FUTURE OF MANUFACTURING: A STUDY ON THE FRONT-END REQUIREMENTS OF INDUSTRIE 4.0 IN MALAYSIA PERSPECTIVE

This report is submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Manufacturing Management) (Hons.)

by

FLORIENA ERIKA JAIBIN
B051310178
940214-12-5758

FACULTY OF MANUFACTURING ENGINEERING
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I hereby, declared this report entitled “Future of Manufacturing: A Study on the Front-End Requirements of Industrie 4.0 in Malaysia Perspective” is the result of my own research except as cited in references.

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Author’s Name : FLORIENA ERIKA JAIBIN

Date : 22 June 2017

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for Degree of Manufacturing Engineering (Manufacturing Management) (Hons). The member of the supervisory committee is as follow:

…….....

(Associate Professor Dr. Mohd Rizal bin Salleh)

ABSTRAK

Tujuan kajian ini adalah untuk mengkaji sistem pembuatan semasa yang diamalkan oleh sektor pembuatan di Malaysia dan juga mengkaji fasa dalam Industrie 4.0 yg di amalkan oleh industri di Malaysia dengan mempertimbangkan dua faktor penting iaitu kemajuan teknologi dan kemahiran jurang. Berada dalam fasa kedua atau fasa ketiga revolusi industri adalah perkara yang menjadi pilihan untuk industri di Malaysia. Bergerak bersama dengan kepesatan kemajuan teknologi merupakan salah satu pemboleh utama untuk bersaing di pasaran pada masa kini. Dalam kajian ini, sistem pembuatan semasa di selidik melalui sorotan literatur. Kajian rintis telah dijalankan untuk mengkaji kaedah membangunkan soalan selidik kaji selidik dalam talian atau tinjauan E-Mail. Kajian E-Mail dipilih kerana kajian ini melibatkan bilangan yang agak besar daripada responden dan jangkauan geografi. Kaji selidik E-Mail telah diedarkan untuk mengkaji fasa pengamalan Industrie 4.0 dari segi kemajuan teknologi dan kemahiran jurang. Kemungkinan talian soal selidik kajian atau E-Mail kaji selidik itu telah diuji dengan menjalankan kajian perintis. Sebanyak 8 responden telah mengambil bahagian dalam kajian ini. ujian Alpha Cronbach telah dijalankan dengan menggunakan perisian SPSS Statistik. Setelah ujian Alpha Cronbach dijalankan, nilai alfa soal selidik kajian didapati melebihi 0.70. Oleh itu, ia boleh dikatakan bahawa soal selidik kajian yang boleh dipercayai. kajian sebenar dijalankan selepas nilai alpha itu disahkan untuk menjadi lebih daripada 0.70.

ABSTRACT

The aim of this study is to investigate the current manufacturing system practiced by manufacturing sector in Malaysia as well as to study the phases of Industrie 4.0 adoption by Malaysia's industries by considering two important factors which are technology advancement and skill gaps. Staying comfortably in the second phase or the third phase of industrial revolution is a matter of choice for all industrial players. The choices always have its consequences. Moving along with the rapid pace of technological advancement is one of the key enabler of competing in the marketplace nowadays. In this study, the current manufacturing system were investigated through literature reviews. Pilot study were carried out to study the method of developing online survey questionnaires or E-Mail survey. E-Mail survey was selected because this study involves fairly big number of respondents and geographical reach. The E-Mail survey were distributed to study the phases of Industrie 4.0 adoption in term of technology advancement and skill gaps. The feasibility of the online survey questionnaires or E-Mail survey were tested by carrying out pilot survey. A total of 8 respondents have participated in this study. The Cronbach's Alpha test was conducted by using SPSS Statistic software. Since the alpha value of the survey questionnaire exceed 0.70, therefore it can be said that the survey questionnaire is reliable. Real survey was conducted after the alpha value is confirmed to be more than 0.70.

DEDICATION

For my beloved family,

For their endless love and support for me throughout my educational endeavour here in UTeM.

ACKNOWLEDGEMENT

I am using this opportunity to express my deepest gratitude and special thanks to my Final Year Project Supervisor, Associate Professor Dr. Mohd Rizal bin Salleh who in spite being busy with his duties, took time out to hear, guide and keep me on the correct path in carrying out this project. This special thanks also goes to the other lecturers whom direct and indirectly taught me regarding my topic of study. I thank them for their constructive comments. I also want to thank my friends whom had helped me directly or indirectly throughout the process of completing this Final Year Project report. Last but not least, I want to thank my dearest parents for their love and support.

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LIST OF ABBREVIATIONS

E&E	-	Electric & Electronic
MIDA	-	Malaysian Investment Development Authority
MPC	-	Malaysia Productivity Corporation
MITI	-	Ministry of International Trade and Industry
MCA	-	Malaysian Chinese Association
CPS	-	Cyber-Physical System
CPPS	-	Cyber-Physical Production System
IoT	-	Internet of Things
PwC	-	PricewaterhouseCoopers
IT	-	Information Technology
SME	-	Small Medium Enterprise
11MP	-	Eleventh Malaysia Plan
VDMA	-	Verband Deutscher Maschinen-und Anlagenbau
PLC	-	Programmable Logic Contol
SMLC	-	Smart Manufacturing Leadership Coalition
BDO	-	Binder Dijker & Otte Co
RFID	-	Radio-frequency Identification Device
AI	-	Artificial Intelligence

CHAPTER 1

INTRODUCTION

This chapter will explain the background of the study. The statement of problem will be discussed thoroughly and the objectives of the study will be established. From the objectives, the scope of the study will be identified. The significance of conducting this study will also be discussed and finally summary of the study will be provided.

1.1 Background of Study

We realize that the global competition become more intense nowadays. Therefore, new approaches and more innovation must be taken into consideration to spark the development of Malaysia's manufacturing industries in order to remain competitive in the global market. According to Chryssolouris (2013), manufacturing is a process of transformation of materials and information into goods to satisfy human needs. Productivity on the other hand is a measure of the efficiency of a person, machine or factory, system and et cetera in converting inputs into useful outputs.

The measurement of productivity is vital as it determine a nation's economy and the well-being of the citizen. It is important to ensure that the productivity to be positively increasing. Malaysia as described in The World Bank (2016), is a highly open, upper-middle

income economy country. Malaysia was recognized as one of the 13 countries identified by the Commission of Growth and Development in its 2008 Growth Report to have achieve an average growth of exceeding 7 percent per year for more than 25 years.

Among selected Asian countries, Malaysia ranked 47th in terms of World Productivity in 2015. One of the largest contributor to Malaysia's productivity is the manufacturing sector. Manufacturing sector productivity growth registered is 7.1% followed by construction and services (Malaysia Productivity Corporation, 2016). One of the most profitable sub-sector in manufacturing is the Electric and Electronic (E&E) industries. According to Malaysian Investment Development Authority (MIDA, 2016), Electric and Electronic (E&E) industries contributes 33.4% to the country's exports and 23.7% of employment in 2014.

Dato' Sri Mustapa Mohamed, Minister of International Trade and Industry Malaysia in the 2015 Productivity Report says, "Productivity has been identified as a crucial-game changer especially against the backdrop of the "Fourth Industrial Revolution" – which alter the way we work, live, and interact with each other." (Malaysia Productivity Corporation, 2016).

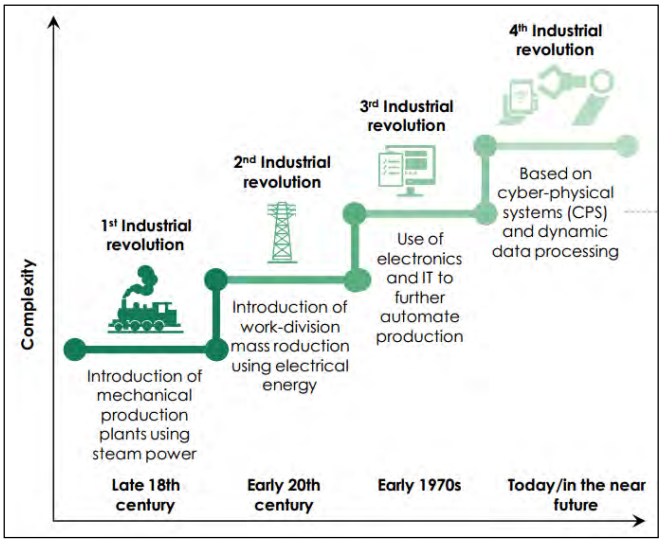

Figure 1.1: Phases of Industrial Revolution (Ministry of International Trade and Industry, 2017)

Figure 1.1 above illustrates the phases of Industrial Revolution. The First Industrial Revolution addressed the used of water and steam in the mechanization of production. Whereas, in the Second Industrial Revolution, mass production is created by using electrical power. In the Third Industrial Revolution, the production is automated by the utilization of electronics and Information Technology. The Fourth Industrial Revolution is characterised by the fusion of technologies that obscuring the lines between physical and virtual world (Schwab, 2015).

In order to analyse what is the criteria that is needed to implement Industrie 4.0 which is also known as the Fourth Industrial Revolution, it is essential to study the current system of manufacturing sector in Malaysia. The performance of manufacturing sector in Malaysia are strongly influenced by competitive advantages, quality initiatives, supplier relationships, quality and reliability practices, field data management as suggested by Mazharul *et al.* (2007). One of the current practice in Malaysia's manufacturing sector is lean manufacturing. Automotive firms in Malaysia have a firm believe that customer satisfaction and ensuring continuous organisational improvement are the main reason to adopt and implement lean manufacturing.

However, the main barrier in implementing lean manufacturing in the automotive firms are the poor understanding on the concepts of lean and the employees' attitude (Norani, Baba, Dzuraidah, 2010). A study has been conducted by Yu and Kuan (2011) on the implementation of lean manufacturing in electrical and electronic companies and they are focused on the approach of adopting lean, problems encountered, implemented tools and techniques, organizational transformation, and the lesson learnt from their study.

Migrating to Industrie 4.0 can bring about a lot of benefits especially to the growth of manufacturing productivity in Malaysia. Datuk Seri Ong Ka Chuan, Second Minister of International Trade and Industry stated during the 17th Malaysian International Food & Beverage Trade Fair 2016 which was held in Kuala Lumpur, that government is open to any ideas related to tax incentives that can employ automation and smart technology in assembly lines of factories (Ministry of International Trade and Industry, 2016). Industrie 4.0 has been

an issue of encouragement for manufacturers in Malaysia to move the Malaysia's manufacturing into advancement and cut down the dependency to manual labour and to be competitive in exports among other developed countries (Malaysian Chinese Association, 2016).

Reported by Ooi in the News Strait Times, Datuk Seri Ong Ka Chuan said that "as robotics, data captured via sophisticated sensors, predictive analytics and Internet of Things become increasingly integrated, manufacturer will be able to reap cost savings in real-time quality control and maintenance." Migrating to the new practice of Industrie 4.0 according to Datuk Seri Ong Ka Chuan, will help to rise the inter-operability, decentralisation of decision making and real-time capabilities. Besides that, Industrie 4.0 can trigger increment in value chain which is vital to deal with the adding up of labour costs (General Electric Malaysia, 2016).

Industrie 4.0 have different meaning through the perspective of different industrial expertise. One of the definition of this so-called Industry 4.0 according to MacDougall (2014), is the technological changes from the current embedded system to cyber-physical systems (CPS). CPS(s) are systems which incorporate the consolidation of computational entities and in rooted connection with the physical world and its continuous processes, accessing and providing data services accessible in the internet (Monostori, 2014).

Monostori (2014) also defined the Industrie 4.0 as a Fourth Industrial upheaval on the journey to the Internet of Things (IoT), Big Data, and Services. Manufacturing industries is influenced in a way that a crucial new aspect is introduced by the representation of the interaction between physical and virtual world. Object networking and individualized process management are being created intelligently through decentralized intelligence.

Industrie 4.0 is not a newbie in the world of industrialization. A study conducted by PricewaterhouseCoopers (PwC), the world largest professional services firm on the opportunities and challenges of the Industrial Internet. A total of 235 German companies

were involved in this study. Based on the results of the survey, they found out that there are few drivers which contribute to the Industrial Internet Solution. Among of the drivers are the opportunity to better integrate the horizontal and vertical value chains.

Technischer Überwachungsverein (TUV), conducted their study in order to gain the information on the current companies understanding of Industrie 4.0. Their study also focused on the level of maturity and the application of Industrie 4.0. Besides that, the study guidance also leaned toward the detailed and high prioritization of the issues of Industrie 4.0. Based on the result of their findings, most of the company shows their understanding of Industrie 4.0 in terms of networking or intelligent system in the production and machineries. Most of the answer also refer to big data which are used to explain an organization that is totally infiltrated and controlled by IT-innovation.

Malaysia currently is in the second phase going to the third phase of Industrial revolution. Therefore, it is crucial for Malaysia to embrace the new era of technology to avoid being left behind in the global competition. Malaysia government have not yet come out with the policy of Industrie 4.0. The role of government in Industrie 4.0 includes gearing the awareness towards the benefits of Industrie 4.0, provides financial support particularly for SME, and creating close collaboration network to push the agenda of Industrie 4.0 forward (Ministry of International Trade and Industry, 2017).

1.2 Problem of the Study

The journey toward Industrie 4.0 is not as easy as we may think. To come out with the suitable framework for the factory of the future, the problem with the current productivity of manufacturing sector must be addressed first. Besides that, the significant challenges and opportunities in addressing the problem must be identified so that, it will be easier to measure the growth of productivity with the implementation of Industrie 4.0.

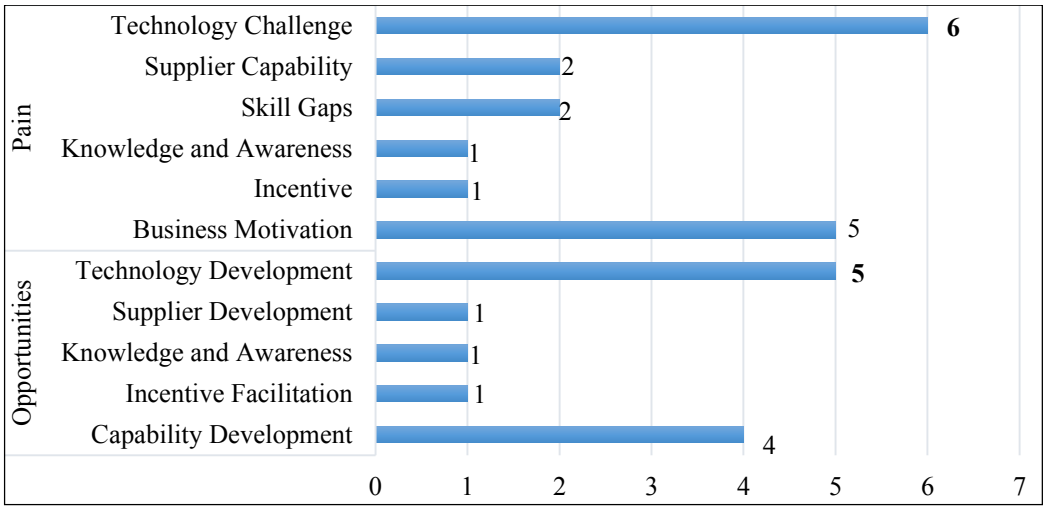

Figure 1.2: Challenges and Opportunities in the field of Robotic and Automation (Collaborative Research in Engineering, Science and Technology, 2016)

Figure 1.2 above shows the challenges and opportunities in the field of robotic and automation. The result was obtained during CREST Workshop. It can be seen from the Figure 1.2 that technology challenge has been identified as the most significant challenges towards Industrie 4.0. Meanwhile, technology development has been identified as an opportunity in adopting Industrie 4.0. It can be interpreted based on the result of the workshop that technology is a challenge that must be addressed in migrating to Industrie 4.0.

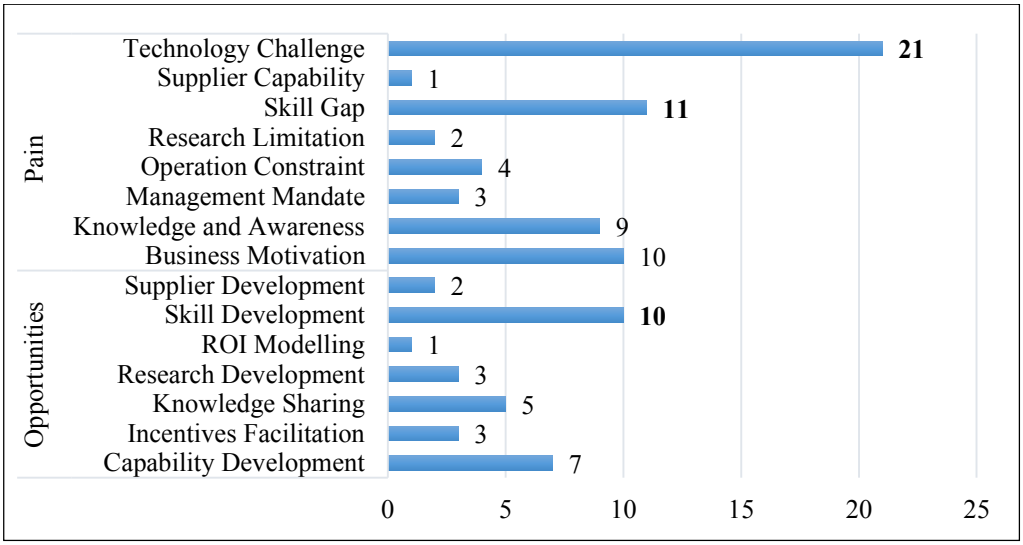

Figure 1.3: Challenges and Opportunities in the field of Smart Manufacturing (Collaborative Research in Engineering, Science and Technology, 2016)

Figure 1.3 portray the challenges and opportunities in the field of smart manufacturing. Both smart manufacturing as well as robotic and automation are a crucial part of the Industrie 4.0. Based on the Figure 1.3, technology and skill gaps were identified as an apparent challenge in adopting Industrie 4.0. Meanwhile, skill gaps have the potential to be developed towards the path of the realization of Industrie 4.0. Therefore, based on these two figures, the technology challenge and skill gaps were proven to be significant in Malaysia towards the implementation of Industrie 4.0. Whereas, skill and technology development are the opportunities in the implementation of Industrie 4.0.

Looking back at the current productivity in our country, the problem of the current productivity in Malaysia according to Hj. Shamsuddin, Executive Director of Malaysia Employers Federation, Malaysia's productivity growth is increasing but productivity level is low. This scenario happened because of high dependency on large number of highly unskilled labour. Besides that, poor level of technological advancement as well as inadequate Research and Development project and innovation also believed to be the culprit of declining productivity in Malaysia.

Increasing productivity might be easier than to maintain. Chief Executive Officer of SME Corp, Datuk Hafsah Hashim said that at the operation level, SMEs have to deal with the increasing costs of raw materials, overhead costs as well as cash flow restraints. Besides that, the lack of advancement in technology and skill mismatches accounted as one of the main causes of the problem of productivity growth in Malaysia (Prebeeden Kannan, 2016). The current state of Malaysian economy does not provide much guarantee to which it will able to maintain stable economic growth for foreign investment on the next few years. Reported recently in Malaysian Chinese News, dated 25th of October 2015, Penang may lose its prominent status of "Silicon Valley in the East" due to the bankruptcy and moving out of nine major plants in the state.

The labour productivity growth in Malaysia for 2015 is 3.3% which has increased from the previous year. This increment has contributed 5% in the economy growth. In the Eleventh Malaysia Plan (11MP), 3.7% annual growth is targeted to be achieved. Malaysia