



**CEO CHARACTERISTICS AND THEIR EFFECT TOWARDS ADVANCED
MANUFACTURING TECHNOLOGY ADOPTION IN MALAYSIAN SMALL
AND MEDIUM SCALE MANUFACTURING INDUSTRIES**

by

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ABSTRAK

Keazaman kerajaan untuk menjadikan Malaysia sebuah negara maju mendorong kepada usaha-usaha memajukan industri kecil dan sederhana dari segi keupayaan teknologi. Secara kasarnya, industri kecil dan sederhana agak terkebelakang dalam memodenkan teknik pengilangan mereka. Oleh demikian, kajian dibuat terhadap sifat-sifat pengarah urusan yang selalunya mempunyai kuasa mutlak terhadap keputusan dan perjalanan syarikat dibawah kawalannya. Kajian adalah untuk memastikan sejauh mana kecenderungan pengarah urusan terhadap inovasi memberi kesan terhadap penggunaan teknologi pengilangan moden di syarikat mereka. Sifat bertolak-ansur, tidak mudah mengalah dan kebolehan menghadapi risiko juga dikaji pengaruhnya terhadap penerimaan teknologi tersebut.

Hasil kajian menunjukkan kecenderungan terhadap inovasi membawa kesan positif terhadap penerimaan teknologi pengilangan moden. Namun begitu, sifat tolak-ansur, tidak mudah mengalah dan kebolehan menghadapi risiko didapati tidak memberi kesan terhadap penggunaan teknologi tersebut. Begitu juga dengan faktor persekitaran yang liar, persekitaran yang berubah-ubah dan kebolehan syarikat menerima perubahan didapati tidak memberi kesan terhadap penerimaan teknologi pengilangan moden.

ABSTRACT

Government effort to bring Malaysia to a developed nation status results in an emphasis on the modernization of small and medium scale manufacturing industries. Generally, SMIs are lagging behind in terms of embracing the latest manufacturing technology. CEOs of small and medium scale manufacturing industry maintain a near total control on the decision making and the operations of the firms. This research attempts to investigate the characteristics of CEOs' innovation mindset, flexibility, perseverance and risk taking propensity on the extent of adoption of advanced manufacturing technology, AMT.

The result shows that CEOs with innovation mindset are more likely to adopt AMT. The finding could not substantiate the effect of CEOs' flexibility, perseverance and risk taking propensity of the adoption level. Furthermore, the moderating effects of environmental hostility, environmental dynamism and the firms' absorptive capacity do not play a significant role.

Chapter 1

INTRODUCTION

1.1 Problem Statement

The launching of the Second Industrial Master Plan, IMP2, 1996-2005, marked the beginning of a new industrial era for Malaysia. Under IMP2, Malaysia's industrialization will continue to be private sector and market driven with a strategic shift to knowledge based, technology intensive and high – tech industries (Malaysia Small and Medium Industry Directory, 1996). The private sector, particularly the manufacturing sector, is entrusted to lead and contribute towards the development of the Malaysian economy. Small and Medium scale Industries (SMIs) has been determined as one of the sub-sectors critical to the achievement of the above objective

Against the backgrounds however, there emerges a strong concern for the state of the SMIs that stemmed from their inability and slowness to keep up with the advancement in manufacturing process (Rahman, 1993). The slowness in adopting Advanced Manufacturing Technology, AMT, warranted a further study.

As noted in several researches (Kitchell, 1997; Charlie, et. al., 1990), SMIs are tightly controlled by their CEOs. These CEOs are usually the entrepreneur who founded the company and they seldom relinquish their total decision making power on the organizations. This is in contrast to the larger firms where the decision making power are distributed among the top management and the stakeholders (Noori, 1987). Furthermore, upper echelon theory proposes that the top management characteristics determine the organizational outcomes (Kitchell, 1997). This makes it important to investigate whether the CEO characteristics, particularly with regards to their

inclination towards innovations, explain the difference in the rate of AMT adoption in Small and Medium Scale Industries.

1.2 Research Questions

There have been several researches done especially in the areas of CEO leadership and its effect on the organization innovativeness (Daellenbach et. al., 1999; Lefebvre et. al., 1997; Kitchel, 1997). This research is a continuation upon those researches and concentrates more in the adoption of advanced manufacturing technology and focuses on Malaysian Small and Medium Scale Manufacturing Industries. The aim of this research is to investigate the specific traits of CEOs and the effect of these traits on the receptiveness of the organizations towards AMT adoption.

Specifically, the research attempts to answer the following questions:

1. Does CEO innovative mindset influence the firms' AMT adoption?
2. Does CEO psychographics (risk taking ability, perseverance and flexibility) influence the firms' AMT adoption?
3. Does the firms' internal and external environment have any effect in promoting or discouraging CEOs to adopt AMT?

1.3 Significance of the Study

Since SMIs are lagging behind larger firms in terms of AMT adoption (SMIs: Small and Medium Size Industries, 1994), in order to help them to catch up, the relevant government agencies such as Small and Medium Industries Development Corporation, SMIDEC and Malaysian Industrial Development Authority, MIDA need to identify factors contributing to the effect. Once the factors are identified, steps can

be taken to maximize the positive factors and minimize the effects of the negative ones. For example, if it is shown that fluctuating demands for their products hinder CEOs from making commitment to AMT, then the relevant authorities can work toward improving the situations. Actions can be taken to reduce this environmental uncertainty so that the CEOs are more comfortable in making their investment decisions.

1.4 Definition of Concepts

While most of the terms and concepts used in the research follow typical meanings associated with them, several of them need further explanation to avoid ambiguity.

1.4.1 CEO Characteristics

The CEO management characteristics under consideration here is his flexibility, perseverance and risk-taking attitude. This is collectively known as psychographics (Kitchell, 1997). They are vital to the makeup of the CEOs especially when it comes to the area of pushing and persuading the organization into embracing the new manufacturing technologies.

It should be noted here that CEOs are assumed to be the most influential persons in the companies. They have the final decision making power. In Malaysia, CEOs are more generally known as Managing Director or General Manager.

1.4.1.1 Innovation mindset

CEOs with innovation mindset not only very receptive towards new technology but also view things differently. They view investment in R&D and in new technologies

as vital to future growth and competitiveness of the organizations. On the other hand, CEOs who lacked innovation mindset, tend to regard the importance of R&D activities has been overblown. They are likely to see it as a necessary cost center that impacts company's bottom line while giving little tangible benefit (Kuczmarski, 1996). They also view investment on new technology as nothing more than a way to get new products to market faster and to take less time to do more projects.

CEOs with high innovation mindset level, believe that innovation plays significant role in accelerating company net values, supporting the business strategy and increasing satisfactions to shareholders and employees (Kuczmarski, 1996). Innovation, to them, offers higher rate of returns and quality products that satisfy customers' needs.

1.4.1.2 Flexibility

Flexibility refers to the characteristic where one can change his stand on the basis of new needs or changing conditions. A flexible CEO is adaptable and receptive to good arguments by people surrounding them (Kitchell, 1997). He is less likely to feel intimidated and resent good suggestions and comments.

1.4.1.3 Perseverance

In the typical use of the word, perseverance can be associated with opposing change, not receptive to ideas from others and generally not flexible. However, this is not the meaning intended in this research. Here, perseverance refers to the ability to continue doing the hard work for an extended period, to endure difficulty and to find a work-

around when facing a barrier. A CEO with high perseverance level keeps on working in achieving his goals despite repeated failures (Kitchell, 1997).

1.4.1.4 Risk-taking propensity

When a CEO has a high risk-taking propensity, he is able to tolerate more failures and setbacks. He is more willing to invest in projects that do not guarantee success and able to turn the threat of failure into a positive factor that keeps him continue doing the task at hand.

1.4.2 Environmental Factors

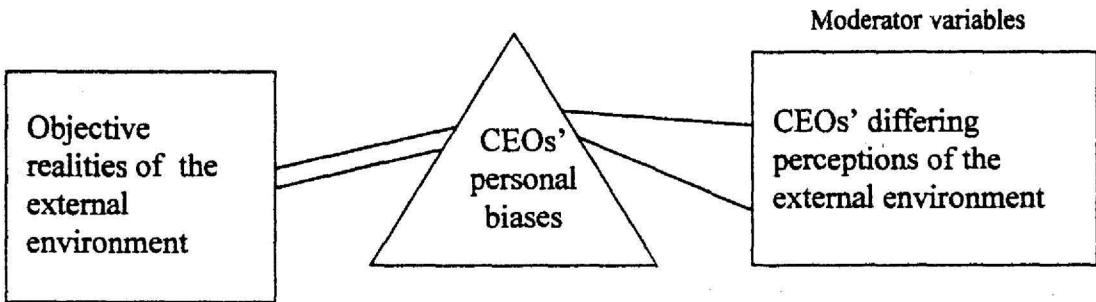
CEOs work in a firm that has both internal and external environment. This environment keeps changing necessitating these CEOs to constantly vigilant. The changing environmental factors have been found to be a critical element in determining the impacts of different competitive and technology strategies (Spital, 1992).

CEOs however, with their own personal preferences and biases, cannot be completely objective when interpreting and responding to the changes. These biases alter their perception and course of action. This is analogous to a prism skewing and scattering lights. The objective realities of the environment are filtered and colored to their preferences, knowledge and perception (Lefebvre, et. al., 1997).

The prism effect creates a differing perception from a common external environment. These perceptions have a moderating effect on the relationships between the CEOs characters and the realized innovative efforts (Lefebvre, et. al., 1997). The selective

processing of information as a result of personal choice and the limited information available to them, make their choice of action taken to differ (Hambrick and Mason 1984).

Figure 1.1 : Prism effects (Source: Lefebvre, et. al., 1997)



1.4.2.1 Environmental hostility

A firm operating in a hostile environment faces the threat of harsh price competition, depleting markets, scarcity of qualified labors, difficulty accessing raw material and government intervention (Daellenbach, et. al., 1999; Spital 1992). While environment is inherently hostile to all manufacturing firms, SMIs with their limited resources and expertise tend to feel it at a greater extent (Noori, 1987).

1.4.2.2 Environmental dynamism

Environmental dynamism is a variable reflecting the perceived degree of unpredictability and the rate of change of the external environment. Firms operating in more dynamic environment tend to have higher innovation effort, especially in terms of R & D spending (Spital, 1992). The investment in innovation effort provides a room to maneuver in the environment.

1.4.2.3 Firms' absorptive capacity

For this research, firms' absorptive capacity refers to the ability of the firm to embrace advanced manufacturing technology. A firm with absorptive capacity has sufficient funding, experience, the right people and the receptive organization structure and culture. The firm will have the ability to adopt new technology without adversely affecting the on-going production processes (Thong, 1999).

1.4.3 Advanced Manufacturing Technology

AMT is a new and better way of doing things. It helps shape and accomplish the strategic and operational objectives of organizations. AMT helps in achieving these objectives by enabling the company to produce maximum output with quality and within time, every time; while keeping the operating cost to a minimum.

There are four (4) categories where AMT change can occur (Lefbvre, et. al., 1997):

- a. The unit production process within the manufacturing system

Example: use of Automated Production Line, use of new modern machines such as CNC, pick and place robots, automated SMT machines), Computer Aided Manufacturing, CAM

- b. The system used in the manufacturing process

Example: Flexible manufacturing system, cluster-based manufacturing

- c. The supporting processes (procurement, storage, handling, delivery, R&D)

Example: MRP II, JIT, automated storage and retrieval system, Computer Aided Design, CAD, TQM

- d. The communication, control and data (information) movement

Example: E-mails, Networked Computers (LAN) and analysis software

1.4.4 Small and Medium Scale Manufacturing industries

The classification of manufacturing companies under the category of SMI varies from one study to the others. Some define it purely on size (ranging from less than 50 employees up to 500 employees) while others on annual sales (Ismail and Jantan, 1998). As for this research, SMIs are defined as companies with employees of not more than 250 staffs. This selection follows Kagen, et. al., (1990) where no attempt is made to include classification based on monetary value. This is done to encourage responses since privately owned companies are often reluctant to disclose their monetary figures (Montazemi, 1988).

This study attempts to survey only the following sectors: automotive, building material, computer and electronics, industrial and engineering, appliances and consumer, stationery and packaging and finally furniture and furniture related products. This choice is made with the assumption that these sectors are quite well mixed. People working within these sectors frequently interact, use or supply their products to one another. They tend to have similar factors affecting their operations.

One distinguishing feature of these manufacturing industries is the repetitive nature of their operation, normally indicated by the existence of assembly line. Therefore, made to order (custom-made products) type operations such as elevators, ships, fire engines and other specialized equipment, do not fall in the scope of this research. They are not produced in large quantities. Similarly, process industry where products like plastic resins, chemicals and iron ingots that are produced continuously (vs. repetitive) also will not be included.

The industries to be studied are those located within or near the government gazette industrial zones in Peninsular Malaysia. While this cover the whole Peninsular Malaysia including Kelantan, Terengganu and Pahang, majority of the respondents came from the western part of Peninsular Malaysia since most of the manufacturing companies are located around this area.

Chapter 2

LITERATURE REVIEW

1.1 Introduction

The need to be aware of and to adopt innovation is inevitable to manufacturing companies. It is one of the important factors in the competitive environment. Investing in innovation activities is a source of sustainable competitive advantage (Porter, 1985). Hayes and Abernathy (1980) and Porter (1990) argue that firms risk losing their competitive advantage due to a lack of commitment to investing in research and development. The decision to adopt innovation changes such as AMT is important for the competitiveness and the survival of the company (Price, 1996; Betz, 1994).

Therefore, organizations must innovate constantly and with courage. Organizational leaders must provide the context that nurtures and acknowledge such innovation at every level. The leadership of CEO is important to encourage and to provide a climate of constant innovation changes into the organization (Daellenbach, et. al., 1999).

According to Noori (1987), AMT is viewed as the strategic and tactical decision for the companies. Strategic decisions are broad in scope, with long time horizons and generally guided by the firms' mission. There are naturally several inherent differences in the benefits of AMT adoption between large companies and SMIs. The differences basically stem from the size and resource differential which exists between them. Table 2.1 on the next page lists some of the major issues of SMIs / Large firms in adopting AMT (Noori, 1987).

Table 2.1: Advantages and disadvantages of AMT Adoption for SMIs and large firms

	Small and Medium sized Firms	Large Firms
Advantages	<p>Greater risks promotes greater commitment to solve any problems</p> <p>Easier to implement in smaller environment</p> <p>New technology allows competition with larger firm</p>	<p>Less risks financially</p> <p>Greater resources to access the AMT</p> <p>More skilled labor</p> <p>Less sensitive to business cycles</p>
Disadvantages	<p>Little specialization of skills (lack of knowledge and time)</p> <p>Financial risks</p> <p>Lack of skilled labor</p> <p>Forced to adopt by large customer</p>	<p>Union resistance and workers attitude</p> <p>Bureaucracy</p> <p>Coordination among various departments</p>

2.2 CEOs' Influence on Innovative Activities

Kitchell (1997) studied the CEO characteristics and technological innovativeness for Canadian manufacturing firms. She found that there is a highly significant relevance of CEO characteristics and personal demographics to corporate innovativeness among small-sized firms. The result supported upper echelon theory that states that top management characteristics can be used to predict organizational outcomes.

In another similar study, but this time on the Top Management Team (TMT), Daellenbach et al. (1999) found that there is a positive relationship between the technical orientation of the TMT and the above-average R&D intensity. They have tested their conclusion and found that it remains valid even after the impact of performance in prior periods and firms diversification has been taken into account.

The CEOs openness to innovation tends to dominate the TMT characteristics towards innovation. This possibly due to loyalty and control the CEO has over the TMT that diminishes their consideration of alternative viewpoints and reduces comprehensiveness in strategic decision-making (Daellenbach et. al., 1999).

In terms of experience, Hayes and Abernathy (1980) noted that the longer the careers in a particular company or industry, the more enhanced a manager's knowledge of the technological trends in the industry. This will also make the manager more open to investments in innovation activities. On the other hand, Hambrick and Mason (1984) suggest that executives who have spent their entire careers primarily in one organization are more likely to focus on current products and markets rather than exploring new and different terrains. They tend to innovate only in their given area of expertise and unwilling to exploit a different area.

In his theory of innovativeness, Kirton (1976) mentions that everyone is located on a continuum ranging from an ability to do things better to an ability to do things differently. He calls the two extreme ends as adapters and innovators. In the case of a small business, the adapter CEO would seek solutions that have already been tried and understood. The innovator CEO would prefer solutions that change the structure in which the problem has not been tried out and are therefore risky.

2.3 Environmental Influence on Firms Innovation

In their study, Lefebvre, et al, (1997) found that for small manufacturing enterprises that share common economic and industrial environment, CEO's perceptions of external environment are key significant issues with respect to technology policy

formulation and enactment. They found that objective measures such educational background, experience with industry and age did not play an important role in the formulation and adoption. The findings of their study show:

- Structural characteristics and scanning mechanisms are less important determinants of technology policy than the strategic orientation of the enterprise.
- Perceived environmental hostility plays a more important moderating role on the relationship between technology policy and its determinants than perceived environmental dynamism.
- Hostility and dynamism are shown to have specific and differing moderating effects on the form and strength of the relationship between technology policy and some of its determinants
- Hostility and dynamism also play moderating roles, mostly with respect to the form of the relationships between technology and realized innovative efforts.
- A more aggressive technology policy leads to greater realized innovative efforts, which in turn are positively related to export performance and to lesser extent, financial performance.

Based on their study, they conclude that misread and / or misinterpreted environment will result in inadequate technology policy. This in turn will probably translate into sub-optimal allocation of resources, which could be detrimental to the overall performance or survival of a firm.

Daellenbach et. al., (1997) research indicates that differing environmental factor inherent in two type of manufacturing industries (primary metal industry – stable demands with lower technological uncertainty vs. semiconductor industry – high

growth and uncertain future) results in differing level of innovation. The semiconductor industry spends on average 11.4% of their profit into R & D whereas primary metals spends only 1.0% for the same purpose.

Spital (1992) argued that environmental dynamism (caused by rapid changes in product and process technology) results in differing competitive and technology strategies. In the environment characterized by high product technology dynamism, the firms tend to have high level of investment in R&D, deep technical competence and follow strategy of product innovation. In the environment characterized by low product technology dynamism, the organizations have lower level of investment in R&D, breadth of knowledge of product technology (as opposed to deep product technology know-how) and follow strategy of product differentiation.

Organizational factor, specifically, the diversification into other business areas, has significant effect on the level of R&D activity. Those who remain at their core business are more receptive to R&D while those who diversify tend to rely less on R&D (Daellenbach, et. al., 1999)

2.4 Malaysian-based AMT Studies

Ismail and Jantan (1988), concentrates on the overall factors affecting the decision to adopt AMT. Their exploratory study shows that the successful adoption and implementation of AMT depends on inter-related three broad factors.

1. The identification of the needs to adopt (motivational factors).
2. The adoption process (enabling factors)
3. The post adoption benefit (realization factors)

Sim (1993) studies the advantages and difficulties of being the first to adopt manufacturing innovations. His survey of 260 manufacturing companies shows only 27% have adopted the new manufacturing system, namely Just in Time (JIT), and Manufacturing Resource Planning (MRP II). The survey indicates the factors that are considered important when adopting JIT are reduced costs, improved inventory control, improved quality of products and processes. For MRP II, the factors are integration of all functional areas with production, improved quality control and increased productivity. A large majority (88%) of the companies had a clear idea of what the benefit and costs of MRP II before they adopted the technique.

As for the timing of the adoption, the main reasons cited are the awareness of the productivity gains, the influence of international competitors, desire to be ahead of competitors, availability of the necessary skills and to keep up with the competitors. The main reason for delaying the adoption are the internal problems (such as resistance to change, restructuring and so on), lack of precise knowledge on the new system and other project had greater priority. Other companies cite the reason for late adoption due to waiting until other requirement (such as computer facilities, TQC) is in place. The lack of internal acceptance and commitment, external pressures and the inherent intangibility of the benefits of JIT, MRP II seems to be key deterrent to adoptions.

Idris (1996) on the other hand studies the experience of manufacturing companies that are either ISO 9000 certified or have Total Quality Management systems. Some of the highlights of their findings are listed next page:

1. The major reason for ISO certification is to improve performance, as part of TQM, demand from customers and competitive pressure.
2. The adoption of TQM provides the benefits of improved customer satisfaction, teamwork, productivity, communication and efficiency.
3. The difficulties faced during the implementation and certification are lack of leadership commitment, uncooperativeness, lack of understanding and the motivation to keep it going.

Mohamed (1993) investigates the innovation and creativity of large manufacturing firms. His research shows that the more innovative firms introduced changes to the way they operate incrementally. They also adopt more technological innovations, organized more programs and campaigns with the aim of stimulating creativity and innovations. These more innovative companies also tends to interact more with their external environment.

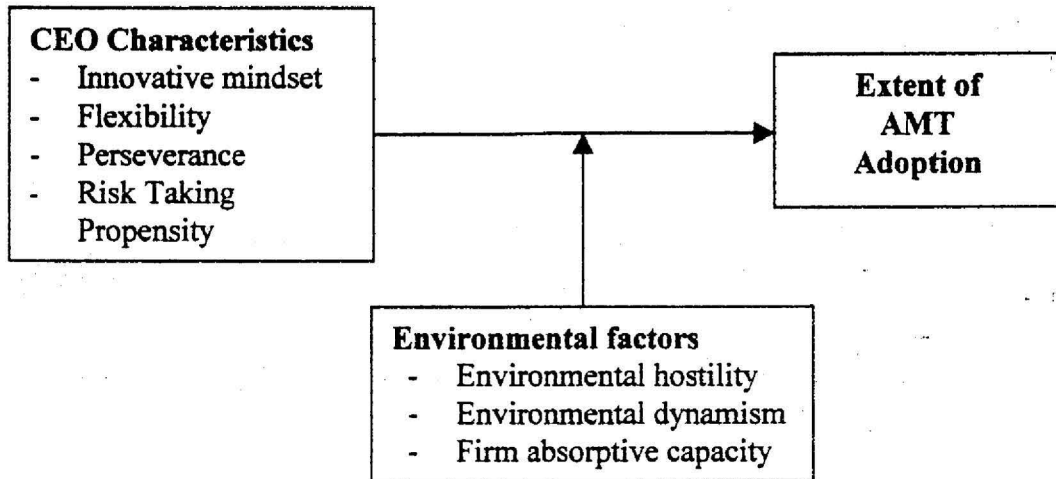
2.5 Theoretical Framework

Based on the literature review above, there are several variables that influence the firms' AMT adoption decision. The relationship among those variables is shown in the schematic diagram shown next page: (Figure 2.1)

The choice of psychographics variables consisting of flexibility, perseverance and risk-taking propensity is similar to that of Kitchell (1997). She , however, included the demographics variables (age, education, working experience and tenure) as another predictor variables. These variables are not included in the theoretical framework. There has been some concern by several researchers that demographics

measures are at best proxies for underlying managerial processes and biases. As such, they are not perfect measure of how individual CEOs assess technological or any other projects (Daellenbach, et. al., 1999, Hambrick and Mason, 1984).

Figure 2.1 : Schematic diagram of theoretical framework



Another writer, Kuczarski (1996), considered CEO innovation mindset as the independent variable. Daellenbach, et. al., (1999) used similar concept called CEO openness to innovation. The term refers to the mindset that believes in and values the role of innovation play in increasing firms' competitiveness.

The moderating effects of the environmental factors is based on Lefebvre, et. al., (1997), Daellenbach, et. al., (1999) and Spital (1992). Lefebvre et. al., studied the moderating role of external environment (hostility and dynamism) and internal environment (structural characteristics and strategic orientation).

The internal environment conducive to AMT adoption has been studied by Ismail and Jantan (1999), Thong (1997), Charlie (1990) and Beatty (1993). Generally, these

researchers were trying to uncover the factors influencing AMT adoption. Several of the common variables were firm size, availability of funding, presence of expert and readiness for change. Since this research main focus is to investigate the influence of CEO characteristics on the AMT adoption and not on the overall factors, these variables are grouped together and called firms' absorptive capacity. This variable measures the ability of the firm to implement and maintain AMT successfully.

2.6 Hypotheses

From the theoretical framework above, several hypotheses are developed for the study. They are:

- Hypothesis 1 The higher the CEO's innovative mindset, the higher the level of AMT adoption.
- Hypothesis 2 The more flexible the CEO, the higher the level of AMT adoption
- Hypothesis 3 The higher the CEO perseverance level, the higher the level of AMT adoption.
- Hypothesis 4 The higher the CEO risks taking level, the higher the level of AMT adoption.
- Hypothesis 5 In a more hostile environment, CEOs with innovative mindset will be more likely to adopt AMT
- Hypothesis 6 In a more hostile environment, flexible CEOs will be more likely to adopt AMT
- Hypothesis 7 In a more hostile environment, CEOs with perseverance will be more likely to adopt AMT
- Hypothesis 8 In a more hostile environment, risk-taking CEOs will be more likely to adopt AMT
- Hypothesis 9 In a more dynamic environment, CEOs with innovative mindset will be more likely to adopt AMT.
- Hypothesis 10 In a more dynamic environment, flexible CEOs will be more likely to adopt AMT.

- Hypothesis 11 In a more dynamic environment, CEOs with perseverance will be more likely to adopt AMT
- Hypothesis 12 In a more dynamic environment, risk-taking CEOs will be more likely to adopt AMT.
- Hypothesis 13 In the firms with better absorptive capacity, CEOs with innovative mindset will be more likely to adopt AMT.
- Hypothesis 14 In the firms with better absorptive capacity, flexible CEOs will be more likely to adopt AMT.
- Hypothesis 15 In the firms with better absorptive capacity, CEOs with perseverance will be more likely to adopt AMT.
- Hypothesis 16 In the firms with better absorptive capacity, risk-taking CEOs will be more likely to adopt AMT

Chapter 3

RESEARCH METHODOLOGY

3.1 Measurement of Variables

The questionnaire consisted of 5 sections; namely Basic Data, Personality Characteristics, Innovation Mindset, Environmental Factors and Technology Adoption.

Section 1 consisted of 7 questions to measure the demographic data such as age, gender, tenure, position, firm size, nature of business and business category. This was used to establish the credibility and the suitability of the respondent as well as a countercheck for representativeness of the samples.

Section 2 questions used 5 point Likert scale ranging from strongly disagree to strongly agree. The section measured psychographics characteristics. The characteristics, namely flexibility (Q 8, 9), perseverance (Q 10, 11, 12, 13) and risk taking ability (Q 14, 15, 16[reverse scale], 17) were taken from Kitchell (1997).

Section 3, using the same Likert scale as in section 2, measured the Innovative Mindsets. The questions were taken from Kuczmarski (1996) and they were numbered from Q18 to Q27. Section 4 measured the environmental factors such as hostility (Q 28, 29, 30, 31), dynamism (Q32, 33, 34, 35) and firm absorptive capacity (Q36, 37, 38, 39, 40). Measurement of environmental hostility and dynamism came from Lefebvre, et. al., (1997) while the firms' absorptive capacity measurement came from Thong (1999).

Section 5, measures the extent of AMT adoption. The measurement of the extent of adoption is based upon the formula below (Lefebvre, et. al., 1997):

Degree of AMT adoption = $\sum i_j \times r_j$ where $i_j = 0$ or 1 depending on adoption and r_j is degree of radicalness of the AMT.

Appendix B explains in detail the measurement technique and the rationale for measuring AMT adoption level using the above formula.

To establish the degree of radicalness, a separate questionnaire was prepared and sent to technical or production managers from larger (with employee size of more than 250) manufacturing companies. The rationale is, since these managers are from larger and more established organizations, they have had the experience in working with those AMT systems. They are experts who know what benefit each of the system have and know how difficult or easy to implement those systems.

3.2 Validity and Reliability

The operationalizations of the variables are taken from various sources. The psychographics measures were taken from Kitchell (1997). Innovation mindsets test were taken from Kuczmarski (1996), environmental hostility, dynamism and measure of AMT adoption are from Lefebvre, et. al., (1997). Firms' absorptive capacity measurement was adapted from Thong (1999).

A minor modification is made to several of the questions especially in the wording to suit local context. In cases where there are many questions available (i.e., Kuczmarski, 1996), only several of them are carefully chosen for brevity.

Nevertheless, when the actual responses come, a test for measurement reliability was conducted to ensure that the criteria are met.

3.3 Research Design

This study was done in a non-contrived way where the various factors are examined in their natural settings. There was no interference with any of the variable.

The time horizon for the study was cross-sectional. The data was collected only once over a period of time of roughly 2 months starting early March 2000 to end of April 2000. The unit of analysis for this study was individual organizations. The data, however, depends entirely from answers of a single individual in that particular organization. The target individuals were the CEOs, Managing Directors or those at the top most level that have the final decision making authority on the organizations.

For practical reasons, the targeted population was narrowed down to those located within or near the government gazetted industrial zones in Peninsular Malaysia. The scope of the manufacturing activities included only those involved in automotive, building material, computer and electronics, industrial and engineering, appliances and consumer products, stationery and packaging and finally furniture and furniture related products.

The list of the SMIs came from those listed in Federation of Malaysian Manufacturer Directory of Malaysian Industries, 1999. This formed the sampling frame for the study. Individual organizations were selected using stratified random sampling method. The stratification is based on the industries the firms are operating in. Disproportionate sampling was employed to take into account the different number of firms from the various industrial sectors. Initially, 50 firms from each industry was selected. Later, mainly due to insufficient responses returned, additional questionnaires were sent. The distribution of mailed questionnaires and door-to-door visits is shown in Table 3.1

This research will gather data purely from questionnaires. As such, care was taken to ensure the responses come only from the correct population. The FMM directory lists the company names together with the number of employees, their main products and their year of incorporation. This enables the criteria defined earlier, to be adhered. The final questionnaires were mailed to the selected SMIs with return postage.

In addition to mailed questionnaires, a door-to-door visit to several companies was done. This method of generating data provides the advantage of being able to personally see the CEOs, gather additional information and take a look at the AMT being adopted. The sampling is based on convenience sampling. Nevertheless, the efforts were made to visit companies from various industrial categories mentioned earlier.

Questionnaires on the measurement of radicalness were sent according to the following sampling criteria. The targeted respondents were production manager,

engineering manager or the managing directors from established manufacturing companies. Only companies that have been operating for more than 10 years and having at least 251 employees were considered. With regards to the type of industries, to ensure representativeness of the answers, the sampling distribution followed that of the main questionnaires'.

Table 3.1 : Number of questionnaire sent to various industry sectors

INDUSTRY SECTORS	MAILED QUESTIONNAIRES	DOOR-TO-DOOR VISITS
Automotive and related products	74	3
Building material and related products	67	3
Computer and electronics products	78	2
Industrial and engineering products	76	5
Appliances and consumer products	68	5
Stationery and packaging	57	3
Furniture and related products	52	1
TOTAL	472	22

3.4 Data Analysis Techniques

The SPSS version 10.0 program was used for the data analysis. All variables except for basic demographic data (age, sex, tenure, firm size and industry type) were examined for inter-correlation among the variables to identify any associations. The characteristics of the demographic variables were analyzed using frequency distribution, checking for central tendency and dispersion. The computed mean, range, standard deviation and variance in the data were then used to identify any biases in the returned responses.