

# Preliminary Qualitative Findings on Technology Adoption of Malaysian SMEs

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**Abstract**--Technology has been recognized as one of strategic resources for sustaining competitiveness among firms regardless of their sizes. Challenges in globalizations and strategic alliances are some of the issues underpinning technology adoption among SMEs. However, existing models on technology adoption have not provided sufficient insights on factors that could influence the successful adoption of technology among SMEs in Malaysia. In particular, uniqueness of SMEs characteristics, especially in terms of pervasive influence of SMEs' owner-managers, has not been considered. Therefore, this study aims to identify significant factors that could have pervasive influence on technology adoption among SMEs in Malaysia by integrating internal and external factors together with the SME unique characteristics. A preliminary study was conducted to propose the SME technology adoption model to validate the influence of external factors, internal factors and SMEs' owner-manager characteristics. This study employed multiple case study strategy as its research design and interviews as primary data collection method. Collected data were analyzed using thematic analyses to identify recurring factors across cases. The findings showed that notwithstanding of the technologies adopted by the firms, internal factors and SME's owner-managers characteristics have significant influence on technology adoption among SMEs.

## I. INTRODUCTION

Technology has been recognized as competitive resources and strategies to maintain organizational effectiveness. Organizational ability to adopt technology would render its competitiveness and sustainability in today's dynamic business environment. This is particularly relevant to small and medium enterprises (SMEs) as the use of technology would enable them to compete with their larger counterparts. Tidd and Bessant [1] further claimed that successful SMEs are those who innovate by adopting technologies that give them a market competitive edge. SMEs that innovate show growth and sustainable performance compared to those whose not [1]. Despite concerted efforts by the government to promote technology adoption among SMEs in Malaysia [2], there is not clear indicator of its success. For example, a study done in 1988 on technology adoption among SMEs found low level of technology adoption [3]. Similarly, recent studies on specific technologies such ICT, internet and e-commerce [4-6] also showed low adoption. Furthermore, in terms of R&D activities, SMEs are still lagging behind [7]. Different categorization of technologies across industries has set hurdles to researchers who would like to study technology adoption at macro a.k.a national level.

Since adoption of technology is complex processes which  
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are affected by multiple factors, identification of the factors that significantly affect technology adoption would provide insight on how to increase technology adoption among SMEs. This is a particularly significant issue since SMEs have been recognized as the economic impetus in both developed and developing countries [8-9]. Furthermore, limited studies on technology adoption among SMEs especially in the context of Malaysia have caused the chasm of knowledge on SMEs' technology adoption issues.

This paper is divided into five sections. Section (i) is the introduction-describing the overall overview of the importance of SMEs, section (ii) is on theories related to technology adoption and related works concerning technology adoption among SMEs, section (iii) is on the methodology, section (iv) is on discussions and section (v) is the conclusions.

## II. OVERVIEW ON TECHNOLOGY ADOPTION THEORIES

Adoption refers to the stage in which technology is selected for use by an individual or organization. Consequently, theories or models on technology adoption tend to cluster around individual and organizational levels. However, at the individual level, technology adoption is commonly referred to as technology acceptance.

Technology Acceptance Model (TAM) by Davis [10] is one of the most frequently cited, researched on and tested since it was introduced in 1986. Emerged from the Theory of Reasoned Action [11], this theory postulates that acceptance of technology by individuals would depend on the technology perceived usefulness (PU) and Perceived Ease of Use (PEOU). Venkatesh and Davis [12] had further revised TAM by excluding attitude towards use from the model as it is claimed not to fully mediate the relationship between PEOU and PU with intention to use [13]. Consequently, the revised TAM (without the attitude construct) has received substantial empirical support from various studies (for example [12-14]). In 2000, another version of TAM called TAM II was introduced. TAM II defined social influence and cognitive instruments as determinants of PU while anchor and adjustments are determinants of PEOU [15]. Venkatesh et al. [16] further introduced a modified version of TAM which is called Unified Theory of Acceptance and Use of Technology or UTAUT. This model suggested that performance expectancy, effort expectancy, social influence, and facilitating conditions are direct determinants of usage intention and behavior [16]. Gender, age, experience, and voluntariness of use are mediators between the relationship of four key constructs and usage intention and behavior [16].

TAM model have been used extensively in the field of information system, specifically with regard to IT adoption (for a comprehensive review, refer to Lee, et al. [17]). Proliferation of IT-based studies using TAM models have witnessed numerous attempts to enhance the model by adding antecedents (e.g. Qi et al. [18]), mediating (e.g. Wang and

Qualls [19]) and moderating (e.g. Featherman and Muller [20]) variables to improve the model's robustness. However, very limited studies have been done with regards to other types of technologies especially in forms of production or strategic technologies. In fact, a recent research agenda on technology adoption among SMEs in Malaysia proposed by a group of researchers in Malaysia also focuses on information technology [21].

Other than TAM, Theory of Planned Behavior (TPB) is another adapted version of TRA. TPB posits that individual behavior is driven by behavioral intentions. An individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior, and the individual's perception of the ease with which the behavior can be performed (behavioral control) are the direct determinants of the behavioral intentions. Unlike TAM, TPB has received less attention among researchers since TAM is claimed to be more robust and simple to use [22].

Both the original theories of TAM and TPB focused on behavioral aspects of technology adoption while Roger's Innovation Diffusion theory focuses on the process by which an innovation is communicated [23]. Rogers [23] classified individuals based on how quickly their adoption of innovation occurs. He depicted a bell-shaped distribution curve of innovation and potential for acceptance that shows innovator (2.5%), early (13.5%), early majority (34%), late majority (34%), and laggard (16%) adopters. Innovators are identified as appreciative of new ideas, and they are usually at the forefront. Early adopters are usually the first to adopt an innovation after the innovators. Early majority adopters are viewed as average persons within a system who adopt new ideas once the early adopters do so. Late majority adopters are skeptical and often adopt new ideas after the average person within an organization. Laggard adopters are the last to adopt innovation in a social system [23]. The diffusion of innovation theory states that adoption phases go through a gradual growth, followed by a dramatic growth, gradual stabilization, and—finally—decline.

A framework of innovation adoption by Tornatzky and Fleischer [24] departs from all the above theories by focusing on integration of three contexts which are technological contexts, organizational contexts and environmental contexts. The technology-organization-environment (TOE) framework postulates that these contexts influence the process which innovations are adopted and implemented in organizations. Although the framework is not enormously popular, it has received some empirical support (e.g. Chau and Tam [25]; Kuan and Chau [26])

A review of these theories indicates the presence of various factors affecting technology adoption. Some of the factors are more salient than others in terms of their recurrence in various models. However, much emphasis has been put on the individual technology adoption via TAM model and its derivatives. Although Roger's model and TOE framework provide a basis for organizational technology adoption theory, their usage might be limited to large

organization since unique characteristics of SMEs have not been accounted for in the models. As for TAM, although there is an effort to adapt the model for organizational analysis, the effort is quite fragmented in nature. This indicates a significant gap in terms of theory development of organizational technology adoption especially in context of SMEs.

#### *A. Determinants of Technology Adoption for SMEs*

The unique nature of small and medium enterprises (SMEs) has proved to be an importance consideration for any research interest. SMEs are significantly influenced by their owner-managers who play significant part in the establishment, development and advancement of the organization [27]. Therefore, any major decisions regarding technology adoption would reside on the SMEs' owner-managers. This contention is further supported by the work of Petroni and Rizzi [28] who claimed that technology adoption is based three stages of cognitive, affective and behavior. They claimed that at the cognitive stage, SMEs' owner-managers become aware of the technology and through analysis of benefits and feasibility, they develop feelings towards it. If the feeling is favorable, the firm will move to behavioral stage in terms of actual adoption of technology which is translated into organizational willingness [28]. Based on this premise, they postulated four constructs which are awareness, analysis of benefits, feasibility and organizational willingness. However, it should be recognized that the technology adoption at organizational level is a 'process' that intricately connected with various determinants. It is hypothesized that the success of any technology adoption will depend on various factors such as technology characteristics, organizational characteristics and external factors.

#### **SMEs' owner-managers' Characteristics**

Leaders play pivotal roles in primary adoption decision in organizations and in almost the whole spectrum of adoption process [29]. Their commitment, both in terms of resources and change in the adoption process is imperative [30]. Wu et al [31] asserted that leadership refers to not only the top leaders' inclination to adopt technology but also the ability to formulate, implement, and regulate technology strategy. A study in 1995 suggested two main classes of variables that are important in determining adoption of an innovation: individual characteristics and organizational characteristics [32]. Three CEO characteristics are studied which includes CEO innovativeness, CEO attitude towards adoption of IT, and CEO IT knowledge. Three organizational characteristics studied are business size, competitiveness of environment, and information intensity. The results suggest CEO characteristics are important factors affecting IT adoption in small businesses regardless of their sizes. Small businesses are more likely to adopt IT when the CEOs are more innovative, have a positive attitude towards adoption of IT, and possess greater IT knowledge. A study by Hashim [4]

found that the characteristics of SMEs owners are significant predictor of SMEs' technology adoption through a survey of 383 SMEs. The ICT adoption among SMEs' owners is not only lower than expected but the ICT skills possessed by the SME owners are poor, and their use of ICT is slow and late. This finding indicates that SMEs owners' characteristics have significant influence on the ICT adoption. This might be contributed to the fact in SMEs' the owner dictates the direction of the firm. SMEs owners that have poor ICT skills might not so incline to adopt ICT and thus perceived IT adoption as difficult.

### **Organizational Characteristics**

Managers make decision to adopt technology within an organizational context [33]. Successful adoption occurs when organizational infrastructures and resources are directed towards sustaining the adoption effort. According to Khalil [34], technology strategy, organization structure, technology culture and people are among assessment areas critical to successful technology adoption. Tarafdar and Vaidya [35] substantiate Khalil's contention and found that organizational culture and structure significantly affect adoption of e-commerce technologies in India. Kuan and Chau [26] found both perceived financial cost and perceived technical competences significantly differentiate adopters and non adopters of electronic data interchange (EDI). Wang and Qualls [19] proposed organizational technology climate which include level of technocratization, management support and technology budget as imperative in technology adoption of hospitality-related technologies.

### **External factors**

It is found that a firm's ability to efficiently adopt high technology involves an assessment of internal factors such as strategy and human organization and external factors like government support and relationships [34]. Moreover, it is argued that as the sophistication of technology increases, the need for such external support increases. Several studies have reported that the external environment have an effect on the intention to adopt [36-37]. They mainly argue that when a company is facing keen market competition, adoption of technology is imperative to maintain or enhance its competitiveness. Furthermore, small businesses are usually characterized by a high level of environmental uncertainty, which necessitate scrutinizing of external factors. Khalil [34] claimed that competitors and markets are important assessment areas for technology positioning. Gradon and Pearson [38] found that external pressure which includes competition, social factors, and dependency of other firms using e-commerce, industry and government as significant determinant of e-commerce adoption. Similarly, Tung and Reick [39] examined 128 companies in Singapore and found that external pressure and social influence are significantly related to the adoption of e-government services. Zhang and Dhaliwal [40] focused on effect of partner dependence and competition intensity on adoption of supply chain

management technology. Consistent with previous studies, they found that significant effect of external factors. However, contrary to above studies, Nikas et al [41] found external competitive pressures in forms of partner's adoption of collaborative systems and the improvement of company's responsiveness to their customers as insignificant.

Review of all the various literatures indicates a wide spectrum of determinants for technology adoptions. Thus, it is necessary to delineate factors that have the most significant effects especially in the context of SMEs. As this paper aimed to identify common, but most significant determinants of technology adoption across industries, further exploration is warranted.

## **III. METHODOLOGY**

Multiple case study design was used to explore the factors that would significantly influence technology adoption among SMEs. This research strategy was advocated due to the exploratory nature of this study [42]. Furthermore, this study would like to capture the 'rich' and 'full' accounts of technology adoption determinants of sampled cases so that the dynamic interaction among them could be further investigated and understood. These two cases were selected using purposive sampling. Purposive sampling was used to identify the sample of persons with known or demonstrable experience and expertise in the area, which in this study, the SMEs' owner-managers. A principle selection criterion for cases is SMEs' owner-managers who use technology for production of their products or services. Technology in the context of this study refers to 'all knowledge, products, processes, tools, methods and system employed in the creation of goods or in providing services' [34]. Thus, no specific technology is focused on as the main purpose of this study is to identify common determinants of technology adoption across industries and technologies used. Primary data collection method was through interviews. Interview durations varied, with a mean of 90 minutes per interview with Bahasa Malaysia as the main language used. Secondary data in forms of company profiles were accessed through the company websites. The interview data were transcribed and later on subjected to data analysis following Miles and Huberman's suggestion which are (i) data reduction, (ii) data display and (iii) draw conclusions.

At data reduction stage, data were categorized into three major themes as per literature reviews which are;

- a) SMEs' owner-managers' Characteristics
- b) Organizational Characteristics
- c) External factors

The data were later tabulated to assist and enable understanding and conclusion.

## **IV. FINDINGS**

### *A. General Information*

The major findings of this study are based on the qualitative evidence gathered in the context of Malaysian SMEs. Thus, generalization of the findings might be limited. In essence, both participating companies used two different technologies for their business. Company A was established in August 1992 as major trader of high technology valves for the oil and gas industry. However, in year 2005, it expanded its operation to include designing, fabrication and supplying various types and sizes of cabin. Company A employs about 120 staff that has extensive engineering know-how, expertise and experience both in high technology valves and cabin construction. On the other hand, Company B was involved in the manufacturing and commercialization of advanced material product based on calcium phosphate hydroxyapatite, and just started its operation in 2007. Due to the nature of its business, it employs only 17 employees with specialized training in the said technology.

## *B. SMEs' owner-managers' Characteristics*

### *1. Age, Qualifications and Experience*

Both the owner-manager of Company A and B held a college degree, with Degree in Electrical Engineering and Degree in Psychology respectively. Owner of Company A was 37 years old Malay male with vast experience working in multinational companies particularly in oil and gas industries. He is an active managing director of the company who was in charged for overall business activities ranging from operation to sales and marketing. Owner of company A was passionate and visionary in terms of future direction of his business. He was a risk taker judging from his decision to invest in technology not commonly used by his competitors in the industry.

Company B's owner is 36 years old. He started his career as a Research Officer in one of a research institute in Penang. Then he became a consultant for Leadership and Development Studies in Selangor. Later, he was the Managing Director in Property Development Housing. He was also a Director of Multi level marketing Company before he joined a Telecommunication business in 2005 as a Marketing Chief Officer. In 2007, he took a significant step in his career advancement whereby, he opened up his own business through licensing in producing a medical device for synthetic bone graft material.

### *2. Technology Know-how*

Company A was involved throughout the technology assessment, selection and acquisition process and were the primary decision maker in final technology adoption process. Their decision on which technology to adopt was significantly influenced by their experience, knowledge and exposure. Benefits of the technology were key selection criteria, especially in terms of long term business sustainability.

Owner of Company A viewed technology as one of the significant contributors to the business strategies. For example, since the engineering simulation software used by

the company could produce accurate 3D simulation of the cabin design required by the customer along with the specification details, the company would be able to secure tender from high end market. This in turn, would stimulate company's growth and profit. According to the owner, the sales had increased about 30% since the use of the technology.

Company B acquired the technology from its licensor research institution. Company B was unique as it is a R&D originated company. The R&D was conducted in a research institution in Malaysia. After that, a prototype was developed and the potential of this technology is envisioned. The owner was convinced of the potential technology and finally decided to start-up the company.

### *C. Organizational Characteristics*

Since the size of both companies was small, the organizational structure remains organic with a few cross functional teams. As for Company A, there were two main operation divisions; valves and cabin. Under these two divisions, there were design, engineering and construction teams that support both divisions. Meanwhile, Company B, it is divided by its functions. All staff in Company A used technology in forms of software in their works. For example, the administrative, purchasing and account departments in Company A, use Quick Book to manage inventory, order and payment while the production staff used Xsteel. Trainings were given to all relevant staff once the technologies were adopted. Although the owner did mention about some difficulties among staffs to accept the technologies, it has not hamper their usage as their core works revolved around them. Furthermore, Company A had developed work system and flow chart to assist assimilation of technology in their work process. According to owner of Company A, the duration of design work was reduced by more than 50% with the use of the software. Sufficient training and skilled staffs had also speed up the adjustment period. The culture of Company A seemed to be dictated by the owner especially in terms of 'green technology' mindset. For example, staffs need to promote the use of green materials for cabins to clients although the clients might not require it. Quality was seen as a strategy competitive advantage and Company A was in the process of being accredited for ISO 9000.

Employees' benefits and welfare seemed to be considered as the company's most important asset. Company A provides not competitive salary and bonus but other fringe benefits. Despite high expectations by the owner, and the demanding jobs given, the employee turnover was low.

For Company B, there are three important functions which are regulatory, quality assurance and production. In company B, there are few competencies that have been nurtured and developed among its staff. It emphasize on the enhancing of negotiation skills especially in the regulatory unit, technology transfer knowledge and technology utilization among the staff of quality assurance and production unit. Most of the staff is fresh graduates from overseas in various disciplines

such as mechanical engineering and law. As a result, the company operates with a highly motivated staff as they are young and intellectual. The Company has a strong teamwork especially in building its reputation as the only producer in synthetic bone graft in Malaysia. The staff benefits and welfare are important to the company. It offers competitive salary and bonus to its staff and a conducive working environment.

#### D. External Factors

Although Company A was not reliant on the financial assistance provided by the government, it utilizes the exclusive licensing that was granted only to the Bumiputera\*. Customer's requirements and market demand remain main drivers for technology adoption. For example, Company A adopt the engineering simulation software to meet the stringent requirement of oil and gas industry. Company A remains a leading supplier of specialized cabin in the market due to its manufacturing capabilities and 'green technology' – based products.

Company B, is highly reliant on the financial assistance, training and skills development by the government agencies.

The main challenge facing by this Company is on the bureaucracy of the government agencies. Company B, has a very good networking with its suppliers and customers. The company uses the *one-to-one* interactions with its customers and trying to get certification from an international body as a marketing strategy to penetrate more potential customers.

### V. DISCUSSIONS AND CONCLUSIONS

In both cases, the characteristics of the owner-managers are major driver of SMEs' technology adoption in Malaysia. These include the knowledge and qualification of the owner manager, commitment, passionate, leadership style, technology know-how, awareness of the technology which was resulted from the exposure and openness to learn of the owner-managers. The result strongly indicates that the owner-manager is the 'drive' of survival of the respective companies. The result is consistent with Chibelushi [43], Thorpe et.al., [44], Qirim [45] and Gray [46] Apparently the intangible aspects such as the owner-managers' value is more essential when we discuss on the influencing factors of the owner-managers of SMEs in technology adoption.

Another interesting finding of this study is that technology alone is not enough for enhancing effectiveness and efficiency of a company. It needs to be supported with other resources such as staff competencies. Technology needs to be integrated with other business functions as suggested by Khalil [34]. The findings also indicated the importance of training needs analysis (TNA) in identifying the suitable trainings for their staff.

The culture and teamwork are another two important influencing factors as the technology-based companies operates in collective strengths of their resources and not only reliant on the owners competencies. However, the two

companies are quite contradicting in terms of receiving financial and other assistance from the government agencies. The findings concluded that there is significant difference between a market-driven company and R&D-driven company.

In essence, the value of these qualitative preliminary findings lie on the variability of SMEs sampled and the technologies being used. Despite various factors previously identified as influencing technology adoption, this study alienated only key factors recurring in both cases as shown in Table 2.0.

**TABLE 2.0: INFLUENCING FACTORS OF TECHNOLOGY ADOPTION**

Characteristics	
SMEs' owner-managers' Characteristics	
	Knowledge
	Skills
	Qualification
	Commitment
	Passionate
	Leadership style
	Technology know-how
	Awareness
Organizational Characteristics	
	Teamwork
	Staff competencies
	Culture
External Factors	
	Networking
	Government Support

Future work will focus on expanding factors identified in the preliminary study to provide a resource to academics and managers in industry. Research is planned to explore further the theoretical and practical aspects of influencing factors of technology adoption among SMEs in Malaysia to improve comprehension and understanding.

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