

A Study on the Environmental Technological Innovation Strategy of a Malaysian Firm

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Abstract

Firms all over the world have pursued sustainable development to be competitive in the marketplace. The purpose of this case study is to examine the factors that enable a firm to pursue the environmental technological innovation (ET-innovation) strategies and how it effectively leverages its resources to achieve the environmental and business targets. This case study also wants to understand how well the firms ET-innovation activities can be explained by stakeholder theory, resource-based view and dynamic of innovation model. This paper uses a qualitative approach and the coding analysis was done on QSR NVivo. The data collection was done through interviews and also compared with other data sources (company brochures, reports, letters, speeches, memos, videos, newspaper articles, trade magazine articles, magazines articles, reports, website articles and technical reports) for triangulation purposes. This research showed that the ET-innovative firm in this case study has leveraged their employee technical abilities to be successful in their respective market. Another factor is the owner's high interest in innovation and environmental protection, and involvement in the design and marketing of their eco-product. Despite stakeholders' different targets, the case study firm manages to acquire support from their stakeholders through common objective which is to see a successful ET-innovation. Finally, it is proposed for the firm to be aware of the dynamics of eco-product lifecycle while also use current tools to manage their eco-product development especially in the earlier development stage.

Keywords: environmental technological innovation, case study, environmental innovation, sustainable development, Malaysia

1. Introduction

Undoubtedly, with the advent of the new millennium, firms will face many unique business and social challenges. It is anticipated that these challenges will extend far beyond typical business concerns of market share, profitability and product life cycle.

When one examines business history, it becomes evident that society has continued to increase its expectations and requirements of business. Society has demanded that firms address and solve problems that are not directly related to their core business activities. Furthermore, the scope of these demands has continued to increase.

One of the greatest, if not the greatest, challenge that business will face in the 21st century is the issue of sustainable development. 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" [1, Para. 27]. Society is requiring that firms examine their business practices and determine the long term environmental impacts of these practices. Furthermore, in some cases, when these practices are deemed to be unsustainable due to adverse impacts, society has forced firms to change their behaviors. Ultimately, the survival of many firms as well as whole industries are at risk - those firms that are able to respond and adapt to change will survive while those that don't will fail. Yet, there are some interesting examples of some firms who have not

only addressed the issue of sustainability, but they have exploited it.

These firms have somehow used the issue of sustainability to drive their environmental technological innovations (ET-innovation). These ET-innovations have lessened each firm's environmental impacts and increased its overall sustainability. This phenomenon raises many interesting questions that can be argued should be investigated and answered for further understanding. The following general questions will attempt to be answered by this research: What are the specific factors that influenced these firm's ET-innovation decisions - specifically, were they internal or external or a combination of both and are these action explained by the current management of innovation paradigms? What are the factors that enabled successful environmentally innovative firms to pursue ET-innovations strategies and what, if any, of the current management models best explain this process? Does the firm somehow anticipate environmental regulations, trends and societal expectations and, if so, is there some type of management tools that the firm uses to guide their ET-innovation process?

2. Literature Review

2.1 Sustainable Development and ET-Innovation

There are major underlying causes and effects that make sustainable development an important concept for the world. Major causes are population growth, urban development and

increasing energy usage while major effects include environmental deterioration, urban dislocation and changes in urban infrastructure [2], [3].

The above challenges of sustainable development can be overcome with a balanced integrated development among economy, environment and society [4] and using technology as an instrument to solve the human problem [5]. Existing technologies and production methods would not be enough for economic development to be ecologically sustainable [6]. Thus, it's important to have new innovation in technology that can reduce environmental impact and also natural resources usage. Innovation that leads to these target was term as ET-innovation [7]. Refer Figure 1.

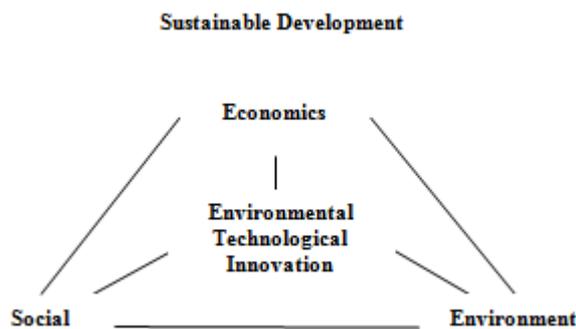


Fig 1: Sustainable Development and ET-innovation Connection [8]

ET-innovation was defined by [9] 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).

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 (CO₂)) in 2008 [10]. Currently, Malaysia contributes slightly above 0.6% of the world's total carbon emissions [11], [12]. 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 [13], [14].

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 [15]. 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"[16].

Since then, policy, regulation, program and fund allocation was introduced to promote innovation at federal's and states' level. Among examples were the establishment of Malaysian Global Innovation & Creativity Centre (MaGIC), Platcom Ventures, and Steinbeis Foundation [17]–[19]. 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 [20].

In addition, the GDP for green business is expected to contribute at about RM60 billion by 2030 and green technology investments is estimated at RM86 billion by the same year to Malaysia [21], whereas if action is overlooked, according to Asian Development

Bank, Southeast Asian countries may risk losing GDP between 7–8% [10].

Looking at global setting, implementing ET-innovation towards sustainable development has now become an ethical part in companies' strategy [22], [23] in reducing environmental damage [24]. 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 [25]–[27]. This action also must bring profits [24], [25], [28] and give the firm competitive advantage [29], [30], albeit in the form of expectation in future performance against competitors [6], [24]. 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 emphasise environmental innovation as solutions to economic competitiveness in response to strict environment regulation and standard [31].

2.2 Stakeholder Theory

The Stakeholder concept has become a part of management literature since Freeman (1988) book entitled *Strategic Management: A Stakeholder Approach*. From this literature stream of research, many researchers have expanded and have added to this theory.

There are many definitions for the term stakeholder. On a broad scale, the term refers to any identifiable group or individual who can affect or is affected by the attainment of an organization's objectives. On a narrow scale, stakeholder refers to any identifiable group or individual the corporation's survival depends upon [33]. One must also understand that the term stakeholder is also defined strategically. Stakeholders can consist of small groups that may have little day to day effect on the firm, but these small groups can affect change in public policy - policy changes that can have far ranging effects on the firm. From a strategic perspective, it can be argued that these groups are important stakeholders to the firm [34].

The basis of Stakeholder Theory is that the firm itself is comprised of a system of stakeholder groups that have a complex set of relationships among themselves. Additionally, these stakeholders have different rights, objectives, expectations, and responsibilities, and the theory is concerned with the nature of these relationships [35]. Thus, the firm will serve each of its stakeholders depending upon their influence upon the firm, the relevance of the issues that they have and the power that they hold. Furthermore, the interests of all of the stakeholders have intrinsic value, and that the firm's managers, as part of their managerial function, should respond to them as part of their moral requirement for management legitimacy [35]. Additionally, the needs of stakeholders will be addressed if there is potential for conflict between the firm and its various stakeholder interests.

2.3 Resource-based View (RBV)

The root of the resource-based view of the firm is that competitive advantage is created and sustained through the judicious and inimitable use of the resources of the firm [36]–[38]. Under the resource-based model, the firm uses its distinctive competence to sustain its competitive advantage [36], [37]. 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 [37], [38].

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 [39]. The core competencies of a firm

refers to the firm's capabilities in using these resources - resources that competitors cannot easily duplicate.

From the environmental perspective, it can be reasonably argued that a firm's basis of competitive advantage is rooted in its ability to facilitate an environmentally sustainable economic activity. The natural environmental perspective states that the firm operate in a manner that minimizes its impact to the environment via environmentally sustainable economic activity. When a firm behaves in this manner, it can create a sustainable competitive advantage [40].

2.4 The Dynamics of Innovation

In their classic model of the innovation process, Utterback and Abernathy (1975) describe a model of innovation in which there are three phases of innovation; these three phases are referred to as the fluid, transitional and specific phases. Furthermore, underlying dimensions in their model that consist of product innovation, process innovation, the competitive environment that exists within the industry, organizations and the life cycle of the industry. The duo describes the fluid phase as a time of market upheaval with uncertain change and outcomes are unclear. These changes occur rapidly and the product, process, market leadership, structure and management of the firms in the industry are unsettled and ambiguous. The firm's products are untried and no industry standard yet exists. Furthermore, these products are relatively expensive and unproven, but their functions initially serve niche markets.

The fluid phase is marked by general uncertainty from both the technical and market perspectives. From a technological standpoint, the technological choice is uncertain, and although there are many custom designs, all are still unproven. The market demand is uncertain and the future potential for the product is unknown. At this stage, product innovation is dominant and process innovation is unrealized.

The second phase, termed transitional, is marked by increasing stability. Finally, a product emerges and the innovation of product attributes begins to wane - innovation is now more focused on the production side rather than the product side. Production processes are becoming more structured and competition is fierce since markets have become more defined. Furthermore, the basis of competition is starting to be based upon product variation rather than functional product performance found in the fluid stage.

Patent protection and process innovation are even more important now. Incremental innovations rather than the radical, technological leaps found in the fluid phase are also more the norm.

In the last stage, referred to as the specific phase, process innovation and incremental change dominate. Price is the prime competitive determinant. At this stage, competition is fierce but a dominant design has emerged. Furthermore, there are fewer competitors since the industry has been shaken by keener competition. At this stage, the market is a classic oligopoly, and market share is stable. More predictability in determining the market wants and needs makes the market more definable. From an organizational perspective, the skills of the inventor and creative management techniques are no longer needed, and typically, management systems, rather than entrepreneurial management systems, predominate.

2.5 Advanced Product Quality Planning (APQP)

The Advanced Product Quality Planning and Control Plan (APQP/CP) was jointly developed by Chrysler, Ford, and General Motors and then published in July 1994. The manual was designed to standardized systematic methods for defining and executing necessary actions to ensure each product satisfy customer requirements and needs [42].

Initially, the main function APQP/CP manual is to give instruction and received feedback to/from internal section, external suppliers and the next level suppliers. It guides the section/supplier to produce a quality plan towards having a satisfied end product. The interactions are important to assure all required steps in the quality plan are completed on time effectively. Cross-functional team approach is used to manage the structured method for the quality planning process. However, commitment from top management is crucial for a successful APQP/CP implementation [43].

There are five critical phases introduced in the APQP/CP manual [44]. The phases are as follows, (1) phases 1-planning and defining the program, (2) phases 2-Product design and development, (3) phase 3-process design and development, (4) phase 4-product and process validation, and finally (5) phase 5-feedback, assessment, and corrective action. Each phases states activities required to be completed for the next phases to be started (refer Figure 2).

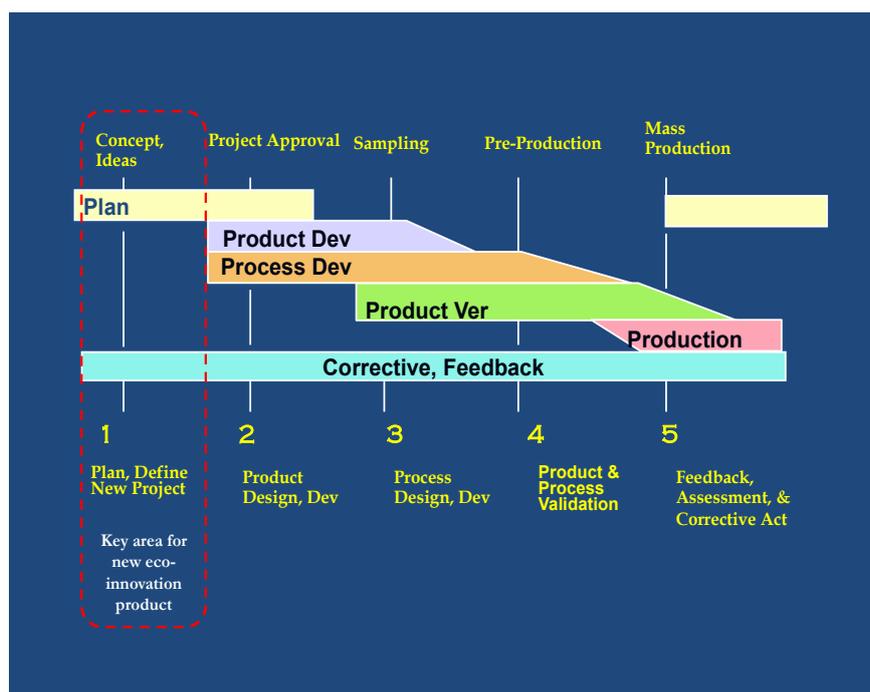


Fig 2: APQP Time Chart [44]

The first phase describes the activities to acquire customers' needs and expectations before a quality program was defined and planned. The second phase concentrates on product/service design development to ensure manufacturing feasibility and concurrent with customers' needs and expectations from phase 1. The subsequent phase focuses on the development of manufacturing related process to achieve required quality level, quantity, cost and customer satisfaction. Phase four centers on validating activities on the manufacturing process design developed in the previous phases. The important idea is to determine the manufacturing design is effective and efficient and capable of fulfilling the needs and expectations as studied from phase 1. The final phase is the fall back section where all variation between target result and expectation is recorded, studied, reduced and continuously improved [44].

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3. Research Design and Methodology

3.1 Approach of the Qualitative Study

This study employed interview techniques to fully exploit the potential of the data that was collected and analyzed. This research was exploratory in nature with an intent to analyze, to identify and to discover how the selected firm have used and are exploiting their ET-innovation practices to achieve a competitive advantage in their respective industry. This paper will explore this practice to gain a better understanding of it as well as to reveal the factors that are necessary for ET-innovation to occur within the firm. Furthermore, this study will look at specific company attributes and attempt to define what factors allowed this company to be successful in their ET-innovation endeavors.

Current management paradigms only partially explain the variables that push and pull the firm towards eco-innovative strategies [28], [45]; furthermore, limited research has attempted to understand how a firm's ET-innovation management is affected by external and internal factors, especially focusing on specific Malaysian firm. Because of this shortcoming, a qualitative research effort will provide the exploratory analysis, develop more insight, and through induction, help develop theory that will better explain this important phenomena (Miles and Huberman 1994). A case study approach will identify the strategic paths the firm has taken.

A firm was selected following list of the criteria below for this study:

- The ET-innovation must conform to the industrial ecology model
- The firm must have developed an eco-product or implement eco-process

The first criteria is that the environmental innovation itself must be part of a closed-loop process, following the industrial ecology model. Industrial ecology is a relatively new discipline and is basically a multi-disciplinary approach to understanding humanity's industrial impact to the natural environment. It is generally accepted that a firm that follows the industrial ecology model of closed loop manufacturing via the re-use of existing materials is generally following a sustainable and eco-efficient path. The goal of an industrial ecology system is zero waste, but from a practical standpoint, this goal is probably unattainable. However, companies that broadly follow the industrial ecology model were included in this study [46].

To satisfy the second criteria of this study, the firm must have developed an ET-innovation. Specifically, this innovation must be either process or product related.

3.2 Specific Research Questions

To be systematic and thorough, generating specific research questions for a case study is important since it allows the researcher to define the research process while also providing for clarity and specificity in the research [34], [47]. The following research questions were used to guide the research process:

What factors enabled the firm to pursue their ET-innovation strategies?

How did the firm effectively leverage its resources to develop its ET-innovations?

How well are the firm's ET-innovation activities explained by the Stakeholder Theory, the Resource-based Theory and the Dynamics Model of Innovation?

Is there some type of New Product Development management process that the firm used to guide their ET-innovation process, and if not, can APQP assist the firm in developing their ET-innovations?

3.3 Sample Selection

The selected sample is a firm acronym as SAZSB in this study. SAZSB was established in 2010 with a mission to create healthy living environment for next generation by involving in research, design, develop and manufacturing mechanical systems that reduce global warming impact.

The core research is in converting waste into renewable energy products such as diesel, petrol, kerosene, methanol, ethanol and naphthalene. The initial research and development activities have started in 2008 at SAZSB parent company factory in Selangor, Malaysia. The project continues in Perlis, Malaysia with collaboration with Universiti Malaysia Perlis in 2009. The pilot plant was funded by the Ministry of Science, Technology and Innovation (MOSTI) and being setup in Sungai BatuPahat, Perlis in 2010. Later in the same year, the R&D center moved to Chuping, Perlis, where the location was designed for mass production of the conversion machine.

The main product is the SAZSB Conversion Machine which is a plastic to diesel conversion plant. The machine consists of double screw extruder manufactured on an electro-welded steel pipe base [48]. The machine has been designed, manufactured and prepared to be used in the waste conversion and renewable energy working industry. The machine is designed for professional industrial use. A few special characteristic of the machine are, the extruder cylinder is made of nitriding steel which makes it very hard, the temperature control system is managed by P.I.D intelligent thermoregulators, and the hot parts of the extruder are protected using stainless steel sheet protection devices in accordance with EC regulations.

3.4 Sample Identification and Data Collection

A historical analysis was used to understand the conception, development and introduction of the ET-innovation. Interviews with key participants in the company were conducted with an event history outline detailing the occurrence and effect of key events undertaken during the ET-innovation period. Since the development of the environmental innovation is a time dependent process, looking at the development of the innovation from an historical perspective has led to a better understanding of the process.

Interviews were conducted with the actors in the firm who were directly involved with the ET-innovation project from inception to implementation. Interview was then transcribed. The seven stages of interview investigation, thematizing, designing, interviewing, transcribing, analyzing, verifying and reporting were followed and helped make the interviews more effective [34].

Table 1: Interview questions [34]

Area	Questions
Opportunity Recognition	How did the ET-innovation originate? What role did the individual play in the recognition and early pursuit of the opportunity? What was the strategic context within which the project evolved, and if so, was their a vision? What were the external and internal drivers for pursuing this project?
Planning Process	Was there a planning process that guided the innovation process? If so, how did this process affect the project?
Decision making: Respondents: senior management and the project champion	What criteria and forms of analysis underlie decision to undertake/continue project? Were there any specific issues, either at hand or anticipated, that contributed to this?
Organization and process	What is organizational approach? What are the elements in your firm (core competencies), that enabled you to be successful with this project? Is there an explicit process map?
Stakeholder Identification	Who do you perceive to be your most important stakeholders? How did they affect this process?
Research & Development	Internal/external R&D as sources of discontinuous innovation? Role of R&D over life of project? How do you evaluate the returns on investment in R&D?
Manufacturing	Role of manufacturing, over time? When and how does manufacturing get involved? How does the firm go about developing and adopting new production technologies that may be required for the project?

The interview process was semi-structured with modified Sloan Study questions asked of each participant based on Butler (2004) as Table 1. A detailed response to the questions was encouraged. Additionally, due to the semi-structured nature of the interview process, areas of investigation that were not initially asked in the set questions were explored further in the interview if they appear to be relevant to the research.

3.5 Data Analysis

Subsequent to each interview, each interview was immediately transcribed and analyzed. By transcribing the tapes immediately, follow-up questions were posed to the interviewee on answers that were either unclear or demanded further explanation. An important component of this dissertation is finding key elements or themes within the various data sources. Coding allows the researcher to categorize and organize the information that is compiled during a study [34]. Since the interviews were electronically transcribed, the coding was accomplished using QSR NVivo, a qualitative data analysis software program. Once the interview was coded, the identified themes and patterns that are described by the codes were compared with other data sources (company brochures, reports, letters, speeches, memos, videos, newspaper articles, trade magazine articles, magazines articles, reports, web site articles and technical reports) for triangulation purposes. Triangulation is a check to see that the multiple sources of evidence converge and that what has been described is in fact real.

3.6 Sources of Data and Data Coding

Various sources of data have been gathered besides interview with SAZSB employee. Main reason of different sources of data needed was to do triangulation and assure the transcribed interview was spot on and happened in actual reality. Other sources are newspaper articles regarding the company, technical manuals, websites, introduction movies and internal and external reports. Refer Figure 4 below on sources of information when clustered by coding similarity in QSR NVivo. Documents and transcribed interview was recorded in QSR NVivo. The information was then coded into major characteristic as the ground for analytical stage. Refer Figure 5 below on the similarity of coding.

4. Discussion

The discussion in this study was guided by research questions as presented earlier.

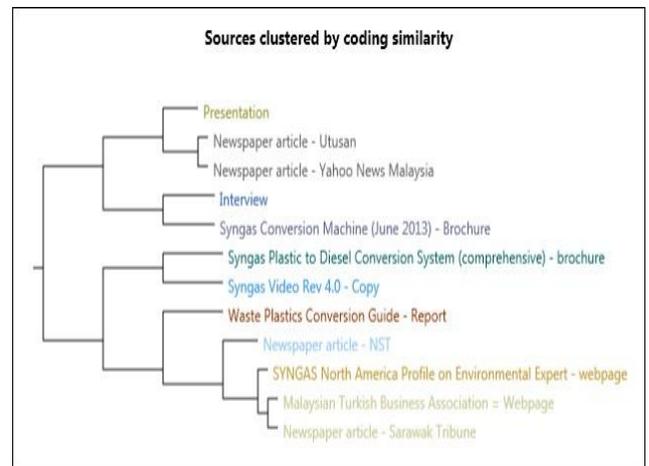


Fig 3: Sources by Coding Similarity

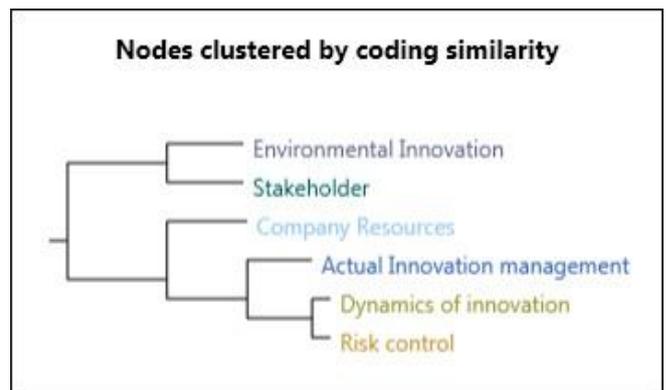


Fig 4: Nodes by Coding Similarity

4.1 ET-Innovation Enabled Factors and Leveraged on Firm’s Strength

4.1.1 Factors Influenced ET-Innovation Decision

The firm owner’s has a high interest in innovation and is very concern regarding sustainable of our world future. The passion of the owner in sustainable development can be felt through his words in articles written about him and his firm [49], [50]. The owner’s passion has encouraged a few parties to join hand with the company in promoting green technology and innovation. State of Perlis for example, has initiated a new portfolio of Green Technology. This new portfolio was established after the 2013

general election [51].

The firm is very concern on sustainable development, hence they mentioned in [52] to enhanced a healthier living environment for the future generation. They also have a five years plan of continue innovating towards producing more eco-product and reducing carbon footprint as mentioned in their presentation to Economic Council [53].

As a private company, the firm cannot divert from the objective of making profit. The eco-product innovated and developed by the firm directly will bring them to achieve both profit and environmental targets. The government of Malaysia also has provided opportunity for Malaysian company to be involved in green technology innovation through Green Technology Financing Scheme [54], [55].

4.1.2 How ET-Innovation Decision Leveraging the Strengths of the Firm

The firm technical department has leverage their technical abilities on the owner himself who are also a designer and innovator. He is also the head designer for the company. It is common for the head of company to manage and also involve in technical and design function; as what happen during Steve Jobs at Apple and while Jimmy Choo at JimmyChoo. As head of company, the CEO also has web of networks, which has benefited the firm well. Using his good network ties, the firm has been visited by International Ambassadors' from Venezuela, Republic of Korea and Indonesia. This visits has open potential collaboration in the mentioned countries.

The firms has interviewed and employed good people for the development of their product. This employees has bring their experiences and know how to the company and also lesson learned from their past positions and reduce risks during the firm's product innovation [50].

Since the firm was financially assisted by the Malaysian Government's Northern Corridor Implementation Authority and Ministry of Science, Technology and Innovation (MOSTI), the firm has to manage their fund properly [56], [57]. Thus, its important for the company to invest efficiently especially during the innovation stage.

To reduce and efficiently use resources, the firm has appointed a turnkey contract to vendors to produce production design and fabricate their final product. This decision has reduced the potential risk of having to employ more people for the activity. The appointed vendor also already has their own permanent manpower and is an expert in their own area, thus able to provide useful recommendation to the firm's designer and avoid costly mistake.

4.2 Stakeholder Theory, Resource based Theory and Dynamics of Innovation Model - how well do they explain the ET-Innovation Process?

4.2.1 Stakeholder Theory

The stakeholder theory explains that stakeholders have their own interest to be taken care of. Therefore, it's an obligation of the firm's management to adhere to the different requirement of stakeholders. Despite various objectives of the stakeholders, interestingly, all the stakeholders have one similar target, which is for the firm to be successful in its product development.

Some of the stakeholders that contribute in the firm development beside the firm's owner are the fund distributor; MOSTI and NCIA [50], State Government of Perlis [58], federal government institution; Ministry of Trade and Investment (MITI) and MIDA [48], [58] and the contracted customer/distributor [56], [58]-[60]

4.2.2 Resource-based View

The resource-based view of the firm probably best explains how

this firm was able to develop and commercialize their respective innovations. Essentially, the core competences of financial resources, physical resources, human resources, technological resources, reputation and organization resources of the firm have allowed them to develop their respective innovations [61].

Firm in green industry that understands resource-based view will focus on their environmental knowledge, technical knowhow, manpower, financial etc. that are valuable, nonsubstitutable, rare and inimitable (difficult to replicate) and use those qualities to help them achieve a competitive advantage [6], [36]. Resource-based theory is a useful tool for firms gather internal resources. These initiative is important for it can make or break a firm, thus some firms are successful while others are not.

4.2.3 Dynamics of Innovation Model

The dynamics of innovation model (DOI) is a tool that explains how these innovations have the potential to affect their respective markets and industry. It allows a firm to understand and assess its competitive landscape. Base on this theory, at some point, the studied firm designs could potentially supplant the dominant design and replace it. In summary, it helps one to understand the cycle of innovation and can be used to increase one's understanding of how these new technologies may or may not affect the marketplace. DOI provides insight as to how an innovation can affect the marketplace and how it should progress in the future. However, DOI does not effectively explain how a firm can formulate a successful ET-innovation.

4.3 ET-Innovation and APQP

New development of eco-product needs a lot of focus. The tribulation of research and trial may cause a lot of problems and may eat up into available fund without control. It is important for development team to have clear direction; however many ET-innovation firms have to go through bad experience during the initial innovation stage [34].

Advanced Product Quality Planning (APQP) is far more than quality planning. It is determining the customer's needs and expectations, defining the steps necessary to ensure customer satisfaction, and managing the entire project so that the timing and cost are in line with the original commitments made to the customer [43]. APQP can assist a lot in the ET-innovation activity.

The author believes that any ET-innovation firm should use APQP for their product development. This firm in particular needs to focus on the first stage and the second stage of APQP as Figure 2. The inputs and outputs of Phase 1 (as Fig 5 below) need to be studied, researched and recorded for improvement in the later phase.

5. Conclusion

This case study reveals how studied firm has been successful in developing and commercializing their ET-innovations. They have developed beneficial networks with the important stakeholders in their respective industries, have been successful in influencing these stakeholders; they also concentrated on promoting the overall benefits of their innovations, while not necessarily focusing on just the environmental aspects.

The firm have internally recognized and exploited their respective core competencies; they are in the process of establishing specific performance standards to enhance their competitive advantage by establishing barriers to competition and creating new markets while actively solicited environmental awards and recognition for marketing purposes.

They also have established long term relationships/partnerships with government for financial support, product recognition and verification of product performance. They have used government support to effectively leverage their ET-innovations. In short,

these strategies have been an immense help to the firm, and most importantly, these strategies and factors may be essential elements that other firms should consider if they want a successful ET-innovation journey.

This case study analysis has been a good introductory study in the field of ET-innovation in Malaysia. The studied firm has shown

that their ET-innovation strategy have proven to be suitable for their firm. And finally, APQP appears to be a good tool for a firm interested in implementing ET-innovation. However, further studies with implementation in actual situation will confirm the proposition.

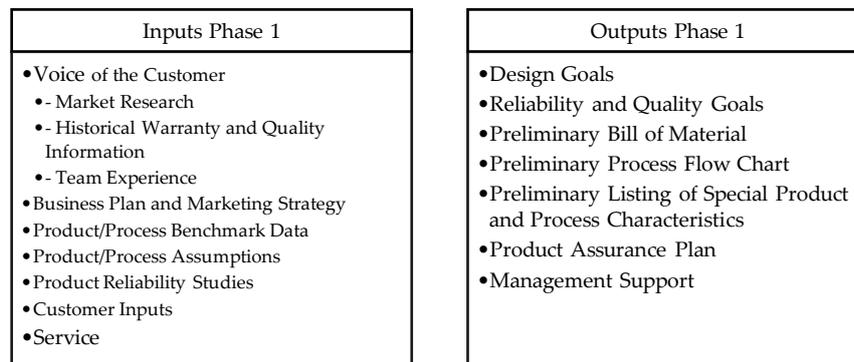


Fig 5: Inputs and Outputs of Faze 1 APQP

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