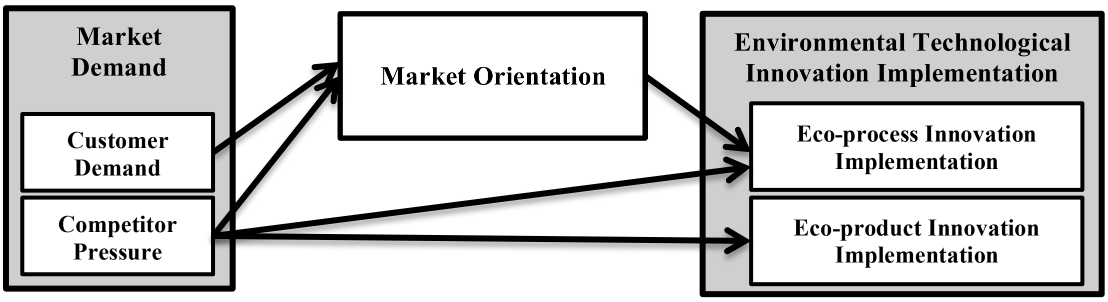

Figure 6.2
Modified Model

Despite the implementation of market orientation has been argued as improperly corroborate with the business organisation mechanism (Subsection 6.2.3), the mediation effect of market orientation on the relationship between market demand (for both customer demand and competitor pressure) and eco-process innovation implementation has been validated. As explained earlier, this slight discrepancy is because generally, the improper implementation of market orientation making it ineffective in most manufacturing firms. However most (more than 75%) Malaysian firms implemented eco-process innovation because they are at the maturity phase where they need to reduce cost while the environmental benefit for eco-process innovation is also difficult to be specified to customers, hence market orientation is important to gather information from customers and uncover competitors' strategy. Thus, the modified model below illustrated a full mediation for customer demand-eco-process innovation and partial mediation for competitor pressure-eco-process innovation relationships respectively.

The study suggests that a significant interaction may not exist for environmental turbulence and managerial ties in the relationship between market orientation and ET-innovation implementation. Thus, both constructs are not indicated the modified model. Although exclusion of both did not interact the effect on ET-innovation, these results should be interpreted with caution. This is because environmental turbulence has a history of mixed results when the situation change, while the value of managerial ties indicates low-to-moderate networking practices despite the encouragement from the Malaysian government with policy and incentives.

6.3 Summary

This chapter has explained the significant and insignificant relationships of market demand dimensions with ET-innovation in details. This essay has also argued that market orientation, in general, has improperly implemented in the Malaysia's manufacturing industry while in a more focus look, the mediation relationship with eco-process innovation is significant for the green technological industry. Finally, this chapter has given an account of and the reasons for the insignificant interactions of environmental turbulence and managerial ties on market demand and ET-innovation implementation link.

CHAPTER SEVEN

CONCLUSION

7.1 Summary of the Study

In the introduction, this study explains the sustainable development causes and effects in length. Sustainable development agenda is an international goal where technology is the key connector in the interdependency of its three pillars: economic, social and environment. Innovation that leads towards environmental technology is termed as ET-innovation.

This first objective of this study was to evaluate the magnitude of market demand effect on ET-innovation implementation from the demand-based view (Subsection 1.4). It was hypothesised that market demand has a direct relationship with ET-innovation implementation (Subsection 3.2.1, H1a and H1b). However, this study has been unable to demonstrate the direct relationship of customer demand with the implementation of ET-innovation. Customer demand in this study is explained as demand from the end user or the purchasing department/management of buyer firms (K. Green et al., 2000, 2002).

This major finding to emerge from this study can be explained by the low level of customer purchase behaviour on eco-product in Malaysia (Goh & Abdul Wahid, 2014; Noor et al., 2012). Malaysian customers or purchasing firms are prone to look into customer benefits such as price, functionality, quality, easy to fine, and expected business benefits, instead of the environmental criteria. Basically, they will buy eco-product because it met their functional requirement and price expectation

(Adner & Levinthal, 2001). Whereas the consumers that purchase eco-product also value firms' green image as important. Green image is correlated with eco-labelling where unfortunately wasn't included in many Malaysian firms strategy (Hasan & Ali, 2015). This has cause risk averse manufacturing firms unwilling to venture into green business.

Furthermore, the green industry in Malaysia is at an early PLC stage, therefore the learning curve is comparatively slower than other countries (Mohd Noor et al., 2016). End users possess' inadequate level of knowledge on environment and sustainability to encourage them into purchasing eco-products (Haron et al., 2005; Noor et al., 2012). While, purchasing firms low of knowledge in particular area, causing they rely on external sources for knowledge (Aljanabi & Noor, 2015; Noor & Aljanabi, 2016; A. Z. Yahya et al., 2011). Since they also didn't believe in the benefit of environmental purchasing, they tend to associate the benefit with external parties instead of their own firm and perceived any involvement in environmental practices would reduce their current profit and may not give positive growth (Ramakrishnan et al., 2015; Zailani et al., 2012).

In addition, awareness of green technology is low among users and also buyer firms (Nik Abdullah & Yaakub, 2015; Ramakrishnan et al., 2015). Thus, become a barrier for successful green practices because of firms' inability to take advantage of the international situation where the environmental requirement is a prerequisite. For example, Malaysian firms low awareness and knowledge on international environmental standard has affected their product acceptance at the global market (EPU, 2015). Although some firms have environmental awareness, they are not ready to purchase eco-product or implement eco-process technology although they are aware of the benefits because of soft commitment from management, lack of adequate manpower capabilities, and low of financial resources (Nik Abdullah & Yaakub, 2015; Zailani et al., 2015).

Finally, the government agencies in Malaysia have introduced regulations and incentives in assisting environmental initiatives to sprout. However, the control and pressure of the regulation and incentives were inconsistent (Abdullah et al., 2016). Hence, the effect on customers and purchasing firms towards increasing their demand is minimal.

Hypotheses H1c and H1d (Subsection 3.2.1) for the first objective (Subsection 1.4) proposed a direct relationship of market demand and ET-innovation implementation. The findings were the most obvious from this study, the competitor pressure has indeed a direct relationship with ET-innovation implementation. This is because, Malaysian firms that compete in the international market have accepted the normal practices where firms already implementing ET-innovation while also maintaining other customer benefits (Hojnik & Ruzzier, 2016). These firms will introduce the same product line (with somewhat similar environmental properties) to the domestic market, and cause green multiplier effect (Eltayeb et al., 2010; F. Ye et al., 2013). The green multiplier effect is where the pressure to implement green practice is pass to the firm's suppliers and upstream competitors, thus pushing local competitors to also innovate towards an environmental direction.

Whereas, whenever competitor firm shifted focus towards environmental initiatives, these will threaten a firm's market share (K. Green et al., 1994). Firms will react strongly by taking actions towards implementing cleaner technologies by complying with environmental regulation or implementing eco-product innovation base on market demand. By implementing ET-innovation, firms indirectly elevate their market reputation and position because generally green technologies are technologically more advanced (Driessen et al., 2013). Firms that search for opportunities in the environmentally oriented ecosystem are more competitive, ready to differentiate themselves from their rival and prepared to outperform their competitors (Porter & van der Linde, 1995a). This competitive situation pushes these firms to go beyond normal application in understanding their clean technology equipment and to be more creative when designing environmental product. These active strategies by firms are a prospect to a more positive market share expansion (R.-J. Lin et al., 2014).

The second objective of the current study was to propose the role of market orientation as a mediator in the relationship between market demand and ET-innovation implementation (Subsection 1.4). The hypotheses (H2a - H2d) for this objective propose a mediating effect of market orientation on the above relationship (Subsection 3.2.2). The findings were market orientation mediates the market demand and eco-process innovation implementation relationships despite rather weak relationships, while surprisingly does not mediate relationship with eco-product innovation implementation. These results can be explained from two sides; market orientation angle and eco-product/eco-process innovation angle.

This study has observed that the implementation of market orientation in Malaysia is inadequate and was not properly integrate with business operation despite showing a high level of implementation. While these inadequacies generally have caused an ineffective firm performance, market orientation has empirically shown a strong impact on eco-process innovation (Guoyou et al., 2013; S. K.-S.

Wong, 2013). Firms in Malaysian green manufacturing industry is at early maturity phase where more than three-quarter innovations were new-to-the-firm or new-to-the-Malaysia-industry eco-process innovations. They need market orientation to figure out the competitor strategy and also customer requirement because; compared to eco-products consumers that enjoy the customer benefit besides environmental benefits, environmental benefits generated when implementing eco-process are difficult to be proclaimed and properly marketed to customers (Ariffin et al., 2016; Chang, 2011).

On the other hand, Global Competitiveness Index rated Malaysian industry as a technological knowledge driven industry (MASTIC, 2017), therefore, although market orientation implementation can be too costly for SMEs firm, as do resources investment in ET-innovation implementation, when management faces this dilemma, enhancing existing technology is more possible, plus firm will focus on firms' internal key resources, the R&D and internal technological knowledge (Magnani & Tubb, 2012; Zhou & Li, 2010). Furthermore, the firm will become technologically superior to their competitor in the same segment (Chiun Lo et al., 2016). Thus, firms will easily be able to upgrade their technology, thus reduce dependency on market orientation (L. Chen & Wang, 2017; Paladino, 2008).

The third objective was to determine the interaction effect of environmental turbulence as moderator in the market orientation and ET-innovation linkage (Subsection 1.4). The hypotheses stated each dimensions of environmental turbulence, the technological turbulence (H3a and H3b), market turbulence (H3c and H3d), and competitive intensity (H3e and H3f), as moderators for the above relationship (Subsection 3.2.3). The results of this examination identified that all three constructs did not interact in the market orientation and ET-innovation relationships. Several possible reasons have been explained from the view of market orientation and technology.

Firstly, Malaysian firms that involve in environmental initiatives are knowledge driven and technologically oriented (MASTIC, 2017). Certainly, with some enhancement to existing facility, firms can introduce a new process or product and will be superior to their competitor (Chiun Lo et al., 2016; Magnani & Tubb, 2012; Paladino, 2008), thus external turbulence has no effect on the relationship.

Secondly, a seminal paper by Jaworski and Kohli (1993), found that firms that implement market orientation appropriately are robust against varying levels of environmental turbulence. This is possible because when firm invested significantly in market orientation strategy in the turbulence time. At different environment, firms are reluctant to change to different strategy because market orientation is already complex with money and time spent, and cultural and operational changes (Abiodun & Mahmood, 2015). Furthermore, market-oriented firms are prepared to sustain against competition in any technological and market uncertainties. In low environmental dynamism, when sales stagnant, margins reduce and competition increase, firms' stakeholder can't wait for the environment to be different, the market orientation activities need to continue as usual (Zhang & Duan, 2010). Therefore external turbulence has a less insignificant effect to firms operation.

The final objective was to determine the interaction effect of environmental turbulence and managerial ties as moderators in the market orientation and ET-innovation linkage (Subsection 1.4). The statement of hypotheses proposed business ties (H4a and H4b), political ties (H4c and H4d), and university ties (H4e and H4f) as moderators in the above relationship (Subsection 3.2.4). This study points out that all three constructs have insignificant interaction on market orientation and ET-innovation implementation relationship.

The study described that firms are reluctant to have external cooperation (business or political) because of several reasons; they fear of losing technology secret and intellectual property, the activity incur costs, they are hesitant to acquire knowledge from ties because of ethic, they are concern about involvement of external parties in their decision making, overload of information may reduce their reaction time in the market, and to avoid scandal if political ties known to public (Guo & Cao, 2014; Muzamil Naqshbandi & Kaur, 2014; Tseng et al., 2013). Thus, with less cooperation, the effect on the relationship will be less visible.

Another possible reason is this study has also measured and reported a moderate strength of university ties among manufacturing firms in Malaysia for the following cause; university ties are relatively new in Malaysia, they are not familiar with the university environment, and difficulty in finding the right expert for their project (Muzamil Naqshbandi & Kaur, 2014). Furthermore, if firms agreed with a research institution, they need to have their own R&D to support the project (Rasiah & Govindaraju, 2009). For small firms, this is beyond their capability and resources. Hence, less possible for firms to have ties with university, thus insignificant impact on market orientation-ET-innovation implementation relationship.

The above findings have important implications for developing a model to explain the direct, mediation and moderation effect on ET-innovation implementation. This modified model (Figure 6.2) was proposed (Figure 3.1), hypothesised (Section 3.2), analysed (Figure 5.2), and validated (Figure 6.2) accordingly for the use in the manufacturing industry in Malaysia.

7.2 Implication of Research

7.2.1 Implication to the Body of Knowledge

The findings of this study have a number of important implications on the body of knowledge. First, the study contributes by exploring the extent of market demand as an antecedent of ET-innovation which being derived from the view of demand-based which has been considered by many authors as underexplored, dispersed and less-known while overlooked in terms of extent and importance (Priem et al., 2011; Stanko et al., 2013). The modified model (Figure 6.2) developed and validated from the study findings suggested a different role for market demand in promoting ET-innovation implementation compared to initial hypotheses. This particular model is an original contribution in itself since it better elaborates the determinants of ET-innovation at dimension level especially in the Malaysian manufacturing industry.

Second, this study further assesses the dimension of ET-innovation implementation, the eco-process innovation implementation and eco-product innovation implementation, and compiles a table of the bottom five of most important but least perform factors for the two dimensions. The items in Table 7.1 will serve as a base for future studies in the body of knowledge of ET-innovation dimension.

Third, this study argues that the Malaysian green manufacturing industry as an export- and competitor-oriented industry (Subsection 6.2.6). This assessment is an important contribution to the body of knowledge for ET-innovation and for environmental innovation in Malaysia.

Table 7.1
IPMA Result Rank by Most Important but Least Perform (Bottom Five)

	Question No.	Construct	Important Indicator Survey Question
Eco-process innovation implementation	**24**	Competitor Pressure	We establish a company's environmental image comparing to competitors through green concept
	25	Competitor Pressure	We increase a company's market share through green concept
	30	Market Orientation	We are quick to detect fundamental shifts in our business environments (e.g., competition, technology, regulation)
	29	Market Orientation	We periodically review the likely effect of changes in our business environment (e.g. regulation on customers/business clients)
	33	Market Orientation	When someone finds out something important about competitors, they are quick to alert the rest of the firm
Eco-product innovation implementation	**24**	Competitor Pressure	We establish a company's environmental image comparing to competitors through green concept
	25	Competitor Pressure	We increase a company's market share through green concept
	22	Market Demand	Our overseas customers/business clients require our products meet the requirements of environmental regulations
	23	Market Demand	Our overseas customers/business clients pay great attention to the green concept contained in products
	21	Market Demand	Our domestic customers/business clients pay great attention to the green concept contained in products

Fourth, the evidence in this study perceives that market orientation implementation, in general, is not properly executed within the wider Malaysian manufacturing industry where Malaysian firms are more technologically driven. The ineffective implementation can be caused by an improper integration between market orientation and business operation mechanism. Business operation mechanism includes participative decision making and commitment by top management, sharing information, resources and influence, and top-down and cross-functional collaboration (T. Lee & Tsai, 2005; Slater & Narver, 1994).

Fifth, despite the low level of market orientation implementation within Malaysian manufacturing industry which contribute to the weak mediation factor for the relationship between market demand and eco-process innovation, the mediating role in itself is fully valid as proposed in the modified model (Figure 6.2). The market orientation factor is critical for firms that implement eco-process innovation to make sense of the knowledge on the market, customer and competitor situations.

Sixth, the study proposed, assessed, and concluded the role of market orientation as the mediator in the market demand and ET-innovation implementation relationship. This relationship study is a major attempt in the scope of ET-innovation and environmental innovation researches. The current findings add to a growing body of literature on market orientation as an important aspect of innovation management literature (Calantone et al., 2010; Ingenbleek et al., 2010; Liao et al., 2011).

Seventh, the test of mediation in this study also contribute to the methodological body of knowledge, the Preacher and Hayes (2008) bootstrapping method was used instead of causal steps (Baron & Kenny, 1986; Sobel, 1982, 1986). Furthermore, the procedure analysis proposed by Nitzl et al. (2016) as adapted from Zhao et al. (2010) was used instead of the procedure by Hair et al. (2014). The methods used for this mediation test may be applied to other mediation analysis and research.

Subsequently, this study determined the moderation interaction of environmental turbulence with market orientation on ET-innovation implementation. In view of a very limited of the above kind of study in a non-western, manufacturing and Malaysia setting, the study further contributes by extending the theory's application by helping academics and practitioners to better understand, explain and predict environmental turbulence patterns. Insignificant interactions were found for technological turbulence, market turbulence and competitive intensity as dimensions of environmental turbulence which interestingly, provide additional empirical support to older but seminal researches (Jaworski & Kohli, 1993; Slater & Narver, 1994).

Finally, this study assesses an important concept from the Asian perspective, the managerial ties, as moderating factor in the relationship between market orientation and ET-innovation implementation. To the best of the author's knowledge, this is the first empirical study which attempted to establish such interaction, thus filling up an important research gap in ET-innovation and environmental innovation literature. Although none of the moderating tests came out significant, the findings justified that external ties are still immature, thus need more exposure in terms of cost, capability and firms understanding before it can become a deciding factor in Malaysian manufacturing industry.

7.2.2 Practical Implication

The results of this study make several noteworthy contributions for owners, managers, policy makers and communities. First, policy makers and ENGOs communities must understand the connection between ET-innovation and sustainable development when looking deeper into sustainable development issues such as; interdependency between economics, social and environment, inclusive development for current and future population, impartiality between and within generation and species, responsibility at all levels to take precaution and prevention, and security against chronic threat and harmful disturbance (Birkin et al., 2009; Elkington, 1994;

Gladwin et al., 1995; Kinnear & Ogden, 2014; Mirata & Emtairah, 2005). This study illustrates (in Figure 7.1) the connection between sustainable development and ET-innovation implementation. With this information, they can organize better strategy because basic environmental knowledge is not sufficient to handle the in-depth sustainable development issue, technical 'know-how' and skill-related information will be necessary.

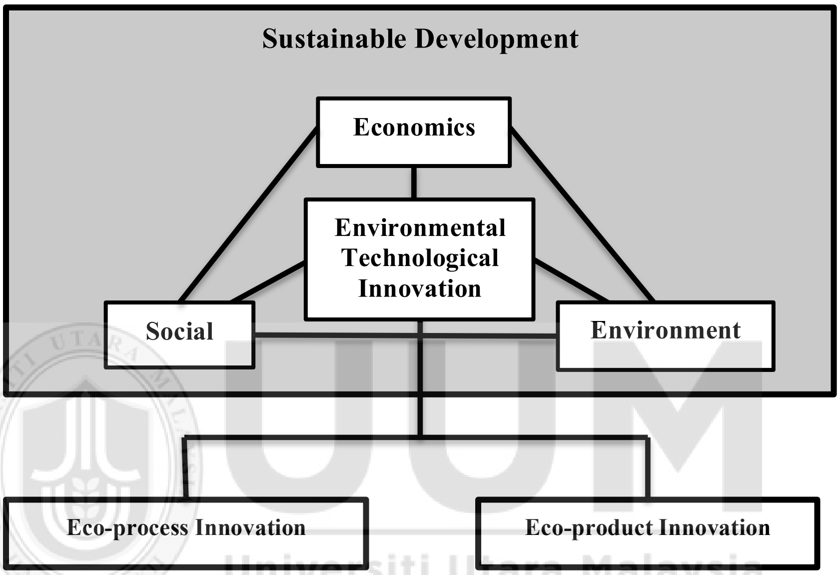

Figure 7.1
Sustainable Development and ET-innovation Connection
Source: Adapted from Mata-Lima et al. (2013)

Second, as shown in Figure 7.1, ET-innovation is the key to achieving sustainable development target. Owners and practitioners that want to implement ET-innovation must adhere to a few important criteria simplified as follows; (1) the innovation must be based on technological knowledge, (2) the knowledge must be at least new-to-the-firm, and (3) the innovation must incorporate the reduction of environmental impact compared to existing technologies (Charter & Clark, 2007; K. Green et al., 1994; Kemp & Pearson, 2007; Rennings et al., 2006).

Eco-process Innovation Implementation	**Eco-product Innovation Implementation**
•**Activity:** the introduction of an improvement to existing production processes or the addition of new processes •**Target:** producing environmentally friendly products capable of meeting eco-targets such as energy savings, pollution prevention •**Innovation types:** Cleaner production technologies, End-of-pipes technologies and Curative technologies •**Other relationship:** Eco-product	•**Activity:** the development of new or improved products or services •**Target:** inflicts no or less negative impact on the environment than a conventional product through different stages of the product's physical life cycle (manufacturing process, product use, and disposal) •**Innovation Type:** Integrated product technologies •**Other relationship:** Eco-product design, Environmental New Product Development (ENPD)

Figure 7.2
Eco-process Innovation Implementation and Eco-product Innovation Implementation Side-by-side

Third, the present study composes additional evidence with respect to the dimensions of ET-innovation. Although eco-process innovation and eco-product innovation is part of ET-innovation as Figure 7.1, the result of this study indicated that each dimension must be considered separately because antecedent and interaction effect can be different. Figure 7.2 shows the difference between both concepts. Technology in eco-process innovation covered a wide area which includes cleaner technologies, end-of-pipes and curative technologies, while eco-product innovation focuses on different life-cycles (manufacturing, use and disposal) of the same product. Thus, it is important for policymakers to appreciate the differences when introducing incentives or regulation. For managers that involve with ET-innovation, they must seek knowledge related to specific innovation, e.g., eco-product innovations need understanding in ENPD and eco-product design while for eco-process innovation, specific knowledge on the eco-product being produced would be crucial.

Fourth, the evidence in Figure 6.2 and Table 7.1 highlights the competitor pressure effects on ET-innovation implementation. Since the international market is pursuing sustainable development thus Malaysian firms have to increase technological knowledge on clean technology, preventive and end-of-pipe, while also design and produce eco-product to be relevant. The same product and technology will be market domestically too, hence will drive the competitor and upstream suppliers to enhance their environmental practice. This finding emphasises the green multiplier effect in the green manufacturing industry in Malaysia (Eltayeb et al., 2010; F. Ye et al., 2013), hence owners and practitioners must aware, ready with proper environmental strategy and take action when industrial situation require.

Fifth, this study also highlights further impact of competitor pressure on ET-innovation. While the test of significance showed a very high competitor pressure effect on ET-innovation ($p<0.01$), a further IPMA analysis (Subsection 5.9.5) provides an in-depth elaboration of the effect. The most important items but least perform (question no. 24), in Table 7.1, were similar for eco-process innovation implementation and eco-product innovation implementation. Owners and managers need to establish their environmental image to be different from their competitor. If a firm entails a higher level of green technology, the environmental image of the firm will be more significant and the reputation as technology leaders will go up too. The reason for this is because a higher level of green technology normally will require higher levels of technological development (Driessen et al., 2013), thus a higher image and reputation for the firm in the environmental aspect and also the technological aspect.

Sixth, the second most important items but least perform (question no. 25), in Table 7.1, were also similar for eco-process innovation implementation and eco-product innovation implementation. The indicator question related to the market share that can be attained by firms when they implement ET-innovation. As more export-oriented firms produce eco-product to compete in the international market, other local firms have to either comply with the environmental regulation and directive by implementing eco-process innovation or develop eco-product that consumers demand to be relevant. Owners and managers have to take advantage of the situation because it is also a prospect to improve firm market position, gain competitive advantage and increase market share.

Seventh, the three indicators (question no. 30, 29 and 33) for eco-process innovation implementation (in Table 7.1) that have been simulated in IPMA, assisted in the understanding of the role of market orientation in the relationship with eco-process innovation implementation. Questions no. 30 and 29 focus on recording knowledge from external environment consistently, whereas question no. 33 is the firm activity of distributing information within the firm. Taken together, consistently recording knowledge from the external environment and quickly distributing important knowledge within the firm can be prioritised as important operational characteristics in promoting market orientation as an antecedent for eco-process innovation.

Subsequently, the next two important indicators (questions no. 22 and 23) for eco-product innovation implementation were from international customer demand variable. As listed in Table 7.1, international demands were more important than local demand. In addition, Appendix N illustrates that international demand showed better performance than local demand. This finding proves that firms which develop eco-product must accept the direction of the international market which incline towards sustainability (Hojnik & Ruzzier, 2016; C.-Y. Lin & Ho, 2011). Managers do not need to worry because when firms decide towards environmentally oriented practice for the international market, it will directly reflect in the domestic market because the eco-product and technology would also be marketed locally. Firms will have a better green image, reputation will increase which ultimately will increase firms' advantage against their competitor.

Ninth, the final indicator (question no. 21 in Table 7.1) was on domestic demand of eco-product innovation implementation. The findings of this study perceived that customer bought eco-product not because they are environmentally conscious, has awareness or environmental knowledge, instead, they bought because the product suits their functional requirement and within their price consideration (Adner & Levinthal, 2001). This information is valuable for firms' managers when developing eco-product design specifications, for policy makers when designing an awareness campaign and regulation/incentives instrument to a targeted public while for ENGOs and communities society when organising an environmental knowledge enhancement program such as Earth hour to increase awareness and knowledge on the environment.

Another point, the empirical findings in this study make up the body of knowledge on environmental turbulence interaction with market orientation on ET-innovation. Although insignificant findings have been reported for all interactions, managers and policy makers need to interpret these situations with caution since the environmental turbulence and its dimensions (technological turbulence, market turbulence or competitive intensity) have a history of a mixed result in different industries and situations.

Finally, an implication of insignificant managerial ties interaction provides evidence that external ties are possibly still immature in Malaysia. On one hand, the global manufacturing industry has left mass-production technology which focuses on personal improvement to flexible specialisation that competes on innovation but cooperates on developing necessary knowledge and technology (Martin, 2012; Narula & Desore, 2016). Malaysian government realised this and acted by introducing government-linked entity, such as; MaGIC for industry-government linkage, Steinbeis Malaysia Foundation for industry-academia collaboration, and PlaTCOM Ventures Sdn Bhd will act as an intermediary in the industry-to-industry network (AIM, 2015a, 2015b; Platcom Ventures, 2015). Therefore, it is crucial for industry practitioners to grab this opportunity in demand-pull policy to expand their market possibilities. Whereas, findings of this study also give some indication for policy makers in terms of effectiveness and efficiency of their policy and for future measures towards having a better external collaboration for the industry.

7.3 Research Limitation

Although this study has reported a series of important contribution, however, caution must be applied before any interpretation being done on the results and findings, as the study might have some limitation that can best be treated under three headings: the scope of the study, the research design and the generalisation.

Firstly, the scope of the study is limited to the manufacturing industry in Malaysia. Although all types of industries have existed in the sample frame, when random sampling being done and respondent replied, some industries may be not represented or under represented. The research scope also meant that environmental innovation in the service industry like healthcare, financial and tourism was not being looked into. The current study was also limited within the scope of ET-innovation implemented at firms level. While heterogeneity of innovation may provide a different result if a higher number of data available for FIMIX or MGA test, the complete FIMIX and MGA tests have shown that observed and unobserved heterogeneity is not a concern. In addition, the findings have shown that the scope of the study is adequate for a conclusion to be derived.

Secondly, the current investigation was limited by the design of research. This study use cross-section survey that may be limiting the ability to analyse the dynamics of ET-innovation implementation across time. Plus, the survey method reduces the ability to fully control unobserved heterogeneity due to data and time constraint. However, the objectives of the study didn't require an analysis of dynamics across time, the data received from cross section survey is sufficient to complete the objectives of the study. Moreover, further statistical analysis cannot find a significant level of unobserved heterogeneity, thus the findings are legit and unbiased.

Finally, a caveat on generalisation needs to be noted regarding the present study. With a relatively small sample size, caution must be applied, as the findings might not be transferable to all manufacturing industry in Malaysia. The data was collected from manufacturing industry in Malaysia, thus context specific and may not be applicable in a wider context. However, the heterogeneity/MGA test was found insignificant, and the FIMIX unable to find a substantial level of unobserved heterogeneity, therefore the generalizability of the findings are secured and not biased.

7.4 Recommendation for Future Research

It is recommended that further research is undertaken in the following areas:

(1) This study focuses on the implementation of ET-innovation, as it is a young sector in Malaysia. Further research might construct a more detail study on the outcome of ET-innovation, such as technological performance, organisational performance, financial performance, green strategy performance, green market percentage and green reputation.

(2) Further work needs to be done to establish understanding on the implementation of other eco-innovation typology beside ET-innovation. These topic include institutional environmental innovation, social environmental innovation, green marketing innovation and eco-organizational innovation.

(3) The study has shown that global demand drives ET-innovation more that domestic market. Therefore, it would be interesting to compare whether firms with more environmental innovations also more internationalised or do more internationalised firms also become more environmental innovative to effectively design incentive, grants and policies towards proper target segment.

(4) The literature on demand-based view in innovation is still low especially for environmental innovation and ET-innovation. This study focuses on customer demand and competitor pressure dynamics from demand-based view. Considerably more work will need to be done to determine other areas of demand-based view, such as customer value, preference discontinuities, consumer involvement, consumer niche market and experimental user, in their effect towards environmental innovation.

(5) Market orientation has an insignificant relationship with eco-product innovation, but findings show that other mediation variables needed in between market orientation and eco-product innovation. Since eco-product innovation has some relationship with ENPD, future studies are suggested to examine the effect of market orientation on the individual components such as product development, manufacturing introduction, launch proficiency, new product performance, and aftermarket disposal.

(6) The replication of the study to another sector especially service sector; financial, tourism and healthcare in Malaysia. Plus, replication in other countries, preferably other Southeast Asian countries could make this study more understandable and accepted as applicable for implementation.

(7) The Malaysian government has invested time and money to encourage a linkage between firms, industry, academia and government through the development of government-backed institutions. However, the findings illustrate ineffective results. Thus, more information on the role of green alliances and external network ties, the level of collaborative efforts among competitors in terms of joint research development and advocacy, and whether green external network has been able to fetch profits for firms, would help to establish a greater degree of accuracy on this matter.

(8) Finally, a longitudinal or multiple cross-section surveys would be good in providing more information for a dynamic study of the same variables or a comparison study across time.

7.5 Conclusion

In conclusion, despite the limitations outlined, it is believed that this study has extended prior knowledge through providing some new and valuable insights into the ET-innovation and environmental innovation literature. It further compiled empirical support for some theoretical propositions advanced in the international literature. It is hoped that the proposed and modified conceptual model in this study forms the basis for future research beyond research recommendations breakdown in the previous section.

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APPENDICES

Appendix A: PLS-SEM Algorithm Setting

Data file Settings	
Data file	Data3 1.0 [186 records]
Missing value marker	none
Data Setup Settings	
Algorithm to handle missing data	Mean Replacement
Weighting Vector	-
PLS Algorithm Settings	
Data metric	Mean 0, Var 1
Initial Weights	1.0
Max. number of iterations	300
Stop criterion	5
Use Lohmoeller settings?	No
Weighting scheme	Path
Construct Outer Weighting Mode Settings	
Business Ties	Automatic
Competitive Intensity	Automatic
Competitor Pressure	Automatic
Customer Demand	Automatic
Eco-process Innovation Implementation	Automatic
Eco-product Innovation Implementation	Automatic
Market Orientation	Automatic
Market Turbulence	Automatic
Political Ties	Automatic
Technological Turbulence	Automatic
University Ties	Automatic

Appendix B: SmartPLS 3 Setting with Bootstrapping

Data file Settings	
Data file	Data3 1.0 [186 records]
Missing value marker	none
Data Setup Settings	
Algorithm to handle missing data	Mean Replacement
Weighting Vector	-
PLS Algorithm Settings	
Data metric	Mean 0, Var 1
Initial Weights	1.0
Max. number of iterations	300
Stop criterion	5
Use Lohmoeller settings?	No
Weighting scheme	Path
Bootstrapping Settings	
Complexity	Complete Bootstrapping
Confidence interval method	Bias-Corrected and Accelerated (BCa) Bootstrap
Parallel processing	No
Samples	1000
Sign changes	No Sign Changes
Significance level	0.05
Test type	Two Tailed
Construct Outer Weighting Mode Settings	
Business Ties	Automatic
Competitive Intensity	Automatic
Competitor Pressure	Automatic
Customer Demand	Automatic
Eco-process Innovation Implementation	Automatic
Eco-product Innovation Implementation	Automatic
Market Orientation	Automatic
Market Turbulence	Automatic
Political Ties	Automatic
Technological Turbulence	Automatic
University Ties	Automatic

Appendix C: SmartPLS 3 – FIMIX-PLS Setting

Data file Settings	
Data file	Data3 1.0 [186 records]
Missing value marker	none
Data Setup Settings	
Algorithm to handle missing data	Mean Replacement
Weighting Vector	-
PLS Algorithm Settings	
Data metric	Mean 0, Var 1
Initial Weights	1.0
Max. number of iterations	300
Stop criterion	7
Use Lohmoeller settings?	No
Weighting scheme	Path
Finite Mixture (FIMIX) Segmentation Settings	
Estimate Regression Intercept	No
Maximum iterations	5000
Number of repetitions	10
Number of segments	2
Stop criterion	10
Use unstandardized latent variable scores	No
Construct Outer Weighting Mode Settings	
Business Ties	Automatic
Competitive Intensity	Automatic
Competitor Pressure	Automatic
Customer Demand	Automatic
Eco-process Innovation Implementation	Automatic
Eco-product Innovation Implementation	Automatic
Market Orientation	Automatic
Market Orientation-\Business Ties/-Eco-process Innovation Implementation	Automatic
Market Orientation-\Business Ties/-Eco-product Innovation Implementation	Automatic
Market Orientation-\Competitive Intensity/-Eco-process Innovation Implementation	Automatic
Market Orientation-\Competitive Intensity/-Eco-product Innovation Implementation	Automatic
Market Orientation-\Market Turbulence/-Eco-process Innovation Implementation	Automatic
Market Orientation-\Market Turbulence/-Eco-product Innovation Implementation	Automatic

Appendix C (Continued)

Market Orientation-\Political Ties/-Eco-process Innovation Implementation	Automatic
Market Orientation-\Political Ties/-Eco-product Innovation Implementation	Automatic
Market Orientation-\Technological Turbulence/-Eco-process Innovation Implementation	Automatic
Market Orientation-\Technological Turbulence/-Eco-product Innovation Implementation	Automatic
Market Orientation-\University Ties/-Eco-process Innovation Implementation	Automatic
Market Orientation-\University Ties/-Eco-product Innovation Implementation	Automatic
Market Turbulence	Automatic
Political Ties	Automatic
Technological Turbulence	Automatic
University Ties	Automatic

Appendix D: Survey Questions

SURVEY QUESTIONNAIRE DOCTORAL RESEARCH

Environmental Technological Innovation Implementation and Market Demand: Accessing Mediating and Moderating Factors of Market Orientation, Environmental Turbulence and Managerial Ties

Universiti Utara Malaysia
06010 UUM Sintok
Kedah Darul Aman, Malaysia

Muhammad Fakhrul Yusuf
Doctoral Researcher

School of Technology Management & Logistic
College of Business

Email: m.fakhrul@gmail.com
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Dear Sir/Madam,

I am currently a PhD candidate studying Technology Management at Universiti Utara Malaysia. As part of my dissertation, I am seeking to understand the relationship between Market Demand and Environmental Technological Innovation* Implementation.

My research title is Environmental Technological Innovation Implementation and Market Demand: Accessing Mediating and Moderating Factors of Market Orientation, Environmental Turbulence and Managerial Ties.

This study will help fellow practitioners, academicians and policy makers to better understand the chemistry of the relationship in the implementation of Environmental Technological Innovation within a firm. Malaysian Green Technology Corporation as attached recommendation letter also has endorsed this study.

The research requires participation of the middle management level (Manager & above) or top-management level (General Manager & above) to complete the enclosed questionnaire.

Please Note:

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact me by email at the email address specified below.

Your participation in answering the questionnaire is very much significant and appreciated to ensure the success of the study.

Thank you for your participation.

Muhammad Fakhrul Yusuf
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**Environmental technological innovation (ET-innovation) also known as technological environmental innovation, technological eco-innovation and green technological innovation. Eco-product innovation and eco-process innovation are subsets of ET-innovation and ET-innovation is part of green innovation. Green technology is the output of ET-innovation.*

Appendix D (Continued)

Ref No. : MGTC/GG/GTFS/423
Date : February 10, 2016

To Whom It May Concern

Dear Sir/Madam,

Re: Recommendation Letter to Conduct Research for GTFS Project.

We write in support for En Muhammad Fakhrul Yusuf, a Ph.D. student, at University Utara Malaysia who is seeking assistance in conducting his research in Environmental Technological Innovation relationship with Market Demand.

The target respondents for the research are companies that implement eco product or eco process innovation in their respective industry. We believe the result of the research will benefit the policy makers, international firms, business owners, academics and environmental interested parties.

We, therefore hope that you provide the necessary assistance and utmost cooperation to En Muhammad Fakhrul Yusuf in conducting his research. If you should require further information, please do not hesitate to contact Kamaradzaman Mohd Bakri at 603-8921 0901.

Thank you.

Yours faithfully,

SYED AHMAD SYED MUSTAFA
Vice President, Green Growth

MALAYSIAN GREEN TECHNOLOGY CORPORATION (462237-T)
No.2, Jalan 9/10, Persiaran Usahawan, Seksyen 9, 43650 Bandar Baru Bangi, Selangor Darul Ehsan
Tel: 03 8921 0800 Fax: 03 8921 0801/03 8921 0802 Email: info@greentechmalaysia.my
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This survey is divided into **6 sections**. Respond to each question with whatever knowledge you have. There are no right or wrong answers. Be honest and realistic in your assessment.

For information: In case you have more than one plant, please choose only one primary plant to base on your answers on all questions contain here

SECTION 1

1. **What is the main industry of your company?**

- ☐ Electrical & electronics
- ☐ Petrochemicals industry
- ☐ Textile and apparels
- ☐ Furniture & wood-based
- ☐ Shipbuilding & ship repair industry
- ☐ Non metallic mineral industry
- ☐ Pharmaceutical
- ☐ Engineering support
- ☐ Jewelry
- ☐ Concrete products
- ☐ Machinery & equipment industry
- ☐ Aerospace
- ☐ Automotive industry
- ☐ Rubber products
- ☐ Basic metal products
- ☐ Food & sustainable resources
- ☐ Medical devices
- ☐ Chemicals
- ☐ Publishing & printing
- ☐ Other, please specify _____

2. **Please indicate who own your company:**

- ☐ Publicly owned
- ☐ State owned
- ☐ Federal owned
- ☐ Privately owned
- ☐ Foreign ownership
- ☐ Mixed ownership/Joint Venture

3. **How long has your company established? _____years**

4. **No of employees in the organisation: _____**

5. **How many years have you been working with the company: _____years**

6. **Please indicate your job title: _____**

7. **How would you describe your company implementation of eco-product innovation?**
   - ☐ Original concept (never existed in/outside of Malaysia)
   - ☐ Originated from an existing concept in Malaysia
   - ☐ Originated from an existing concept from outside of Malaysia
   - ☐ Other (please specify) ______

Note: Eco-product (green product) innovation implementation involves the development of new or improved products or services that inflicts no or less negative impact on the environment than a conventional product through different stages of the product's physical life cycle (manufacturing process, product use, and disposal)

8. **How would you describe your company implementation of eco-process innovation?**
   - ☐ Original concept (never existed in/outside of Malaysia)
   - ☐ Originated from an existing concept in Malaysia
   - ☐ Originated from an existing concept from outside of Malaysia
   - ☐ Other (please specify) ______

Note: Eco-process innovation implementation is the introduction of an improvement to existing production processes or the addition of new processes with the aim of producing environmentally friendly products capable of meeting eco-targets, such as energy savings, pollution prevention, waste recycling, no toxicity, low energy consumption, recycle, reuse and remanufacture material and use of cleaner technology to make savings and prevent pollution

SECTION 2

For SECTION 2, based on the following statement, please TICK (✓) your answers as scales below.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	**Neither agree nor disagree**	Somewhat agree	Agree	**Strongly agree**

"In last 3 years, relative to your competitors, please rate your firm on a scale of 1 to 7 on the following questions:"	1	2	3	4	5	6	7
9. Our company often emphasizes developing new eco-products through new technologies to simplify their packaging	☐	☐	☐	☐	☐	☐	☐
10. Our company often emphasizes developing new eco-products through new technologies to simplify their construction	☐	☐	☐	☐	☐	☐	☐
11. Our company often emphasizes developing new eco-products through new technologies to easily *recycle* their components *Note: Recycle in this case, can be done by third party company or collected by your company for recycling activity*	☐	☐	☐	☐	☐	☐	☐
12. Our company often emphasizes developing new eco-products through new technologies to easily *decompose* their materials *Note: Decompose reflects to materials that can be tossed onto the ground and can become food for plants and animals and nutrients for soil*	☐	☐	☐	☐	☐	☐	☐
13. Our company often emphasizes developing new eco-products through new technologies to use *natural materials* *Note: A natural material that comes from plants, animals, or the ground including minerals and the metals that can be extracted from them without further modification*	☐	☐	☐	☐	☐	☐	☐

	1	2	3	4	5	6	7
14. Our company often emphasizes developing new eco-products through new technologies to reduce damage by waste as much as possible	☐	☐	☐	☐	☐	☐	☐
15. Our company often emphasizes developing new eco-products through new technologies to use as little energy as possible	☐	☐	☐	☐	☐	☐	☐
16. Our company often innovatively updates manufacturing processes to protect against *contaminations* *Note: Contaminations means the availability of unwanted constituent, waste or impurity in the natural environments (soil, water and air etc.)*	☐	☐	☐	☐	☐	☐	☐
17. Our company often innovatively updates manufacturing processes to meet standards of environmental law	☐	☐	☐	☐	☐	☐	☐
18. Our company often uses innovative technologies in manufacturing processes to save energy.	☐	☐	☐	☐	☐	☐	☐
19. Our company often innovatively updates manufacturing equipment in manufacturing processes to save energy	☐	☐	☐	☐	☐	☐	☐

SECTION 3

For SECTION 3, state your responses based on the following scales, please TICK (✓) your answers.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	**Neither agree nor disagree**	Somewhat agree	Agree	**Strongly agree**

	1	2	3	4	5	6	7
20. Our domestic customers/business clients require our products meet the requirements of environmental regulations	☐	☐	☐	☐	☐	☐	☐

Appendix D (Continued)

Pusat Pengajian Pengurusan Teknologi dan Logistik
SCHOOL OF TECHNOLOGY MANAGEMENT AND LOGISTICS
Universiti Utara Malaysia

21. Our domestic customers/business clients pay great attention to the green concept contained in products	☐	☐	☐	☐	☐	☐	☐
22. Our overseas customers/business clients require our products meet the requirements of environmental regulations	☐	☐	☐	☐	☐	☐	☐
23. Our overseas customers/business clients pay great attention to the green concept contained in products	☐	☐	☐	☐	☐	☐	☐
24. We establish a company's environmental image comparing to competitors through green concept	☐	☐	☐	☐	☐	☐	☐
25. We increase our company's market share through green concept	☐	☐	☐	☐	☐	☐	☐
26. We improve our company's *competitive advantage* over competitors through green concept *Note: Competitive advantage is a concept where for example, a company can achieve a cost advantage when the company operates at a lower cost than its competitors but offers a comparable product. Or, a company has differentiation advantage when the company offers a unique product from its competitor.*	☐	☐	☐	☐	☐	☐	☐

SECTION 4

For SECTION 4, state your responses based on the following scales, please TICK (✓) your answers.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	**Neither agree nor disagree**	Somewhat agree	Agree	**Strongly agree**

	1	2	3	4	5	6	7
27. We meet regularly with customers/business clients to find out what products or services they will need in the future	☐	☐	☐	☐	☐	☐	☐
28. We often poll end users/business clients to assess the quality of our products and services	☐	☐	☐	☐	☐	☐	☐
29. We periodically review the likely effect of changes in our business environment (e.g. regulation on customers/business clients)	☐	☐	☐	☐	☐	☐	☐
30. We are quick to detect fundamental shifts in our business environments (e.g., competition, technology, regulation)	☐	☐	☐	☐	☐	☐	☐
31. When something important happens to a major customer or market, the whole firm knows about it in a short period	☐	☐	☐	☐	☐	☐	☐
32. Data on customer/business clients satisfaction are disseminated at all levels in this firm on a regular basis	☐	☐	☐	☐	☐	☐	☐
33. When someone finds out something important about competitors, they are quick to alert the rest of the company	☐	☐	☐	☐	☐	☐	☐
34. We are quick to respond to significant changes in our competitors' pricing structures	☐	☐	☐	☐	☐	☐	☐
35. Personnel get together periodically to plan a response to changes taking place in our business environment	☐	☐	☐	☐	☐	☐	☐

36. If a major competitor were to launch an intensive campaign targeted at our customers/business clients, we would implement a response immediately	☐	☐	☐	☐	☐	☐	☐

SECTION 5

For SECTION 5, state your responses based on the following scales, please TICK (✓) your answers.

1	2	3	4	5	6	7
Strongly disagree	Disagree	Somewhat disagree	**Neither agree nor disagree**	Somewhat agree	Agree	**Strongly agree**

	1	2	3	4	5	6	7
37. The technology in this industry is changing rapidly	☐	☐	☐	☐	☐	☐	☐
38. Technological changes provide substantial opportunities in this industry	☐	☐	☐	☐	☐	☐	☐
39. A large number of new product ideas have been made possible through *technological breakthroughs* in this industry *Note: Technological breakthrough happens when radical technological innovations are produced, challenging the old or outdated paradigm and system and gradually replacing it*	☐	☐	☐	☐	☐	☐	☐
40. It is very difficult to forecast where the technology in this area will be in the next few years	☐	☐	☐	☐	☐	☐	☐
41. In our kind of business, customers'/business clients' product preferences change constantly.	☐	☐	☐	☐	☐	☐	☐
42. Our customers/business clients tend to look for new products all the time.	☐	☐	☐	☐	☐	☐	☐
43. We are witnessing demand for our products from new customers/business clients	☐	☐	☐	☐	☐	☐	☐

Appendix D (Continued)

44. New customers tend to have product-related needs that are different from those of our existing customers/business clients	☐	☐	☐	☐	☐	☐	☐
45. Competition in our industry is cutthroat.	☐	☐	☐	☐	☐	☐	☐
46. Promotion wars are common in our industry	☐	☐	☐	☐	☐	☐	☐
47. Anything that a competitor can offer, others can match easily	☐	☐	☐	☐	☐	☐	☐
48. Price competition is common in our industry	☐	☐	☐	☐	☐	☐	☐

SECTION 6

For SECTION 6, based on the following statement, please TICK (✓) your answers as scales below.

1	2	3	4	5	6	7
Very little	Little	Somewhat little	**Neither little nor extensive**	Somewhat extensive	Extensive	**Very extensive**

"Please mark the number best describing the extent to which managers at your firm have utilised personal ties, networks, and connection during the past three years with…"	1	2	3	4	5	6	7
49. Managers at supplier company	☐	☐	☐	☐	☐	☐	☐
50. Managers at buyer company	☐	☐	☐	☐	☐	☐	☐
51. Managers at competitor company	☐	☐	☐	☐	☐	☐	☐
52. Official in industry bureaus	☐	☐	☐	☐	☐	☐	☐
53. Political leaders in various level of the governments	☐	☐	☐	☐	☐	☐	☐
54. Official in regulatory bureaus	☐	☐	☐	☐	☐	☐	☐

55. Official in supporting organisations such as tax bureaus, state banks, commercial administration bureaus and the like	☐	☐	☐	☐	☐	☐	☐
56. University researchers for *R&D* activities and formal consulting work *Note: R&D = Research and Development*	☐	☐	☐	☐	☐	☐	☐
57. University researchers for training and transfer of personnel	☐	☐	☐	☐	☐	☐	☐
58. University researchers for commercialisation related to intellectual property rights	☐	☐	☐	☐	☐	☐	☐

Thank you for your participation, if you need summary of the result, please attach your name card or fill up the information below. Thank you again.

Name: ______

Name of organisation: ______

Address: ______

Email: ______

Gmail

fakhrul m <m.fakhrul@gmail.com>

Universiti Utara Malaysia Doctoral Research Survey Invitation

1 message

m.fakhrul@gmail.com <m.fakhrul@gmail.com> Mon, Apr 18, 2016 at 11:03 PM
To: "m.fakhrul" <m.fakhrul@gmail.com>

Pusat Pengajian Pengurusan Teknologi dan Logistik
SCHOOL OF TECHNOLOGY MANAGEMENT AND LOGISTICS
Universiti Utara Malaysia

Dear ,

I am Muhammad Fakhrul Yusuf, currently a PhD candidate studying Technology Management at Universiti Utara Malaysia. As part of my dissertation, I am seeking to understand the relationship between Market Demand and Environmental Technological Innovation Implementation.

This study will help fellow practitioners, academicians and policy makers to better understand the chemistry of the relationship in the implementation of Environmental Technological Innovation within a firm. This study also has been endorsed by the Malaysian Green Technology Corporation as attached recommendation letter (http://www.questionpro.com/qp_userimages/sub-3/2686924/CCI20022016.pdf).

Please help by giving your feedback in our survey. We really appreciate your reply. All responses will remain confidential and secure. Thank you in advance for your valuable insights. Please click on this link to complete the survey:

http://www.questionpro.com/t/CTdhFZThg2o

Please contact email below for further clarification

Thank you.

Muhammad Fakhrul Yusuf
PhD Candidate
Universiti Utara Malaysia
06010 Sintok,

Kedah, Malaysia
016-2380780
m.fakhrul@gmail.com

Universiti Pengurusan Terkemuka

Appendix F: First Reminder Email

Gmail fakhrul m <m.fakhrul@gmail.com>

Soft reminder on UUM Doctoral Research Survey Invitation

1 message

for record <m.fakhrul@gmail.com> Mon, Apr 18, 2016 at 11:03 PM
To: "m.fakhrul" <m.fakhrul@gmail.com>

Dear ,

As mentioned before, I am Muhammad Fakhrul Yusuf, currently a PhD candidate (UUM) doing research on Environmental Technological Innovation and market demand.

We are sorry for disturbing your busy schedule, however we really hope you can help us by answering our survey. Please click on this link to complete the survey:

http://www.questionpro.com/t/CTdhFZThg2x

This study will help fellow practitioners, academicians and policy makers to better understand the relationship of Environmental Technological Innovation implementation within a firm.

Thank you in advance for your valuable insights. Please be assure that all responses will remain confidential and secure.

Please contact email below for further clarification.

Thank you.

Muhammad Fakhrul Yusuf
PhD Candidate
Universiti Utara Malaysia
06010 Sintok,
Kedah, Malaysia

016-2380780
m.fakhrul@gmail.com

Appendix G: Second Reminder Email

Gmail

fakhrul m <m.fakhrul@gmail.com>

University Research Survey - Special Reminder

1 message

for record <m.fakhrul@gmail.com> Mon, Apr 18, 2016 at 11:04 PM
To: "m.fakhrul" <m.fakhrul@gmail.com>

Dear ,

As mention in my first email, I am Muhammad Fakhrul Yusuf, currently a PhD candidate studying Technology Management at Universiti Utara Malaysia.

My research focuses on Environmental Technological Innovation Implementation relationship with Market Demand within manufacturing industry in Malaysia.

Please assist me in completing this survey as it will also help fellow practitioners, academicians and policy makers to better understand the effect of Environmental Technological Innovation within a firm.

I greatly appreciate your feedback in our survey. Please click on this link to complete the survey:

http://www.questionpro.com/t/CTdhFZThg2z

Please contact email below for further clarification.

Thank you.

Muhammad Fakhrul Yusuf
PhD Candidate
Universiti Utara Malaysia
06010 Sintok,
Kedah, Malaysia

016-2380780
m.fakhrul@gmail.com

Universiti Pengurusan Terkemuka

Appendix H: Final Reminder Email

Gmail

fakhrul m <m.fakhrul@gmail.com>

Reminder for involvement in Research Survey for Universiti Utara Malaysia

1 message

for record <m.fakhrul@gmail.com> Mon, Apr 18, 2016 at 11:05 PM
To: "m.fakhrul" <m.fakhrul@gmail.com>

Dear ,

As stated earlier, I am Muhammad Fakhrul Yusuf, a UUM doctorate candidate doing research on Environmental Technological Innovation Implementation.

Please help me by answering the survey as it will also have an impact on understanding Environmental Technological Innovation within manufacturing industry in Malaysia for fellow practitioners, policy makers and academics. Please click on this link to complete the survey:

http://www.questionpro.com/t/CTdhFZThg20

I greatly appreciate your feedback and thank you in advance for your time.

All responses will remain confidential and secure. Please contact email below for further clarification.

Best regards.

Muhammad Fakhrul Yusuf
PhD Candidate
Universiti Utara Malaysia
06010 Sintok,
Kedah, Malaysia
016-2380780
m.fakhrul@gmail.com

Universiti Pengurusan Terkemuka

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Appendix I: Table of Mean, Kurtosis and Skewness for Indicators

Indica-tors	**Mean**	**Std. Dev.**	**Kurto-sis**	**Skew-ness**	**Indica-tors**	**Mean**	**Std. Dev.**	**Kurto-sis**	**Skew-ness**
09	4.9	1.494	-0.214	-0.600	**34**	5.25	1.25	0.520	-0.708
10	5.04	1.442	-0.020	-0.690	**35**	5.38	1.119	0.210	-0.575
11	5.03	1.47	-0.076	-0.655	**36**	5.24	1.208	0.570	-0.718
12	4.74	1.503	-0.234	-0.526	**37**	5.22	1.424	-0.084	-0.658
13	4.9	1.55	-0.098	-0.594	**38**	5.38	1.26	0.077	-0.638
14	5.51	1.304	0.648	-0.944	**39**	5.28	1.293	-0.157	-0.595
15	5.39	1.403	0.427	-0.858	**40**	4.85	1.346	-0.318	-0.324
16	5.39	1.368	0.021	-0.753	**41**	4.72	1.395	-0.533	-0.348
17	5.58	1.238	0.520	-0.840	**42**	4.88	1.467	-0.682	-0.365
18	5.41	1.28	0.465	-0.799	**43**	5.26	1.148	0.881	-0.780
19	5.32	1.308	-0.005	-0.577	**44**	5.02	1.369	-0.246	-0.502
20	4.74	1.613	-0.588	-0.471	**45**	5.04	1.389	-0.291	-0.423
21	4.43	1.538	-0.554	-0.336	**46**	4.87	1.561	-0.779	-0.395
22	5.31	1.375	0.166	-0.792	**47**	4.83	1.455	-0.308	-0.355
23	5.23	1.362	0.203	-0.777	**48**	5.62	1.355	0.219	-0.911
24	5.04	1.481	-0.300	-0.569	**49**	4.82	1.521	0.187	-0.759
25	4.88	1.534	-0.316	-0.480	**50**	4.95	1.458	0.291	-0.762
26	4.97	1.559	-0.243	-0.629	**51**	4.11	1.604	-0.531	-0.392
27	5.45	1.356	0.998	-1.048	**52**	4.37	1.566	-0.330	-0.557
28	5.29	1.316	0.355	-0.766	**53**	3.78	1.761	-0.964	-0.217
29	5.37	1.238	0.400	-0.789	**54**	4.15	1.65	-0.508	-0.550
30	5.36	1.232	0.242	-0.664	**55**	4.15	1.656	-0.614	-0.393
31	5.33	1.166	0.326	-0.636	**56**	4.02	1.793	-0.901	-0.366
32	5.13	1.216	0.404	-0.552	**57**	3.75	1.76	-0.981	-0.180
33	5.28	1.181	0.435	-0.730	**58**	3.73	1.793	-1.009	0.067

	Business Ties	Competitive Intensity	Competitor Pressure	Customer Demand	Eco-process Innovation Implementation	Eco-product Innovation Implementation	Market Orientation	Market Turbulence	Political Ties	Technological Turbulence	University Ties
Business Ties	0.865										
Competitive Intensity	0.230	0.791									
Competitor Pressure	0.224	0.067	0.952								
Customer Demand	0.206	0.170	0.741	0.875							
Eco-process Innovation Implementation	0.133	0.146	0.591	0.485	0.876						
Eco-product Innovation Implementation	0.200	0.168	0.737	0.624	0.737	0.788					
Market Orientation	0.277	0.313	0.561	0.507	0.560	0.526	0.801				
Market Turbulence	0.466	0.409	0.372	0.405	0.264	0.348	0.557	0.821			
Political Ties	0.589	0.130	0.211	0.224	0.104	0.178	0.243	0.463	0.882		
Technological Turbulence	0.256	0.401	0.347	0.423	0.361	0.402	0.497	0.576	0.192	0.815	
University Ties	0.368	-0.025	0.153	0.188	0.077	0.167	0.132	0.324	0.667	0.181	0.958

Appendix K: Heterotrait-Monotrait Ratio (HTMT)

	Business Ties	Compe-titive Intensity	Compe-titor Pressure	Customer Demand	Eco-process Inno-vation Imple-mentation	Eco-product Inno-vation Imple-mentation	Market Orien-tation	Market Turbu-lence	Political Ties	Techno-logical Turbu-lence	University Ties
Business Ties											
Competitive Intensity	0.291										
Competitor Pressure	0.249	0.079									
Customer Demand	0.244	0.192	0.823								
Eco-process Innovation Implementation	0.153	0.187	0.648	0.538							
Eco-product Innovation Implementation	0.224	0.192	0.810	0.693	0.813						
Market Orientation	0.294	0.366	0.595	0.551	0.600	0.559					
Market Turbulence	0.560	0.522	0.416	0.456	0.295	0.398	0.621				
Political Ties	0.732	0.178	0.227	0.235	0.108	0.191	0.260	0.522			
Technological Turbulence	0.284	0.508	0.381	0.477	0.398	0.440	0.546	0.685	0.207		
University Ties	0.471	0.127	0.167	0.211	0.077	0.181	0.144	0.365	0.740	0.200	

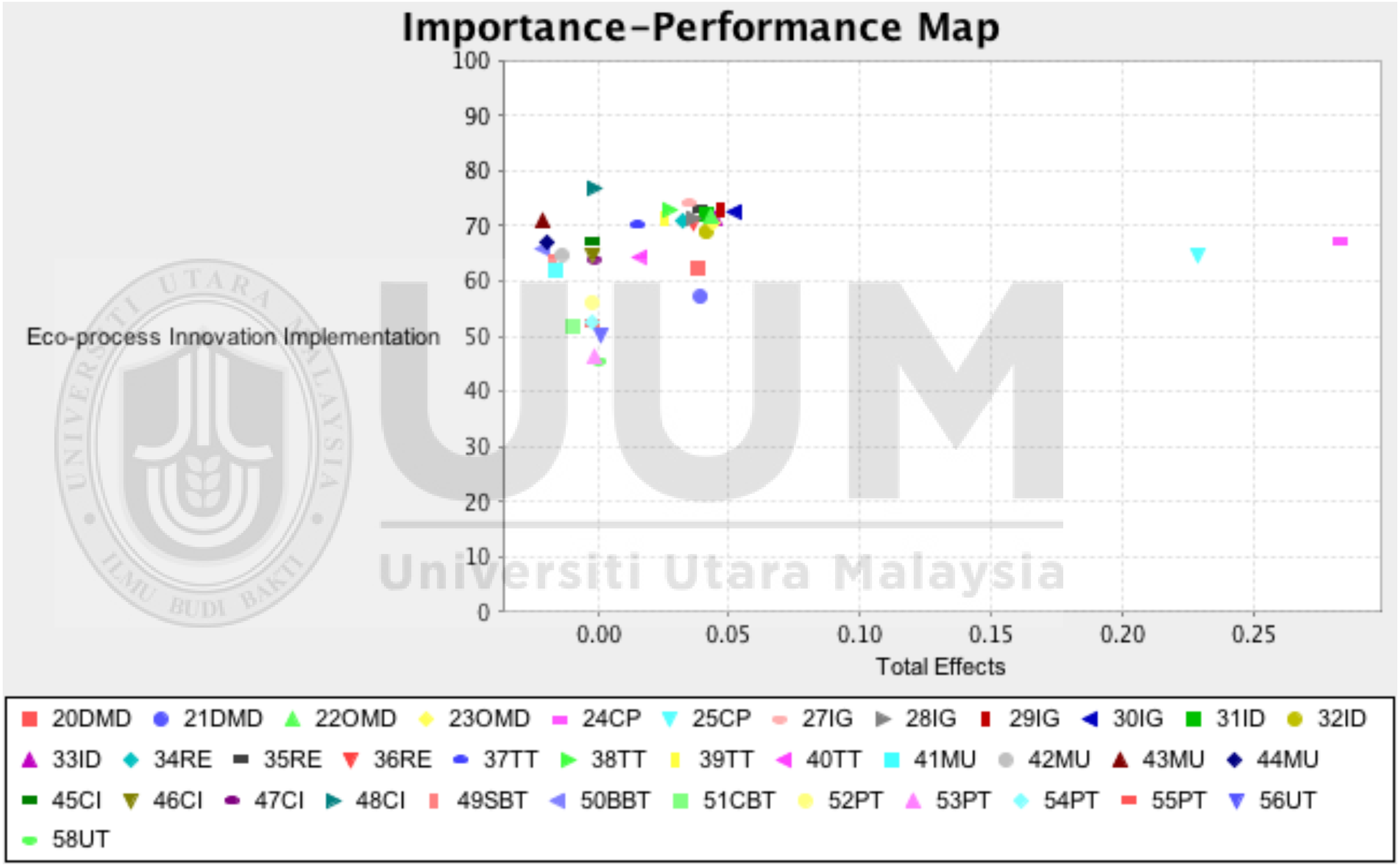
	Business Ties	Competitive Intensity	Competitor Pressure	Customer Demand	Eco-process Innovation Implementation	Eco-product Innovation Implementation	Market Orientation	Market Turbulence	Political Ties	Technological Turbulence	University Ties
09EP	0.263	0.159	0.558	0.454	0.574	**0.775**	0.466	0.365	0.295	0.349	0.123
10EP	0.146	0.166	0.657	0.502	0.637	**0.846**	0.428	0.316	0.132	0.470	0.114
11EP	0.124	0.092	0.512	0.487	0.520	**0.767**	0.304	0.228	0.106	0.209	0.095
12EP	0.110	0.155	0.568	0.529	0.508	**0.779**	0.349	0.269	0.183	0.268	0.164
13EP	0.135	0.035	0.497	0.466	0.443	**0.687**	0.360	0.333	0.099	0.198	0.222
14EP	0.171	0.108	0.581	0.501	0.635	**0.825**	0.485	0.241	0.112	0.309	0.130
15EP	0.152	0.186	0.663	0.504	0.703	**0.824**	0.480	0.189	0.066	0.361	0.095
16EPs	0.128	0.121	0.487	0.383	**0.845**	0.608	0.513	0.279	0.122	0.337	0.095
17EPs	0.122	-0.023	0.520	0.439	**0.855**	0.622	0.475	0.181	0.090	0.203	0.106
18EPs	0.114	0.196	0.529	0.428	**0.906**	0.681	0.491	0.223	0.076	0.394	0.027
19EPs	0.104	0.209	0.532	0.449	**0.896**	0.669	0.483	0.241	0.077	0.325	0.046
20DMD	0.182	0.146	0.603	**0.862**	0.392	0.479	0.427	0.296	0.187	0.328	0.180
21DMD	0.128	0.089	0.625	**0.845**	0.379	0.501	0.465	0.388	0.253	0.302	0.228
22OMD	0.189	0.204	0.638	**0.909**	0.450	0.594	0.439	0.337	0.156	0.387	0.128
23OMD	0.217	0.151	0.720	**0.883**	0.470	0.596	0.444	0.392	0.194	0.452	0.133
24CP	0.239	0.085	**0.962**	0.717	0.639	0.754	0.580	0.344	0.174	0.353	0.143
25CP	0.183	0.037	**0.941**	0.693	0.469	0.640	0.477	0.366	0.234	0.302	0.148

Appendix L (Continued)

	Business Ties	Compe-titive Intensity	Compe-titor Pressure	Customer Demand	Eco-process Inno-vation Imple-mentation	Eco-product Inno-vation Imple-mentation	Market Orien-tation	Market Turbu-lence	Political Ties	Techno-logical Turbu-lence	University Ties
27IG	0.231	0.213	0.376	0.400	0.367	0.347	**0.760**	0.540	0.287	0.351	0.150
28IG	0.228	0.290	0.391	0.450	0.382	0.374	**0.743**	0.463	0.201	0.320	0.120
29IG	0.216	0.183	0.533	0.473	0.500	0.471	**0.847**	0.461	0.202	0.334	0.096
30IG	0.201	0.240	0.588	0.419	0.588	0.527	**0.834**	0.422	0.146	0.437	0.034
31ID	0.222	0.313	0.431	0.423	0.459	0.424	**0.804**	0.382	0.143	0.430	0.073
32ID	0.230	0.297	0.424	0.414	0.444	0.437	**0.828**	0.546	0.245	0.437	0.217
33ID	0.188	0.242	0.481	0.382	0.489	0.480	**0.816**	0.372	0.167	0.441	0.148
34RE	0.279	0.306	0.341	0.316	0.364	0.329	**0.768**	0.488	0.234	0.487	0.069
35RE	0.204	0.121	0.432	0.360	0.456	0.379	**0.806**	0.405	0.202	0.367	0.098
36RE	0.253	0.341	0.415	0.407	0.357	0.372	**0.797**	0.437	0.159	0.391	0.072
37TT	0.163	0.369	0.191	0.309	0.176	0.243	0.326	0.412	0.085	**0.818**	0.124
38TT	0.272	0.225	0.373	0.415	0.366	0.403	0.481	0.497	0.144	**0.886**	0.153
39TT	0.260	0.380	0.310	0.381	0.349	0.373	0.489	0.586	0.229	**0.926**	0.183
40TT	0.082	0.405	0.198	0.234	0.224	0.236	0.253	0.332	0.144	**0.590**	0.117
41MU	0.355	0.497	0.230	0.281	0.180	0.264	0.386	**0.779**	0.343	0.564	0.234
42MU	0.349	0.392	0.237	0.283	0.168	0.221	0.387	**0.790**	0.320	0.446	0.187
43MU	0.379	0.210	0.374	0.388	0.287	0.311	0.564	**0.850**	0.400	0.486	0.278
44MU	0.440	0.307	0.347	0.356	0.209	0.328	0.461	**0.863**	0.441	0.412	0.340

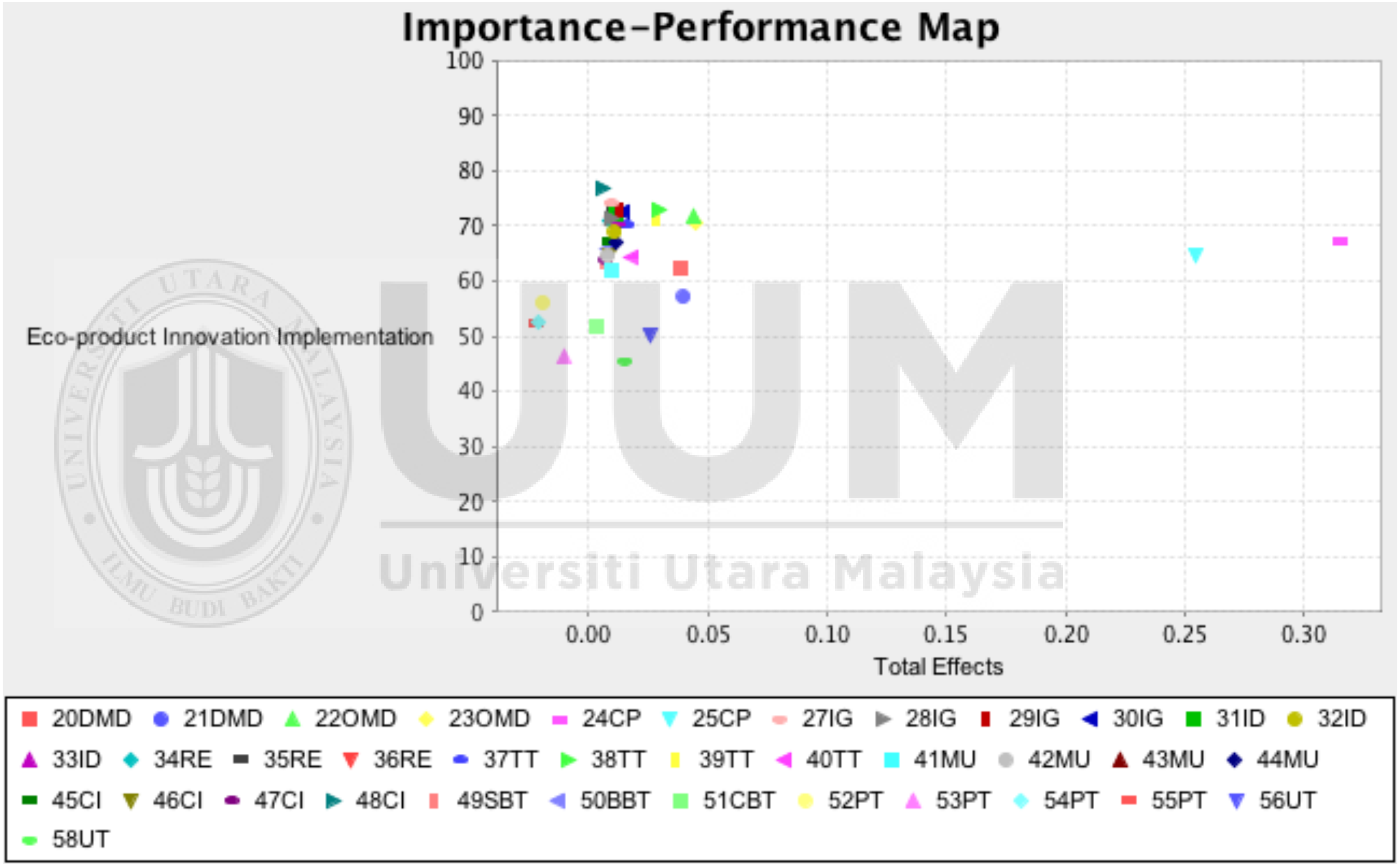
	Business Ties	Compe-titive Intensity	Compe-titor Pressure	Customer Demand	Eco-process Inno-vation Imple-mentation	Eco-product Inno-vation Imple-mentation	Market Orien-tation	Market Turbu-lence	Political Ties	Techno-logical Turbu-lence	University Ties
45CI	0.115	**0.794**	0.095	0.166	0.102	0.182	0.253	0.235	-0.009	0.366	-0.051
46CI	0.163	**0.854**	0.061	0.143	0.136	0.132	0.240	0.375	0.113	0.387	0.000
47CI	0.264	**0.711**	0.019	0.134	0.117	0.111	0.274	0.453	0.255	0.268	0.100
48CI	0.211	**0.797**	0.019	0.079	0.107	0.090	0.222	0.235	0.075	0.208	-0.141
49SBT	**0.937**	0.221	0.207	0.187	0.130	0.174	0.276	0.442	0.513	0.273	0.303
50BBT	**0.947**	0.218	0.224	0.182	0.147	0.209	0.291	0.414	0.456	0.223	0.273
51CBT	**0.686**	0.147	0.134	0.181	0.035	0.117	0.095	0.368	0.698	0.156	0.495
52PT	0.606	0.146	0.169	0.175	0.099	0.157	0.276	0.473	**0.846**	0.201	0.517
53PT	0.435	0.097	0.120	0.107	0.026	0.096	0.143	0.382	**0.844**	0.112	0.611
54PT	0.484	0.084	0.202	0.202	0.117	0.161	0.202	0.370	**0.925**	0.160	0.585
55PT	0.527	0.126	0.221	0.261	0.093	0.185	0.208	0.409	**0.911**	0.181	0.657
56UT	0.367	-0.050	0.154	0.182	0.098	0.184	0.130	0.302	0.639	0.192	**0.978**
58UT	0.334	0.018	0.135	0.180	0.034	0.122	0.122	0.327	0.647	0.145	**0.937**

Appendix M: IPMA Representation of Eco-process Innovation Implementation at Indicators Level



(Numbers in the coding is the question no.)

Appendix N: IPMA Representation of Eco-product Innovation Implementation at Indicators Level



(Numbers in the coding is the question no.)