INDUSTRIAL REVOLUTION 4.0 IMPLEMENTATION: CURRENT PRACTICE
AND BARRIERS IN MANUFACTURING FIRMS OF MALAYSIA

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DEDICATION

I would like to dedicate this project report to my respected supervisor, Ts. Dr. Lee who gave me valuable guidance, blessings, time, and encouragement throughout my research. Furthermore, I'm very thankful to my beloved family members, friends, co-supervisor, lecturers and each respondent that assist me a lot in my research. I would like to express my gratitude for all the support, assistance, guidance, and encouragement from them throughout my research. I am sure that if without all your encouragement and support it would have been a hard and challenging task for me to accomplish this research.

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ABSTRACT

The Industrial Revolution 4.0 is the stage in the knowledge development in which the lines between digital, physical, and biological spheres are being distinct. Industrial Revolution 4.0 is controlled by digital physical frameworks and artificial intelligence that make human-machine interface more universal. Industry 4.0 was introduced by German during 2011, which is a contemporary issue that concerns today's industrial production as a whole and is meant to revolutionize it at many countries. In Malaysia, where is still presently depend heavily on low cost foreign labor for their production, especially in the sector of manufacturing. Malaysia has been rather slow-moving to embrace Industry 4.0 if compared with neighboring countries like Thailand or Vietnam which already have Industry 4.0 policy frameworks earlier than Malaysia. This research aims to identify the current practices and implementation of industries 4.0 in Malaysia; and to determine the barriers encountered by the manufacturing firms in Malaysia on implementation of Industry 4.0. The scope of study was focused on the manufacturing industries in Malaysia which have been implementing the Industry 4.0.This research was conducted using qualitative approach where the data were obtained from seven manufacturing companies that implementing Industry 4.0 by choosing multiple case study alternative. Semi-structured interview and purposive sampling were used to obtain the relevant data. In this research, it was found that the current practice of implementation Industry 4.0 in Malaysia still at the initial stages according to respondents. Most of the companies involved in the study were at the beginning level to kick start the implementation Industry 4.0 in their organization. In additional, the big barriers faced by respondents were the data managements and integration and the education. Besides that, there were a few new barriers discovered from this study namely culture, competitor, mind set and environment. In conclusion, this research reveals the current practices and barriers that contributed and faced by all the manufacturing firms that can assist the government in preparation draft of national policy Industry 4.0 in Malaysia.

ABSTRAK

Industrial Revolution 4.0 adalah tahap dalam pengembangan pengetahuan antara bidang digital, fizikal, dan biologi yang menjaringkan hubungan antara manusia dengan mesin supaya lebih universal. Industri 4.0 diperkenalkan oleh negara Jerman sejak tahun 2011 dan ia merupakan isu kontemporari yang memberi pengaruh kepada pengeluaran industri hari ini secara keseluruhan dan bertujuan untuk merevolusikannya ke pelbagai negara. Di Malaysia, kebergantungan kepada buruh asing kos rendah terhadap pengeluaran terutama dalam sektor pembuatan membuktikan bahawa kelewatan Malaysia dalam memperkenalkan industri 4.0 jika dibandingkan dengan Thailand atau Vietnam yang sudah mempunyai dasar industri 4.0 lebih awal. Oleh yang demikian, kajian ini bertujuan untuk mengenal pasti perlaksanaan semasa Industri 4.0 di Malaysia; dan untuk menentukan halangan yang dihadapi oleh syarikat pembuatan di Malaysia sepanjang perlaksanaan Industri 4.0. Skop dalam kajian ini memfokuskan kepada sektor pembuatan di Malaysia yang telah melaksanakan dasar Industri 4.0. Kajian ini menggunakan pendekatan kualitatif dimana data yang diperoleh daripada tujuh syarikat pembuatan yang memperkenalkan Industri 4.0 dengan memilih pelbagai kajian kes sebagai alternatif. Temuduga separa berstruktur dan kaedah persampelan bertujuan digunakan untuk mendapatkan data yang relevan. Dalam kajian ini mendapati bahawa, perlaksanaan Industri 4.0 di Malaysia masih pada tahap awal dimana, kebanyakan syarikat yang terlibat dalam kajian ini juga masih berada di peringkat permulaan untuk memperkenalkan industri 4.0. Halangan yang dihadapi sepanjang perlaksanaan Industri 4.0 ini adalah berkenaan pengurusan data, integrasi dan pengetahuan berkaitan dasar tersebut. Tambahan pula, terdapat beberapa halangan baru yang ditemui dalam kajian ini iaitu budaya, persaingan, pemikiran dan persekitaran. Kesimpulannya, kajian ini mendedahkan perlaksanaan semasa dan halangan yang dihadapi oleh syarikat sektor pembuatan yang boleh membantu kerajaan dalam penyediaan draf dasar kebangsaan untuk Industri 4.0 di Malaysia.

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CHAPTER 1

INTRODUCTION

1.1   Introduction

The Industrial Revolution 4.0 is the stage in the knowledge development in which the lines between digital, physical, and biological spheres are being distinct. Industrial Revolution 4.0 is controlled by digital physical frameworks and artificial intelligence that make human-machine interface more universal (Shahroom & Hussin, 2018). Before moving onto Industry 4.0, there are three industrial revolutions have led to changes of paradigm in the domain of manufacturing and mechanization through water and steam power, mass production in assembly lines, and automation using information technology (Liao *et al.*, 2017). The appeared of Industry 1.0 began around 1780s by introduced water and steam power which helped in mechanical production enhanced the agriculture sector greatly. Next, the Industry 2.0 defined as the characteristic of that period with introduction of mass production as a primary means to production in general (Strozzi *et al*., 2017). The mass production of steel helped introduce railways into the system, which consequently contributed to high-volume production. During the 20th century, Industry 3.0 rose with the concept of Digital Revolution which is without a doubt better known to us than the rest as society today are acquainted with industries leaning on digital technologies in production. Perhaps Industry 3.0 was, and still is a direct result of the huge development in computers and information and communication technology for regions around the world (Liao *et al*., 2017).

Introduced by the Germans in 2011, the term of Industry 4.0 defined as the means of data exchanges and automation in manufacturing technologies that includes

eleven characteristics. There are Internet of Things (IoT), cyber-physical systems (CPS), Big Data and analytics, simulation, augmented reality, autonomous robots, cloud computing as well as additive manufacturing (Strozzi *et al*., 2017). Industry 4.0 has transformed many professions. People who are committed to learn new tasks and use the hi-tech gadgets which become most absolutely necessary factor of their work (Gorecky *et al*., 2014). Industry 4.0 has been introduced as general change by automation and digitalization of every part manufacturing process of the company. Large-scale corporates that use idea of ongoing improvement with high standards for development and research will accept concept of Industry 4.0 that will improve the competitiveness on the market. This becomes feasible by introducing self-cognition, self-optimization, and self-customization into the industry. Therefore, the manufacturers will more easily to control and communicate with computers rather than operate them (Gorecky *et al*., 2014).

Industry 4.0 takes the automation of manufacturing processes to a new hierarchy through the introduction of flexible and customized mass production technologies. Industry 4.0 served as a role to integrate and combine the intelligent machines, human actors, physical objects, manufacturing lines and processes throughout organizational stages to build a new types of technical data, systematic and high agility value chain (Schumacher, Erol & Sihn, 2016). This bring towards the machines cooperate with humans or operate independently to create customer-oriented production field that continuously works on maintain itself. On the other hands, the machine becomes an independent entity that used to collect, analyse, and advise data upon it. This new industrial revolution can cope by the fundamental idea that had been widely implemented in many other countries which include Japan, German, Korea, United State, and others. This phenomenon implied that many governments have perceived the trend and act specifically to the impact of Industry 4.0 could bring. For instances, Singapore government has launched its Research, Innovation and Enterprise (RIE) 2020 Plan with budget of $19 billion in year 2016 while Japanese government endeavored in realizing its advancing 'Super Smart Society' by adopting the fifth Science and Technology Basic Plan since 2015 (Ishihara, 2017).

Based on research conducted by PricewaterhouseCoopers (PwC) in 2016, Industry 4.0 seems an optimistic future in the digitalization of services, products and means of robotic engineering and manufacturing companies believe to cut down the

operational costs by 3.6% per annum (Jesper, Stefan & Reinhard, 2016). During the British colonial era, there are 70-80% of industries in Malaysia are still squeezed in the Industry 2.0 where the labor-intensive phase is still widespread. Most of the neighboring countries such as Singapore, Thailand, Indonesia, and others beyond are already improving relationship from Industry 3.0 to 4.0 while strengthen efficiency by 4.1% over the course of five years annually (Ariff &Low, 2017).

In summary, Industry 4.0 is act as the label given to the gradual combination of industrial practices and traditional manufacturing with the progressively technological world. However, Industry 4.0 still unable to implement well in many countries including Malaysia.

1.2   Research Background

Industry 4.0 is referred to the companies positioning themselves to the customers through digital marketing, social media, E-Commerce and beyond the customer expectation and experience. This level is dominating industrial transformation that overwhelms every aspect of economic activities and industries of living. Moreover, it is also a total transformation of several sectors into latest system or/and way that will change the method to operate the businesses. Disruptive technologies which also considered as existing technological advances at times because the convergence of the digital, biological, and physical worlds. On the others hand, Industry 4.0 is defined as the manufacturing or production based on industries digitalization transformation which driven by the connected technologies. "Smart factory" also referred to Industry 4.0 in which cyber physical systems (CPS) can make decentralized decisions and monitor the progression of real time physical factory. Another terminology of Industry 4.0 includes Smart Manufacturing. The implementation of industry 4.0 beneficial for many aspects for a country. There was increased efficiency, quality, productivity and cut down time to market, increased in flexibility, stimulated more activities of R&D and development of new talents and skills globally (Wang *et al*., 2016).

According to National Industry 4.0 Framework 2018, the development of Malaysia's visions towards manufacturing sectors in the future of next 10 years which are increasing strategic partner for smart factory and related products and services in

Asia Pacific where is first destination for high technologies industry and acts as total solution provider for latest technology is made in comprehensive realisation that need to transform more manufacturing industry to embrace Industry 4.0 (Ministry of International Trade and Industry, 2017). This is because the certainty that global trends towards the potential to adopt the latest technology development which drive Malaysian towards more competitiveness.

In 2015, there are more than 18,000 employees were retrenched in the sector of banking due to banks had adopted technologies which able replace the job of workforce according to the Malaysian Employer Federation on 2015. Perhaps, this clearly shows that the computerization and automation were already occur in the sector of financial. Besides that, Iskandar Malaysia had prepared for the approaching data usage and automation that will fundamentally change the landscape of employment in the future. Looking ahead to the advent of Industry 4.0, the trend Industry 4.0 toward the increasing use of data and automation of jobs, policies that concern on education and technology must take in place immediately (Sivanandam, 2017).

According to Open Gov Asia, former Malaysia Prime Minister Datuk Seri Najib Razak initiated the government's plan to implement a TVET plan. This is to assist the development of Industry 4.0 in the future by increasing the workforce. In this program, government allocated RM50 million to improve caliber and the competitiveness of the workforce to stimulate in the economic development of the nation. This budget is allocated from 30% of the Human Resources Development Fund (HRDF) funds collected for the purpose of TVET (Bhunia, 2017). In additional, the report on the Readiness for the Future of Production Report 2018, which jointly published by the World Economic Forum (WEF) and Kearney, positions Malaysia in the "Leader" quadrant. Over global assessment of 100 countries, there are countries belong to "strong current production base" and "positioned well for the future". According to the results, noted that China and Malaysia are the only two countries in the "Leader" quadrant, who are not high-income countries. It emphasizes Malaysia is strong current manufacturing position and its preparation for Industry 4.0. It also highlights the value of economic at stake assuming that Malaysia is unable to transform itself in an accelerated manner (Ariff & Low, 2017). In Malaysia, manufacturing industry is important because this sector bring big impact on the Malaysian economy. Contribution of manufacturing sector to the economy of

Malaysia is evidenced in the external trade, job creation and gross domestic product (GDP). According to Department of Statistics Malaysia, manufacturing sector recorded an increase in GDP % whereas in 2017, manufacturing sector recorded a better result of increase in 6.0 %.Moreover, Malaysia has been listed as the world's top manufacturing in latest suitability index by Cushman and Wakefield (Business Circle, 2014).

However, in spite of Malaysia was one of the leader in industrial countries back then, a majority of neighboring countries such as Singapore, Thailand and Indonesia and beyond are already building the bridge from Industry 3.0 to 4.0 while improving efficiency at 4.1% annually over the course of four years (Ministry of Finance Malaysia, 2017). Organizations are willing to afford the huge expenses in the hopes of strengthening their positions and influences in the multifaceted industrial ecosystems. The aspect of high expenses becomes the obstacle of inability for the manufacturing industries firm to adopt Industry 4.0.

According to the budget speech 2017, the investigation shows that most of the manufacturing industry in Malaysia is currently still in industry 2.0 and 3.0. Malaysia's manufacturing sector differs in terms of where they are currently stopped between Industry 2.0, mass production and Industry 3.0, automation (Ministry of Finance Malaysia, 2017). Despite that, there are still have industry leads moving towards Industry 4.0 or embracing Industry 4.0 compliant on their own.

This research intents to investigate the current practices, adoption, and barriers of implementing industries 4.0 for manufacturing firms in Malaysia. Due to the exploratory nature of this research study, qualitative research is used to achieve the objectives of research. The sample for this study is purposive sampling that constitutes of two types of manufacturing industries which are current manufacturer and potential manufacturer which will implements Industries 4.0 in their firm.

Lastly, this research is expected to provide new insight on implementation of industries 4.0 in developing countries, particularly in Malaysia. This also will uphold the current and potential manufacturers which will implementing industries 4.0 establishing better understanding on the current practice, adoption, barriers, and opportunities in this industry.

1.3   Problem Statement

Malaysia has been rather slow moving to embrace Industry 4.0 if compared with neighboring countries like Thailand or Vietnam which already have Industry 4.0 policy frameworks earlier than Malaysia. Perhaps, Malaysia still clogged at the level of Industry 3.0, automation in terms of manufacturing technology. Recently, Industry 4.0 Malaysia Association president Raja Teagarajan explained that the government already set a key performance index to lean a hand for at least 500 companies at aspects of manufacturing sector in their migration to Industry 4.0. Nevertheless, there were only 90 of companies to date it (Predeep, 2019). According to Human Resources Development Fund (HRDF), most of the huge amount of Malaysian workforce in the private sector require to be up skilled and trained to be more multi-skilled to meet requirements of jobs follow increasing digitalization and automation of workplaces (Pandiyan, 2017). This situation shows that the knowledge driven such as training and skills of Industry 4.0 still lack for the workforce in Malaysia.

Besides that, the main ideas of fourth industrial revolution to construct the basic base for the Industry 4.0 manifesto. The study was published by the German National Academy of Science and Engineering (Kagermann, Wahlster & Johannes, 2013). The Public Private Partnership (PPP) for Factories of the Future (FoF) deploy and initiate related topics of Industry 4.0 at European level. In the United State, they promote Industry 4.0 by Industrial Internet Consortium (ICC) (Liao *et al*., 2017). This new industrial revolution can cope by the basic idea that had been widely implemented in many other countries. Internationally, many governments have realized the trend and take action specifically to the impact of Industry 4.0 could bring. It can be noticed from the government plans as stated below. However, all these studies also done by foreign researchers in Europe, Japan, United State, and other Asia countries. There is less of study focus on the trend of Industry 4.0 in Malaysia (Ee, 2017).

According to the FMM-Malaysian Institute of Economic Research Business Conditions Survey in 2016, listed that there are only 12% of the respondents are very aware and pay attention of Industry 4.0, followed by about 41% are somewhat aware and 28% require more information for Industry 4.0, next is 19% of them are totally not aware Industry 4.0 at all (Ee, 2017). The low and weak adoption and awareness of Industry 4.0 among Malaysian manufacturers with the reason of the limited and

insufficient market size to incentivize them to automate their operation according to Second Minister of International Trade and Industry Datuk Seri Ong Ka Chuan. Ong opined that some of manufacturers are lacking knowledge and not ignorant, but the production and market size is insufficient for them to embark on automation (Ee, 2017). They also focus on labor intensive system, almost 80% of the organizations here employ low-cost and skills of foreign workers rather than high skill-based workforces due to the insufficient capital or low wages from foreign workers to enhance their profitability (Ee, 2017). This reliance on a labor-intensive cause most of manufacturing firms in Malaysia are too comfortable with Industry 2.0. With the appearance of policies such as the ASEAN Economic Community (AEC), Malaysia which belong to country that have high potential of export had push Malaysia easily access to Asian to European countries' economies through the implementation of zero and free trade (Ee, 2017).

Furthermore, according to National Industry 4.0 Framework, the manufacturing industry in Malaysian is a crucial economic sector that contributing about 23% to the gross domestic product (GDP) in the last 5 years. It can't be denied that manufacturing sectors has brought the effect of attracting investments, creating business chances, stimulating and increasing jobs in the related services sectors and downstream activities. The manufacturing sector is believed to withstand and is on track to reach the targeted annual gross domestic product (GDP) growth rate of 5.1% under the 11th Malaysian Plan (RMK-11). Furthermore, manufacturing sectors in Malaysia is made up of an enormous number of small-medium enterprises (SMEs), which totally with for 97% of the manufacturing firms. Most of these SMEs have the potential to be global exporters although they do not have well-build global presence. Next, in conjunction with other continuing initiatives such as Digital Free Trade Zone (DFTZ) or e-Commerce Strategic Roadmap, the Government is attempting to provide the platform for SMEs to take up radically way by themselves to adopt the new technologies to be globally competitive (Ministry of International Trade and Industry, 2017).

Industry 4.0 will restructure manufacturing pushing down expenses, enlarge the market reach to customers as well as creating new competitors. In Malaysia, where is still presently depend heavily on low cost foreign labor for their production, there is a need for mindset change to embrace new technology to increase efficiency and

productivity and to expand markets through digital platforms (Ibrahim, 2016). In Malaysia, especially in sectors of construction, automotive and electronics industries to increase modern and new manufacturing technologies towards industry 4.0. With the arrival of regional economic bunch like the ASEAN Economic Community (AEC), Malaysia has the basically technology to capitalize and rank up on the wider ASEAN markets comprising greater access to European and Asian countries' economies through the implementation of zero and free trade agreements (Ibrahim, 2016).

In the last Budget announcements during 2017, there have been announce new incentives provided for companies to invest in latest and new equipment and technology to help Malaysian companies to adopt and acquire new technologies towards Industry 4.0. In addition, Industry 4.0 topics also become one of the manifestos that emphasized for both parties. For example, five million students to be equipped with digital technology for Industrial revolution 4.0 within five years from education sectors while for the sector of economy is to increase the speed to drive the country toward Industry 4.0 through the plan public policies according to big data and draft development path in science and technology (Ministry of Finance Malaysia, 2017).

In the nutshell, literature on current practice, adoption, and barriers for implementation of industries 4.0 in Malaysia is still in its infancy regarding this topic (Ibrahim, 2016). Malaysia's journey to Industry 4.0 is being restricted by lack of exposure as well as information on the initiative to transform the sector of manufacturing with cutting-edge technology, an industrial training expert told a forum today. To address the issues, this research was conducted to investigate the current practice, adoption, and barriers of implement industries 4.0 from the perspective of manufacturers and potential manufacturers.

1.4   Research Questions

The primary research question addressed in this study are:

a)   What is the level of current practice industries 4.0 implementation in Malaysia?

b)   What are the barriers faced by manufacturer on implementation of industries 4.0 in their business?

1.5   Research Objectives

The specific objectives of the research included:

a)   To identify the level of current practices Industry 4.0 implementation in Malaysia.

b)   To analyze the barriers of Industry 4.0 implementation among Malaysia manufacturing firms.

1.6   Research Scope

This study was conducted at manufacturing industries under category of multinational companies (MNCs) in Malaysia which are implementing industries 4.0 in their organization. Multinational companies (MNCs) in Malaysia was targeted because they had sufficient support of capital, technological advances and knowledge from parent company to embrace the technological revolution of Industry 4.0. The research data gained by using qualitative method through the interview upper management and technical team of manufacturer, for instance executive staff and engineers in manufacturing firms which implement Industry 4.0 in their organization. Lastly, the Nvivo software are used to analyze the data.

1.7   Research Significance

This research had given a large impact on company or organization of manufacturing industries that attempt to improve their status of Industry to Industry 4.0. This research revealed and knew the current practices and barriers that contributed and faced by all the manufacturing firms that can assist government in preparation draft of national policy Industry 4.0 in Malaysia. In additional, requirement of investments such as financial aids and support or incentives from government to beneficial manufacturers by providing incentives in the starting point for those who are ready to embrace and adopt Industry 4.0. Ultimately, review the Industry 4.0 concepts, covering areas such as national policy, manufacturing industry objectives, industry control, level of

Industrial revolution, practices of industry, barriers faced and performance indicators of Industry 4.0.

The framework of the integrated barrier of Industry 4.0 is essential as a tool for manufacturing firms to overcome it as the good practices and encourage implementation of Industry 4.0 to apply it in their organization processes. The beginning of this research is to classify the barriers faced by the manufacturing firms to embrace Industry 4.0 because this efforts may give obviously opinion polls through the respondents and lead to the refinement to overcome the barriers faced by manufacturing firms in Malaysia.

Lastly, knowledge driven about Industry 4.0 also become one of the significances for this research. To up skill the existing and next generation of workforce, the higher and further education to better understanding about Industry 4.0 should be develop at institutions of education to students for the changes implied by Industry 4.0. Furthermore, leverage on the training programs driven by Industry 4.0 important to the workforce in improvement knowledge and skills on Industry 4.0 and lead to contribution significantly to the company and country growth. Hence, through the knowledge driven Industry 4.0 can fill the research gap.

1.8   Term Definition

This study contained several of technical terms related to Industry 4.0. Before proceeding further into chapter 2 where these terms had elaborated in detail. In this chapter there had a brief introduction on those terms to allow the reader to make sense of what presented in the literature review.

a)   **Industry 4.0 -** Served as a role to integrate and combine the intelligent machines, human actors, physical objects, manufacturing lines and processes throughout organizational stages to build a new type of technical data, systematic and high agility value chain.

In this study, Industry 4.0 is a high intelligence industrial operation mode that can produce high productivity and efficiency by the interaction between the software and hardware and machine and human.

b) **Current Practices -** Current practices is the immediate present or in progress application or use of an idea, belief, or method.

In this study, current study referring to the level of industrial mode in Malaysia which is in between Industry 2.0 and Industry 3.0.

c) **Barrier -** Barrier is a fence or other obstacle that prevents movement or access.

In this study, barrier is the challenges that obstruct the development of Industry 4.0 in Malaysia.

d) **Manufacturing Industries -** Manufacturing industry refers to those industries which involve in the manufacturing and processing of items and indulge in either creation of new commodities or in value addition.

In this study, manufacturing industry refers to the company in Malaysia that involves in production and processing of raw materials or finished goods.

1.9   Summary

This chapter primarily had presented where the scheme and plan of the research bloomed and the subsequent questions in order to deal the issues that basically for the thesis was established. It gives the direction of the research objectively based on the research questions and problem statement. In next chapter will continue to explore the previous literatures that had already existed to catch on what had been done.

CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

Literature review is a report containing the evaluation of the information accumulated from the literature related to the field of study. It synthesized the information into a compact and comprehensive chapter. Concept of Industry 4.0 is outlined in this chapter which involves the aspects of industry revolution from Industry 1.0 until 4.0, nine characteristics of Industry 4.0, related models of industry 4.0 and lastly the barriers during implementation of Industry 4.0.

2.2   Industrial Revolution

At present, there are four times of Industry Revolution. The first industry revolution was happened in 1700s and based on the mechanization of production equipment through the water and steam engines. Later, the second industrial revolution is based on mass production archived by division of labor concept due to the introduction of electrical energy since century 1800s. Next, the third industrial revolution started at 1900s by the utilization of IT and electronic devices for further automate production. Until right now the introduction of the term Industry 4.0 is based on the use of fusion of cyber technology and physical manufacturing system. It might have expected to take 10-20 years during the realization of this vision. This cyber-physical system platform monitor factory processes and make decentralized that will lead to smart factories and build a platform of compliance together with customers' requirements.

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