



Faculty of Technology Management and Technopreneurship

**READINESS FACTORS FOR AMT IMPLEMENTATION IN
MANUFACTURING SMEs**

Hafini Suhana binti Ithnin

Master of Science in Technology Management

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SMEs**

HAFINI SUHANA BINTI ITHNIN

**A thesis submitted
in fulfillment of the requirements for the degree of Master of Science
in Technology Management**

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DECLARATION

I declare that this thesis entitled “Readiness Factors for AMT Implementation in Manufacturing SMEs” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : HAFINI SUHANA BINTI ITHNIN

Date :

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Technology Management.

Signature :

Supervisor Name : ASSOC. PROF. DR. JUHAINI BINTI JABAR

Date :

DEDICATION

I dedicate this thesis to my beloved father, mother and husband, Mr. Ithnin Bin Haron, Mdm. Ramaina Binti Ghani, Mr. Khairul Fahmi bin Abdul Aziz and also to my lovely family.

ABSTRACT

Malaysia has been independent more than five decades since 1957. Along that way many changes and improvement had been experienced by Malaysian government and citizen. Since 1980 Malaysia had a big changes from agricultural sectors to industrial sectors. This great changing is consistent with world economic development and towards high income countries. Many activities and programs were planned to accomplish the goals. One of them is improving the production part. Implementation of Advanced Manufacturing Technologies (AMT) is the best strategy to speedy the production activities. For the large and established companies, this phenomena is not a big deal but for small organization especially for Small and Medium Enterprise (SMEs) many aspects need to be considered. Implementing AMT requires higher cost, risk and complexity. Although AMT are well known for long term profits but further research need to be done so that implementation is not futile. In this research, the researcher examined the relationship of readiness factors with AMT implementation within manufacturing SME. Other than that is to recognize the most influencing factor of implementing AMT in manufacturing SMEs. This research modified two domain theories which are Theory of Technology Index (TRI) and TOE Framework that analysed three independent variables (Individual Dimensions, Organization and Technology). Quantitative method was used for data collection that developed a set of questionnaire from previous literature review. Total of 120 questionnaire were distributed to manufacturing SMEs in southern of Malaysia. Results indicates that only two constructs had contributed significantly to the relationship with AMT implementation, which were innovativeness and technology favourability. This shown that presenting of these factors encourage AMT to be implement. Moreover, from these eight readiness factors, technology favourability shows the strongest impact towards AMT implementation. It can be proven that people are more interested to implement with new technology when they realize the benefits and suitability with the existing technology. This research indicates several theoretical implication and make several insights for development of manufacturing SMEs in Malaysia. For the view of managerial, this research provide an applicable framework that useful for AMT implementing. Subsequently, practical implication able to examine whether the SMEs are ready to implement AMT or not. Hence, an important implication of this study to the academics, policy maker and manufacturing practitioners in Malaysia is by creating knowledge on readiness factors to amend with better standard of manufacturing SMEs in Malaysia.

ABSTRAK

Malaysia telah merdeka lebih lima dekad semenjak tahun 1957 lagi. Sepanjang jangka masa ini banyak perubahan dan penambahbaikan dialami oleh kerajaan dan warganegara Malaysia. Sejak tahun 1980 Malaysia telah mengalami perubahan yang besar dari sektor pertanian kepada sektor industri. Perubahan yang besar ini adalah selaras dengan perkembangan ekonomi dunia dan menjurus ke arah negara berpendapatan tinggi. Pelbagai aktiviti dan program dirancang untuk mencapai matlamat tersebut. Salah satunya ialah peningkatan dari segi teknologi pengeluaran di sektor industri. Pelaksanaan Teknologi Pembuatan Terkini (AMT) adalah strategi terbaik untuk meningkatkan aktiviti pengeluaran terutama syarikat yang besar dan kukuh. Walaubagaimana pun, bagi organisasi kecil terutamanya Perusahaan Kecil dan Sederhana (PKS) pelbagai aspek perlu dipertimbangkan. Pelaksanaan AMT memerlukan kos, risiko dan kerumitan yang lebih tinggi. Walaupun pelaksanaan AMT bermanfaat dan komitmen jangka masa panjang, kajian mendalam perlu dilakukan supaya pelaksanaannya kelak tidak sia-sia. Dalam kajian ini penyelidik meneroka faktor hubungan kesediaan untuk melaksanakan AMT bagi PKS dalam sektor pembuatan. Selain itu, kajian ini mengkaji faktor yang memberi kesan yang lebih kepada kesediaan AMT. Kajian ini mengubahsuaikan dua teori utama iaitu Teori Indeks Teknologi (TRI) dan Rangka Kerja TOE yang menganalisis tiga pembolehubah bebas (Individu Dimensi, Organisasi dan Teknologi). Kaedah kuantitatif digunakan untuk mengumpul data yang menggunakan set soal selidik daripada kajian terdahulu. Sebanyak 120 soal selidik telah dikumpulkan daripada PKS pembuatan di selatan Malaysia. Keputusan menunjukkan hanya dua faktor mempunyai hubungan dengan pelaksanaan AMT iaitu sikap inovasi dan teknologi yang bermanfaat. Ini menunjukkan kehadiran faktor-faktor ini membantu pelaksanaan AMT berlaku. Selain daripada itu, daripada lapan faktor kesediaan, teknologi yang bermanfaat mencatatkan keputusan yang paling tinggi kepada kesediaan melaksanakan AMT. Ini dapat dibuktikan bahawa PKS lebih berminat untuk melaksanakan AMT apabila mereka mengetahui kebaikan dan kesesuaian teknologi tersebut dengan teknologi sedia ada. Kajian ini juga menyatakan beberapa implikasi teori dan pandangan untuk perkembangan PKS dalam sektor pembuatan. Bagi pandangan pengurusan, kajian ini memberikan rangka kerja yang berguna kepada pelaksanaan AMT. Seterusnya, implikasi praktikal membolehkan PKS menilai kesediaan untuk melaksanakan AMT atau tidak. Oleh itu, implikasi utama untuk kajian ini kepada akademik, pembuat polisi dan pengamal pembuatan di Malaysia adalah menyediakan kefahaman terhadap faktor kesediaan untuk meminda piawaian pembuatan PKS yang lebih baik di Malaysia.

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LIST OF ABBREVIATIONS

SMEs	-	Small Medium Enterprise
AMT	-	Advanced Manufacturing Technology
TAM	-	Technology Acceptance Model
TRI	-	Theory of Readiness Index
TOE	-	Technology, Organization and Environment Theory
RF	-	Readiness Factors
TP	-	Top Management
OS	-	Organizational Structure
OR	-	Organizational Rules
RA	-	Relative Advantages
p	-	Significant value
Sig	-	Significant

LIST OF PUBLICATIONS

Journal Article

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Ithnin, H. S., Murad, M. A., Jabar, J., 2015. Conceptual Study of Readiness Factors for AMT Implementation in Manufacturing SMEs. In: *International Conference on Technology Management and Technopreneurship*. pp.22-28.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Small and Medium Enterprises (SMEs) are key players in the national economy since they contribute to economic growth as well as provide employment, maintain high productivity, increase exports as well as the nation's gross domestic profit (GDP). Moreover, the SME Annual Report 2016/17, reporting on the Asia-Pacific Economic Cooperation (APEC) Conference, stated that 97 percent of establishments that offered 50 percent of employment in the workforce comprised SMEs and its economic activities. In addition, Organization for Economic Co-operation and Development (OECD), in its report entitled 'Enhancing the Contribution of SMEs in a Global and Digitalised Economy', had stated that SMEs play a key role in national economies around the world by generating job opportunities, provide value added features and contribute towards innovation (SME Annual Report 2016/2017, 2017). Hence, a better access to global markets and knowledge networks would be able to strengthen SMEs' contributions.

The growth of SMEs driven by development businesses in the service sector followed by the manufacturing, construction, agriculture and mining and quarrying sectors. However, in 2016, the performance of manufacturing SMEs had decreased radically to about 1.2 percent, compared to 2015. According to Low et al., (2016), Malaysian SMEs in the manufacturing sector face challenges, such as the lack of guidance to help them produce high-quality products. The study also added that manufacturing SMEs also faced problems

that occur on a daily basis, such as defective products, lesser employees in the production line and failure to deliver products on time.

Hence, adoption of technology is one tool that could offer a competitive advantage and reduce challenges faced by manufacturing SMEs (Murad, 2016). Two primary functions in gaining competitiveness through the adoption of technology are: 1) assisting the business process related to products or services production while being cost effective, and 2) time saving via the development of efficient yields (Husain et al., 2002). Nowadays, technology change has become a mode of operation for the business community (Afzal et al., 2013). Singh and Khamba (2010) and Saberi et al., (2010) found that implementing the advanced manufacturing technology (AMT) is an alternative for companies to create competitive advantage by improving delivery time, satisfying customer demand and lowering cost of the workforce.

Advanced Manufacturing Technology (AMT) is an advanced technology that is very useful for production (Bourke and Roper, 2016). Producing products in bulk plus maintaining the standard and quality of the products require high machinery usage. Adopting AMT is synonym with manufacturing since it provides benefits to production, saves time and reduces energy. Moreover, AMT could be defined as technologies that are connected to applications, such as mechanical, electronic, and computer-based systems, to operate and control production (Koc and Bozdog, 2009; Bourke and Roper, 2016). Adopting AMT is one of the key strategies for long-term competitiveness and also an alternative for SMEs to be sustainable in the industry.

Adopting advanced technology might not be a big problem for large firms, however, for small and medium firms, it requires a deep understanding and much resources to be successful. In comparison to large companies, Chatzoglou et al. (2010) claimed that SMEs are entitled to be laggards in technology adoption because of their inability to cope with

technology changes that later become barriers to technology adoption. Furthermore, there are studies that indicate failure when implementing AMT, which had decreased the intention of other companies to follow suit (Koc and Bozdag, 2009). This happens because some implementations of AMT did not fully benefit the firms that adopted it (Small and Yasin, 1997; Garcia and A. Alvarado, 2013). The situation is critical for small and medium enterprises (SMEs), which is the focus in this research. Most of these companies have the intention and strive to adapt with AMT changes but lack certain information and resources that led them to abstain from the adoption. Implementing AMT requires a high-level of understanding and crystal clear information about organizational capabilities, accessibility to technology and availability of employees (Chan et al., 2015).

The main purpose of this study was to understand the readiness factors for implementing Advance Manufacturing Technology (AMT) in manufacturing SMEs in southern Malaysia, especially Johor, Negeri Sembilan and Melaka. An overview of SMEs in Malaysia according to different states indicated that 17.9 percent of 907,065 establishments were found in the southern region (SME Corp Malaysia, 2017). This shows that about 162,364 SMEs are located in this area and the study conducted in this area was relevant and able to explore with readiness factors.

Examining the readiness factors is one of the main areas of this research. Many of the previous studies focused on the barriers and obstacles faced by SMEs but not many examined the readiness factors. Some of the earlier studies had focused on readiness from different aspects of interest and subjects. For example, Summak et al., (2010) had identified technology readiness among primary school teachers, while Selvarajah et al. (2017) used e-learning readiness to examine entrepreneurship training among Bumiputera SMEs. Others like Martens et al., (2017), identified technology readiness with the acceptance model for mobile payments. However, this study found that not many studies were conducted for

assessing readiness factors for implementing AMT. Therefore, this created a new gap for this research.

Hence, examination of the readiness factors could serve as a guide for implementing AMT in the future. Thus, if there are no actions taken, the percentage of failure might still be high. In addition, the study of readiness is significant as observations could be made on businesses, especially the failure of SMEs to adopt AMT in their operations. This happens due to lack of finances, knowledge, skilled manpower, resources etc (Mannan, 2012; Chan et al. 2015).

Therefore, this study examined the readiness factors of manufacturing SMEs before the SMEs implemented AMT. From these results, future implementers, which refers to manufacturing SMEs, were able to receive beneficial knowledge on how individual dimensions, as well as organizational and technological factors could influence SMEs to adopt AMT and sustain the implementation.

1.2 Problem Statement

Small and Medium Enterprises (SMEs) have important roles to play in economic performance. It has been identified as a catalyst that helps national development, both in developed and developing countries. Some of them labelled SMEs as the backbone that provides huge opportunities in employment and new business start-ups (Rosnah Mohd Yusuff, Lo Woon Chek, 2005; Chan et al., 2015). In 2016, SMEs provided an employment growth of 2.1% compared to 2015 (3.2%) for a total of 6.7 million workers (SME Annual Report 2016/2017, 2017). SMEs in Malaysia continued their success in boosting the overall economy even though facing challenges in 2016. During that year, SMEs recorded 5.2 percent of Gross Domestic Product (GDP) resulting in 36.6 percent of SMEs contributing to the country's GDP (SME Annual Report 2016/2017, 2017). According to that report, the

performance percentage of SMEs declined from 6.1 percent in 2015 to 5.2 percent in 2016. This was due to the lack of improvements in process and products, automation, mechanisation, innovation and digitalisation including e-commerce activities to enhance productivity.

Furthermore, manufacturing SMEs are also one of the biggest sectors, after the service sector, to experience the same fate. According to the annual growth of SMEs' GDP based on key economic activities provided by the Department of Statistics for 2016, the performance of manufacturing SMEs slightly decreased by approximately 1.2 percent compared to 2015 (SME Annual Report 2016/2017, 2017). This was due to a high-level of competitiveness from big and established firms that have easy access to advanced technology and strong financial resources.

According to a web article in SciDev.Net (2016), comparatively, Singapore was 7th in innovation capability and technological development, while Malaysia was 32th. This article also discussed the five-stage topology of technology development that investigated four key factors (basic infrastructure, high technology infrastructure, network cohesion and global integration) and Malaysia was at the third stage, which is the catch-up stage. This shows that Malaysia is still struggling to improve technological development in order to be competitive with the other countries.

Malaysian SMEs are also facing a similar predicament in technology development. It is a long-standing problem to get SMEs to expand more than 90% of business registration when they only contribute 33% to the nation's GDP and to adopt technology to boost efficiency, productivity and competitiveness. It seems like a challenge for SMEs and even if they realize the potential return that technology offers, many of them lack resources, both financial and manpower to implement technology (Global Competitiveness Article 01/2016, 2016).

Based on the scenario where SMEs and factors lead to the failure in implementing technology, this study focused on the readiness factors to examine their preparedness for implementing technology. Implementation of Advanced Manufacturing Technology (AMT) was selected as the main interest in manufacturing SMEs in southern Malaysia. Therefore, ten readiness factors were revalidated from three main theories, namely the TRI, DOI and TOE, to examine the relationship and identify the most influencing factor that triggers AMT implementation. Furthermore, the result of this study would assist the government to enhance SMEs' contribution to the nation's growth through government programs and incentives.

1.3 Research Questions

This study was conducted to identify the readiness factors that influenced SMEs in the manufacturing sector to adopt AMT. The main research questions developed to identify the factors are:

1. What is the level of AMT readiness among manufacturing SMEs?
2. What is the relationship between readiness factors and AMT implementation in manufacturing SMEs?
3. What is the most influencing readiness factor that contributes to AMT implementation in manufacturing SMEs?

1.4 Research Objectives

With the concern of research background and problems, this study proposed two main objectives to be achieved, they are:

1. To analyse the level of AMT readiness among manufacturing SMEs.

2. To examine the relationship between readiness factors and AMT implementation in manufacturing SMEs.
3. To identify the most influencing factor in AMT implementation among manufacturing SMEs.

1.5 Significance of the Study

This study aimed to identify the level of AMT readiness among manufacturing SMEs and also examine the relationship between readiness factors and AMT implementation. Besides that, this study intended to examine the most influencing factor that triggers AMT implementation so that it can be used as a framework and provide guidance for manufacturing SMEs. At the same time, the SMEs are able to examine their ability and capability before deciding on implementing AMT. Furthermore, this study could assist both manufacturing SMEs and policy makers or the government to reconstruct the existing strategies or outline an appropriate plan to help SMEs in general and the manufacturing sector, specifically, to be better at AMT implementation and adoption.

Since SMEs are mostly struggling with limitations in the financial, knowledge and know-how aspects, many manufacturers keep focusing on improving their performance by enhancing the quality of products and the delivery system. These limitations impede the manufacturing SMEs from adopting advanced production technology for their business operations. Hence, this study aimed to examine the readiness factors in order to create intention and awareness among manufacturing SMEs. A combination of three major theories (TRI, DOI and TOE framework) was used to identify the level of readiness among manufacturing SMEs. Furthermore, this study also examined the relationship and identified the most influencing factor that triggers AMT implementation. With the presence of a new