



GRADUATE SCHOOL OF BUSINESS (GSB)  
UNIVERSITI SAINS MALAYSIA

### DECLARATION

I hereby declare that the project is based on my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at USM or any other institutions.

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Date: 18 December 2013

THE EFFECT OF CO-PRODUCTION ON SUSTAINABLE BUSINESS  
PERFORMANCE:  
MODERATING EFFECT OF INTERNET OF THINGS

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## ABSTRAK

Objektif kajian ini ialah untuk membangunkan satu konsep produksi bersama mencapai prestasi mampan yang berjangka panjang dan prestasi inovasi untuk organisasi elektrik dan elektronik. Kajian ini mencadangkan bahawa penyumbangan pengetahuan produksi bersama dapat memberi idea baru untuk industri elektrik dan elektronik amalan pengeluaran. Kajian ini termasuk operasi elektrik dan elektronik dan sektor pengeluaran yang di rantau Malaysia. Malaysia sebagai lokasi sesuai untuk saya menjalankan kajian ini pada dasarnya kerana ia mempunyai GDP tertinggi dalam kemudahan pengeluaran produk elektrik dan elektronik. Syarikat-syarikat multinasional (MNC) dari seluruh dunia datang dan membangun kilang pengeluaran mereka di Malaysia sejak awal 1960-an. Menurut maklumat terkini daripada Perbadanan Pembangunan Perdagangan Luar Malaysia dan Persekutuan Pekilang-Pekilang Malaysia, syarikat-syarikat elektrik dan elektronik hak milik tempatan dan negara asing telah mencapai sejumlah 1,695.

Soal selidik telah diedarkan kepada semua industri elektrik dan elektronik yang mempunyai pembangunan produk baru. Sedemikian, pengagihan soal selidik yang telah diedarkan mengguna talian sistem e-mel. Satu kajian telah dijalankan dan data yang diperolehi adalah 154 set soal selidik. Kajian ini merupai kajian berkuantitatif, unit analisis ialah organisasi dan asas teori yang menyokong kajian ini adalah teori sistem umum dan pandangan berasaskan pengetahuan. Oleh itu, kaedah persampelan yang digunakan ialah persampelan rawak. Berdasarkan dapatan kajian berkuantitatif, terdapat hubungan yang positif wujud antara co-pengeluaran dan perniagaan mampan dan prestasi inovasi. Kajian ini juga mendapati bahawa tahap penggunaan internet perkara yang signifikan dengan prestasi perniagaan mampan pengeluar elektrik dan elektronik. Kajian ini mendapati bahawa co-pengeluaran adalah penting dalam

mempengaruhi pengeluar elektrik dan elektronik untuk mencapai prestasi perniagaan yang mampan. Oleh demikian, ia juga membantu untuk membangunkan sebuah negara dari segi ekonomi. Dari segi social dan amalan persekitaran, ia boleh meningkatkan prestasi kehidupan yang lebih baik dan mencapai masa depan yang lebih cerah untuk generasi yang akan datang.

## ABSTRACT

The objective of this study is to develop a co-production concept in achieving long term sustainable business performance and innovation performance for an electrical and electronic organization. This study proposed to contribute the knowledge of co-production and give a new idea for electrical and electronic manufacturing practice. The study has covered the electrical and electronic operation and production sectors that been found in the Malaysia region. Malaysia is suitable for me to conduct this study is basically due to it has the highest GDP in electrical and electronic manufacturing facilities. Multinational companies (MNCs) from all over the world came and setup their production activities in Malaysia since as early as 1960s. Until now, Malaysian and foreign owned electrical and electronic companies has reached almost 1,695 in numbers.

The questionnaires have been distributed to all the related electrical and electronic industries that have new product development. Hence, the distribution of questionnaires was using online form through email system. A survey was conducted and data obtained from 154 sets of usable questionnaires. In this quantitative study, unit of analysis is organization and the underlying supporting theories are general system theory and knowledge based view. Therefore, the sampling method used was stratified random sampling. Based on the quantitative findings, there is a positive relationship exists between co-production and sustainable business and innovation performance. The current study also finds that the level of usage of internet of things is significantly related with sustainable business performance of an electrical and electronic manufacturer. The study is drawn to the conclusion that co-production is important in influencing an electrical and electronic manufacturer in achieving a

sustainable business performance. Thus, it also helps to develop a great nation, brings a better life and brightened the future for the next generation.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Introduction**

Organizations and industries sustainable business development remains the key challenges facing in many Electrical and Electronic (EE) industries including Malaysia without exception (TheEDGE, 2012). According to Aras (2009), sustainability should equate to doing business that remains profitable but takes nothing from society or the environment that it does not replenish. Setting a course in corporate sustainability performance measurement still need much work to do in measuring sustainability, and that many companies remain ill-advised on how to integrate it with existing initiatives (Searcy, 2009). Therefore, Georgiadis (2008) stated that for EE firms want to continue in their successful business roadmap, they had need to performance sustainable business performance to keep themselves proactivity in the EE field. A sustainable strategy need to be planned early in order for EE industries to design a product that meet the requirement of the social (DeSilva, 2009). Co-production is a solution in development of resources that could support firm's long-term sustainability (Rice, 2002).

Malaysia has developed to be a main global manufacturing center for electrical and electronics business and production, as showed by the huge number of multinational companies and could be called the (MNCs) in which came from Japan, USA, Taiwan, Europe and Korea which selected Malaysia as their base. Obviously, the EE sectors has grown-up became Malaysia's major contributor to productivity, investments, employment and exports. This sector is contributed more than 35% of Malaysia's total exports (MATRADE, 2011).

Electrical and electronic industries basically roll out their technology products that having a short life cycle (TheEDGE, 2012). Malaysia has numbers of local manufacturers which produce Electrical and Electronic appliances for global market. The ability of local manufacturer to introduce and involve in new product development is lack behind MNC owned manufacturers. In order for Malaysian owned EE firms to survive from the foreign MNC owned manufacturers, the local EE firms might need to define a strategy in sustainable business performance as well as innovation performance to continue excel in Malaysia's electrical and electronic field. New product development plays an important role in emerging strategies by highlighting the need for change and leading the way in the EE industries (Leonard, 2002).

In order for Malaysia EE firms to maintain strong sustainable business performance and innovation performance, Co-production does seem to be an important key aspect affecting the new product development decision. This study would identify the important key aspects of EE firms to practice involving themselves in Co-production function in new product development. This would be a strategy in continuous secure and expand their market share in Malaysia's technological market (Joniarto, 2008).

This chapter one contains several sections; initially it delivers an introduction follow by the background of this study. Furthermore, the problem statement is accessible that deliver a perception of how Malaysia's electrical and electronic firms product development is critical to the sustainability business performance now a days. Thirdly, it will focus on the scope of this study objectives and research questions trailed by the definition of key terms that been used in this study in providing vibrant

thoughtful of the measurement in this study. This chapter one concludes by citation the significance of this study to the organizations as well as to the related theories.

## **1.2 Background of the Study**

Malaysia having GDP of real development rate as 7.2% in 2010, 4.0% in 2011 and 5.0% in 2012 estimated by (MIER, 2011). Meanwhile, Malaysia has the export capability of RM513.6 Billion ranging from the period from January 2011 until September 2011. The ranges of exports supplies included were 34.5% from electrical and electronic sector, 9.9% from petroleum and oil products sector, 9.3% from cruel palm oil sector, 6.9% from chemical goods sector, 3.4% from machinery, 3.0% from productions of metal sector and 2.6% from latex products sector (MIER, 2011). This proved that electrical and electronic sector take up the major significant level in influencing Malaysia economy performance.

This study was motivated by the semiconductor industry in the whole electrical and electronic field, where integrated chips (ICs) and electronic modules are produced in Malaysia. Happening on 2010, EE industries are the leading segment in Malaysia's industrial segment, it underwriting expressively to the Malaysia's manufacturing production (31%, compare back in year 2008 was 29.3%), exports (48.7%, compare back in year 2008 was 55.9%) and employment (33.7%, compare back in year 2008 was 28.8%). The unpolished yield in 2010 of the manufacturing made RM166.3 billion (compare back in year 2008 was RM167.2 billion), exportation amounted RM249.9 billion (compare back in year 2008 was RM233.8 billion) and the manufacturing sector shaped employment chances for 336.408 individuals (compare back in year 2008 was 296,870) (MIDA, 2011). These amounts show the important of

EE sector's growing symptom. Malaysia EE firms should ensure the sustainable business performance in order to overwrite to higher numbers of scoring.

Below were some figures (1-1, 1-2, 1-3 and 1-4) summaries the growth breaks down of EE sectors in Malaysia. Figure 1-2 and Figure 1-3 show the breakdown of the EE export of Malaysia in the year 2010. Figure 1-1 show the output of Malaysia's electronics productions that been manufactured locally, while Figure 1-4 further breakdown the amount into sub-sectors of the EE manufacturers. Although Malaysia production of EE products is at high output, Malaysia's EE firms should take up further challenge to outperform the numbers of production outputs to a higher level. In order to accomplish that, the EE firms had need a method or practice to steadily innovate and perform in sustainable business performance. Co-production would be a good practice for EE firms to achieve a sustainable business performance in the future throughout Malaysia.

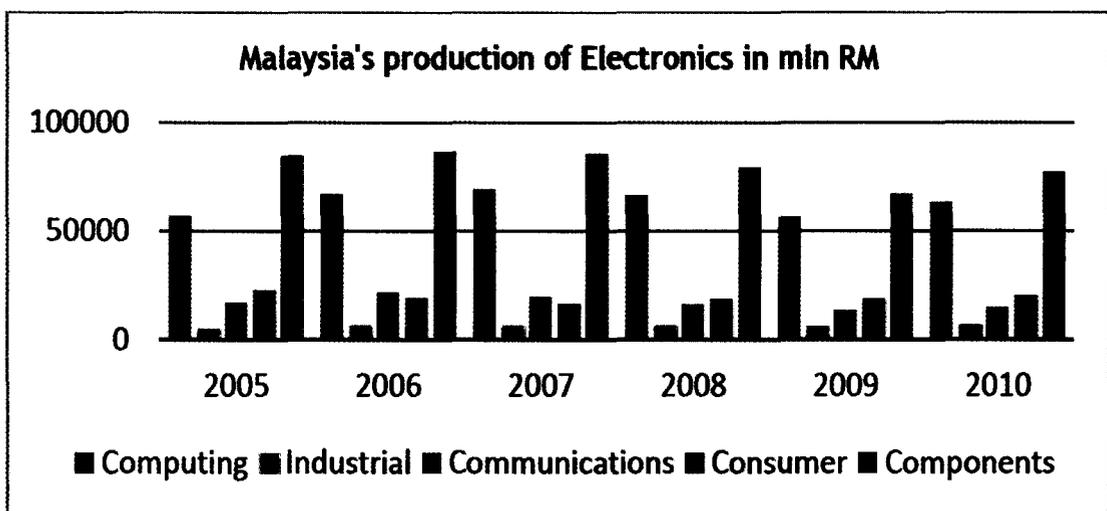
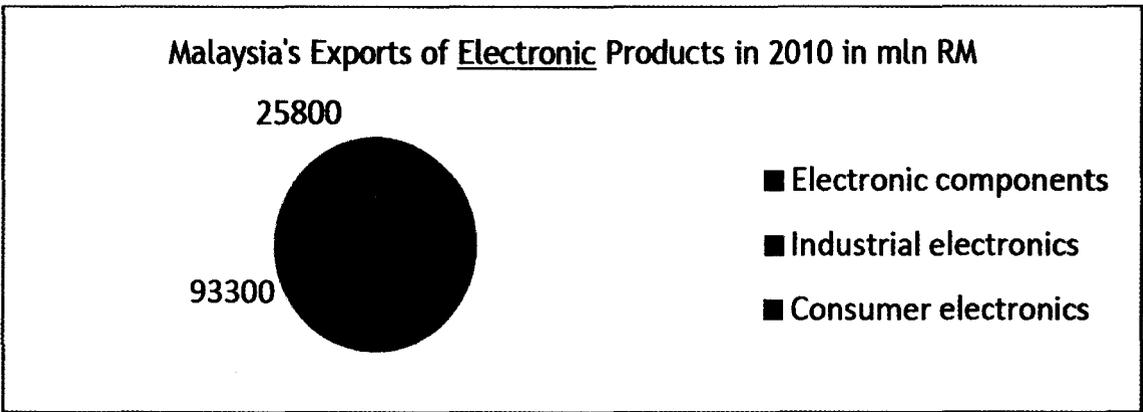


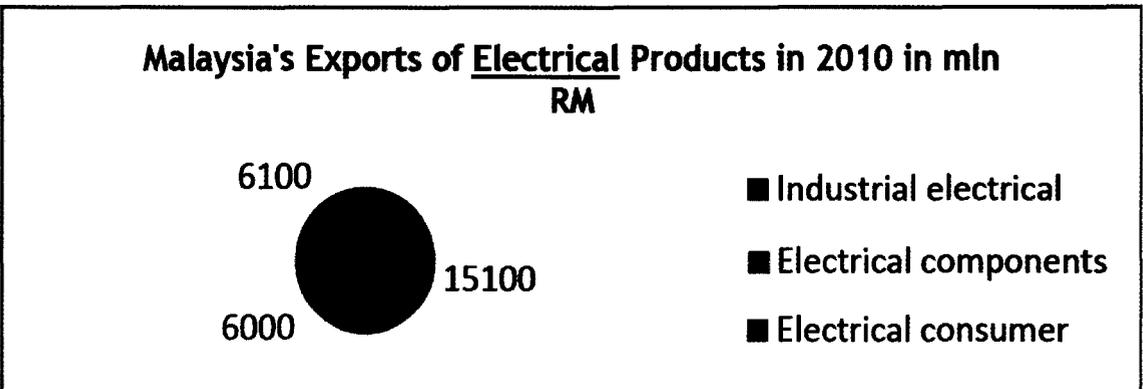
Figure 1- 1: Malaysia's production of Electronics 2005-2010 in million [RM]

Source from (MATRADE, 2011)



*Figure I- 2:* Malaysia's Exports of Electronic Products in 2010 in million [RM]

Source from (MATRADE, 2011)



*Figure I- 3:* Malaysia's Exports of Electrical Products in 2010 in million [RM]

Source from (MATRADE, 2011)

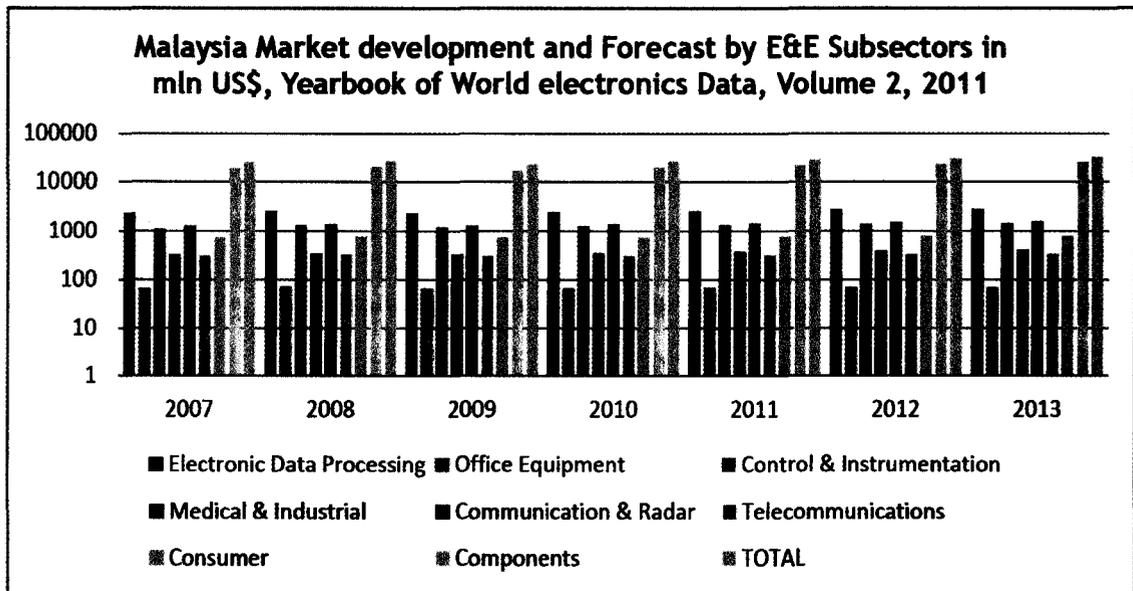


Figure 1- 4: Malaysia's Market Development and Forecast in EE Subsectors in millions [USD]

Source from (MATRADE, 2011)

Apart of Malaysia's economic development, Malaysia telecommunication has been upgrading in recent years. Telekom Malaysia has done significant result on the infrastructure building. Since year 2000, Telekom Malaysia introduced broadband services, establishing TM Net as the largest Internet Service provider in the South-East Asia region. It was also in 2001 that TM became a major partner in the launch of the submarine cable Asia Pacific Cable Network 2 (APCN2) and launched CDMA service fixed wireless telephony (Telekom, 2013). TM's High-Speed Broadband (HSBB) project was initiated in 2008 with the signing of a Public-Private Partnership Agreement with the Malaysian government (Telekom, 2013). These infrastructures helped internet of things to grow into another higher level where industries would benefits from it.

The co-production would help in developing customer experience. Co-production has modifications the entire situation. It marks the structure well-organized, more operative and more approachable to public needs. More prominently, it able to creates community care completely more humane, more dependable, more appreciated and altogether further transforming for those who practice it (Boyle & Harris, 2009). This variety of interpretations is perhaps because co-production is in many respects elusive; as numerous practitioners often note, it is a mind-set, and not something that can be easily distilled in a sentence. At its most basic co-production of public services is about 'action', for example people (including professionals and people who use services) coming together and producing a product or an outcome. Co-production requires a contribution in terms of time and resources from public service professionals as well as people who 'use' services. The way in which time and resources are contributed may well look different from more traditional service provision but it is essential that this contribution is present.

Co-production can be practice and develop in between same industry to industry, industry to public/social experience, industry to community, industry to Government or even industry to government linked company (Jiménez et al, 2013). From what we had seen on worldwide good co-production practices were one among a very successful products development is Apple's products that co-production with Samsung original design manufacturer (ODM) LCD retina display that screened up all the Apple's iPad, iPhone, iPod and Mac series of books (techradar, 2012). Thus, another example was Apple did co-production with Foxconn to build their devices' energy supply which basically the battery that power up most of Apple's devices.

### **1.3 Problem Statement**

In today hyper competitive market, manufacturing organization shall be able to compete with introduction of innovative products with lower production cost. The sustainable business performance and innovation performance of a new product development remain the key challenges for the electrical and electronic firms that based in Malaysia. Innovative products with lower production cost have been pushed in manufacturing EE industries. Hence, an organization facing technological changes as well as rises in global competition and rivalry. This was a direct challenge for the EE firms to achieve good level of innovation performance standard. Another issue was demographic fluctuations and the changes in end consumer's anticipation of the goods designed by the firm or organization. The changes have modeled an excessive challenge to hold the EE firm's sustainable business performance (SBP) within an organization. From today's technology industry, organizations no longer only need to achieve sustainable economy performance. They needed to include two more entities where environment and social performance would remain the two major pillars in retaining the firm's long term sustainable business performance (SBP) in full confident level.

There are several potential problems that may happen in the co-production of EE industry. The problems were like poor peer support networks, blurring distinctions, un-mutuality and not reciprocity. As the EE firms not fully engaging peer and personal networks alongside professionals as the best way of transferring knowledge and supporting change. This would generate insufficient and inaccurate information sharing and transfer in between two or more parties. In regard of the blurring distinctions, happened in the firms where co-production problem was blurring the distinction between professionals and recipients, and between producers and

consumers of services, by reconfiguring the way services are developed and delivered. Lastly, the un-mutuality and not reciprocity of co-production is about a EE firms unable to achieved mutual and reciprocal partnership, where professionals and people who come together in an interdependent relationship unable in recognizing that each are valuable to producing effective services and improving outcomes.

To remain competitive in the market, EE companies have to start implement the co-production strategy with business partner, customers and competitors (Tomlinson, 2010). However, most of the studies regarding customer-company interactions have been conducted in the context of services not in product manufacturing (Bendapudi and Leone, 2003). It is difficult for EE firms to continue in gaining competitive advantages without a develop co-production activity as a background support because it is a new concept in the industry and not much study on it. In the field of EE industries, internet technology especially the internet of things is an important tool in helping an EE firm to run their daily operation such as manufacturing and inventory control. Currently, there were not lots of study found regarding internet of things (IoT) in Malaysia. The latest research from UMIT (2010) shows that Malaysia is just at the beginning stage of implementing IoT, this has reflected that Malaysia is lacking on the internet technology dependency. This has become a great challenge for Malaysia EE firms to compete with other's emerging countries that have more efficient IoT infrastructure.

Even though most of the EE firms have experienced and talented R&D support team, the EE firms had need to retain information and technology know-how on the competitive market to recognize the weakness and strength of their competitors and provide customer's satisfaction. By failing to do that, the EE firms might not able to develop a quality product that be accept by the public. In order to maintain all these

brilliant features, the organization had needed to raise a high cost in all the technology product design and manufacturing process. This would incur high budget and running cost in the firm itself, thus, the firm could not able to achieve economy performance (Seuring and Müller, 2008).

While Malaysia is having a high GDP in EE products as a main contributor, Malaysia EE industries had face a difficult to sustain the current market since low cost countries like Vietnam, Myanmar, Thailand and Indonesia are also offering the lower production cost and leading in R&D of new products. Malaysia's EE firms had hard time in achieving economy performance in the future. Apart of that, the EE firms failed to safeguard their employees' job as most of the MNCs would move away to lower salary country to continue their production there. Thus, the EE firms might loss the position in countries' social performance. As IoT could assist in R&D and production system, however, it is absolutely useless if the technology change does not go hand-in-hand with a change in mindset and behavior within the EE firms.

Apart of this, environment performance is an issue for the EE firms in Malaysia. Often, EE firms obey to minimal requirements of environmental standard for as long as possible, only changing practice after the law requires them to (Aras and Crowther, 2009). The EE firms lack in environmental protection mentality due to the low enforcement of environmental law in Malaysia. For the many companies who want to move towards sustainability but are not quite sure how to begin. The big mistake that a firm made is not following the proper guidelines from the beginning (Searcy, 2009).

Another challenge to EE firms is on the innovative performance. If the organization unable to design an innovative products that meet customer's

requirement, this will in-turn influence on the growing and effectiveness of an organization and shrinkage the return on investment (ROI) of the organization itself. This is definitely an important factor where now many local EMS companies struggling to become global EMS with introduction of more innovation products. Apart of that, Malaysia EE firms should put more effort in the R&D section in designing more innovative products where they should avoid in just providing contract manufacturing services that would be losing position in the innovation performance. The stakeholders might observe higher risk in continuous participating and investing on the organization and turn away their participating and investment to other companies or organizations. Finally, the organization had lose their competitive advantage in the marketplace. Once they lost their competitive advantage in the marketplace, it drive a straight influence on the country's economic growth (Croteau & Bergeron, 2001).

The lack of motivations of EE organizations in reducing their new product development has discolored the added value that technology producers used to create, just by selling existence current products in the local market. It has left the productivity weaker in the flow of demand, thus, without inspiration to reach 'upstream' in finding ways of undertaking the root cause that would lurk the EE innovation performance as well as their customers' expectation. Thus, the purchasing process has often imperfect the pool of information for EE manufacturers undermining competition and rising costs. The grouping of all the issues has undermined the tradition of innovation in technological services, and weakened the ability of frontline staff to change the way they work to make themselves more effective (Hallin, Holm, & Sharma, 2011).

However, if the organizations retain not to change their operation and product planning, they would face potential risk in meeting high development cost and low response from end line customers. Somehow, it produced an unwelcome product to the market. As a result, regulations have been created to induce organizations to adopt sustainability business strategies to improve their economic, social and environmental performances (Pusavec et al., 2010).

#### **1.4 Research Objectives**

This study has five main objectives to be achieved:

1. To investigate the level of sustainable business performance in electrical and electronic (EE) sector in Malaysia.
2. To examine whether co-production will affect the sustainable business performance in electrical and electronic (EE) sector in Malaysia.
3. To examine whether co-production will affect the sustainable innovation in electrical and electronic (EE) sector in Malaysia.
4. To examine whether sustainable innovation will affect the sustainable business performance in electrical and electronic (EE) sector in Malaysia.
5. To investigate whether level of usage of Internet of things (IoT) moderate the relationship between co-production and sustainable business performance on electrical and electronic (EE) industry in Malaysia.

#### **1.5 Research Questions**

1. What is level of sustainable business performance in Electrical and Electronic sector in Malaysia?
2. Is there any significant relationship between co-production on sustainable business performance in Electrical and Electronic sector in Malaysia?
3. Is there any significant relationship between co-production on sustainable innovation in Electrical and Electronic sector in Malaysia?
4. Is the level of usage of Internet of things (IoT) influencing the relationship of co-production toward sustainable innovation in Electrical and Electronic sector in Malaysia?
5. Is the level of usage of Internet of things (IoT) influencing the relationship of co-production toward sustainable business performance in Electrical and Electronic sector in Malaysia?

## **1.6 Significant of the Study**

### **1.6.1 Theoretical Significant**

There are several theoretical contributions that able to be brought to the researcher. This study provided preliminary evidence that sustainable and innovation performances are determined by co-production factors. This study of co-production which combines four dimensions is less addressed. The co-production study has become prominent concept in operations strategy. This study steps beyond existing production literature to offer a more rigorous empirical finding of interaction effect of IoT (internet of things) on sustainable and innovation performances especially in Malaysia's EE firms where this area of study is very much lacking. The nearest study of co-production is found to be in the service line not manufacturing and product

development yet. However, this study could contribute an empirical study on co-production towards an EE firm sustainable business performance and innovation performance. It could let the EE firms understand the important of co-production concept which extended body of knowledge for sustainable business performance and innovation performance into their operation and product development.

The lack of co-production study in EE sector and inadequate theoretical grounding limits the contribution to the literature of operation management. This study also provides new insight from EE sector in Malaysia by advance theory and builds better understanding of current practices and specific measurement of constructs. The EE firms had inspire to know more on increasing material efficiency of production processes by sharing their knowledge and understanding of the co-production concept. Thus, the research and development (R&D) team had implement eco-design for environment performance. While the level of usage of internet of things moderate the researchers' and users' knowledge in implementing it benefits the firm.

### **1.6.2 Practical Significant**

The benefits of co-production do improve the practitioners' in several aspects. Those were included as the skill to pool monetary capitals; gained admission to the partner organization's encouragements or incentives as well as subsidies. Co-production is able to get admission to the partner's market or to a third party market. Hence, obtain access to a specific project introduced by the partner, locate to a wanted site or to inexpensive inputs and have chance to study from their partners as well (Ertimur & Venkatesh, 2010).

Co-production is functionally equivalent to the ideas of interconnection circle, co-evolution and optimistic reaction. All of which define exactly how two or more variables of an organization affect and fundamentally produce each other, while with respect to dissimilar variables functioning at dissimilar scales. From the practitioner point of view, co-production challenges the traditional way of providing technological services such as delivering new product to the market. It is the process that literally turns services users from passive recipients into active shapers of technology market because it means involving all stakeholders, including the people who use a product, in the process of determining what products are delivered and how they operate (Boyle & Harris, 2009).

From what have been mentioned above, the EE industries must need co-production with certain clear circumstances. It was because the main advantage of co-production is to reduce cost, flexibility and meet customer expectation. Both or more organizations must have their cooperation terms and condition to be clear to protect both company's' interest if it is related to industry to industry cooperation. Industry and organization could bring in their customer's feedback and recommendation in order to add value in their new product development. Further study of internet of things is essential to create more room of improvement in the EE manufacturing area.

Thus, co-production has appeared as an analysis of the way that specialists and common users have been insincerely divided, occasionally by technology, occasionally by specialized and managerial exercise, and sometimes by a false understanding of effectiveness and efficiency. It could provide additional way for individuals to share in the design and delivery of products and services, hence, contribute their own knowledge, experience and wisdom, in ways that can widen and reinforce services and make them further effective (Sang, 2009).

### **1.6.3 Social Significant**

The results of this study would basically contribute numbers of benefits to the social mainly the users and the consumers. The impact of this study is to deliver a wide range of lower cost and high quality of EE products to the society not only Malaysian customers but as well as global customers due to the export of Malaysian manufactured EE products is throughout the rest of the world. Global customers could benefits from cheap but reliable EE products, able to buy the energy conservation product where the new energy safe design concept and it helps in increase their quality of life.

With a proper co-production strategy, the EE firms could help in developing the country's workforce. It is not only to create more jobs, thus, it would also help in developing skills and working capital by having a green manufacturing facilities. The same time, the EE industries could gain competitive edge by producing better quality of lifestyle and eco-design of products by consume less energy using high technology.

## **1.7 Definition of Key Terms**

**Suppliers** – They were categories as a party that supplies services or goods. A supplier is well-known from a contractor or subcontractor, who usually adds specialized contribution to deliverables. They had also called as vendor. (Tomlinson, 2010)

**Competitors** – Any type of party or entity which is a rival against another. A firm in the similar industry or same industry that offering the same service or product. The

existence of one or more competitors can decrease the prices of goods and services as the firms try to gain a larger market share. (Tomlinson, 2010)

**New product development** – It is a process of developing a new product or service for the market. This type of development is considered the preliminary step in product or service development and involves a number of steps that must be completed before the product can be introduced to the market (Behrens & Ernst, 2013). It is essential to any business that must keep up with market trends and changes.

**Co-production** - It is a fundamental phenomenon defined as “the degree to which the client is involved in producing and delivering the service” (Dabholkar, 1990: 484). It is also used to discover the new ways in which practical specialists and other groups in society produce new knowledge of understanding and technologies know-how together (Scott, 1994).

**Customer involvement** – Relative information about consumer’s behavior will be used in predicting and recognizing their activities in the market (Villads and Supphellen, 2012). All the consumers’ relative information would be useful in new product development.

**Value of co-production** – It can be considered as both old and a new developing product or prototype that focuses on how organizations engage their customers or partners in the joint design of new products, services, and innovation (Lehrer, Ordanini, DeFillippi, & Miozzo, 2012).

**Co-production with suppliers** – It is where one EE firm and their suppliers develop such a close and long-term relationship that the two work together as partners. The aim is to secure the best possible commercial advantage. Partnership sourcing works

usually happening here because both parties have an interest in each other's success (Shu and Peck, 2011).

**Co-production with competitors** – It is where one EE firm and their competitor develop a long-term collaboration relationship that the two work together as partners. The principle is that teamwork is better than combat, trust is the primary objective in this relationship (Piller, 2004). If the end customer is to be best served, then the parties must work together and both must win.

**Internet of things** – It is a proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data at anytime and anywhere. It is also the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment (Carnot, 2011).

**Sustainable business performance** – It is the dimension toward sustainability broadcasting in business function has concentrated increased consideration on economy, social and environmental metrics as main performance indicators. It is important that companies handpicked appropriate metrics to determinate better performance and better decisions (Morgan & Strong, 2003).

**Innovation Performance** – It refers to regular innovation by the aim to decrease the negative impacts the product (good and/or service) has on the environmental, social, and economical aspects. It is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention striving for the commercial success of the invention (Garcia & Calantone, 2002).

**Economic performance** – An assessment for a firm of its success in areas related to its assets, liabilities and overall market strength (Buckley & Carney, 2013). Application of resources efficiently on a firm would determine their economic performance position in the market.

**Environment performance** – It is the relationship between the organization and the environment. It includes the environmental effects of resources consumed, the environmental impacts of the organizational process, the environmental implications of its products and services and the recovery and processing of products (Roy, Boiral & Paillé, 2013).

**Social performance** – It is about making a firm's social mission into reality. This had include creating benefits for client, serving larger numbers of poor and excluded people, improving social responsibility and improving the quality and appropriateness of financial services (Hong and Cho, 2012).

## **1.8 Summary**

This chapter contains the brief introduction of the study. It showed the importance in carrying this study in the Malaysia EE industries. The content of this chapter include background of study, problem statement, research objectives, significant of study and important key definitions. From the study above, it is note that co-production is an important factors in influencing an EE organization in achieving innovation performance and sustainable business performance in the current competitive market.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter will present the previous literature that has been undertaken. As such, this chapter will give an overview of literature on co-production functions and the underlying theory as well as related literatures. There were five variables in the proposed model that is customer involvement, value of co-production, co-production with suppliers and co-production with competitors together with level of usage of internet of things as the moderator variable. Hence, the dependent variable would be the sustainable business performance that consists of four components. They are economic performance, environment performance, social performance and Innovation Performance. The theoretical framework and the hypothesis development will be presented towards the end of this chapter.

#### **2.2 Electrical and Electronic Industry in Malaysia**

Malaysia GDP is mainly contributed by five industries specifically services, agriculture, manufacturing, mining or quarrying and building construction. In the range, manufacturing industry contributed more over 25% of the total Malaysia GDP in the year of 2012. The electrical and electronic subsector is not only the major contributor to the manufacturing industry but it also delivers one third of employment to the Malaysian population. Malaysia manufacturing industry is very significant because nearly half of Malaysian export derives from this type of industry, specially the electrical and electronic subsector. Hence, the precise objective of this study is to

determine the co-production accomplishments of Malaysian electrical and electronic industrial that are involved in product development (Mazila, 2013).

Additional info found that there are 48 EE companies that listed in the Bursa Malaysia that involves in distribution and manufacturing of the EE related products. Malaysian EE subsector is categorized into distributing and manufacturing operation. However, in this study we are only concentrating on the companies of EE in Malaysia including that non-public listed companies but they did also having product development activity. Table 2-1 below shows the structure of EE industry in Malaysia.

Table 2- 1: *The structure of EE industry in Malaysia.*

Sectors	Sub-Sectors	Examples of Products
Electronics	Components	Semiconductors, passive components, printed circuit boards, metal stamped parts and precision plastic parts
	Consumer	Audio visual products such as televisions, portable multimedia players (PMP), digital cameras and electronic games
	Industrial	Multimedia and information technology products such as computers and computer peripherals, telecommunications equipment, office equipment and box built products for industrial applications
Electrical	Electrical	Distribution boards, control panels, electrical apparatus, lightings, transformers, cables and wires, primary cells and batteries, solar cells and modules, air conditioners and household appliances

Source: (MIDA, 2011)

### 2.2.1 Electrical Sector

The electrical sector is largely controlled by Malaysian companies. It had its early stages in the 1960s with the formation of industrial projects for the import replacement of wires & cables, household appliances, automotive batteries and electrical fittings. These projects were commenced through joint ventures with overseas partners. The industry has yet developed over the years and now deliveries the local market and global markets (MATRADE, 2011).

### **2.2.2 Electronic Sector**

The electronic sector leads the EE business in Malaysia; with almost more than 38% of electronic exports is underwritten by integrated circuits (ICs), semiconductor devices, transistors and valves. The MNCs are still the highest catalyst in the growth of this industry since its beginning in 1970s. Over the years, the business has industrialized important capabilities and skills for engineering a wide variety of electronic products. Electronic producers in the country have continuous to move-up the value chain to create advanced value-added products. These include strengthening of research and development (R&D) efforts and subcontract non-core activities nationally (MATRADE, 2011).

### **2.2.3 Malaysian Capabilities and Standards Compliance**

Malaysian firms have collected vast knowledge through supportive the global corporations in EE sector. They have the capable exporters in the subsequent areas like IC designs; standard assembly, packaging and testing production functions; power and energy generation; electronic manufacturing services; manufacturing parts & components for electrical products; wafer fabrication; solar power solutions;

fabricating consumer electrical items; LED lighting solutions and IT parts & accessories. In line with the present global trend for 'green and environmental friendly products' (minimizing waste and pollution, energy savings, non-hazardous) as well as the change to sustainability so called renewable energy, Malaysian EE firms are capable to meet the world standards and create great components and quality parts for EE products that can be distributed everywhere in the world.

Malaysian exporters are also prepared to board on co-production projects for new product development (NPD), research & development (R&D) and innovation with any interested business associates towards attaching the upcoming technology. According to Matrade report (2012), Malaysian government does encourage the EE firms to adapt and adopt the compliance of “Waste Electrical and Electronics Equipment (WEEE)”, “Restriction of Hazardous Substances (RoHS)” and “Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)” in meeting the ultimate goal of sustainability business performance.

### **2.3 Factors on New Product Development (NPD) in an Organization**

The management of new product development (NPD) in large firms has been planned in excessive depth. It has been distributed relating in how a new product development is managed successfully and in specific to management practices that have been found to be factors of new product success in launching to the market place. Yet, during their meta-analysis, they outline variables in 4 categories that have been identified as determinants of new product development success (Montoya-Weiss and Calantone, 1994). These have been slightly summarized in Table 2-2. A dialog of each category of factors as follows. The factors are further elaborate in sections 2.3.1,

2.3.2 and 2.3.3. However, marketing & new product features would not be discussed due to it is not a part in co-production activity.

Table 2- 2: *The determinants of new product development success*

<b>Organizational Factors</b>	<b>Development Process Factors</b>
Internal or external relations	Proficiency of activities
Organizational factors	Top management support/skill
	Speed to market
	Financial factors
<b>Skills &amp; Capabilities Factors</b>	<b>Marketing &amp; New Product Features</b>
Technological synergy	Product benefit
Marketing synergy	Market potential
Company resources	Market competitiveness
Firm's Strategy	Environment

Source: (Montoya-Weiss and Calantone, 1994)

### 2.3.1 Organizational factors

As the management of internal & external relations in new product development (NPD) is one zone where it marked difference between the present literature on large and small firms. Most of the published about large firms normally deals with internal relations, it is claimed that integration between different functional departments will achieve better results in the characteristics and features of the products developed and time taken to develop them (Shrivastava and Souder, 1987; Wheelwright and Clark, 1992; Towner, 1994).