The Development of an International Model For Technology Adoption: The Case of Hong Kong

Presented to:
Professor Peter Enderwick
School of Management Studies
The University of Waikato
in Fulfillment of the Requirements
for the Degree of
Doctor of Philosophy

Submitted By
Alan Kai Ming Au
October 1997

Acknowledgments

Without the support and guidance of numerous individuals, I would not be able to complete this research with such a magnitude. I wish to express my heartfelt gratitude to Professor Peter Enderwick, my Chief Supervisor, for his unreserved efforts to assist me in charting the course of my studies and guide me through this intellectual demanding, but rewarding, process. At every corners and crossroads of my studies, Professor Enderwick has always unfailingly provided me immense academic assistance in every stage of the writing up of my thesis. His profound wisdom, constructive comments and continuous support are indispensable to the successful completion of my studies. It is a great honour and fortune of mine to have associated with this distinguished scholar. In addition, I am also indebted to Dr. Ed Weymes, the Supervisor of my thesis, for his understanding, encouragement, and affirmative guidance over this long course of studies.

I would also like to thank Professor Danny Wong, Academic Vice-President of The Open University of Hong Kong, for his encouragement and Mrs. Polly Fok, my Clerical Assistant, for her kind help in the data collection process.

I am also indebted to my parents and many friends for their supports, encouragement and sacrifice during my doctoral studies. I am especially grateful to my parents, who have raised me with all they have in the past thirty years, for their faith and belief in me and, in particular, my late grant aunt, who always has complete confident in me even in the last few days of her life. They have demonstrated to me the value of a family. I have learnt from them how to live as a better human being and how to develop a fruitful relationships with others in return.

Last but definitely not the least, I would like to thank my wife, Bonny, for her love, encouragement and support which carry me through all the stresses during the course of my pursuant. For the sacrifice she has made during my doctoral studies, I may never be able to show my love to her in such a profound manner.

Abstract

The purpose of this study is to examine the causal relationships between the internal beliefs formation of a decision-maker on technology adoption and the extent of the development of a technology adoptive behaviour. In particular, this study aims to develop an International Model For Technology Adoption (IMTA), which builds upon the Theory of Planned Behaviour (Ajzen 1992) and improves on the framework of the Technology Acceptance Model (Davis 1986).

The development of such a model requires an understanding of the environmental factors which shape the cognitive processes of the decision maker. Hence, this is a behavioural model which investigates the constructs influencing the adoption behaviour and how the interaction between these constructs and the external variables can impact on the decision making process at the level of the firm.

Previous research on technology transfer and innovation diffusion has classified factors affecting the diffusion process into two dimensions: 1)

external-influence and 2) internal-influence. Hence, in this research, the International Model For Technology Adoption looks at how the endogenous and exogenous factors enter into the cognitive process of a technology adoption decision through which attitudes and behavioural intentions are shaped.

Under the IMTA, the behavioural intention to adopt is a function of two exogenous variables, 1) Strategic Choice, and 2) Environmental Control. The Environmental Control factor is further categorised by two exogenous factors, namely, 1) Government Influence, and 2) Competitive Influence. In addition, the Competitive Influence factor is, in turn, classified into five forces: namely, 1) Industry Structure, 2) Price Intensity, 3) Demand Uncertainty, 4) Information Exposure, 5) Domestic Availability.

Regarding the cognitive process which forms the attitude to adopt, it is hypothesised to be affected by six other endogenous beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4)Adaptative Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment.

A survey research method was utilised in this study and the research instrument was developed after a comprehensive review of the relevant literature and an expert interview. A total of 298 completed questionnaires were returned; giving a response rate of 13.56%. Of the 298 questionnaires, 39 of the responses were unusable with missing date. This gives a total of 259 usable questionnaires and an effective response rate of 11.78%.

The results of the analysis suggested that the fitness of the International Model For Technology Adoption was good and the data of this study supported the overall structure of the IMTA. When compared with the null model, which was used by the EQS as a baseline model to judge to overall fitness for the IMTA, the IMTA yielded a value of 0.914 in the Comparative Fit index; hence, indication of a good fit model.

In addition, the results of the principal component analysis also illustrated that the 16-factor International Model For Technology Adoption was an adequate model to capture the information collected during the survey. The results shown that this 16-factor structure represented nearly 77% of the total variance of all items. A further analysis into the factor structure, again, revealed that there existed a perfect match between the conceptual dimensionality of the International Model For Technology Adoption and the empirical data collected in the survey.

However, the results of the hypotheses testing on the individual constructs were mixed. While not all the magnitude of these ten hypotheses was statistically significant, almost all pointed to the direction conceptualised by the IMTA.

From these results, it can be interpreted that while the results of the structural equation modelling analysis provided overall support to the International Model For Technology Adoption, the results of individual constructs of the Model revealed that some constructs were forming a larger impact than others in the decision making process to adopt foreign technology. In particular, the intention to adopt was greatly affected by the attitude of the prospective adopters, the influence of the government and the degree of industry rivalry. However, the impact of the overall competitive influence factor on the intention to adopt was not supported by the results. Again, the existence of investment alternative was also not a serious concern for the prospective adopters.

TABLE OF CONTENTS

Chapter One: Introduction

1.1 Introduction

"[A] decade of globalization." Paul Beamish, et al (1991, 95) used this phrase to describe the 1990s. In recent years, the term "globalisation" has been applied very loosely to imply an entirely prevalent collection of forces which is affecting the fundamental ways of conducting business in a multinational environment. In order to provide a common platform for the understanding of this term, "globalisation" is defined, in this study, as an activity involving a certain "degree of functional integration between internationally dispersed economic activities." (Dicken 1992, 1)

The importance of technology transfers in the process of globalization is highlighted by Simon (1991, 6) who noted that "Globalization is primarily the result of the proliferation of technology transfer mechanisms ... [and] the results of concerted efforts .. to create competitive advantage." In fact, technology imported from other nations has become one of the major sources for gaining international competitiveness. This globalization trend has not only affected the development of the world in past decades but has also had a significant impact on the development of academic research in the area of international business.

Earlier research in international business reflected the comparative nature of the subject as a teaching area. Current studies are more of a pragmatic nature and have been directed by the globalization activities and the need for such activities (Dunning 1989). Such a shift in focus was probably the result of the unprecedented competitive pressure faced by both domestic and international companies alike and the consequent pressure on companies to rethink their strategies (Morrison, Rick and Roth 1991; Steingraber 1990).

Along with these changes in the international competitive environment have come significant changes in the world's political and economic environments. This is witnessed by the completion of the European Union in 1992, and the signing of the North American Free Trade Agreement. Recent developments in the Asia Pacific Economic Cooperation and the Association of South East Asian Nations groups have also highlighted the potential of a Pacific Rim trading area.

Furthermore, technology imported from other nations has become a major source for achieving economic development for many countries. Indeed, the following citation can best describe the importance of technology transfer in today's world:

"Technology transfer represents the single most important hope of alleviating the ever-widening gap between the haves and have nots in the world.... Technology transfer is the visible alternative to war and poverty, and we all must do our part to sustain it and to make it more successful (Samli 1985, xiii)."

Technology transfer is not only important to countries of the world, but also represents a significant income for many international companies (Stobaugh and Wells 1984; Contractor 1980). Therefore, decisions about international technological flows have a profound impact on the lives of millions -- through their influence from profits of a firm to the economic growth of a nation. This is one of the important reasons for conducting this research. It is hoped that, with a better understanding of the making of a technology transfer decision at the firm's level, governments would be able to devise policies which could facilitate and enhance the transfer and adoption process; thereby, fostering economic development in many of the under-developed nations and improving the standards of living for millions currently living under the proverty line.

The present study strives to provide an analytical framework to unlock the secret of the initial, and also the most essential, stage of the technology transfer process at the firm's level; that is, the process under which a technology adoption decision is being made. This is an essential part of the entire technology transfer process because it is at this stage that the decision to adopt a foreign technology is made and without the making of this decision, the entire technology transfer process will not commence. The next part provides a brief theoretical foundation for this research.

1.2 Theoretical Foundation

Agmon and Von Glinow (1991) suggested that the heart of international business is technology transfer which involves many complex issues such as economic, political, social, cultural and organisational factors. In order to understand the complexity of the subject, a deductive approach has been employed by many researchers in the literature on technology transfer (Agmon and Von Glinow 1991). This study adapts a similar approach. Like any deductive approach which starts with a hypothesis based on a conceptual framework outlining the constructs involved, and strives to be supported by empirical data (Kidder and Judd 1986), the theoretical framework of international technology adoption is found in the behaviourial connection between the processes of innovation diffusion and international technology transfer.

The study of international technology transfer is based on a motivation in response to the competitive demand and the ability to exploit competitive advantages through transferring technology across national borders. The area of technology transfer has been well researched by economists and political scientists. Economists tend to look at both the micro and macro economic factors affecting the transfer such as the speed, scope, choice, and costs of technology transfer and the subsequent impact of such a transfer on the production efficiency and profitability of recipient firms; while political scientists are inclined to analyze the impact of technology transfer on the economic, social and political institutions of a nation.

For innovation diffusion studies, the focus has been on the individual at the consumer level and the majority of the studies concern the speed and pattern of diffusion in a particular society, the influence of product characteristics, communication channels, adopter categories, role of opinion leaders as well as change agents on the behaviourial pattern of an adoption versus rejection decision.

Notwithstanding the volume of literature on the topic of international technology transfer and innovation diffusion, several important questions on the decision making process of technology adoption still remain unanswered.

First, while economists contended that technology adoption should be a purely economic decision, sub-optimal technology adoption decisions have been made by managers, especially in less developed countries (Contractor and Sagafi-Nejad 1981; Keddie 1984; Lecraw 1984; Well 1984).

Second, as mentioned above, the research focus of innovation diffusion has been at the consumer level and organisational behaviour has been relatively neglected (Cooper 1979; Czepiel 1975; Robertson and Wind 1980; Webster 1969).

Third, even when organisational innovation is the subject, most studies lack an integrative perspective. For example, organisational sociologists only examine the environmental and structural attributes (Shepard 1967; Thompson 1965; Zmud 1982). Organisational psychologists merely look into the value orientation, personal constructs of management, and environmental stimulus of innovative forms (Gupta et al 1986; Hage and Dewar 1973; Robertson and Wind 1980, 1981; Roger 1983). Further, economic variables such as market structure, size of organisation, resource and organisation slack have been the subject of partial analysis (Cummings 1965; Farrell and Saloner 1985; Mansfield 1961; Rogers 1983; Stoneman 1981). All of these studies have provided partial insights into the nature of organisational innovation. However, none have furnished a comprehensive model of the technology adoption decision.

Fourth, how environmental conditions affecting the decision of technology adoption are interpreted by decision makers is still uncertain. Even though it is understood that the environment conditions under which a firm operates can be affected by government stability, economic volatility, sociocultural receptivity, and technology capacity of the recipient countries (Contractor and Segafi-Nejad 1981; Kedia and Bhagat 1988; Keller and Chinta 1990; Rosenberg and Frischtak 1985), it is also equally true that the interpretation of these conditions and the subsequent incorporation of these conditions into the strategic decision of technology adoption are quite subjective and only rest with the decision maker (Hambrick and Mason 1984; Montanari 1978; Murray and Javidan 1988).

Fifth, a review of the literature on innovation diffusion reveals another weakness. While the majority of the research has attempted, by utilising the characteristics of individual and systems variables, to predict the innovativeness of an individual or an organisation (Rogers 1983), very few have developed conceptual and empirical examinations of the effects of competitive industry factors on innovation diffusion (Robertson and Gatignon 1986). Hence, an inter-disciplinary inquiry of how environmental and organisational attributes intertwine to affect international technology adoption behaviour is needed.

Therefore, the development of a comprehensive behavioural model and the subsequent empirical testing of the model are essential to foster our understanding of the international technology adoption process. To be useful, an international technology adoption model should address the fundamental issue of the topic, that is, the interactions between external environmental and organisational variables and the cognitive processes which dictate the attitude and behavioural intention of decision makers. In this study, a conceptual model called the "International Model For Technology Adoption" will be developed to determine the linkages between these variables.

1.2.1 Research Methodology

A detailed discussion of the research methodology will be provided in Chapter 4 of this thesis. In this section, only a brief overview will be given. For the current study, a survey research method will be utilised. Firstly, a research instrument to capture the various theoretical constructs of the International Model For Technology Adoption will be developed. The instrument will be developed through a comprehensive review of the literature and an expert interview.

The questionnaire survey method will be adopted to collect the necessary data to empirically test the validity of the model. Finally, the reliability and validity of the instruments as well as the model will be determined by investigating the Cronbach's alpha of the scales for the instrument, as well as by conducting the item-to-total correlation analysis, the principal component analysis, the structural equation modeling analysis and the ANOVA analysis.

1.3 Statement of the Problem

The phenomena of technology transfer was first investigated by economists who utilised neo-classical economic theory for their analysis (See Pugel 1981 for a review). However, a majority of the studies only developed static models and failed to incorporate the effects of imperfect market conditions such as the existence of proprietary knowledge (Caves 1982). Furthermore, the restrictive assumptions imposed on these models also limited their explanatory power to describe behaviour observed in the technology transfer process (Stobaugh and Wells 1984; Capon and Glazer 1987).

Recently, the innovation diffusion process of technology transfer has drawn wide interest from international business researchers (Arnould 1989; Capomn and Glazer 1987; Czepiel 1974; Davis 1986; Davis; Bagozzi and Warshaw 1989; Dicherson and Gentry 1983; Gupta, Raj, and Wilemon 1986; Gatignon and Robertson 1985, 1989; Leonard-Barton 1985; Ridgway and Price 1984; Rogers 1976; Robertson and Gatignon 1986). While most of the economic models of technology transfer have focused on the macro aspect of the subject, research on innovation diffusion provided an alternative view on the subject by focusing on a micro perspective; thereby suggesting an alternative paradigm which can explore the behavioural aspects of technology transfer. Despite the apparent difference in perspective, the integration of these two streams of research provides an opportunity to investigate the subject of technology transfer in a more holistic manner. Such an integration is feasible because of the similarities between technology and innovation. In fact, technology can be seen as a pool of knowledge developed in a particular economic entity while innovation is associated with a more specific element of that pool of knowledge.

Roger (1983, 5) defined innovation as “an idea, practice or object that is perceived as new by an individual or other unit of adoption.” Hence, innovation can simply mean the adoption of new technology by a given economic entity. Then, technology transfer can be seen as the materialization of an innovation diffusion process through which an innovation is transmitted and shared among members of such an entity (Rogers and Shoemaker 1971; Roger 1983). Hence, in order to understand technology transfer, one must understand the innovation diffusion process. Likewise, in order to comprehend the innovation diffusion process, one must comprehend the fundamental behavioural aspect of innovation diffusion, that is, innovation adoption decisions.

The literature on managerial decision making has developed with a philosophical basis that the individual grows one’s sense of reality through interpretation (perception) of one’s environment (Asch 1952; Feldman 1981; Leavitt 1972; Weick 1969). Asch (1952) believed that circumstance makes the man, that is, managers create their own environment to which they operate. In an extension of Asch’s proposition, Weick contended that the environment is an “enacted environment” which is “constituted by the actions of interdependent human actors” (Weick 1969, 27).

Besides the human context, recent diffusion studies have also investigated the organisation and industry characteristics. Some researchers explore the role of competitive factors in determining organisational adoption. The conceptual link between an industry's competitiveness and the rate of diffusion is another area of recent interest (Robertson and Gatignon 1986). However, little effort has been put into integrating the effects of technology adoption with the characteristics of decision maker, organisation and environments in which an organisation is operating. Such a theoretical model, supported by empirical evidence, would be beneficial to researchers and practitioners alike. For practitioners, an empirically tested model may facilitate their strategic development and implementation of technology transfer, whereas for academicians, a comprehensive conceptual framework is useful to provide new directions for further research development. Therefore, the current study addresses this theoretical lacuna in the literature of technology transfer.

1.4 Purposes of the Study

The purpose of this study is to examine the causal relationships between the internal beliefs formation of a decision-maker on technology adoption and the extent of the development of technology adoptive behaviour. In particular, this study aims to develop an international technology adoption model.

The development of such a model requires an understanding of the environmental factors which shape the cognitive processes of the decision maker. Hence, this is a behavioural model which investigates the constructs influencing the adoption behaviour and how the interaction between these constructs and the external variables can impact on the decision making process at the level of the firm.

1.5 Significance of the Study

"Technology transfer is fundamental to the accomplishment of international business" (Agmon and Von Glinow 1991, 1). Hence, an attempt to improve our understanding of the mechanisms behind technology transfer can enhance decision makers' ability to develop better international competitive strategy (Hambrick and Mason 1984). By investigating the decision making process of international technology adoption, the current study will contribute to the common body of knowledge in the international technology transfer literature.

In addition, the information collected in this research will also explicate the relationships between perceptions of external and internal environmental factors and the decision to adopt international technology. This information will also serve to uncover the selection process of decision makers in the adoption of new technology; thereby facilitating international technology transfer.

Furthermore, research into the innovation diffusion process among organisations requires an in-depth and process approach to allow researchers to unveil the nature of the innovation process in organisation (Regers 1983). Thus, this study strives to develop a behavioural model which can capture the key attributes influencing the adoption intention of decision makers. The results of this study will heighten our knowledge of organisation adoption versus rejection behaviour.

Despite the importance of the technology transfer in today's global business environment, limited empirical studies have been conducted to explore the decision behaviour of a recipient firm to adopt or reject a new technology. The current research will contribute to the exiting literature by investigating the behaviour pattern of transnational technology adoption.

Dymsza (1984) emphasized the need for multi-discipline research. Since the present study includes an examination of governmental influence, economic infrastructure, organisational influences, industrial characteristics and individual decision makers' idiosyncracies, it will embrace the fields of economics, technology and innovation, organisational management, international business and strategic management; thereby addressing technology adoption from an interdisciplinary approach.

Obviously, there is also perspective of developing countries seeking to upgrade technology who would benefit from the findings of the currently research.

1.6 Organisation of the Study

This thesis is organised into six chapters. Chapter One is the introduction. The literature review will be provided in Chapter Two, while Chapter Three explains the research methodology of this thesis. Chapter Four will provide the research hypotheses. The results of the data analysis will be provided in Chapter Five, with the concluding chapter discussing the research findings and presenting some policy implications derived from these findings. An overview of the contents of each chapters is given below:

Introduction -- This chapter will introduce the major topics of study, identify the problems and research purposes. Further, both a theoretical and practical justification for this inquiry will also be included.

Literature Review -- This chapter will provide a review of the existing theoretical and empirical literature on two important topics in international technology adoption, that is, international technology transfer and innovation diffusion.

Brief Review of the Hong Kong Industry -- This chapter will set out the Hong Kong situation. In particular, the industrial structure, the trade development, the status of technology in the Hong Kong industrial settings, reasons for the decline of Hong Kong's manufacturing sector as well as the sources of Hong Kong's advantages will be discussed.

Research Hypotheses -- After reviewing the literature, hypotheses for this research will be developed and a conceptual model of international technology adoption will also be introduced.

Research Methodology -- This chapter will exhibit a detailed explanation of the research methodology and statistical techniques developed and utilised for examining the hypotheses of this study.

Data Analysis -- This chapter will report the results of the study.

Conclusion and Policy Implications -- This chapter will discuss the applications and conclusion of the study. Policy recommendations will also be given.

Chapter Two: Literature Review

2.1 Introduction

The process of international technology diffusion embraces a number of ideas drawing upon a range of disciplinary areas. Relevant literature useful for the development of the conceptual framework and theoretical model for this current study is reviewed in this chapter. Since the theoretical foundation of international technology adoption studies has grown out of two streams of research, that is international technology transfer and innovation diffusion, this chapter is divided into three parts, with each of the first two parts providing a discussion of each subject area separately. The final part of the chapter describes the recent development of research in technology adoption.

In particular, part one summaries the literature on innovation diffusion. Through a review of research work on innovation diffusion, an orderly understanding of the factors which influence the rate and pattern of innovation diffusion can be achieved. Such an understanding is essential for delineating the process of innovation diffusion which is very important in understanding the process of technology adoption.

Part two looks at the literature on technology transfer. Technology transfer research extends the knowledge acquired in innovation diffusion further by extending diffusion studies to the transnational environment. Like any international matter, once business operations move across national boundaries, the issues and environments facing a company become more complicated. Hence, when technology diffuses across nations, forces from additional external parameters such as economic, social, cultural and competitive variables from both the host and home countries will exert a profound impact on technology adoption decisions.

2.2 Innovation Diffusion

The area of diffusion research has attracted considerable interest since the publication of Ryan and Gross' (1943) study on the diffusion of hybrid seed corn in two Iowa communities. Numerous studies can be found in a range of disciplines including rural sociology, communication, anthropology, economics, education as well as marketing (Chatterjee and Eliashberg 1990; DeBresson 1995; Dosi 1988; Downs and Mohr 1976; Gatignon and Robertson 1985; Herold, Farmer and Mobley 1995; Kitchell 1995; Mansfield 1996a; MacPherson 1994; Rogers 1976, 1983; Mahajan and Peterson 1985; Metcalfe 1988; Stoneman 1984; Venkatraman; Loh and Koh 1994; Weiss

1994; Wildemuth 1990). Among many of the issues involved, the major ones are the diffusion and adoption process, perceived innovation and adopter characteristics, and factors influencing adoption decision. Such wide interest across a range of subjects illustrates the inherent difficulties of attaining acceptance of novelty. A crucial issue in the area of diffusion studies is the identification of what is being diffused. The question of how to accelerate both the rate and extent of diffusion remains of major significance (Metcalfe 1990; Rogers 1981).

2.2.1 Definition of Innovation

It has not been easy to define something as abstract as "innovation". Sometimes, it has been described as "a process", "a specific item" or "an adjective to describe individual people or organisations" (Kimberly 1987). Innovation can be viewed from three perspectives: i) the components of innovation, ii) the novelty nature of innovation and iii) the behavioural aspect of innovation.

Rogers (1983) considered the elements of innovation to be divided into two parts, that is, the "idea" component and the "object" component. He suggested that most innovations have both components with a novel idea(s) underpinning the development of a tangible object. But, sometimes, innovation can be an idea by itself, without any physical nature. In such circumstances, adoption requires a symbolic decision, for example, new ideologies such as Marxism in the nineteenth century.

Regarding the novelty nature of innovations, Barnett (1953) perceived the novelty of innovation to be something "qualitatively" different which Kimberly (1987) described as a significant departure from the existing form at the time the innovation appeared. Again, innovation may not be a universal concept. While some may perceive a novel idea as innovative, others in another setting may have already accepted or even improved upon the innovation. So, it is the perception of an individual or a relevant adopting unit that is important in determining the novelty of an innovation (Pavitt 1990).

Based on the behavioural pattern of innovations, Robertson (1967, 1971) indicated that innovations should be considered by their impact upon one's established behaviour pattern. Using this definition of innovation, Roberston classified innovations into three patterns: i) continuous innovation, ii) dynamically continuous innovation, and iii) discontinuous innovations. Continuous innovations are those which have little disruption on the behaviour pattern of adopters. Dynamically continuous innovations will have a moderate disruption on the behaviour pattern; whilst discontinuous innovation will have a total disruption on existing behaviour pattern and will require a new behaviour pattern to be adopted.

In addition, Metcalfe (1990) saw innovation as a sequence of artefacts which could compose of a set of design principles, concepts and facts. Relating these into a sequential forms was called a design configuration. This concept was used to distinguish two types of innovations: radical and incremental. A radical innovation develops new design configuration while an incremental innovation only improves on existing design configuration (Freeman 1987; Metcalfe 1988, 1990).

2.2.2 Definition of Technology

The concept of technology is very similar to innovation. Like innovation, technology can be embodied in a person, a process or a product (Kedia and Bhagat 1988), or disembodied as a product (Robinson 1988). However, the technology concept is more specific than innovation. Monsour (1981), following the suggestions of Mansfield (1971), defined technology as “society’s pool of knowledge ... used by industr[ies] ... [for] the day-to-day operations of production” (p 2). More generally, technology can be defined as knowledge, skills, and means for “converting inputs to outputs in accomplishing a specific task” (Asheghian and Ebrahimi 1990, 291).

In addition, technology can also be distinguished by the form of its embodiment: that is, embodied technology and disembodied technology (Pugel 1981). The distinction between the two forms of embodiment is related to how the existing factors of production are affected by a new technology. When embodied technology is adopted, at least one existing factor of production must be altered or a new factor of production must be employed simultaneously in the production process in order to cater for the use of the new knowledge. Disembodied technology means that no new factor has to be involved (Pugel 1981).

Technology can further be distinguished by the level of information (Hall and Johnson 1970). They defined technology into three information levels: i) general technology, ii) system-specific technology, and iii) firm-specific technology. General technology embraces common information known to all or most of those engaged in an industry, profession or trade. Systemic-specific technology involves information acquired through experience in certain tasks or projects. The possession of such information provides a firm with a competitive advantage because the information represents particular systems solutions to unique problems. Firm-specific technology includes information acquired by a firm by way of the firm's collective activities and such information is also beyond the general knowledge possessed by the industry as a whole.

This argument is very similar to the emerging resource-based theory of the firm which emphasis the source of competitive advantages lies in the imperfect imitability of resources (Barney 1991; Lippman and Rumelt 1982; Wernerfelt 1984). In particular, following the line of reason of this theory, the value of an innovation is determined by the "isolating mechanism" which maintains the rent-generating capacity of the organisational resources (Dierickx and Cool 1989). Hence, the pattern of diffusion can be affected by the level of imitability of the innovation (Barney 1991; Mahajan et al 1988, 1990).

2.2.3 The Process of Diffusion

Roger and Kincald (1981) depicted the main element of diffusion as innovation which is communicated and shared through various channels of members of a specific social system. Gatignon and Robertson (1985) further elaborated on the characteristics of a diffusion process:

"The diffusion process can be characterised in terms of three dimensions: the rate of diffusion, the pattern of diffusion and the potential penetration rate" (p 858).

While the rate of diffusion means the speed of adoption over time, the pattern reflects the shape of the diffusion curve. The penetration level indicates the size of the potential market which is represented by the maximum cumulative sales over a specific period of time (Gatignon and Robertson 1985).

The rate of technology diffusion is perceived by Teece (1981) as a function of resource costs, both transmitting and absorption. There exists a negative relationship between the codification costs and transfer costs. The more a given technology is codified untacitly the more easily and economically it can be transferred. On the other hand, uncodified knowledge can be slow and costly to transfer and may further be subject to the ambiguities of verbal interpersonal communication (Teece 1981).

The term "diffusion of innovation" is generally used within the context of structural economic change and is used to describe the process through which new technologies are integrated into an economy (Metcalfe 1990).

In addition, there are also recent attempts to adopt stochastic model to explain the inter- and intra-industry diffusion of new technologies. These studies attempts to look at 1) how existing relationships between, and 2) specific performance thresholds required by, different industrial sector might restrict new technology diffusion. These models could serve to provide benchmark for monitoring progress of new technology diffusion. (DeBresson 1991, 1995; DeBresson and Lampel 1985)

2.2.4 Foundations of Diffusion Theory

As mentioned earlier, diffusion literature can be found in areas such as rural sociology, communication, anthropology, economics, education as well as marketing. Earlier interests in diffusion studies were initiated in the field of rural sociology where researchers attempted to improve the efficiency of technology diffusion within farming communities. In fact, the majority of diffusion research can be found in the social science discipline (Dosi 1988; Mahajan and Peterson 1985; Metcalfe 1990).

The contribution of the social science literature to diffusion research is its precise investigation of the personal characteristics and traits of innovators and adopters as well as the important communication channels in the diffusion process. As a result, a wide range of innovations have been the subject of considerable research. However, since different disciplines utilise different research methodologies and specific types of technology in their studies, there is little opportunity for generalisation of this type of research (Warner 1974).

2.2.5 Diffusion Models

"Diffusion models have been developed to represent the level or spread of an innovation among a given set of prospective adopters in a social system in terms of a simple mathematical function of the times that has elapsed from the introduction of the innovation" (Mahajan and Peterson 1985, 10). Perhaps the best model of diffusion is the S-shape curve which is used to describe the cumulative adoption time path of the diffusion process. In this model the successful diffusion of innovation is contingent on four factors: the characteristics of the innovation itself (that is, the dimensions of technology); a champion to encourage others to adopt the innovation; the length of time it takes to comprehend the new idea; and the absorptive capacity of the adopters (Fulk et al 1987). This S-shape curve has been the subject of numerous studies and has been supported by many theoretical and empirical studies of the diffusion process (Bates and Flynn 1995; Foster 1986; Mahajan, Muller and Bass 1990).

In order to fully understand the underlying variables affecting the shape of the diffusion curve, Mahajan and Peterson (1985) categorised diffusion models into three types: i) external-influence (initiated by Coleman et al 1966), ii) internal-influence (initiate by Mansfield 1961), and iii) mixed-influence models (initiated by Bass 1969).

External-influence models assume that the diffusion function is affected by external influences which are outside the social system and which play the role of a "change agent". Change agents are responsible for a number of tasks in order to exert considerable influence on the potential adopters. Their roles include: i) the development of prospective user need for the innovation; ii) the establishment of an information exchange network; iii) the identification of problems; iv) the creation of change intentions; v) the activation of change intentions; vi) the stabilisation of adoptions to prevent discontinuity; vii) the development of ongoing relationships with prospective users (Gatignon and Robertson 1985; Robertson and Gatignon 1986; Roger 1983).

On the other hand, internal-influence models assume that the diffusion process is initiated only by interpersonal contacts and facilitated, in part, by imitative behaviour. There are two types of players in the diffusion process, that is, "innovators" and "imitators". Innovators make the purchase on their own initiative, while the purchase made by imitators is influenced by those who have made the purchase (Mahajan et al 1988).

As the term indicates, mixed-influence models combine the features of both the internal-influence and external-influences models. As such, they are the most commonly used framework. Mahajan and Peterson (1985) indicated that Bass (1969) initiated the first model of this type and that the model was developed to forecast the sales of durable goods. The two basic coefficients used in the Bass model, that is, the coefficient of innovation and the coefficient of imitation, represent the external and internal influences of the model. But, no matter whether the influences originate internally, externally or both, the basic foundation of all diffusion models is innovation.

Recently, Venkatraman, Loh and Koh (1994) building on the foundation of these works and extended to investigate the applicability of innovation diffusion models on administrative innovations (Barney 1991; Contractor and Lorange 1988; Donaldson 1990; Mahajan et al 1988; Teece 1980). Venkatraman et al (1994) developed alternative diffusion models using two forms of organisational structures, joint venture and M-form structures. They found that the internal-influence model was more applicable to the joint venture mechanism while the external-influence model was more consistent with the M-form structure.

2.2.6 Innovation Characteristics

Attributes of innovations have been a popular topics of inquiry in the innovation diffusion literature. Six attributes have been found to be associated with innovation. They are i) relative advantage, ii) compatibility,

iii) complexity, iv) trialability, v) observability, and vi) perceived risk (Dickerson and Gentry 1983; Gatignon and Robertson 1985; Fidler and Johnson 1984; Hirschman 1981; Labay and Kinnear 1981; Ramiller 1994; Rogers 1983; Rogers and Shoemaker 1971; Zaltman and Stiff 1973) Even though all six attributes are empirically intertwined with each other, Rogers (1983) contended that each of them is "conceptually distinct".

Recently, Pavitt (1990) summarised four main characteristics of innovation activities. First, innovation activities involved a "continuous and intensive collaboration and interaction" among key functional disciplines with an organisation in the search for new development strategies. Second, the outcomes of these activities were "uncertain", with only a 10% successful rate. Third, they exhibited a "cumulative" nature. Fourth, innovation activities were "highly differentiated", which meant they could not be applied universally to any industry (Pavit 1990, pp. 18-19).

2.2.6.1 Relative Advantage

"Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers 1983, 213). It includes the degree of economic profitability, low initial cost, lower perceived risk, saving in time and effort, and the immediacy of the reward (Mansfield 1961;

Nabseth and Ray 1974; Roger 1983; Utterback and Kim 1986). In addition, in the international environment, the cost advantage becomes more complex and includes factors such as age of the technology, number of years of manufacturing experience of the recipient of the technology transfer, number of previous transfers provided by the supplier of the technology, volume of sales of the recipient, alternative sources identified by the recipient and the level of GNP per capita of the host country (Arthur 1989; Mansfield et al 1982; Metcalfe and Gibbons 1989; Stoneman 1984). The cost factor becomes more critical when developing countries are involved (Contractor 1984). In general, the perceived relative advantage of an innovation is positively associated with the level of adoption (Premkumar and Nilakanta 1994; Strutton; Lumpkin and Vitell 1994).

2.2.6.2 Compatibility

"Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of the potential adopters" (Rogers 1983, 223). The impact of compatibility is related to the rate of diffusion. The more compatible is an innovation with the existing sociocultural beliefs and values, currently adopted concepts and ideas, and perceived individual need for innovations, the less the effort required for adopters to alter their thinking and behaviour in order to adopt the innovation; thus, a faster rate of diffusion is anticipated (Premkumar and Nilakanta 1994; Ramiller 1994).

In the international environment, compatibility is sometimes referred to as "technology applicability" (Nabseth and Ray 1974). Due to technical problems, not all new technology can be transferred to any country. Hence, when an innovation cannot be fully transferred to a third country as a result of technical feasibility, a "technological ceiling" occurs. Furthermore, like the attribute of relative advantage, the issue of compatibility is also affected by the technical experience of the recipients (Cortes 1982). In Cortes' study, it was also found that the technical capability of the recipient firms could not only affect the efficiency of the production, but also substantiate the bargaining position of the recipient firm through the empowerment of a choice to independently select a wider range of alternatives (Cortes 1982).

Besides influencing the bargaining power of recipient firms, technical strength and experience also influence the rate of the diffusion process (Sounder and Song 1997; Dickerson and Gentry 1983). Gatignon and Robertson best describe this relationship: "related knowledge and experience of an innovation are associated with a faster rate of adoption. Alternatively, the greater the disparity between an innovation and the consumer's existing knowledge and experience base, the slower the rate of adoption" (p 863).

2.2.6.3 Complexity

Innovations vary in terms of their degree of simplicity for use. Hence, the third attribute of innovation which may affect diffusion is complexity (Fariborz 1996). Complexity is defined as "the degree of difficulty in understanding and/or using the new product" (Robertson 1971, 46). Unlike the relative advantage and compatibility attributes, it is perceived that complexity has a negative relationship with the rate of adoption (Roger 1982; Strutton, Lumpkin and Vitell 1994).

2.2.6.4 Trialability

The fourth attribute of innovation found to be associated with diffusion, trialabiltiy is defined as "the degree to which an innovation may be experimented with on a limited basis" (Roger 1983, 231). It is obvious that innovations which can be adopted on a trial basis can stimulate usage in a more rapid manner than those not suitable for experimental scrutiny before purchase. Hence, untrialability of an innovation can increase the perceived risk of adoption. There is likely to be a positive relationship between trialability and innovation adoption.

2.2.6.5 Perceived Risk

Perceived risk is referred to as "the expected probability of economic or social loss resulting from innovation" (Labay and Kinnear 1981, 271). The level of perceived risk is negatively associated with the level of information received and processed by the potential adopter. In addition, the higher the degree of novelty in an innovation, the greater is the risk (Gilbert 1996). Therefore, perceived risk can be reduced by providing more adequate information (Taylor 1974). Fidler and Johnson (1984) further suggested that in the case of increased uncertainty, additional motivation or influence can help facilitate the innovation and diffusion process (Germain 1996) and success could depend on the level of market uncertainty and the risk-taking attitude of firms (Damanpour 1996; Sounder and Song 1997; Tezuka 1997). In short, perceived risk is negatively associated with the rate of adoption.

2.2.6.6 Observability

Observability can be expressed as "the degree to which results of an innovation are visible to others" (Rogers 1983, 232). The potential of some innovations can easily be observed and communicated to the prospective adopters, while for others, it may be difficult to perceive (Barney 1991; Mahajan et al 1988). As explained in section 2.2.5 regarding factors affecting the speed and pattern of diffusion, influences can be classified as external and internal. The higher the observability of an innovation, the more effective will the benefits of such an innovation be communicated through the external and/or internal influences to the respective social system; thereby, improving the rate of adoption. Hence, there is a positive relationship between observability and innovation (Strutton, Lumpkin and Vitell 1994).

From a practical point of view, it is the perceptions of adopters that determine the usefulness of these attributes to predict their influences on both the rate and pattern of innovation diffusion (Robertson 1971, 1984; Rogers 1971, 1983). Besides these six attributes, at least two other variables can affect the rate and pattern of innovation diffusion. They are the "social systems" as well as the "communication channel" through which innovation information is disseminated.

2.2.7 Social Systems and Diffusion

Robertson (1971) defined social systems as "the boundaries within which an innovation diffuses" (p. 43). Social systems have been found to have a significant influence on the pattern of innovation diffusion (Barney 1991; Mahajan and Peterson 1985; Venkatrman et al 1994.) The rate of diffusion may vary according to the different sphere on a social system; with the moderating factor the compatibility of the innovation with the culture of the social system (Robertson 1971). Subsequent studies also illustrated the importance of interactions between adopters and suppliers in the process of the technology diffusion (Lundvall 1988; Rothwell and Gardner 1985; Pavitt 1984.)

In order to facilitate innovation diffusion, social change must take place. Rogers (1969) described social change as "the process by which [planned or unplanned] alteration occurs in the structure and function of a social system" (p 3). Such a process must be initiated by the decision makers. Therefore, since all decision makers must interact within the social system to gain and disseminate information, it can be seen that social change is a linkage mechanism through which diffusion and adoption can take place (Zaltman and Stiff 1973). In addition, subsequent studies also had identified mechanisms through which firms and technological-generating institutions exchange knowledge to the benefits of the diffusion process (Allen 1983; Barney 1991; Mahajan et al 1988; Mahajan and Peterson 1985; Venkatrman et al 1994; Von Hippel 1988.)

The way that innovations are diffused within the social system can be divided into two types: i) vertical diffusion, or ii) horizontal diffusion. Vertical diffusion implies a vertical flow of innovation diffusion and information flows from higher levels to lower levels within the social system. Horizontal diffusion involves information flowing horizontally within similar levels of a social system (Autio and Laamanen 1995). It is through the social system that organisation learning takes place. Organisation learning means that new understanding about the relationships between actions and their corresponding outcomes are shared among members of an organisation (Duncan and Weiss 1979; Lefebvre, Lefebvre and Roy 1995). The learning process is essential to ensure smooth and successful diffusion and adoption processes within an organisation because diffusion and adoption require an ability to understand and comprehend new knowledge (Herold et al 1995; Mansfield 1996a; Nord and Tucker 1987).

Again, in order to understand the learning process between the social systems and the firms, it is not enough to just look at the institutional location of the knowledge. Of the same level of importance is the types of the knowledge concerned (Metcalfe 1990.) In this respect, it is necessary to distinctive between to forms of knowledge, that is, codifiable and tacit knowledge (De Vincenti 1985; Valentin 1989.) Hence, Metcalfe (1990) suggested that in order to realise how the generation of skills and knowledge happened in the process of the interactions between producers and users, a comprehension of the industrial communication structure was not just necessary but inevitable.

2.2.8 Information Communication Channels

There are two types of communication channels: i) mass media channels, and ii) interpersonal channels (Rogers 1983). Mass media channels involve the use of media, like radio, television, newspapers, which allow messages to be communicated to a vast audience. On the other hand, interpersonal channels require a face-to-face interaction among at least two individuals.

Regarding the different types of information which pass through different communication channels, it has been found that mass media channels are more effective in the initial stage of innovation adoption, whilst interpersonal communication is critical in influencing the final adoption decision (Roger 1983). Again, it was found that the prior experience with the message source and the type of communication channel used had significant effects on the perception of the message received (Moenaert and Sounder 1996).

One form of interpersonal influence worth mentioning is the role of opinion leaders in the adoption process. Opinion leadership can be referred to as “the degree to which an individual is able informally to influence other individuals’ attitudes or overt behaviour in a desired way with relative frequency (Rogers 1983, 271). Hence, in order to understand the rate of diffusion within a social system, it is beneficial to investigate the impact of the behaviour of opinion leaders on the diffusion process. The imitation parameter of the Bass model (Bass 1969), as discussed above, illustrates how the forces of opinion leadership work to shape the adoption process of innovation (Mahajan et al 1988).

Having considered the factors affecting the innovation diffusion process, it is useful to consider another focal point of the diffusion process: the adoption decision making process of innovation diffusion.

2.2.9 Perceptions of Decision Makers on Innovation

Perceptions of an individual can exert a huge influence on the innovation decision making process (Swan and Newell 1994). Rogers (1983) described the innovation decision making process as stages which an innovation decision maker would pass through before concluding the adoption choice. The process involves the following stages: knowledge, persuasion, decision, implementation, and confirmation. When going through these stages, two factors will dictate the outcome of the decision making process: perceived novelty; and the perceived respective level of uncertainty involved.

In addition, individual decision-makers perception characteristics have been found to have an important impact on organisational adoption. Individual perception characteristics include: i) the perceived need for novelty or improvement, ii) tolerance of ambiguity, iii) willingness to take risks, iv) belief in the value of innovation, v) belief in the ability to obtain benefits from innovations, vi) involvement in social networks (Pessemier 1982; Peters and Waterman 1982; Rogers 1983; Tushman 1979; Webster 1979).

Furthermore, both the expectation of future improvement and the expectation on the rate of diffusion could also influent an adoption decision (Bridges, Coughlan and Kalish 1991; Chatterjee and Eliashberg 1990; Jackson 1985; McCardle 1985.) If diffusion is a continuous process which involves linking a stream of related innovations which shares common elements of skill and knowledge (Metcalfe 1990), an extremely high level of expected rate of diffusion could prevent diffusion to take place (David and

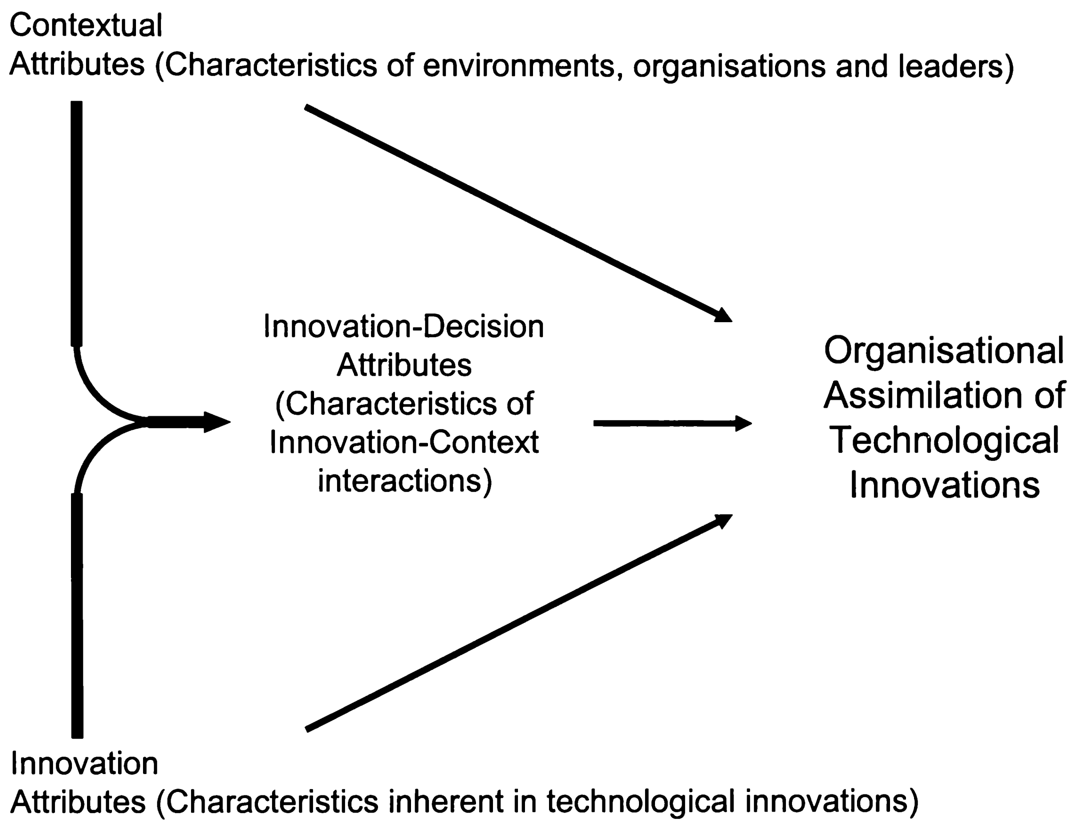
Olsen 1984; Jovanovic and Lach 1989.) This is because when diffusion is a continuous process, it can lead to the development of a chain reaction: first, diffusion leads to improvement; improvement extends the markets for innovation; larger market opportunities accelerate the diffusion rate, which in turn induces further improvements; thereby, proliferating the diffusion process. Hence, the faster is the rate of diffusion, the higher is the expectation that the innovation will be obsoleted very quickly which will cause adopter to delay the adoption of the "current" innovation and awaiting for "newer" innovation in the immediate future.

2.2.10 Innovation Assimilation

When studying how innovation was assimilated into organisations, Meyer and Goes (1988) put forward a model of innovation assimilation, as depicted in the Figure 2.1.

According to Meyer and Goes (1988), assimilation is an organisational process which must satisfy there criteria: 1) immediate response by member of an organisation at the first instance the innovation is discovered or uncovered, 2) subsequent acquisition of the innovation, and 3) occasional ultimate success in gaining full acceptance, utilisation, and institutionalisation of the innovation.

Figure 2.1 A Model of Innovation Assimilation



Source: Meyer and Goes 1988, p901

In their model, Meyer and Goes (1988) argued that innovation assimilation is a process involving “a series of decisions to evaluate, adopt ,and implement new technologies” (p897). They further advanced a model suggesting that three classes of antecedents determined the process of technological innovations assimilation into organisations. These three classes of antecedents are: contextual attributes, innovation attributes and innovation-decision attributes.

2.2.11 Organisational Characteristics

Many organisational characteristics can affect the innovation adoption of a company. Perhaps the most widely studied factor is organisation size. Organisation size can be measured by several indicators such as sales volume, numbers of employees or managers, or level of investment. Despite a considerable amount of research which has examined the relationships between organisation size and adoption behaviour of organisations, no conclusive evidence can be found to determine exact relationships (Bates and Flynn 1995; Chandrashekaran and Sinha 1995; Kimberly and Evanisko 1981; Malerba and Orsenigo 1996; Meyer and Goes 1988; Sanchez 1994; Souder and Song 1997; Venkatraman, Loh and Koh 1994).

Some studies found that the larger the size of an organisation, as measured by employee numbers, volume of sales and number of establishments, the higher the chances for innovation to be adopted by an organisation (Archibugi, Evangelista and Simonetti 1995; Cainarca, Colombo and Mariotti 1990; Germain, Droge and Daugherty 1994; Hannah and McDowell 1984; Hawes 1986; Moch and Morse 1977). On the other hand, other studies found no or a weak relationship between organisation size and propensity or speed to adopt (Kimberly 1981; Robertson and Wind 1980; Utterback 1974). In addition, some recent studies suggested that technology adoption was first concentrated in larger firms but would gradually flow to smaller firms when the technology price was lowered as time lapsed (Leviy and Meisel 1987; Pavitt, Robson and Townsend 1987; Sanchez 1994)

In fact, some researchers have contended that organisation size is only a surrogate of some other determinants of adoption behaviour. In the absence of these determinants, organisation size simply fails to predict adoption behaviour. Only with the concurrent existence of these determinants such as personnel specialisation, differentiation, decentralisation, and professionalism can organisation size become a good predictor of innovation behaviour (Baldridge and Burnham 1975; Mintzberg 1979).

Again, when studying on the technological innovative advantage between small and large firms, Acs and Audretsch (1988) found that larger innovative firms tended to be found predominantly in capital intensive industries while smaller innovative firms tended to have an advantage in industries where there was intense needs on qualified employee. Further, the advantages of small firms in the process of innovation adoption might also be stemmed from their flexibility and less constrained by bureaucracy and unionism

(Bughin and Jacques 1994; Langley and Truax 1994; Meredith 1987; Noori 1988).

Besides the size factor, previous research has also investigated several other facets of an organisation and their association with innovation behaviour (Blau and Mckinley 1979; Cohn and Turyn 1980; Gatignon and Robertson 1985; Souder 1987). Organisation factors which have been studied include: i) organisational complexity, ii) the intensity of centralisation, iii) the extent of normalisation; iv) the level of specialisation; v) the degree of functional differentiation, and vi) the magnitude of external integration.

2.2.11.1 Organisational Complexity

Cohn and Turyn (1980) referred to organisation complexity as "the extent to which an organisation's managers possess specialised knowledge and expertise" (p 98). The higher the level of organisational complexity, the better can the adoption process be facilitated through the expert knowledge of the employees of the organisation. Highly complex organisations are characterised by the existence of a diversity of specialists. The propensity for experts or specialists to promote innovation is explained by the proposition that specialists or experts can use innovation as a means to consolidate their feeling of job prestige and high performance (Cohn and Turyn 1980).

However, the results are not conclusive even though most of the existing literature seems to support the relationship between organisational complexity and innovativeness. Some studies found that while the complexity of incentive systems and task structure in an organisation can positively affect innovative behaviour, measured in terms of numbers of innovations (Hage and Aiken 1967, 1970, 1971), they have a negative impact on the rate of innovation (Sapolsky 1967; Lawrence and Lorsch 1967).

2.2.11.2 Centralisation

Centralisation depicts "the locus of authority to make decisions affecting the organisation" (Pugh et al 1968, 76). Mintzberg (1979) believes that decentralisation is an effective stimulus for motivating employees whose job requires creativity. In addition, a decentralised organisation structure is especially important for an organisation operating in a dynamic environment. Like the studies on organisation complexity, the evidence is still inconclusive (Chandrashekaran and Sinha 1995). The general belief is that centralisation inhibits innovation (Barney 1991; Bates and Flynn 1995; Koberg, Uhlenbruck and Sarason 1996; Mintzberg 1979; Moch and Morse 1977). However, some studies found the contrary (Burgelman 1983; Dean 1987; Malik and Wilson 1995).

2.2.11.3 Formalisation

Formalization is the extent to which organisations utilise written rules, procedures, instructions, and communications (Pugh et al 1968). More precisely, formalisation is "the extent to which managerial duties are precisely specified" (Cohn and Turyn 1980, 98). In order to control the behaviour of employees and to standardise as well as regulate work activities, organisations need to formalise the flows of such work activities (Mintzberg 1979). Formalisation is very similar to centralisation. Hence, the results of studies on these two subject areas are quite comparable. Whilst some research suggested innovation adoption was restrained by formalisation (Aiken and Hage 1971; Gordon et al 1974), others found that formalised organisations were more receptive to innovation adoption (Koberg, Uhlenbruck and Sarason 1996; Malik and Wilson 1995; Moenaert, Souder, De Meyer and Deschoolmeester 1994; Nutt 1984; Roger 1983; Song, Neeley and Zhao 1996).

2.2.11.4 Specialisation

Perhaps one of the best known concepts in capitalistic society, specialisation is equated with the division of labour. Mintzberg (1979) suggested that specialisation can be either horizontal or vertical. Horizontal specialisation means the scope of a task and vertical refers to the separation of administration and the actual content of a job.

Specialisation is one of the least researched topics in the area of the relationships between organisational characteristics and innovation adoption. Most of the studies on specialisation have focused on the form rather than the substance of specialisation. Many of these studies only considered structural variables such as positions or departments of organisation (Gupta et al 1986; Robertson and Wind 1980) and ignored the other real parameters of specialisation such as the degree of segregation and repetition in jobs, and the uniformity of production. It was found that there was a positive relationship between specialisation and innovation (Germain 1996; Ricottilla 1994). Interestingly, some studies even advocating that the dominance of different types of specialised skills and knowledge could also affect the success of an the adoption process (Bates and Flynn 1995); with some found that when top management were composed of mainly accounting and finance personnel, manufacturing performance would be depressed (Hayes and Wheelwright 1984; Govindarajan 1989).

2.2.11.5 Functional Differentiation

Functional differentiation comes from an insufficiency of coordination and communication among and between individuals and departments. Characteristics of functional differentiation are i) the existence of constant but constructive conflict among employees (Lawrence and Lorsch 1967), ii) the absence of a consensus professional ideology (Mohr 1969) and iii) the flow of ideas (Aiken and Hage 1971).

The nature and characteristics of functional differentiation mean that it has both a positive and negative impact on innovation adoption (Gilbert 1996a; Griffin and Hauser 1996; Moenaert et al 1994). The lack of communication and coordination can hinder innovation adoption. On the other hand, the diversity of a functional differentiation culture can facilitate innovation adoption. Likewise, it had also been found that collaboration was more important than procedural interaction in foster innovation (Kahn 1996).

2.2.11.6 External Integration

Rogers (1983) indicated that external integration means the degree of linkage developed between an organisation and other external organisations such as competitors and suppliers. The more "open" is an organisation, the better is the communication network established between the organisation and the external social system, thereby facilitating innovation activities within social systems which share complementary knowledge (Harianto and Pennings 1994).

2.2.12 Industry Characteristics

In addition to individual and organisational characteristics, another factor which has been found to have a significant impact on innovation diffusion is industry characteristics. Robertson and Gatignon (1986) proposed a diffusion paradigm showing the effects of interactions between competitive forces and diffusion. The model is depicted in Figure 2.2. Robertson and Gatignon (1986) not only illustrated the inter-relationships between the adoption/diffusion activities and the competitive environment, they also suggested that industrial factors, as included in the industry competitive environment, could affect the organisation adoption process. Within the industry competitive environment, Robertson and Gatignon (1986) postulated that two factors influenced the environment, that is, i) structural factors and ii) communication factors. Each factor was then divided into three variables. The three variables representing the structural characteristics were: i) industry heterogeneity, ii) competitive intensity, and iii) demand uncertainty. Regarding the communication factors, the corresponding three variables were: i) signal frequency and clarity, ii) professionalism, and iii) cosmopolitanism.

2.2.12.1 Industry Heterogeneity

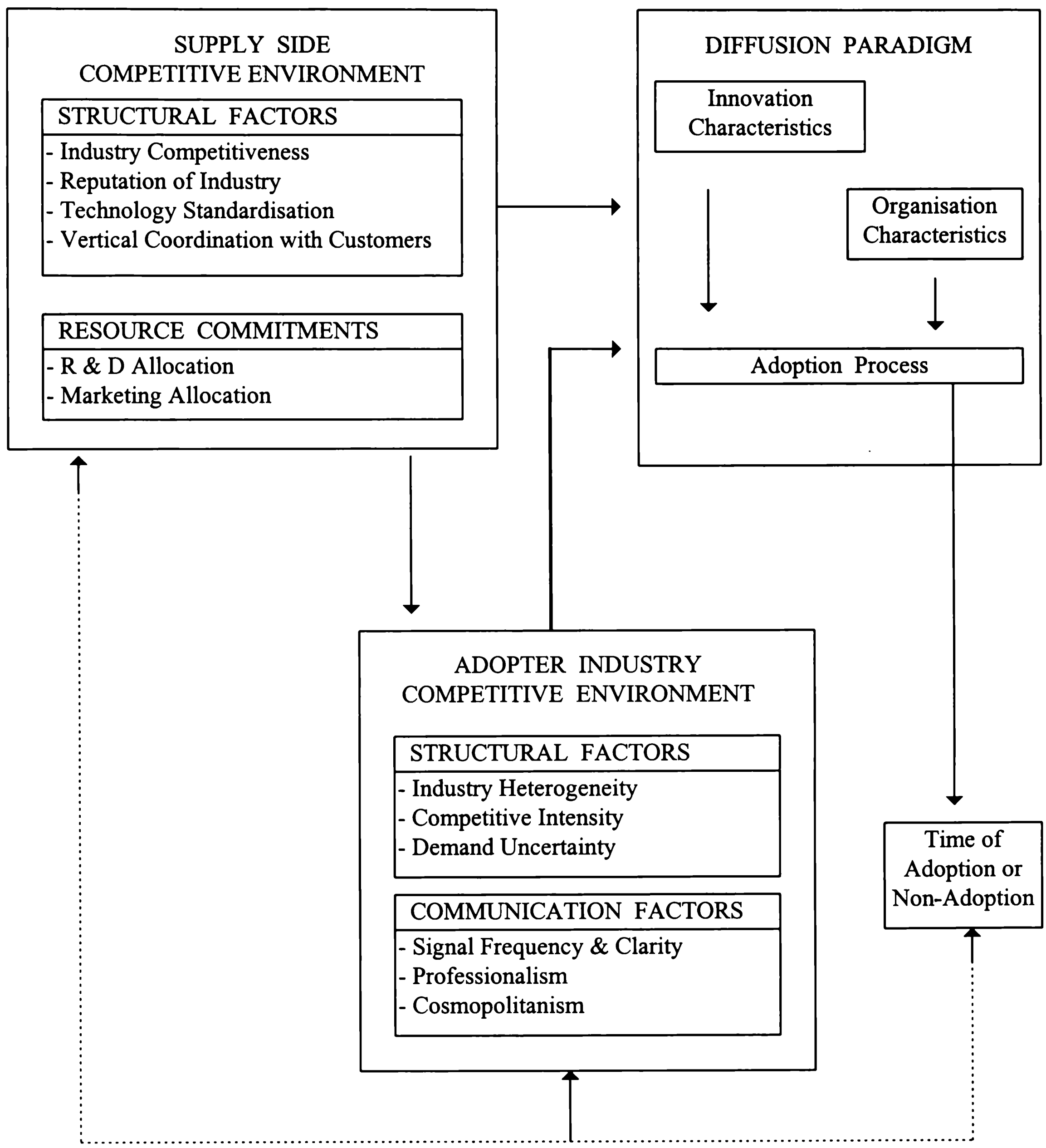
Robertson and Gatignon defined industry heterogeneity as “the extent to which differences exist between organisations within an industry” (p 6). Previous research had found that heterogeneity improved the dynamics of the industry environment through organisations’ continuous search for competitive advantages (differentials) thereby vitalising the innovation adoption process (Balsridge and Burnhams 1975; Kaigler-Evans et al 1978; Mintzberg 1979).

2.2.12.2 Competitive Intensity

Competitive intensity means the degree of competition between organisations. It is certain that the competitive environment of a market can influence the innovative behaviour of firms. However, the exact effect is not so certain.

Moderate levels of competitive intensity can cultivate innovation adoption. On the other hand, the technological superiority gained from continuous adoption of innovation is also an excellent means of creating or maintaining an effective barrier to entry. Therefore, on the one hand, competition can foster innovation adoption. On the other hand, in order to maintain barriers to entry, organisations operating in a monopolistic environment are also inclined to adopt innovations (Baker et al 1967; Levin 1978; Robertson and Gatignon 1986; Utterback 1974).

Figure 2.2: A Competitive Behaviour Paradigm For Technology Diffusion Among Organizations



Source: Robertson and Gatignon 1986, 2

2.2.12.3 Demand Uncertainty

Demand uncertainty exists when an organisation is unable to predict the level of demand and level of marketing activities. When operating under demand uncertainty, organisations tend to seek out additional market information, to assume more risks, and to endeavour to adopt novel technology. As a result, such organisational behaviours can greatly enhance the propensity of innovation adoption (Dasgupta and Stiglitz 1980; Ettlie and Bridges 1982; Germain 1996). This is also reflected by a recent study which found that technology-oriented firms under demand uncertainty would result in better performance (Gatignon and Xuereb 1997).

2.2.12.4 Signal Frequency and Clarity

Signals mean announcements or explanations made by organisations on their intentions for making new investments, developing new production processes or made new product introductions. Signal frequency is related to the amount of signalling about the adoption of new technologies by organisations within a social system. Signal clarity refers to the quality and accuracy of communications related to the adoption of innovations carried out among organisations of a social system. It has been found that organisations more active in searching and exchanging information with other members of the social system are more likely to adopt innovations (Robertson and Gatignon 1986).

2.2.12.5 Professionalism

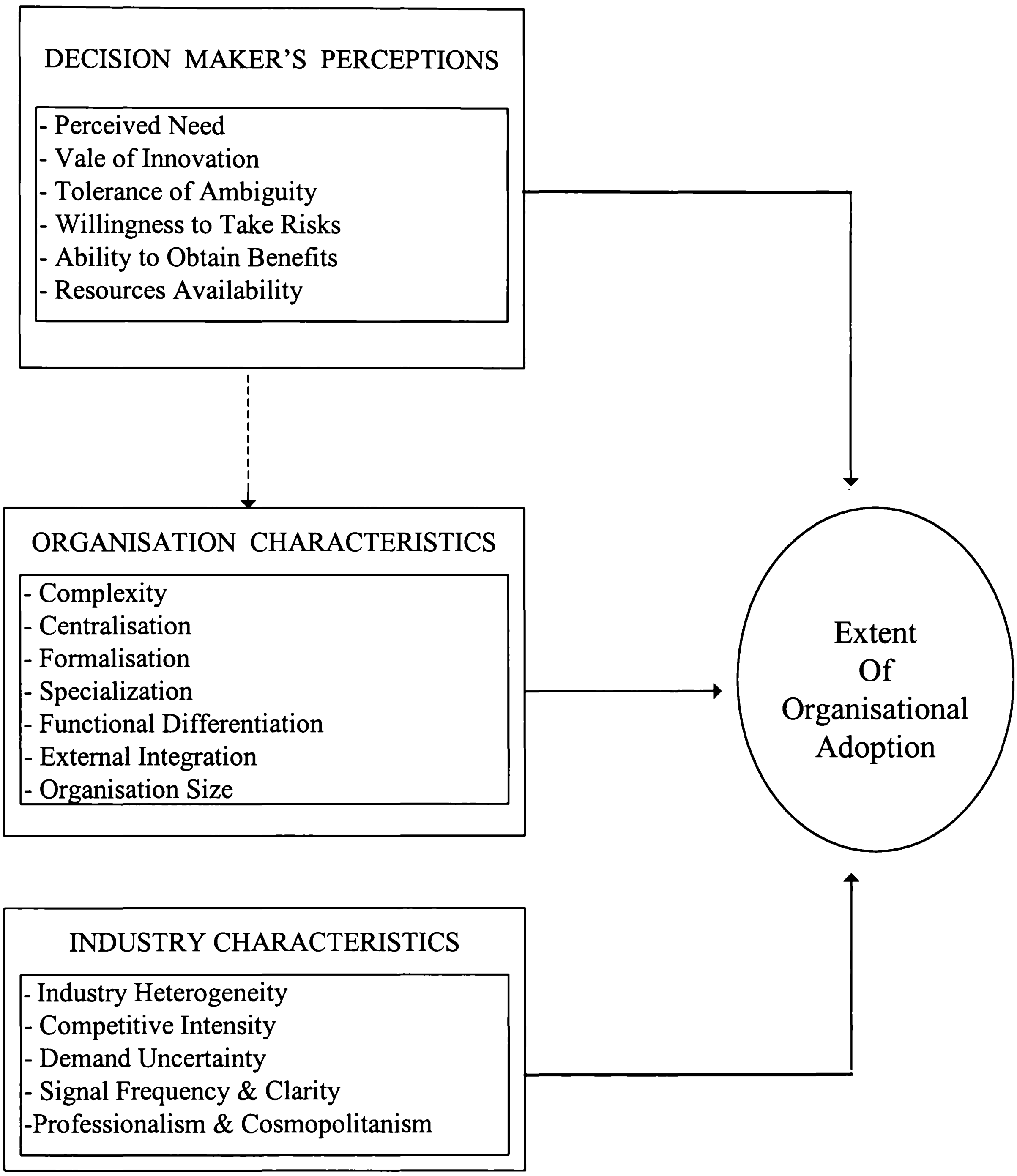
Professionalism means the degree of industry identification with the respective profession or the organisation. It has been found that professionalism can, in general, facilitate diffusion of innovations through the characteristics of a professional work force such as: i) additional experience, ii) self-confidence, iii) additional inputs from external resources, and iv) commitments to progressing beyond the status quo (Leonard-Baritone 1985; Pierce and Delbecq 1977; Swan and Newell 1995).

In particular, the existence of professionalism among members of an organisation can increase the possibility of interorganisational information exchange. In fact, professionals are more inclined to be receptive to innovative ideas which are perceived to be relevant to their needs (Bigoness and Perreault 1981; Leonard-Barton 1985; Moch and Morse 1977; Robertson and Wind 1983).

2.2.12.6 Cosmopolitanism

Cosmopolitanism refers to the "external orientation of members of an industry" (Robertson and Gatignon 1986, 8). Many studies suggested that external linkages had a positive impact on rate and direction of innovation and diffusion (Kimberly 1978; Kimberly and Evanisko 1981; Robertson and Wind 1983; Rogers 1983; Swan and Newell 1995; Teece 1996). The effect of cosmopolitanism on innovation adoption is affected by the level of external integration within the industry. Interestingly, the concept of cosmopolitanism is often used in the individual or organisational context. However, Robertson and Gatignon (1986) contended that cosmopolitanism can be applied at an industry level by measuring the level of international sales, number of market segments, and number of employees with working experience in other industries.

Figure 2.3: Factors Affecting Innovation Adoption in Organisations



2.2.13 A Framework of Organisational Adoption

To summarise what has been discussed so far, a framework of organisation adoption is presented. Firstly, this chapter has demonstrated that the literature of organisation adoption has traditionally focused on three factors: i) individual decision makers within an organisation, ii) organisational factors; and iii) industry factors. Figure 2.3 depicts the relationships between these variables and the organisation adoption behaviour.

2.3 International Technology Transfer

This section focuses on reviewing the conceptual development of technology transfer models. As the subject of international technology transfer have evolved over the years, conceptual models developed to explain this process have become more comprehensive. With the maturity of these international transfer models, broader recognition of non-economic influences such as political and social factors have also been incorporated into explaining the transfer process.

Technology transfer has been defined as a technology movement through which people, firms, or countries share, lease or sell technological know-how

(Asheghian and Ebrahimi 1990; Contractor and Sagafi-Nejad 1981; Daniels and Radebaugh 1992.) The technology transfer process includes various aspects: 1) a technology; 2) a country to which the technology is transferred; 3) a recipient of the technology; and 4) a mode for transferring the technology from the supplier to the recipient. Hence, since technology transfer involves two parties, the suppliers and the recipients, two major streams of research have emerged over the years. The first stream are the fields relating to corporate policy, organisational behaviour, and strategic management issues which focus on the supplier side of technology transfer. The second stream investigates issues concerning the absorptive capabilities of the recipients (McLntyre and Papp 1986.)

As mentioned in the previous sections, there exists a large body of literature on the subject of technology transfer which far exceeds the scope of this study. Therefore, for the purpose of this research, only literature on international technology transfer is discussed.

The growing interest in understanding international technology transfer has given rise to the development of models spanning a variety of disciplines, and three groups are of special relevance to this research as they serve to enhance our understanding of the diffusion and adoption process.

The first group of models is related to communications concepts, especially those oriented around cross-cultural settings and those with various levels of technical education. The relevance of this grouping stems from the fact that technology transfer basically involves the transmission and reception of technology know-how. Therefore, it is, in essence, a communication process.

The second grouping considers technological development as a life form which experiences various stages in a technology life cycle. This group of models looks at topics such as the propensity to transfer technologies which are at their maturity stage; the protection of proprietary property of a firm; and the pace of new technical development.

One inseparable element in the quest for understanding of international technology transfer is the diffusion process. Diffusion research has already been discussed in the last section. However, besides considering the diffusion models separately, some models have incorporated both communications concepts and diffusion characteristics in a cross-cultural context. This is the third group of models this section will be reviewing. The following sections provide a detailed discussion of these three groupings one by one.

2.3.1 Communication models

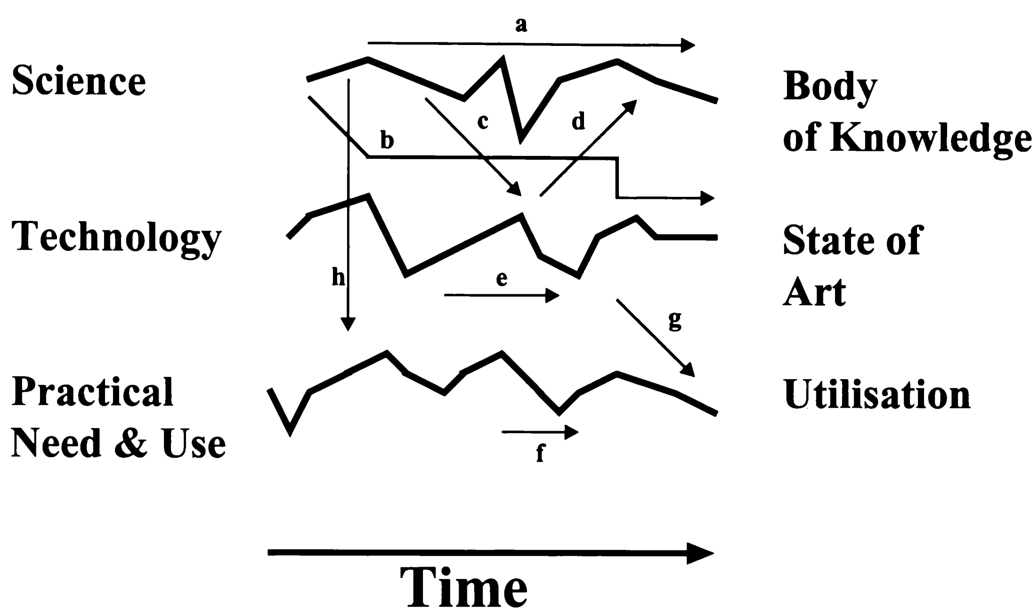
The first group to be discussed involved the communication models. Marquis and Allen (1966) described the relationships between technology change and communication flows as a time line. The purported technology-associated communication flows follow a three-level pattern:

1. science, as a body of knowledge;
2. technology, as a state of the art application of knowledge; and
3. utilisation of knowledge, as a drive motivated by practical need (Marquis and Allen 1966, 1053)

Figure 2.4 exhibits the pattern of the communication flows. Marquis and Allen described the pattern as a series of interdependent communication flows which were composed of eleven paths, that is Path a to Path g.

Path "a" describes communications among scientists who are working in different fields but with a substantial common core of knowledge existing among them.

Figure 2.4: Paths of Technology Communication

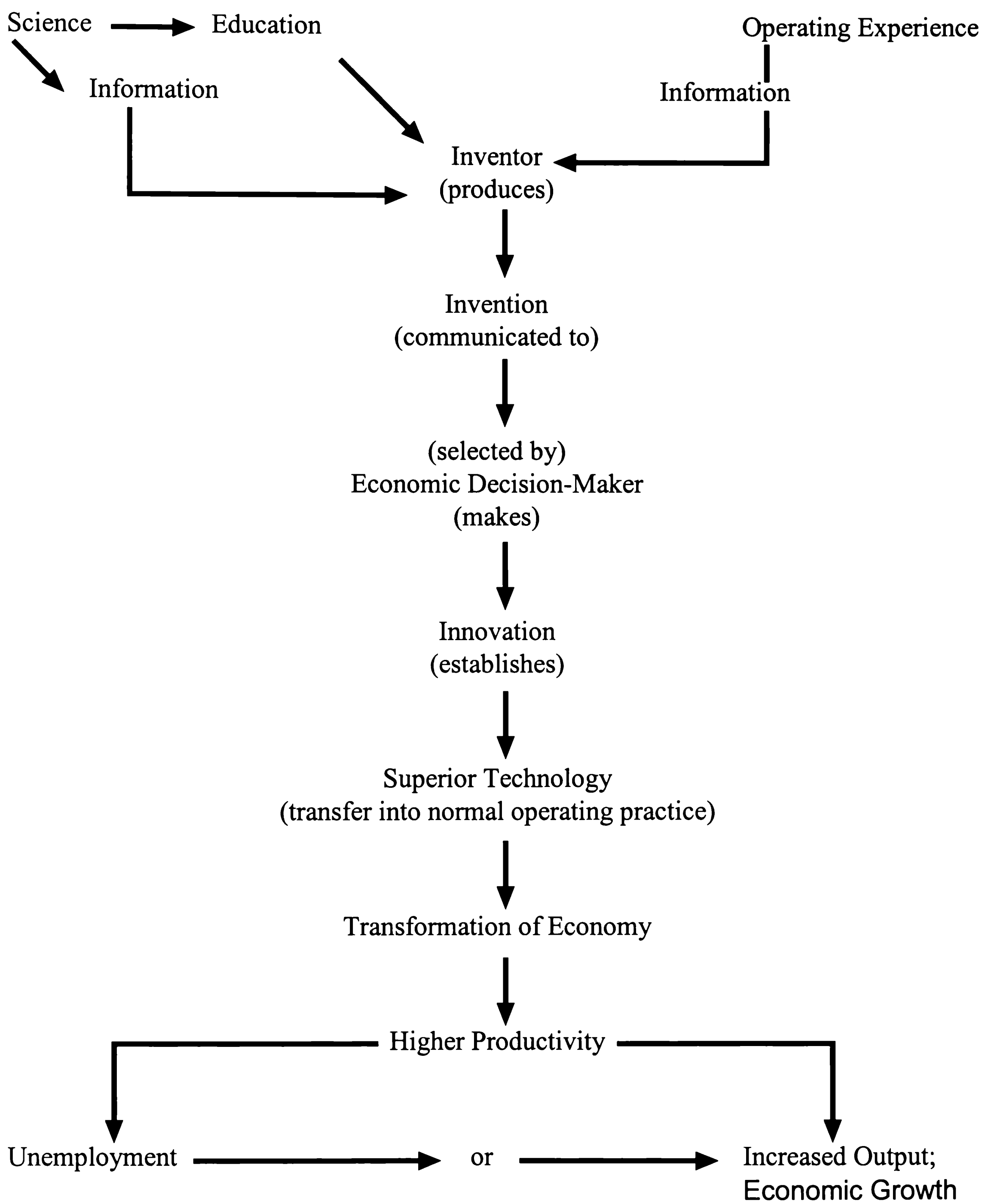


Source: Marquis and Allen (1966, 1053)

Paths "b" and "c" both reflect the retransmission of information from the scientific segment to the technological one. The difference between "b" and "c" is that path "c" represents a fast gap. Path "d" mirrors a return of know-how from technology to science in the form of new instruments. Path "e" illustrates the effects of technology feeding its own growth through continuous innovation. Path "f" is the diffusion of innovation at the technology segment as a result of an increase in both awareness and understanding of the new technology by users. Path "g" exhibits the application of innovation during the stage of technological refinement; while path "h" shows the direct application of scientific knowledge at the practice level, perhaps after the lapse of a rather long period of time. Last but not the least, the most appropriate path to describe the conception of international technology transfer; hence most relevant to this study is path "f" which depicts the dissemination of knowledge at the practical level inspired by a need for economic development.

The relationships between technology transfer and economic growth have long been studied by economists in an attempt to understand the mechanism behind economic development (Raj 1991). One of the earliest studies was conducted by Solow (1972) who suggested that new technologies are prime determinants of economic development though their ability to increase productivity. In particular, Solow set out the critical role of communication in the process of technological evolution. Figure 2.5 depicts the kind of technological communication cascading down from the stage of pure scientific development to the realisation of economic growth.

Figure 2.5: Technology Transfer and Economic Growth



Source: Solow (1972, 7)

As described in Figure 2.5, technological innovative information must be transmitted and received during each and every stage of the interface before it can finally be used to transform the economy through increasing productivity. Hence, rather than the unique problem of the developing world, technology transfer, when considered from the context of communications, is a common problem shared by suppliers and recipients alike.

Brasseur (1976) further suggested that, in order to effect successful technology transfer, effective technical communications must be based on the existence of a common frame of education, training and know-how environment. However, complications occur when transfers were made in multi-lingual, cross-cultural settings. Language was only a partial problem.

Technology transfer was also blocked by ineffective communication techniques, which in turn, sometimes resulted from differences in professional experiences and knowledge between the suppliers and recipients of the technology.

For example, transmitters with superior technical expertise often like to communicate at the top level of their knowledge. Hence, if the recipients do not process the same level of knowledge of the transmitters, recipients may fail to comprehend the message.

A well-trained sender of knowledge should lower the level of knowledge transmitted until the peak of the receiver's knowledge has been reached; above which a communication barrier exists. However, in the area of advanced technology, the sophistication of the subjects may prohibit the use of simpler terms of knowledge.

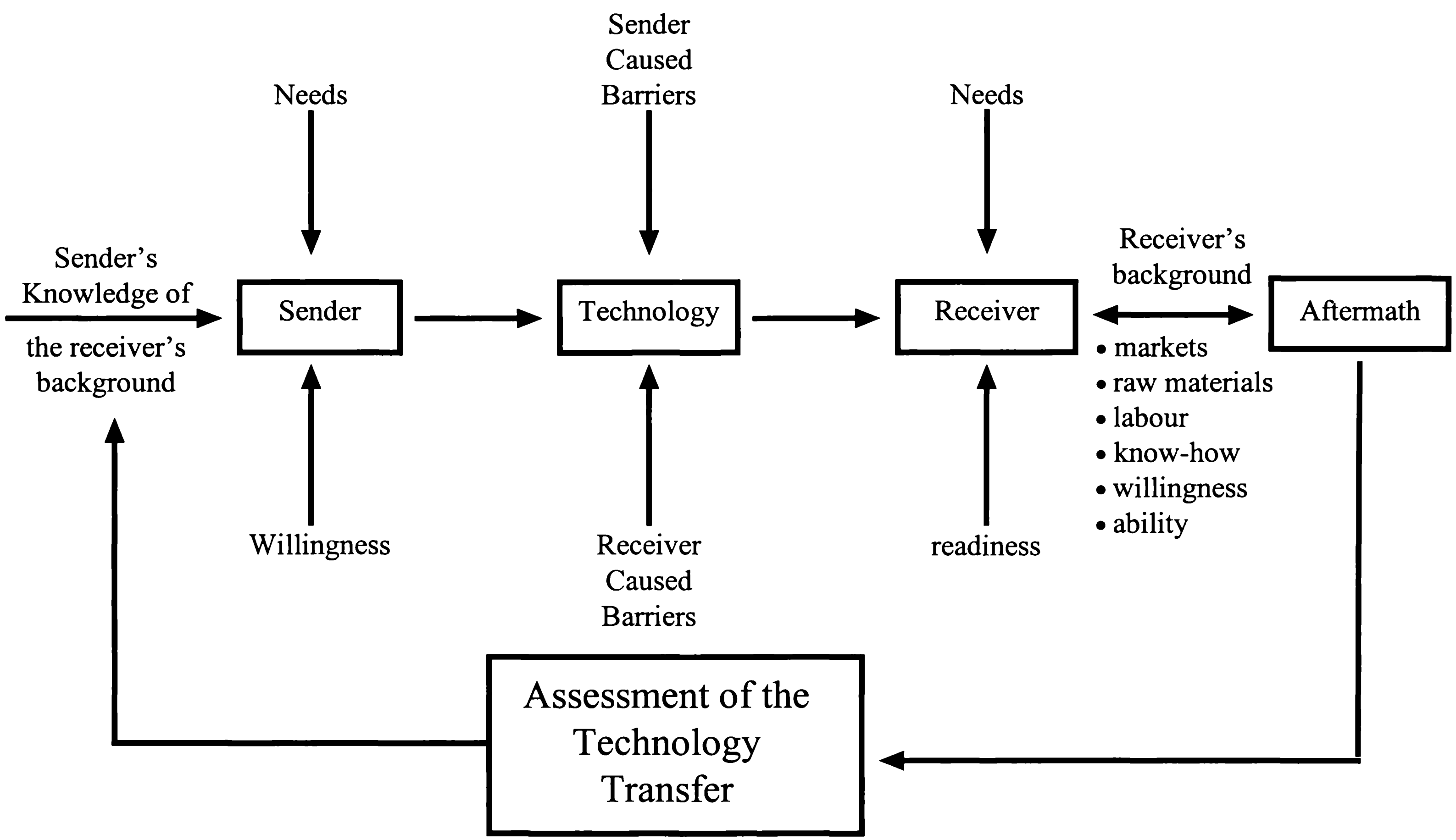
The situation can be further complicated when cross-cultural transmission is needed. Even when the recipients can speak the transmitters language, cultural differences can hinder the effective communication of technical knowledge. As an example, for some cultures, communication can simply be blocked through a general reluctance to admit ignorance to avoid a loss of face.

Under such circumstances, it is very difficult for the transmitters to recognise whether an intellectual connection can be established hence, resulting in some loss of essential knowledge. The complexity of the situation can further be raised when the senders and receivers do not speak the common language (Brasseur 1976, 12-19).

Samli (1985) not only considered the communication process, he also described a kind of suspended tension during the communication process between senders and receivers focusing on the technology. Figure 2.6 illustrates this process.

In Samli's model, both the behaviours of the sender and receiver are conditioned by their assessment of the impact of their prior experiences on technology transfer. In addition, Samli also included in his analysis the concept of technology appropriateness which could be evaluated according to five factors: market characteristics, raw material availability, economies of scale, labour intensity and machinery adaptability (1985, 9).

Figure 2.6: International Technology Transfer Model



Source: Samli (1985, 9)

2.3.2 Life Cycle Models

The next group of models involves the life cycles models. Under this type of model, technology, conceptually, is believed to have evolved in a time-related dimension and a demand/need-related dimension. There are three elements to the pattern of technology transfer: invention, innovation, and diffusion. Within the demand/need-related dimensions, inventions alone cannot give rise to economic development unless the potentials of the invention have been realised by an innovative process before it is diffused to the economic system (Schumpeter 1939). Hence, invention not only has to be creative but also needs to be perceived as relevant before it is adopted for use.

For the time-related dimension, Burgleman and Maidique (1988) described the technology life cycle as composed of three stages: 1) development; 2) application; and 3) degrading. The process which technology penetration goes through as a function of time resembles those of a product-life cycle or S-curve. However, one unique feature of the technology life cycle is that it treats technology as disembodied from products in the early and latest stages of the cycle. In the initial stage of technological development, technology is independent of its application to products developed thereafter. Likewise, as the penetration of technology moves to its final stage, product revenue growth begins to decrease. This triggers the sales of the technology as a way to maximise the scrap value. This distinction is particularly relevant when the cost-risk-benefit-related propensity to transfer technology is considered within the global context.

2.3.3 International Models

The third groups of models are the international models (Holstius 1995). Within international technology transfer models, the impacts of culture are considered. Kedia and Bhagat (1988) were unique in their direct recognition of cultural variations under both the national and organisational settings. In Kedia and Bhagat's model, technology dimensions and organisational cultures were brought together as influential factors affecting the effectiveness of technology transfer. Furthermore, societal cultural differences and the absorptive capacity of the recipient were included as moderating factors.

Kedia and Bhagat (1988) utilised Hofstede's four cultural dimensions (1980) and the abstractive-associated cultures dimension suggested by Glenn and Glenn (1981) to measure the societal culture dimension of their own model. Hence, the five dimensions are: 1) uncertainty avoidance, 2) individualism, 3) power distance, 4) masculinity, and 5) abstractive vs. associated cultures.

Perhaps the most comprehensive model of international technology transfer developed so far is that of Robinson (1988). However, the focus of the model is developed from the perception of the suppliers.

In an attempt to provide an overall conceptual framework, the Robinson model (1988) is developed around three interrelated aspects of an international technology transfer:

1) the propensity of a supplier to transfer technology;
2) the propensity to transfer externally or internally; and
3) the choice of technology.

The complexity of the model stems from the fact that each of these three decisions is not only conditioned upon an independent set of variables but also depends upon the interaction with an adjacent decision. For example, technology choice is affected not just by an array of direct variables but also by the decision to transfer internally or externally. In addition, a firm may favour an internal transfer for a highly proprietary technology. However, with host government intervention on the mode of transfer (such as allowing only external transfer), only more mature technologies may be considered for transfer.

The process of technology transfer is described to be triggered by the sole propensity of the supplier firm to transfer. This propensity to transfer technological know-how is considered to be a reciprocal decision initiated by whether an external or internal transfer is preferred or conditioned.

The model also incorporates the concept of perception in the assessment of costs, risk and benefits. The perceived costs and benefits of the technology transfer transactions, in turn, can affect the firm's propensity to transfer technology as well. In fact, this is the most complex component of the model. Robinson recognised that cross-cultural factors influence not only the transfer process, but also the supplier's decision-making process. The relationships between the cost-benefit trade-off and the cultural factor stems from its association with risk aversiveness: some cultures are more risk aversive then others. Hence, within the context of endogenous firm variables and exogenous country variables, which will be discussed below, the propensity to transfer is inherently governed by the perceived net outcome of cost-benefit analysis adjusted for the level of perceived risk.

Perceived benefits are anticipated to accrue from the following factors:

1) market penetration,

2) augmented competitive position,

3) preferential tax treatment,

4) reduced costs of production, and

5) other government incentive such as monopoly.

On the other hand, perceived costs of transfer stem for the following factors:

1) investment costs,

2) lack of compatibility between host and home country environment,

3) communication clarity, and

4) complexity of the technology in relation to recipient's ability to absorb.

Risk is perceived to be affected by the following factors:

1) degree of integrity of the recipient or the host country environment,

2) viability of contracts, arbitration and protection of intellectual property, and

3) availability of insurance to lower the risk.

In describing the choice decision, Robinson's model brings together one set of direct variables, three sets of indirect variables and the transfer mechanism into the analysis. The three sets of indirect variables relate to:

1) home country environment,
2) host country environment, and
3) costs of modifying technology.

The first set of variables is composed of a broad range of exogenous host country environmental factors such as political, economic, and social characteristics; government policy; infrastructure; technology appropriateness; and political and economic relations with the home country government.

The second set comprises host government policy; availability of external financing; tax treatment, regulations on competition; restrictions on exports, and political and economic relations with the host government.

The third set includes the five dimensions of the technology influencing the cost of modification: availability, environmental specificity, factor substitutability, and scale and firm specificity.

Finally, the set of variables described to have a direct impact on the technology choice decision relates to the relative importance, maturity, continuity, and the process/product orientation characteristics of the technology.

With regard to the question of the propensity to transfer internally or externally, home and host government policies, no doubt, play a significant role. Over and above government incentives and restrictions, the following factors play a decisive role:

1) the maturity of the supplier firm in international business and technology transfer;
2) the ability of the supplier in effective cross-cultural communications; and
3) the nature of the technology.

Regarding the third point, the propensity to utilise internal transfer mechanism is more intense, the more central the technology is. This is for the protection of a firm's proprietary assets. Likewise, when a firm is confident that its considerable research and development capability can generate abundant follow-on innovations, and together with intensive international competition, the firm is more inclined to adopt a disembodied transfer mechanism.

Finally, a vast number of studies also examined international technology transfer and adoption on a country or regional basis and resulted in calling for governments to provide various forms and types of supports, ranging from active intervention such as direct subsidies to passive support such as the development of science park (some of the more recent studies are: Al-Ghailani and Moor 1995; Ambrosio 1995; Baba and Hatashima 1995; Crow and Nath 1992; Kim and Ro 1995; Kumar and Neyer 1992; Tang and Yeo 1995; Wong 1995).

2.4 Technology Adoption Model

Technology adoption models focus on delineating the impacts of both the internal and external factors affecting the adoption decision. One branch of this type of studies relevant to this research is the behavioural model of technology acceptance which is designed to portray the causal linkages between external variables, beliefs, attitudes, and behaviour intentions towards adoption.

Recently, Herold, Farmer and Mobley (1995) studied on the anticipatory reactions of workers to a possible adoption of robotic technology. They found out factors which would positively and negatively affect pre-adoption attitude of workers towards adoption and demonstrated the importance of anticipatory reactions on the shaping of interventions later in the implementation process.

In addition, Tyre and Orlikowski (1994) further found that the process of technology adoption did not happened in a gradual fashion, but was a rather short and discontinuous process. Moreover, there has been some discussions on at which point in time should the beginning of an adoption process be defined

(Hartwick and Barki 1994; Herold et al 1995; Leonard-Barton 1988; Tyre and Orlikowski 1994). The argument seemed to have stemmed from whether the beginning earmark should be at the physical installation of the technology or at the initial formation of attitudes towards such a technology before the adoption was to be ultimately confirmed.

Kitchell (1995) tried to look at technology adoption from a corporate cultural perspective and concluded that "corporate culture is predictive of technology adoption" for companies attempting to survive in a competitive international environment (p195.) This study belonged to a volume of literature which look at the linkage between corporate culture, innovation adoption and environmental influence (Achrol 1991; Attewell 1992; Cherian and Deshpande 1985; Deshpande and Webster 1989; Gatignon and Robertson 1989; Smircich 1983; and Smircich and Stubbart 1985.)

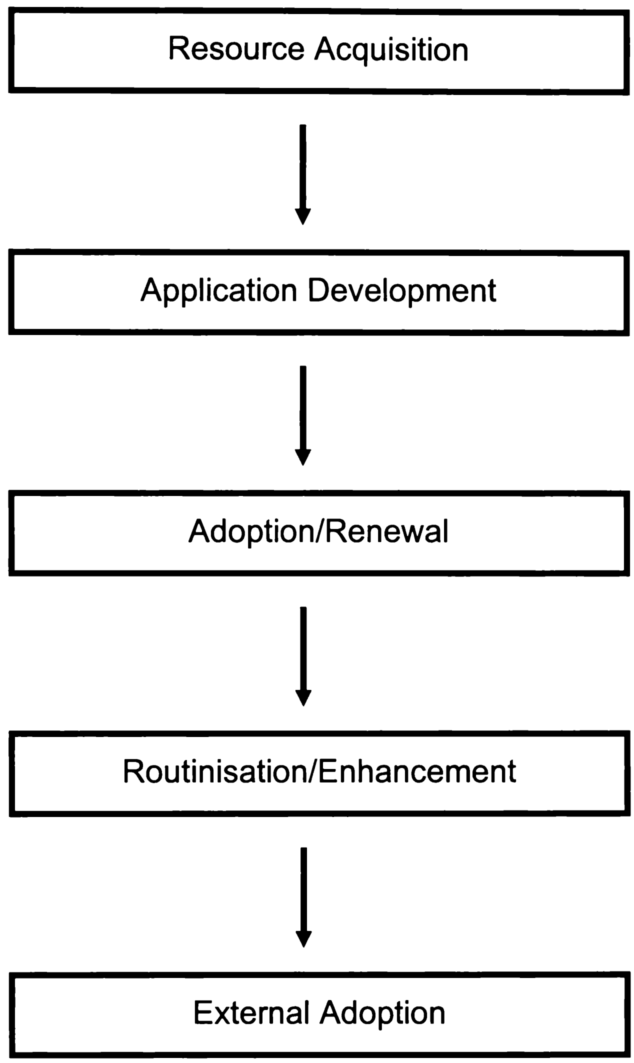
In addition, a reveal of previous literature also further indicated that technological adoption models could be divided into two levels: at the organisation's level and at the decision-maker's level. The majority of the research seemed to have focused on the organisation's level.

When looking at innovations from an organisational context, researchers tended to agree that technological innovation adoptions should be going through stages.

This seems to be the level of consensus achieved. Obviously, different studies would propose different level of stages where an innovation adoption could take place and there were also disagreement regarding the benchmarks of when a stage started and when it finished (McKenney and McFarlan 1982; Rogers 1983; Wildemuth 1992).

Striving to provide answers to these questions, Wildemuth (1992) developed a grounded model of adoption and concluded that organisational adoption of intellectual technologies followed five stages: resource acquisition; application development; adoption/renewal; routinisation/enhancement; and external adoption, as depicted in Figure 2.7.

Figure 2.7 Stages of Adoption Process



Source: Widemuth 1993, p218

As mentioned earlier, Gatignon and Robertson (1986) developed a diffusion paradigm showing the interactions between competitive forces and diffusion.

Subsequently, Gatignon and Robertson (1989) empirically tested this organisational adoption model. The model strives to explain adoption or rejection behaviour by examining four sets of factors:

1) the adopter industry environment,
2) the supply-side competitive environment,
3) organisation/task characteristics, and
4) decision-maker information processing characteristics.

Perhaps the most significant contribution of the work of Gatignon and Robertson is the development of a model which can be used to predict the organisational adoption/rejection decision. Central to the organisational decision-making process is the effect of the competitive variables in influencing the individual informant's own decision on adoption. However, the model fails to provide the most important missing piece of the jigsaw describing the adoption decision-making process - a comprehensive model delineating the shaping of an individual adoption decision.

This observation is also supported by various studies (Goodman and Griffith 1991; Kelly & Kranzberg 1978; Kimberly & Evanisko 1981). Kelly and Kranzberg (1978) argued that literature on innovation was "fragmentary (p164), while Kimberly and Evanisko (1981) suggested that the literature was "contradictory" (p698.) For Goodman and Griffith (1991), they noted that there was an absence of strong theories which relates factors in a coherent manner. They further suggested that many studies just presented the different variables which might affect adoption but did not go into details as to how and why they behaved in such manners.

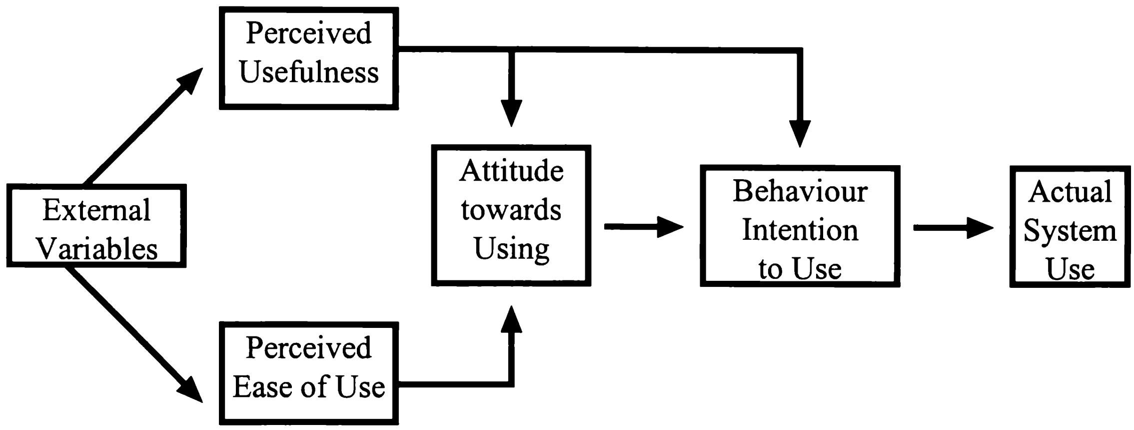
Davis (1986) seemed to have provided a solution. He proposed the Technology Acceptance Model to specifically describe user's acceptance of information systems. Adapted from the Theory of Reasoned Action (Fishbein and Ajzen 1975), the Technology Acceptance Model attempts to explain the determinants of computer acceptance by tracing the impact of external factors on internal beliefs, attitudes, and intention (Davis, Bagozzi, and Warshaw 1989).

The model postulates that two beliefs dictate the computer acceptance behaviour:

1) perceived usefulness, and
2) perceived ease of use.

How these two beliefs work to influence acceptance behaviour is described in Figure 2.8.

Figure 2.8: Technology Acceptance Model



Source: Davis (1986)

Perceived usefulness is defined as the probability perceived by the prospective users that the using of a specific application system will enhance the job performance. Perceived ease of use concerns the degree to which efforts have to be made for the adoption of a targeted system (Davis, Bagozzi, and Warshaw 1989, 985). They also found that both factors are related but statistically distinct dimensions of technology acceptance behaviour. In addition, it is considered that both the perceived usefulness and ease of use factors are determined by external variables. These external variables again serve as the bridge through which internal beliefs, attitudes, as well as intention of adoption are connected with various individual differences, situational constraints, and managerial interventions.

The Technology Acceptance Model also suggested that attitude toward adopting a certain computer system is jointly determined by perceived usefulness and perceived ease of use. The exact relationships between these variables can be estimated by linear regression. In addition, perceived usefulness is argued to be positively related to the attitude of adoption because of the anticipated positive relationship between attitude and intention. Two basis mechanisms, self-efficacy and instrumentality, facilitate the perceived ease of use factor's influence on attitude. This is because the easier the system is perceived to be, the greater will be the user's sense of efficacy and control over the system. The instrumental effect of a system comes from the improved performance of the user to discharge his/her job after using the system.

Furthermore, perceived usefulness, again, can directly affect behaviour intentions. This relationship between the perceived usefulness and behaviour intention is activated under circumstances where affect does not have a full impact on the decision to adapt a specific system. Hence, the attitude is not expected to capture all the impact of the performance considerations on the intention.

Based on the well-established Theory of Reasoned Action, the Technology Acceptance Model has established a model to systematically describe the behaviour of innovation adoption within organisations. Even though the model is developed to particularly investigate the behaviour of making a specific acceptance decision, computer systems, the structure of the model, upon further exploration, can be extended to a generalised setting. Hence, this model may provide the most important missing link for understanding the adoption decision-making process - a comprehensive model delineating the shaping of an individual adoption decision upon the impacts of various external factors.

2.5 Summary

This chapter provides a review of the literature concerning the discipline of technology diffusion and adoption. The chapter first looks at the diffusion literature and the second part reveals the literature on adoption. The division of this chapter in this manner is because there exists a difference between the areas of investigation in these two topics.

It is very important to understand the distinction between the concept of technology diffusion and adoption. In analysing adoption, it is the decisions taken by economic entities to introduce the new technology into their activities which are of concerns. Areas of interests can be ranging from the nature and timing of the decision-making process to specific characteristics common to the adopting agents. Regarding the studies on diffusion, the central question is on the consequences of adoption in relation to the varying economic significance of the technology over time.

From the vast amount of literature on technology diffusion and adoption, only one thing is clear: innovations do not diffuse instantaneously and the pattern of diffusion varies across technologies.

During the course of reviewing past literature on the subject, it has demonstrated that innovation diffusion is a very complex matter which involves changes in behaviours of economic entities. The literature shows that academics have been trying in the past 50 years or so to find out: 1) what is innovation and technology; 2) how do decision makers make choices; 3) how do organisations become aware of the existence of innovations and how do the diffusion process occurs as well as the pattern of it; 4) how do organisations response to these new opportunities brought forth by new technologies which emerge to challenge long established patterns of activities; 5) what is the relationships between adoption behaviours and the surrounding environments, and in particular the competitive environment; and 6) how do the technology strategies of organisations and their interaction with other systems affect the choice of technologies.

Again, after reviewing the literature on technology adoption, there seems to be several deficiencies. First, the onus of the literature seems to have leaned towards studying the firm's level rather than on the unit's (or individual's) level. Second, despite previous literature has demonstrated the importance of innovation in affecting the survival of companies in turbulent environments, there are relatively few studies investigating explicitly the impacts of environment on innovation adoption behaviours. Third, human decisions are highly likely to be affected by psychological factors, little attempts has been made in the past to explore the relationships between psychographic factors and innovation adoption behaviours (Achrol 1991, Attewell 1992; Robertson and Wind 1980; Soni, Lilien and Wilson 1993, Kitchell 1995; Zeithaml and Zeithaml 1984).

Hence, Chapter Four will strive to address these issues through the development of a behaviour model to investigate factors affecting the international technology adoption decisions of manufacturers in Hong Kong. But, before going into the theoretical issues, a brief review of Hong Kong's manufacturing industries is provided in the next chapter to highlight the relevance of this research to the Hong Kong environment.

Chapter Three: A Brief Review of the Hong Kong Industry

3.1 Introduction

"Twenty years ago, it would have been rare indeed to find anyone who believed that industry in Hong Kong had no future at all. Today, such a view is common. In the course of our research we encountered a widespread belief -- among government officials, in the universities, in the press, and even in industry itself -- that high land and labour costs and the lack of technological investment are making industry in Hong Kong terminally uncompetitive, ... and that Hong Kong is ... to becoming a 'post industrial' society." (Berger and Lester 1997, p 27)

The quotation above is taken from "Made by Hong Kong" which reports the finding of a team of researchers at the Massachusetts Institute of Technology (MIT) on the future of Hong Kong industries. The above quotation is definitely not the view of the MIT's research team. However, as the report suggested, this is the dominant view shared by many people in Hong Kong. To understand how this pessimistic view is formed, the best way is to look at the current performance of the manufacturing industries in Hong Kong.

3.2 An Overview of Hong Kong's Manufacturing Industries

The watershed of the industrial past of Hong Kong can be dated back to the Second World War. Before the outbreak of World War II, manufacturing power was primarily of local importance. The post-war era saw the two massive inflows of immigrants and capital to Hong Kong. These two inflows were of unsurpassed importance to Hong Kong for her future development into one of the world's most spectacular economic miracles.

The first ever industrial establishment can be dated back to 1843 where Hong Kong started its shipping industry. In 1860, Hong Kong saw its largest graving dock opened at Aberdeen. Then, eighteen years later, Hong Kong had its first sugar refinery. Again, in 1885, a rope factory was founded and after another fourteen years Hong Kong opened its first cement factory. In the same year as the cement factory, the first spinning mill was also established but was not successful and eventually closed down. The year 1906 also saw the founding of Hong Kong's first iron mining operation and a flour mill. However, industrial activities were not the major sector of the economy at that time. The major income earners for Hong Kong at that period were entrepot activities.

The outbreak of World War I provided the first driving force to the development of Hong Kong's light industry. Between the years 1914 and 1918, the war in Europe deprived Hong Kong of supply of a number of industrial products. This sparked the beginning of local manufacturing of these products, such as towels, biscuits and etc.

But, the local manufacturing activities were still comparatively minor amidst the entrepot activities in Hong Kong. However, the introduction of the Imperial Preference under the Ottawa Agreement provided the biggest incentive for Hong Kong manufacturers to start up their first international trading activities and compete beyond their adjoining areas. The year 1935 witnessed the upsurge of the manufacturing sector as one of the major income earners for Hong Kong, with knitting and weaving, flashlights and rubber footwear industries playing a leading role.

Unlike World War I which was mainly fought in Europe, the period during the Second World War which stretched its battle field to the Asia Pacific region, inflicted severe damage on Hong Kong's industrial development. The aftermath of World War II saw the revitalisation of the development of Hong Kong's industry. In the four years of the civil war in China and subsequently the Communist victory in 1949, there was a massive influx of refugees. The population in Hong Kong between 1945 and 1949 grew by over 75 percent. The second wave of immigration from China happened during the Cultural Revolution in China between the 1960s and 1970s.

Such a massive inflow of migrants caused serious problems for the Hong Kong government. In order to avoid massive unemployment and hence, social unrest, the Hong Kong government was forced to set up the Department of Commerce and Industry in 1949 and began to lay down policies to provide a more favourable environment for local industries to grow such as the establishment of the Tai Po and Yuen Long industrial estates.

The major industries at that time were mostly involved in cotton spinning and weaving activities. This is because the influx of migrants from China not only brought ordinary people, but also rich Shanghai industrialists, many of whom used to be successful operators in the textile industry. The wealthy textile entrepreneurs not only injected capital and advanced technology into Hong Kong. Their major investment in the textile industry also forced the British government to start allowing Hong Kong to negotiate internationally as a separate customs territory in bilateral and multilateral commercial agreements because of a conflict of interest with the British textile industry. This practice is still in place even after Hong Kong's reunification with China.

Hence, the initial success of the industrialisation process in Hong Kong was developed out of chaos in China. Ironically, the second wave of industrialisation was again born out of the crisis in China. In 1951, the United Nations issued a trade embargo against China. This embargo, in effect, destroyed Hong Kong's heavy reliance on entrepot trade. Since that time, the economy of Hong Kong began to undergo a fundamental change in its drive for economic development. Hong Kong commenced another economic structural adaptation, with a move towards an industrial economy. Hence, the number of manufacturing establishments expanded by more than 260 percent to 5,346 and the number of people employed in the manufacturing sector increased by 160 percent to 218,405 during the decade of the 1950s. By 1961, the manufacturing sector accounted for 40 percent and 25 percent of total employment and of the total GDP in Hong Kong, respectively (Hong Kong Industry Department 1995).

From this modest start, the manufacturing sector has set a course of development which dominated the economic well-being of Hong Kong people for a further 40 years. But, other incidents developed in the late 1970s and earlier 1980s, such as the Open Door Policy of China and the 1997 issue, which, once again, have changed the role of the manufacturing sector in the economic development of Hong Kong. Unfortunately, this time, it is for the worse for this sector; in spite of the continuously strong economic growth experienced by the territory.

The economy of Hong Kong has grown significantly during the past two decades. Government statistics show that between 1975 and 1995, the total Gross Domestic Product (GDP) and per capita GDP have experienced a real annual growth rate of 7.5 percent and 5.7 percent, respectively (Census and Statistics Department 1996). Calculated in purchasing power parity, the GDP per capita of Hong Kong people by 1994 reached US$23,080 which is significantly higher that her major Asian competitors, such as Singapore ($21,430), Taiwan ($13,022) and South Korea ($10,549) (The Economist March 6, 1996.) Part of Hong Kong's success derives from her strong export position.

3.3 Hong Kong's Export Performance

As a small open economy, Hong Kong has no choice but to rely heavily on exports to achieve its economic growth. This is manifested by the fact that about 80 percent of Hong Kong's industrial output is for export purposes. Domestic exports grew from HK$2,867 million in 1960 to a peak at HK$234,123 million in 1992. Hong Kong experienced a decline in exports in 1993 and 1994 to $223,027 million and $222,092 million, respectively; but started to pick up again in 1995 and rose to $231,657 million (Census and Statistics Department 1996).

As revealed in Table 3.1, in 1993, China became the largest market for Hong Kong's exports, surpassing the United States which was the biggest buyer for Hong Kong's exports since 1960 (Census and Statistics Department 1996).

In fact, starting from 1984, China has been the second largest market for Hong Kong's domestic products and experienced an annual average growth rate of 35.8 percent between 1970 to 1995. Exports to China in 1995 were $63,555 million which represented 27.4 percent of Hong Kong's total domestic exports and 3.8 percent more than those to the United States (Census and Statistics Department 1996).

As the economy of Hong Kong grows, the relative role of the United States as the single most important buyer of Hong Kong exports has gradually declined. Despite domestic exports to the United States expanding at an average annual rate of 10.4 percent from $5,190 million in 1970 to $61,250 million in 1995, its importance in terms of her share in Hong Kong's total domestic exports dropped from 42.0 percent of in 1970 to 26.4 percent in 1995 (Census and Statistics Department 1996). In other words, Hong Kong has been gradually reducing its reliance on a single market as her economic power ascended (See Table 3.1).

Table 3.1: Value of Hong Kong's Domestic Exports (in HK$ Million)

Market	1970	1980	1990	1995	Average Growth
China	30 (0.2)	1605 (2.4)	47470 (21.0)	63655 (27.4)	35.8%
USA	5190 (42.0)	22591 (33.1)	66370 (29.4)	61250 (26.4)	10.4%
Singapore	280 (2.3)	1791 (2.6)	7796 (3.5)	12236 (5.3)	16.3%
Germany	985 (8.0)	7384 (10.8)	17991 (8.0)	12178 (5.3)	10.6%
Japan	492 (4.0)	2329 (3.4)	12079 (5.3)	11877 (5.1)	13.6%

Note: Figures in brackets denote the percentage share in Hong Kong's total domestic exports of the respective country.

Singapore, for the first time, became the third most important trading partner to Hong Kong in 1995 when she overtook Germany as the third largest domestic exports buyer. But, Singapore has not always been one of Hong Kong's most important export markets. Germany, Japan and the United Kingdom were the largest exports markets between 1960 and 1992 (Census and Statistics Department 1996).

In 1995, domestic exports to Germany were $12,178 million; with an average annual growth rate of 10.6 percent for twenty five years between 1970 and 1995. Germany was the third largest market for Hong Kong's domestic exports since 1986 but was pushed down to the fourth place by Singapore in 1995.

Japan was ranked fifth as Hong Kong's largest market for domestic exports in 1995, with an amount of $11,877 million. In fact, Japan has mostly been occupying this fifth place since 1970. She only lost to the United Kingdom once during this period in 1993.

The United Kingdom was Hong Kong's third largest domestic export market until 1985. It's third position was taken over by Germany in 1986. Since then, the United Kingdom had been in the fourth position until 1993 when her position was taken over by Singapore. The value of domestic exports to the United Kingdom in 1995 was $10,941, accounting for 4.7 percent of Hong Kong's total domestic exports and becoming Hong Kong's sixth largest market for domestic exports (Census and Statistics Department 1996).

3.4 Demise of Hong Kong Industry

Despite the strong growth enjoyed by the economy of Hong Kong, the role of the manufacturing sector has been declining for the past 10 years. The manufacturing sector used to be the largest employer in Hong Kong. But, by 1990, its leading position had been overtaken by the wholesale, retail and import/export trades, restaurants and hotels sector. The manufacturing sector saw a significant fall in its share of the total workforce in Hong Kong from 46 percent in 1980 to 29.5 percent in 1990 and further drop to 15.3 percent in 1995 (Census and Statistics Department 1996).

It is in 1987 where the manufacturing sector loss its 40 years prominent leadership as the single largest contributor to Hong Kong's GDP. In 1994, the manufacturing sector dropped to fifth place, only accounting for 9.2 percent of GDP compared with 24 percent just ten years earlier (Census and Statistics Department 1996). This may be the partial result of a corresponding reduction in investment in the manufacturing industries in Hong Kong. Measured in terms of gross additions to fixed assets, there has been a sharp fall in investment of 32.2 percent ($7,051 million) in 1994 when compared with the figure in 1993 (Census and Statistics Department 1996).

Such a development in the manufacturing sector of Hong Kong has been the dual effects of increased automation and the shift of labour-intensive as well as lower-end production to China. During the period 1984 to 1994, value added in manufacturing rose, at an annual rate of 5.1 percent, from $52,741 million to $86,536 million (Census and Statistics Department 1996).

In addition, the data on the number of manufacturing establishments, number of people engaged in the manufacturing sector as well as the average size of industrial establishments further confirm this decline trend. The number of manufacturing establishments fell from its peak in 1988 of 50,606, at an annual rate of 6.7 percent, to 31,114 in 1995. The number of people employed in manufacturing also dropped from a peak in 1984 of 904,709, at an annual rate of 7.4 percent, to 386,106 in 1995. Furthermore, the average size of industrial establishments decreased from 20 people in 1980 to 12 in 1995, with 88.5 percent of the establishments (27,534) employing less than 20 people (Census and Statistics Department 1996). In order to investigate possible reasons for the demise of Hong Kong industry, a brief investigation on the structure of the industry is beneficial.

3.5 Structure of Hong Kong Industry

The basis of the Hong Kong manufacturing sector has been in the clothing, electronics, textiles, watches and clocks, chemical and jewellery industries. In terms of their total exports, these sectors, in aggregate, constituted 78.0 percent of Hong Kong's total domestic exports in 1995 (Census and Statistics Department 1996). When measured according to their share in the manufacturing sector's total gross output and total value added, these six industries accounted for 62.3 percent and 53.2 percent in 1994, respectively (Census and Statistics Department 1995).

The rise and fall of the manufacturing sector can be demonstrated by the fate of Hong Kong's textile industry. The textile industry prospered during the 1950s and 1960s. But, entering the 1970s, the industry's share of total exports began to fall, from 19.3 percent in 1960 to 6.1 percent in 1995. Fulfiling the role of the textile industry is the electronics industry. Coinciding with the growth period of the textile industry, beginning from the 1950's, the clothing industry was Hong Kong's largest export earner. This trend continued until very recently. After reaching a peak in 1975 when it made up of 44.6 percent of Hong Kong's domestic exports, the share of the clothing industry began a decline to today's share of 31.9 percent.

The second largest export earner in Hong Kong manufacturing is the electronics industry which experienced an annual average growth rate of almost 41 percent between 1960 and 1995. In 1995, the electronics industry exported $64,282 worth of products, constituting nearly 28% of Hong Kong's total domestic exports. Nevertheless, the combined export value of the clothing and textile industries still provided nearly 40% of Hong Kong's export earnings in 1995.

When compared with the clothing, electronics and textile industry, the contribution of the fourth and fifth export earners, that is, watches and clocks and chemical industries, was relatively weak; only accounting for

5.9 percent and 4.0 percent of total domestic exports in 1995, respectively.

Looking at the statistics, it seems that after the 1970s, Hong Kong manufacturers have not been investing in upgrading their technological capabilities and have remained in the traditional low technology and labour intensive types of industry. Such a development, fortunately or unfortunately, was the result of the opening up of China and the second wave of illegal and unskilled immigrants from China during the Cultural Revolution in the 1970s. This provided manufacturers with a massive supply of cheap labour. Hence, Hong Kong manufacturers were able to stay very profitable with little or no investment in innovation and upgrading their technological capabilities. So used to producing in a low-cost labour environment, even today, the emphasis of the so-called "industrialists" in Hong Kong is still put on labour cost as the most important factor affecting their decision to locate new investments (Hong Kong Industry Department 1996).

The observations from Hatch and Yamamura (1996) may provide an appropriate explanation of the demise of Hong Kong industry. They believe that Chinese industrialists follow a "strategy of turning quick profits, rather than investing for the long run and ... dynamic technological efficiency." (Hatch and Yamamura 1996, p96)

3.6 The Challenges to Hong Kong Manufacturing Industries

Despite this gloomy picture of the performance of the manufacturing sector in Hong Kong, the future of Hong Kong industries has not yet been firmly set. The industrial sector in Hong Kong still has an opportunity to halt or reverse this apparent deindustrialisation.

It is true that much of Hong Kong's manufacturing establishments have moved out of Hong Kong in search of comparative advantages such as lower land and labour costs and these activities have partially caused the downfall of this sector in Hong Kong. However, this move can also strengthen the development of the manufacturing sector in Hong Kong if manufacturers have a long-term commitment and vision to upgrade the competitiveness of Hong Kong. (This argument will be discussed in the latter part of this chapter.)

In a sense, the decline of the industrial sector in Hong Kong is caused by the myopia of Hong Kong's manufacturers. Hong Kong manufacturers focus too much on sustaining their comparative advantages and lack the vision to develop their competitive advantages. When faced with ever increasing international competition, Hong Kong manufacturers only shift their production capacities to China and other low costs countries so as to continue a "low-tech" pattern of industrial development. The majority of Hong Kong manufacturers are engaged in producing mature products via OEM or subcontracting arrangements with foreign buyers (Chiu, Ho and Lui 1997, p39.) Though concrete statistics are not available, this can be indirectly supported by the following evidence:

1. the lack of investment in new products and process by Hong Kong manufacturing industries, as indicated by a recent survey conducted by the Hong Kong Industry Department, which suggested that less than 2.5% of the total respondents reported an intention to develop new products and less than 1.2% were planning to introduce new production process (Hong Kong Industry Department 1996);

2. a major shift of low-technology production capacities from Hong Kong to China, which is illustrated by the high proportion of China-Hong Kong outward processing trade to Hong Kong's domestic export (71.4%) and re-exports to China (45.4%) in 1995 (Census and Statistics Department 1996);

3. the lack of brand development for the majority of Hong Kong's manufacturing products (Berger and Lester 1997, p 69); and

4. the lack of R&D investments among Hong Kong industries, as evidenced by the fact that Hong Kong's total spending on R&D was less than 0.1 percent of her GDP in 1994.

Probably one of the few competitive advantages of Hong Kong manufacturers has been their ability to promptly respond to changing market needs through speedy and timely swaps to new product lines whenever demand changes. This ability is derived from the fact that Hong Kong manufacturers are largely made up of small operators. Such an ability to respond swiftly to market conditions together with the opportunity to get access to low-cost labour, initially from Hong Kong and more recently from China and other developing South East Asian countries, has provided the necessary impetus for strong growth in Hong Kong for the past forty years.

Because of a heavy reliance on OEM or sub-contracting modes of manufacturing, Hong Kong manufacturers only focus on ensuring customers' requirements and product specification. To avoid huge investments in importing technology, manufacturers tend to import advanced technological components.

Hence, with such a strategy for development, the majority of Hong Kong manufacturers have been avoiding investing heavily in innovation and developing or even adopting novel technology. This is echoed by a recent annual survey conducted by the Hong Kong Industry Department on Hong Kong manufacturers. The results of the survey indicated that only 7 percent of the respondents had expressed their intention to expand their production in Hong Kong. Of these 7 percent, only about 30 percent and 16 percent of the respondents revealed that they intended to introduce new products and new production process, respectively (Hong Kong Industry Department 1996)

As a result, manufacturing industries in Hong Kong are lagging behind Taiwan, South Korea, and even Singapore in their technological capability. For example, in the 1995 Techno-Economic and Marketing Research Study on Hong Kong's Textiles and Clothing industries commissioned by the Hong Kong Industry Department, it is reported that in the industries of clothing and electronics, manufacturers in Hong Kong were lagging behind their Singaporean counterparts in investing in new technology (Hong Kong Industry Department 1995).

In this respect, it is not too surprising to find out that in the financial year up to the 31 March 1994, the total spending on Research and Development as a percentage of GDP in Hong Kong was only 0.085 percentage and only 105 patents were granted to both domestic and foreign investors (Au and Tse 1995).

Again, despite this depressing result, there are some companies undertaking "R&D" and adopting technology from overseas. There are still a few manufacturers in Hong Kong competing at the technological frontier in the world market, such as Vtech, Gold Peak, Prima, and Varitronix, who are world leaders in their own industries.

In addition, there has been a slight but gradual shift in government attitudes towards providing support to the manufacturing sector as a whole. In recent years, the Hong Kong government has become more active in the area of fostering technology transfer and applied R&D in these industries. The establishment of the Hong Kong Industrial Technology Centre Corporation in 1993 was an indication of the government's commitment to new technology. Subsequent measures, such as the establishment of the Applied Research Council and the Industrial Support Fund, coupled with existing support to the Hong Kong Productivity Council, sees the Hong Kong government injecting more than HK$ 650 million into the manufacturing sector of Hong Kong.

In this connection, despite the dismal statistics presented in the earlier part of this chapter, it is still not too late for the Hong Kong manufacturing industries to reverse their current position of disadvantage. Again, the statistical picture of a serious industrial decline is not totally correct.

It is indisputable that the contribution of the manufacturing sector to the gross domestic product has been dropping and reached a new low of 9.2 percent in 1994. However, this is not the whole picture. Such a dramatic drop in the importance of the manufacturing sector of Hong Kong is due to the fact that Hong Kong manufacturers have been moving their production operations to China for the past 20 years. This has allowed Hong Kong manufacturers to develop and operate a far-flung network of manufacturing activities and establishments in the coastal regions of China and beyond.

This move will transform the manufacturing sector to a highly profitable and eminently strategic position if Hong Kong manufacturers are willing to operate this network to its fullest potential by gradually upgrading their technological capability. This transformation has inevitably expanded the manufacturing capacity of Hong Kong manufacturers to a scale which is beyond the reach of many in Hong Kong if only local resources (both physical and human) were to be used. For example, in 1990, the estimated number of migrant workers in the Guangdong Province of China alone was between 5 and 6 million, that is, almost the whole population of Hong Kong in 1990. In addition, it is estimated that by 1997, Hong Kong manufacturing firms could be employing up to 5 million workers in their plants in Hong Kong and China. This figure is five times the workforce of Hong Kong even at its peak in 1984 (Far Eastern Economic Review, January 9, 1997).

In this respect, Hong Kong manufacturers have developed a network of production systems which far exceeds the production capability of Hong Kong. If these resources can be put into a chain of higher value adding activities, there could be a revitalisation of Hong Kong's manufacturing sector. Even at the present time with an over-emphasis on the "low-tech" pattern of industrial development in Hong Kong, it is estimated that the value added created to Chinese exports to the United States by Hong Kong manufacturers producing in China is 20 percent to 25 percent (Berger and Lester 1997.)

Hence, the current problem of the Hong Kong manufacturing sector is the inability to move up the technology ladder. Obviously, there are many ways to help the manufacturing industries in Hong Kong upgrade their technology capabilities, such as, improving government's technological capabilities, strengthening the research and development base in Hong Kong, human resources development in the technology aspect (Berger and Lester 1997.) However, most important of all, given the smaller size of Hong Kong manufacturers, the very limited experience of Hong Kong manufacturers in the development of applied and pure research, the lack of a linkage between the universities and the industrial sector, as well as the increasing financial support from the Hong Kong government, it is expected that acquiring technological know-how from abroad could be the most effective way to achieve this end in the short to medium terms.

3.7 Concluding Remarks

So far, there is little serious research in Hong Kong to investigate why Hong Kong is lagging behind the other three "little dragons" in upgrading her technological capabilities. There has been impressionistic evidence suggesting that the lack of direct government support could be the most important reason for this phenomenon. However, this may over-simplify the case. Hence, it is the main purpose of this research to find out exactly what factors would enter into the mind of Hong Kong manufacturers when they were considering a technology adoption decision.

The following quotation is used to conclude this chapter:

"Even as traditional manufacturing in Hong Kong has shrunk, financial, trade, transportation, and other services have flourished. Hong Kong's leap into the future of information technology-driven connectivity and organisation ranks it among world pioneers in creative uses of the new technologies. The question is whether industry still has a future in this dynamic, prosperous society and whether industrial activities can generate a high standard of living for Hong Kong people." (Berger and Lester 1997, p xiii)

It is the firm belief of the author that industries in Hong Kong should play this role. Hence, it is hope that the finding of this research can provide useful policy implications for the Hong Kong government to upgrade the technology capabilities of Hong Kong; thereby, help charting the course for Hong Kong's voyage to become a world-class industrial power.

Chapter Four: Conceptual Framework and Research Hypotheses

4.1 Introduction

The purpose of this chapter is to explain the conceptual model for this study. This research strives to develop a decision-making model of international technology adoption. The literature reviewed in Chapter Two provides a basis from which a theoretical behavioural framework is constructed by integrating concepts and findings from innovation diffusion and international technology transfer studies.

In particular, building upon the Theory of Planned Behaviour (Ajzen 1992) and improving on the framework of the Technology Acceptance Model (Davis 1986), this study attempts to build an International Model For Technology Adoption (IMTA) which explores an organisation's decision to adopt technology from a foreign source.

It should be noted that the Technology Acceptance Model (Davis 1986) was based on the Theory of Reasoned Action (Fishbein and Ajzen 1975). However, Ajzen (1992) has improved the Theory of Reasoned Action (TRA) by including an additional determinant of behaviour into the TRA and renamed the new model as the Theory of Planned Behaviour (TPB).

Therefore, this study is developed in accordance with the conceptual framework of TPB rather than that of TRA.

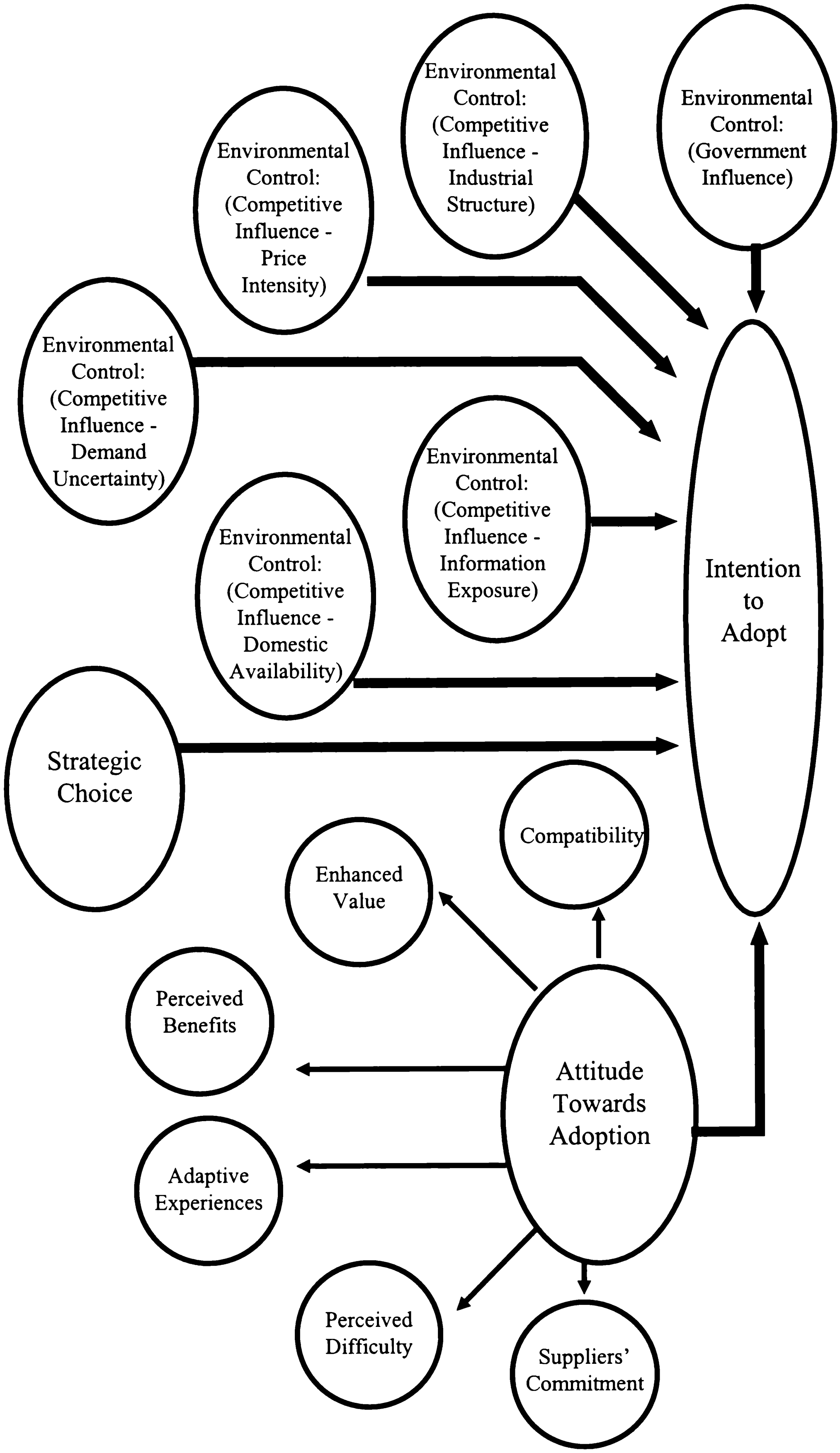
During the discussion of previous research on diffusion models in section 2.2.5, it has been illustrated that diffusion models can be classified according to two dimensions: 1) external-influence and 2) internal-influence. Hence, in this research, the International Model For Technology Adoption looks at how the endogenous and exogenous factors enter into the cognitive process of a technology adoption decision through which attitudes and behavioural intentions are shaped.

The chapter first considers the development of the research constructs. Then, it presents the hypotheses linking the relationships between these constructs.

4.2 International Model For Technology Adoption

The International Model For Technology Adoption focuses on the cognitive process which forms the attitudes and behavioural intention towards technology adoption. The cognitive process is also hypothesised to be affected by a series of both endogenous and exogenous variables. Figure 4.1 depicts the relationships between these variables and the intention to adopt.

Figure 4.1: International Model For Technology Adoption



As shown in Figure 4.1, under the IMTA, the behavioural intention to adopt is not only determined by just the endogenous attitudinal factor, but also is a function of two other exogenous variables, 1) Strategic Choice, and 2) Environmental Control. The Environmental Control factor is further categorised by two exogenous factors, namely, 1) Government influence, and 2) Competitive Influence. In addition, it is suggested that the Competitive Influence factor can be classified into five forces: namely, 1) Industry Structure, 2) Price Intensity, 3) Demand Uncertainty, 4) Information Exposure, 5) Domestic Availability.

In addition, the cognitive process which forms the attitude to adopt is subsequently hypothesised to be affected by six other endogenous beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4)Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment.

In order to provide a systematic presentation of the model, the discussions will look at the behavioural intention to adopt and the three determinants, namely, "strategic choice", "environmental control", and "attitude towards adoption", which form the behavioural intention to adopt, sequentially.

4.3 Behavioural Intention to Adopt

Behavioural intention is the desire of the prospective adopter to adopt the technology from foreign sources. It is one of the most important signals indicating the propensity to adopt. The intention to adopt is hypothesised to be affected by three factors, two exogenous influences and one endogenous belief. The two exogenous factors are "Strategic Choice" and "Environmental Control"; while the endogenous belief is the "Attitude Towards Adoption". These three constructs characterise the individual cognitive process which forms the behavioural intention towards adopting a technology. It is further hypothesised that attitude to adopt is developed through the formation of six endogenous beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4) Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment. In addition, the Environmental Control factor is again hypothesised to be composed of two exogenous determinants: that is, 1) Government Influence, and 2) Competitive Influence. The exact relationships between these exogenous and endogenous variables are discussed in the following sections of this chapter.

4.4 Attitude Towards Adoption

This part of the model reassembles the conceptual framework of Davis' Technology Acceptance Model (TAM). However, the IMTA further suggested that the external variables in TAM can be classified into two exogenous factors, that is, 1) Environmental Control; and 2) Strategic Choice.

The attitude towards adoption is the cognitive process which constitutes the endogenous process of the IMTA. Attitude towards adoption means the prospective adopter's positive or negative affection about adopting the foreign technology. As stipulated by the theoretical framework of the Theory of Planned Behaviour (Ajzen 1992), attitudes towards a behaviour are determined by relevant internal beliefs. Hence, for the International Model For Technology Adoption, attitude towards adoption is hypothesised to be influenced by six internal beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4) Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment to the firm. In short, "attitude" is a latent variable which is, in turn, measured by these six internal belief indicator.

Following the line of reasoning of both the Theory of Planned Behaviour and the Technology Acceptance Model (Davis, Bagozzi, and Warshaw 1989), positive attitudes towards a behaviour trigger the formation of an intention to perform such a behaviour. Therefore, a positive attitude towards adoption of technology from foreign sources tends to mould a stronger intention to adopt as well. It is hypothesised that:

H_1: There exists a positive relationship between attitude towards adoption and behavioural intention to adopt

4.4.1 Perceived Difficulty

Transfer and application of new technology from foreign sources require substantial resources commitment. As indicated in section 2.2.3, Teece (1981) suggests that there exists a negative relationship between resource costs of transfer and the rate of diffusion. Part of the costs relates to codification costs.

Hence, "perceived difficulty" is postulated to be the first construct affecting the attitude towards adoption. "Perceived difficulty" is defined as the degree to which the prospective adopter expects the application of foreign technology to be free of efforts. Since the perceived difficulty of adoption relates to the interaction between both the suppliers and receivers of the technology, it is further hypothesised that the "perceived difficulty" factor is affected by the perceived support provided by the supplier. The exact relationships of these variables are discussed below.

The "suppliers' commitment" factor is instrumental to the perceived difficulty of adopting the technology. The instrumental function of the "suppliers' commitment" factor stems from the fact that the more the support is perceived to be provided by the suppliers, the lower is the level of perceived difficulty of adopting the technology anticipated by the recipient firm. The lower the perceived difficulty, the greater will be the expected benefits.

The benefits are derived from sources such as reduced transfer costs, more effective application of the technology, improved performance of the workforce; all of which can contribute to the perceived ease of using the technology. This argument follows a similar line of thought as the "complexity" issue (Robertson 1971) discussed in section 2.2.6.3. Hence, the second hypothesis of this research is that:

H_{2a}: Suppliers' commitment has a positive impact on reducing the perceived difficulty of the technology.

Of course, the perceived difficulty factor can have a direct effect on the attitude towards adoption as well. When the new technology is perceived to be easy to apply and transfer, the lesser is the perceived investment on the technology; thus, reducing the level of perceived risk (Fidler and Johnson

1984; Labay and Kinnear 1981; Taylor 1974) and improving the probability of a successful transfer. In this respect, it is hypothesised that:

H_{2b}: Perceived difficulty has a negative impact on attitude towards adoption.

4.4.2 Adoption Experiences

Adoption experiences mean 1) adopters' prior experiences with similar technology, and/or 2) adopters' prior experiences with the supplier of the technology. It is expected that adoption experiences can exert a direct impact on the attitude towards adoption. This can be a function of the accumulated technical knowledge of the adopters and the augmented working relationships with the suppliers through previous experiences.

It has been shown that the speed of innovation diffusion is a function of the accumulated associated knowledge or experience of the adopters (Gatignon and Robertson 1985; Hamel 1991; Heller 1985). This is the same as the "Compatibility", "Complexity", and "Trialability" issues (Cortes 1982; Dickerson and Gentry 1983; Roger 1983) discussed in section 2.2.

The positive effects of previous experiences come from the power of learning. The learning obtained from prior experiences with the technology provides an excellent opportunity for the adopting firm to collect a certain amount of information regarding the technology (Cusumano and Elenkov 1994; Madu 1989). In addition, this experience also allows the workforce to receive relevant training thereby, providing the needed personnel for similar future engagement (Keller and Chinta 1990; Kumar 1995).

Moreover, having gone through some prior experiences with the technology, the adopter is in a better position to evaluate the needs and requirements more accurately. This will provide the adopter with some understanding of the level of support required from the suppliers of the technology. This learning process can smoothen the transfer process.

In addition to the adopter's own experience with the technology, the adopter's prior working relationships with the suppliers can also be a critical factor. This is supported by some of the research into the effects of "source loyalty" in industrial markets which suggest that buyers' past experience with the suppliers is one of the contributing factors for source loyalty in industrial markets and industrial firms tend to favour suppliers with whom the firm is familiar (Morris and Holman 1988; Wind 1970).

Therefore, adaptive experience is measured by both the experience of the prospective adopter with similar technology and the working experience of the prospective adopter with the supplier of the technology.

It is hypothesised that:

H_3: The adaptive experience of the prospective adopter has a positive impact on the attitude towards adoption.

4.4.3 Supplier's Commitment

The adoption of new technology carries a high risk and this is particularly so where foreign parties are involved. The level of perceived commitment from suppliers can help reduce this perceived risk through the transmission of adequate information from the suppliers to the adopters (Cusumano and Elenkov 1994; Fidler and Johnson 1984; Labay and Kinnear 1981; Taylor 1974).

Supplier's commitments are also of vital importance during both the initial stage and the aftermath of the technology transfer. The perceived action and behaviour of the supplier can, hence, not only affect the perceived ease of use of the technology but also the attitude towards adoption. Supplier's commitments can either be supportive or restrictive.

4.4.3.1 Resources Support

Supportive commitments from suppliers are expected to be the most critical in the area of resources support which are essential to the successful transfer and adoption of the technology. In many cases, resource commitment by suppliers can often affect the recipient's ability to absorb the technology. This is especially important when the transfer takes place between industrialised countries and less developed countries where substantial differences in industrial infrastructure and technical development exist (Cohen and Levinthal 1990; Kumar 1995; Reddy and Rao 1985; Steele 1974).

The resources support generally involves two key aspects: human resource and product (Samli and Kosenko 1982). Product encompasses equipment and its operation, maintenance and repair. This requires the adequate supply of parts for maintenance and on-site assistance in technical support. As for the human resource aspect, it means the provision of adequate training to the personnel of the adopter.

The more extensive the perceived support provided by the supplier of the technology, both before and after the technology transfer, the more positive is the degree of perceived supplier's commitment. Thus, it is hypothesised that:

H_{4a}: The more extensive is the perceived resources support from the technology supplier, the greater is the perceived suppliers' commitment.

4.4.3.2 Supplier's Restriction

In certain circumstances, the supplying firm may impose some restrictions on the conditions through which the transferred technology is to be used. This can be done by imposing restrictive clauses on the agreement of technology collaboration. Restrictions can take the form of some tie-in clauses such as requiring the adopting firm to purchase raw materials and equipment from an approved undertaking specified by the supplier or conditions on production, sales and exports matters (Cusumano and Elenkov 1994; Tarapore 1972). In doing so, the supplier could strengthen its position to control the technology. However, these restrictions could decrease perceived usefulness of the technology by the recipient of the technology as some operations adjustments may be required which, in turn, leads the adopter to create a negative perception on the level of supplier's commitment. Therefore, it is hypothesised that:

H_{4b}: There is a negative relationship between types of restrictions and the perceived suppliers' commitment.

Finally, the attitude to adopt the foreign technology is inevitably affected by the perceived level of supplier's commitment. It is further hypothesised that:

H_{4c}: There is a positive relationship between attitude towards adoption and the perceived suppliers' commitment.

4.4.4 Perceived Benefit

"Perceived benefit" is the adopter's belief of the likelihood that the adoption of the technology can improve the economic benefits of the organisation and/or of the person. From the perspective of the adopting company, such benefits may come from productivity enhancement, quality improvement, cost reduction, gain in market share, and new market development (Calantone, Lee and Gross 1990; Lefebvre, Lefebvre and Roy 1995; Nabseth and Ray 1974; Naik and Chakravarty 1992; Rogers 1983).

As to the individual adopter, benefits can not only come from an improvement in job performance and the associated intrinsic and extrinsic rewards (Davis, Bagozzi and Warshaw 1989) but may also be derived from just the sense of modernisation (Forsyth 1985). To some managers and engineers in developing countries, the ability or opportunity to use sophisticated or state-of-the-art technologies can be considered as some kind of an achievement and a sense of modernisation even when no apparent economic benefits can be obtained. In addition, perceived benefit is also expected to be derived from the perceived relative advantages of adopting the technology.

As described by Roger (1983), relative advantages are the degree to which the innovation is perceived by the adopter to be better than the preceding ones. Relative advantages include improved profitability through better quality and enhanced productivity, low initial costs, lower perceived risk, savings in time and effort, and the immediacy of rewards (Mansfield 1961; Nabseth and Ray 1974; Roger 1983; Sutherland 1959; Utterback 1971). Hence, the more relative advantages are perceived to be provided by the new technology, the more is the perceived economic benefit obtained from adopting the technology.

Perceived benefit is expected to affect the attitude towards adoption in several ways. First, the feelings of an individual towards adopting the technology may be affected by the individual's expectation of achieving good performance as a result of adopting the technology.

Second, it is also conceivable that positively valued outcomes contingent upon the adoption of the technology can facilitate the development of a promising affection towards the technology itself through the achievement of the desirable outcome. It is contended by some researchers that this relationship is established from the learning and affective-cognitive consistency mechanism (Bagozzi 1982; Davis et al 1989).

Hence, it is hypothesised that perceived benefit is positively related to the attitude towards adoption. Hence, the following hypothesis will be tested:

H_5: Perceived benefit is positively related to the attitude towards adoption

4.4.5 Compatibility

As mentioned in section 2.2.6.1, in the international environment, the relative advantages of adopting a foreign technology can become more complex, especially when the process involves developing countries (Contractor 1984; Mansfield et al 1982). The complications may stem from the fact that technology developed by overseas companies under a foreign environment may not be compatible with the manufacturing facilities of the adopting firm (Cortes 1982; Kim and Ro 1996; Nabseth and Ray 1974; Rogers 1983). Such incompatibility often reduces the anticipated economic benefits from the adoption; thereby creating a negative attitude towards adopting the technology.

The compatibility of a new technology is to a large extent the subjective judgement of the decision-makers for the adoption. It is very difficult to establish compatibility in an objective sense. In fact, this provides a partial explanation of why firms in developing countries tend to select "inappropriate" technologies when objective criteria are used to judge such transfer (Al-Ali 1995; Al-Ghailani 1995; Stobaugh and Wells 1984; James and Watanabe 1985; Vavakova 1995).

Hence, in this study, "compatibility" is treated as a perceived issue. It has been argued that the more a foreign technology is perceived to be compatible with existing technology, the higher is confidence of mastering the new technology and the more positive attitude that can be derived (Brancheau and Wetherbe 1990; Cortes 1982; Dickerson and Gentry 1983; Gatignon and Robertson 1985; Leonard-Barton 1987; Nabseth and Ray 1974; Orlikowski and Robey 1991; Ramiller 1994; Robertson 1971; Zaltman and Stiff 1973). Hence, it is hypothesised that:

H_6: Perceived compatibility of the technology will positively affect attitude towards adoption.

4.4.6 Enhanced Value

In addition to the benefits derived directly from the technology itself, there could be some other forms of benefit relating indirectly to the adoption of the technology such as the generation or enhancement of a quality image or a novelty perception from adopting the technology. Such benefits can generate extra value as perceived from the consumers point of view. Hence, the attitude towards adopting the technology may not only be related to the firm's utilisation point of view, but also incorporate the firm's perception of the extra (enhanced) value carried by the new technology to the consumers. It is, therefore, hypothesised that:

H_{7a}: Enhanced value is positively related to the attitude towards adoption.

In addition, it is further hypothesised that the more the experience a perspective adopter has, the better the understanding the adopter will have of the foreign technology. A better understanding of the technology will allow the adopter to better appreciate the additional value carried by the foreign technology. Hence,

H_{7b}: There is a positive relationship between enhanced value and the adoption experience of the perspective adopter.

4.4.7 Attitude and Behavioural Intention

According to the Theory of Planned Behaviour, attitude may not be able to explain the behavioural intention of the ultimate decision-maker. "Perceived Behavioural Control" can be a moderating factor. Perceived Behavioural

Control is a function of control beliefs and perceived facilitation. Control belief is a perception of a decision-maker that certain requisite resources and opportunities are present or absent; while perceived facilitation is the decision-maker's assessment of the importance of those resources to the achievement of the desired outcomes. The higher the perceived control over these factors, the more positive is the intention (Ajzen and Maddem 1986).

Hence, for this study, it is hypothesised that "Environmental Control" is the control belief that will enter into the behavioural intention to adopt foreign technology. Environmental Control is, in turn, generated by two control factors and they are: 1) Government Influence, and 2) Competitive Influence.

4.5 Environmental Control

Besides the endogenous belief, the behavioural intention to adopt is also affected by two exogenous factors, one of which is the perceived control factor, namely the "Environmental Control" factor, which is further hypothesised to embrace two constituents: 1) Government Influence, and 2) Competitive Influence. These exogenous factors represent the individual perception of competitive environments, situational constraints, and managerially controllable activities which can impinge on the behavioural intention to adopt.

4.5.1 Government Influence

Government influences are conditions imposed by national governments to either aid or discourage the transferring of technologies into the country and/or to restrain particular transfer practices. Certainly, among other things, economic policies of a country can serve as a decisive factor in the initiation, choice, and adoption of certain technologies (Cusumano and Elenkov 1994; Chen 1995; Hiraoka 1995).

As mentioned in section 2.3.1, economists have long purported the existence of a relationship between technology transfer and economic growth (Marquisand Alle 1966; Solo 1972). Hence, through various channels, governments incline towards coordinating and manipulating the importation and diffusion of foreign technologies. Various studies have found that governments have an important role in the process of technology transfer (Cusumano and Elenkov 1994; Chen 1995; Gerstenfeld and Sumiyoshi 1980; Hiraoka 1995; Kim 1984; MacDowall 1984; Nabseth and Ray 1974; Saxonhouse 1982; Whiting 1984; Zysman 1983; Zysman and Tyson 1983). Governmental influences can be classified into two types: 1) Material Incentives; and 2) Transfer Restrictions.

4.5.1.1 Material Incentives

Policy and political considerations provide the drive for interventions from governments on technology transfers (Cusumano and Elenkov 1994; Chen 1995; Hiraoka 1995; James and Watanabe 1985). However, the effectiveness of these policies may vary across different environments under different economies. For this study, the concern is on how firms react to the various policy tools manipulated by the government to influence firms behaviour to adopt. It is expected that the more incentive provided by the government, the better equipped, financially or operationally, the prospective adopter will be perceived; hence the higher the perceived control over the environment.

Typical economic benefits offered by governments range from low interest to interest free loans for the importation of technology, preferential tax treatment, research and development support for technology development such as science parks to aids for promotion of exports generated as a result of the influx of certain technology from foreign sources. All these forms of assistance from the national governments serve as "sweeteners" to facilitate perceived "appropriate" technology transfer so as to ensure the country can benefit from the adoption of the technology. Hence, it is hypothesised that:

H_8: The existence of economic benefits offered by a government have a positive impact on the intention to adopt.

4.5.1.2 Transfer Restriction

Besides economic incentives to attract the transfer of appropriate technology for the benefit of the country, a government can also impose restrictions on transfer practices. These measures could be the direct result of certain political and/or economic side-effects experienced by prior engagement with the transfer activities. Restrictions of this type include the forbidden importation of certain “inappropriate” technology and/or the control of the process of technology transfer through the restraint of transfer from particular channels (Blake and Walters 1983; Correa 1981; Cortes 1982; Contractor 1981; Long 1981; Newfarmer 1984).

Government policies relating to this type of restriction comprise import licences for certain or all technologies and restrictions on foreign direct investment. Obviously, such measures can considerably limit the behaviour of the adopting firms or even, at some extremes, preclude the firms from engaging in technology transfer activities. However, since the Hong Kong government adopts a positively non-interventionist policy, no such restriction is imposed on manufacturers in Hong Kong. Therefore, despite being found to be a factor in determining technology adoption decision by previous studies, this factor is not included in the International Model For Technology Adoption.

4.5.2 Competitive Influence

One important precipitating factor urging firms to search for novel technologies is competition. The role of technology is becoming more and more prominent for firms to sustain competitiveness (Acs and Audretsch 1990; Julien, Estimé and Drilhon 1993; Kim and Ro 1995; Porter 1980; 1992). As indicated in Chapter 2, the industry environment under which a firm operates can affect the potential firm's receptiveness to the adoption of technology. The degree to which industries are receptive to the adoption of new technology depends on the intensity of competitive pressure within the various industries.

Robertson and Gatignon (1986) have suggested that it is not only the inter-relationships between adoption/diffusion activities and the general competitive environment that influence the adoption process, but also the industry competitive environment as well. Robertson and Gatignon (1986) and other researchers attribute three structural factors to the effects of the competitive environments on the adoption process: 1) industry heterogeneity (Baldridge and Burnshams 1974; Kaigler-Evans et al 1978; Mintzberg 1979), 2) competitive intensity, (Levin 1978; Utterback 1974) and 3) demand uncertainty (Dasgupa and Stiglitz 1980; Ettlie andBridges 1982; Phillips, Calantone and Lee 1994) (For details see section 2.2.11)

In addition to the structural factors, Robertson and Gatignon (1986) postulate that communication factors, defined in terms of three variables, can also influence the competitive environment: 1) signal frequency and clarity (Daft et al 1986, 1987; Kimberly 1978; Crans 1972; Rebentisch and Ferretti 1995; Rice 1987; Rice and Shook 1990), 2) professionalism (Aiken and Hage 1971; Leonard-Barton 1985; Pierce and Delbecq 1977), and 3) cosmopolitanism (Kimberly and Evanisko 1981; Robertson and Wind 1983; Rogers 1983). All these three variables are, in fact, related to the openness of the communication systems.

For the International Model For Technology Adoption, it is postulated that the openness of the communication system can facilitate the adoption process through the increased availability of additional information to the decision-maker on the competitive environment (Chakrabarti and Hauschildt 1989; Souder and Padmanabhan 1989; Roger 1983). Indeed, it is purported that while the decision-makers may have a positive attitude towards certain foreign technology for adoption, the decision is bound to be affected by the decision-maker's perception of the competitors affection to the adoption of the technology as well.

In short, even if the decision-maker has developed a positive attitude towards adopting the technology, the decision-maker may delay or simply not adopt the technology if s/he believes that once adopted, competitors will follow the move and introduce the technology to their operation as well; given there is no first mover advantage to adopting the technology. Hence, the more competitive an environment is, the less the decision-makers of firms feel that they are in control. Following this line of reasoning, the domestic availability of the prospective adoption technology can also affect the competitive pressure faced by competing firms.

In this respect, this study suggests that Competitive Influence can be classified in five control factors which, individually and separatively, can affect the competitive environment within which a firm is operating: 1) Industry Structure, 2) Price Intensity, 3) Demand Uncertainty, 4) Information Exposure, 5) Domestic Availability.

4.5.2.1 Industry Structure

Industry structure means the degree of rivalry within an industry which is measured by the total number of firms and the market shares controlled by the firms. The intention to adopt is posited to be higher in more concentrated industries because of the difference in the anticipated benefits derived from the adoption of the technology and their perceived ability to control the adoption process. For example, firms under oligopoly are more concerned about the moves made by competitors and because of the smaller number of players involved, the payoff from the adoption of the technology is, in general, higher. In addition, because of the possibility of earning an abnormal profit, firms in an oligopoly industry structure may have better access to financial resources necessary for the adoption of the technology; hence, developing a sense of control over the adoption process.

Of course, there may be an exception to this argument on the inclination to adopt. In the case of monopoly, the single firm controlling the entire market may be less inclined to adopt new technology even though the company may feel complete control over the environment. However, this should only affect the attitude of adoption for the monopolist as the perceived benefits may not be fully recognised. However, this should not change their perceived ability to control the environment. In addition, it may not be necessary that a monopolist must have a negative attitude towards adoption since the monopoly may rely on the continuous supply of innovation and new technology to enhance or consolidate its monopolistic position by using technology to create the necessary barriers to entry so as to ensure a low competitive intensity within the industry (Baker et al 1967; Levin 1978; Reinganum 1981; Robertson and Gatignon 1986; Swan 1970).

Therefore, the fewer the number of players in an industry, the lower is the perceived competitive pressure and the greater is the firm's perceived ability to control and adopt the technology. Hence, it is hypothesised that:

H_{9a}: The degree of industry rivalry has a negative effect on the firm's intention to adopt.

4.5.2.2 Price Intensity

Numerous research has shown that the extent to which differences exist between organisations within an industry can affect the competitive environment. Industry heterogeneity can improve the dynamics of the competitive environment within an industry through organisation's continuous search for competitive advantages. One way of creating competitive advantages is to pursue a differentiation strategy and this process can vitalise the innovation adoption process (Baldridge and Burnhams 1975; Kaigler-Evans et al 1978; Porter 1980; 1992; Robertson and Gatignon 1986).

Besides competing on differentiation, firms can choose to compete on price. Firms competing on price may face a different type of pressure when compared with firms choosing to compete on differentiation in terms of the need to actively seek for innovative technology.

The logic is that firms engaged in price competition may only focus on cost reduction. A cost reduction strategy can be pursued by either attaining comparative or competitive advantages. Firms in the low to medium technology spectrum or firms which are smaller in size may choose to acquire comparative advantages, such as lower labour and/or material costs, to lower their costs of production.

Hence, adoption of innovative technology from foreign sources may not be a vital force for survival for small businesses such as those in Hong Kong; but it does not imply lesser competitive pressure. According to the International Product Life Cycle theory, when the product has reached its maturity stage, price competition becomes a prominent phenomenon. Therefore, the degree of competitive intensity in such industries must be enormous; thereby, more common than not, further reducing the firms discretionary financial ability to acquire expensive new technology. Under such circumstances, firms may be faced with enormous competitive pressure and, therefore, have little control over their ability to adopt new technology. So, it is hypothesised that:

H_{9b}: The price intensity within an industry has a negative effect on the firm's intention to adopt.

4.5.2.3 Demand Uncertainty

Demand uncertainty exists when firms find themselves unable to predict the level of demand and level of marketing activities. Demand uncertainty can intensify competition within an industry because when operating under demand uncertainty, firms are likely to seek out additional marketing information and to assume more risks. All these activities can greatly intensify the level of competition (Dasgupta and Stiglitz 1980; Ettlie and Bridges 1982; Phillips, Calantone and Lee 1994; Pierce and Delbecq 1977; Robertson and Gatignon 1986) and, hence, lower the level of perceived control and the intention to adopt. Thus, it is hypothesised that:

H_{9c}: The higher the demand uncertainty, the lower the intention to adopt.

4.5.2.4 Information Exposure

Information exposure represents the amount of helpful information an individual decision-maker is exposed to. It has been found that firms more active in searching and exchanging information with members within the social system are more willing to adopt innovation (Crans 1972; Kimberly 1978; Kitchell 1995; Midgley; Robertson and Wind 1980; Gatignon and Robertson 1989).

Of particular interest in this process is exposure to information from sources external not only to the firm environment but also to the home country where the firm is operating. Furthermore, when firms are more open to the external systems, they are more likely to receive additional information regarding the competitive environment. Again, the more open is the firm to external information, the better the firm's ability to assess and judge the utility of the technology.

The better is the firms' ability to evaluate the benefits of the new technology, the higher is the firms' capacity to process the information. Hence, the degree of openness of an industry to information can affect the firms perception of their ability to control the environment. As mentioned earlier, the higher the level of perceived control, the higher is the intention to adopt. Hence, the next hypothesis of this study is:

H_{9d}: The greater is the information exposure of the adopting firm, the higher is the intention to adoption.

4.5.2.5 Technology Availability from Domestic Sources

Perhaps the most obvious reason for adopting technology from overseas sources is the unavailability of such technology from domestic sources. However, under some circumstances, even when compatible technology is domestically available, the owner(s) of the technology may be unwilling to release the technology information so as to preserve a competitive advantage among domestic producers; thereby creating barriers to entry. In this respect, other local firms still consider the technology as domestically unavailable.

On the other hand, even when technology is available from domestic sources, in a lot of developing countries, local firms may perceive foreign technology to be of superior quality and tend to adopt from overseas sources rather than obtaining the technology locally. In such circumstances, the technology is still considered as domestically unavailable.

If the technology is freely available to any local firms, it is likely that the perceived risk and costs of using the local technology is conceived to be lower by local operator and vice versa. Hence, it is hypothesised that:

H_{9e}: There is a relationship between domestic availability of similar technology and intention to adopt the technology.

4.6 Strategic Choice

The ultimate aim of any business decision is to maximise profit and this is the fundamental assumption of economics. This assumption is considered as a valid one in the current study. The basic objective for decision-makers in judging whether or not to adopt a foreign technology is the bottom-line effect of such a strategy. Hence, the decision to adopt is made after evaluating the perceived benefits of the new technology, along with other business investment opportunities as technology transfer may be merely one of the many ways to sustain growth for the business.

In short, the decision-makers must convince themselves that the adoption decision has to provide a big enough opportunity to warrant not only the investment, but also the time, the opportunity cost in not doing other things in that same period of time. Strategic Choice can be measured in terms of the perceived availability of other external investments at the time of the adoption decision. Thus, it is hypothesised that:

H_{10}: The existence of strategic choices can negatively affect the behavioural intention to adopt.

4.7 Summary

The purpose of this chapter is to present the conceptual framework of the International Model For Technology Adoption and the hypotheses derived from the model.

The International Model For Technology Adoption conceptualised the cognitive processes that determine the attitudes and intention towards technology adoption and is composed of two elements: the exogenous factors and the endogenous process.

In particular, the behavioural intention to adopt is hypothesised to be affected by three forces: 1) Environmental Control, 2) Strategic Choice and 3) Attitude Towards Adoption. Of these three forces, “Attitude Towards Adoption” is described as the endogenous process while the remaining two are construed as exogenous factors, one of which reassembles the Perceived Behavioural Control factor of the Theory of Planned Behaviour.

In the International Model For Technology adoption, this exogenous control variable is referred to as the “Environmental Control” factor, which is further categorised into two control influences: 1) Government Influence, and 2) Competitive Influence. Government influence is suggested to be a function of “material incentives”. Competitive influence is classified into five elements: “industry structure”, “price intensity”, “demand uncertainty”, “information exposure”, and “domestic availability”. As for the strategic choice factor, it is believed to represent the investment alternatives available to the firm besides adopt the foreign technology.

In addition, the cognitive process which forms the "attitude towards adoption" is, again, explicated as influenced by another six endogenous beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4)Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment.

Exact relationships among and between these constructs can be found in Figure 4.1. A summary of the hypotheses derived from the model is shown in Tables 4.1a and b. Finally, the operational definitions and the procedures for measurement, together with the methodological and statistical procedures utilised for testing the hypotheses will be discussed in Chapter Four.

Table 4.1a A Summary of Hypotheses

Hypothesis	Variables	Relationships
H_1	1) Attitude towards adoption 2) Intention to adopt	Positive
H_{2a}	1) Supplier's commitment 2) Perceived difficulty	Positive
H_{2b}	1) Perceived difficulty 2) Attitude towards adoption	Negative
H_3	1) Adopter's experience with technology 2) Attitude towards adoption	Positive
H_{4a}	1) Resources support 2) Suppliers' commitment	Positive
H_{4b}	1) Suppliers' restrictions 2) Suppliers' commitment	Negative
H_{4c}	1) Suppliers' commitment 2) Attitude towards adoption	Positive
H_5	1) Perceived benefit 2) Attitude towards adoption	Positive
H_6	1) Perceived compatibility 2) Attitude towards adoption	Positive
H_{7a}	1) Enhanced Value 2) Attitude towards adoption	Positive
H_{7b}	1) Enhanced Value 2) Adoptive experience	Positive
H_8	1) Government Influence 2)Intention to adopt	Positive

Table 4.1b A Summary of Hypotheses

Hypothesis	Variables	Relationships
H_{9a}	1) Industry rivalry 2) Intention to adopt	Negative
H_{9b}	1) Price intensity 2) Intention to adopt	Negative
H_{9c}	1) Demand uncertainty 2) Intention to adopt	Negative
H_{9d}	1) Information exposure 2) Intention to adopt	Negative
H_{9e}	1) Domestic availability 2) Intention to adopt	Negative
H_{10}	1) Strategic Choice 2) Intention to adopt	Negative

Chapter Five: Methodology

5.1 Introduction

This chapter will describe, in detail, the method used to empirically test the International Model For Technology Adoption and the hypotheses derived from the model. In particular, this chapter will discuss the research design of the current study, and offer a discussion on the development and implementation of the research constructs, the research questionnaire, data collection procedures, the sampling plan, and the appropriate research and statistical methods.

5.2 Research Design

A survey research method is adopted for the current study because this is a commonly used method in studies of attitudes and behavioural intentions. The advantages of a survey are that it represents an inexpensive, efficient, and accurate means of assessing information about the population (Churchill 1995). In addition, survey research also provides the potential for replication and generalisation to further assess the construct validity of the model proposed in this study. Again, it can offer a basis for development of subsequent comparative studies.

5.3 Questionnaire Design

The purpose of this study is to develop a conceptual model to delineate the cognitive processes and perceptions involved in the decision to adopt foreign technology. The model hypothesises that perceptions influenced by exogenous factors are key constituents of the adoption or rejection decision-making process. Hence, the first issue relating to the questionnaire design process is the determination of the measurement scales.

5.3.1 Measurement Scales

Basic research methodology textbooks have illustrated that the four most commonly used measurement scales are: nominal, ordinal, interval, and ratio (Churchill 1995). Nominal scales provide categorical data which can be used to differentiate between member characteristics. Ordinal scales arrange alternatives according to some rank-order relationships. Interval scales not only indicate the order, but also measure the magnitude of order in units of equal intervals. Ratio scales provide an absolute zero value which facilitates a comparison of the proportional magnitude between variables, such as the number of times A is greater than B (Churchill 1995).

A commonly used measurement scale which can allow the expression of the intensity of attitude is the Likert-scale (Likert 1932). When using the Likert-scale, respondents are asked to indicate the magnitude of agreement or disagreement with a series of statements by indicating with a mark on the appropriate response.

The major concern relating to the use of Likert-scales as a means of measurement is that the scale produced may not be applicable to the statistical tests used. It has been contended that the Likert-scale measurements of attitudinal predisposition represent at best ordinal scale items. But, when parametric statistical techniques are involved in the analysis, these statistical techniques require the use of interval scale data.

But, this concern has been addressed by Likert (1931) who argued that the characteristics of response obtained from the Likert-scaled techniques can be sufficiently robust to be considered as intervally scaled and can be applicable to parametric analysis. Other researchers also endorse the use of Likert scales as interval measurements (Borgatta and Bohrnstedt 1981; Burke 1953; Labovitz 1970; Gaito 1980).

Hence, given the previous support on the applicability of parametric statistical techniques to Likert-type items, Likert-scales can be utilised in the current study for the construction of the research instrument to detect the attitudinal predisposition of individual decision-makers on the issue of technology adoption.

5.3.2 Development of Construct Measures

The development of the construct measures for the beliefs, attitudes and behavioural intentions of the International Model For Technology Adoption will follow the guidelines of Churchill (1995) as closely as possible. In short, the procedure first requires the construct of items based on literature or field interview. Second, data need to be collected to further modify the measures so that they are valid and reliable. The final measurements after the purification process can then be adopted for use.

Having reviewed the literature, a set of items will be developed to establish the domains. The content validity of the items will be determined by the judgement of an expert panel composed of three experts in the field of international business. The experts will judge independently on the items and will be required to categorise each item into three types: "suitable", "moderately suitable", and "not suitable". Only items with at least two experts rated “suitable” and none rated “not suitable” will be included in the questionnaire.

To further ensure the reliability of the items, Cronbach’s alpha will be calculated. The selection criterion for the retention of an item will be based on the item’s correlation with the total score of each construct.

5.3.3 Operational Definitions of the Constructs

The primary focus of this research is to study the cognitive process of the adoption decision. The process is characterised to be affected by both endogenous beliefs and exogenous factors. Hence, this research relies on the development of measurements to measure the endogenous cognitive constructs and their linkages with these exogenous factors through the influence of the decision-maker’s perception of the exogenous factors on the endogenous process. The operational definitions of all the exogenous and endogenous variables used in this study are laid down in this section.

5.3.3.1 Intention to Adopt

Behavioural intention to adopt is operationally defined as the magnitude of the prospective adopter’s desire to adopt the technology. Fishbein and

Ajzen (1980) have laid down the guidelines for developing the behavioural intention construct. These guidelines are followed in this research. Respondents are asked how likely they will make or support the decision to adopt the technology.

5.3.3.2 Attitude Towards Adoption

Comparable to that suggested by Davis (1986), "attitude towards adoption" is operationally defined as a prospective adopter's positive or negative affection on the company's decision to adopt the foreign technology. This definition of the "attitude towards adoption" construct resembles the "attitude" construct developed by Fishbein and Ajzen (1980) which comprises the four elements of an attitude: action, target, context, and time.

Action, in the context of the current study, means the adoption or rejection of the foreign technology. While target is the specific technology aimed to be adopted from the foreign source, context represents the organisational structure within which the adoption behaviour is committed. Finally, time indicates the current attitude towards the adoption.

5.3.3.3 Environmental Control

According to the Theory of Planned Behaviour (Ajzen 1985; Ajzen and Madden 1986), perceived behavioural control forms part of the antecedent of intention. Perceived behavioural control is the perceived ease or difficulty of performing the behaviour and it is anticipated to be a reflection of past experience as well as expected impediments and obstacles. It is expected that the greater the perceived behavioural control, the stronger should be the individual's intention (Ajzen and Madden 1986.)

Under the International Model For Technology Adoption, the behavioural control factor is denoted as the "Environmental Control" factor. In addition, it is hypothesised that Environmental Control is, in turn, made up of two control elements, namely, 1) government influence; and 2) competitive influence.

5.3.3.4 Government Influence

Government Influence can take the form of either providing carrots or imposing sticks. Carrots are in the form of providing economic incentives which are defined in terms of the probability of government assistance such as subsidies, loans, tax holidays, or preferential tariffs. Sticks means restrictions on transfer practices in the form of restraints on imports or requiring import licenses.

5.3.3.5 Competitive Influence

Competitive influence is defined in terms of five types of influence: 1) Industrial Structure; 2) Price intensity, 3) Demand uncertainty; 4) Information exposure; and 5) Domestic availability. Each of these factors, individually, shapes the competitive environment under which a firm operates. Gatignon and Robertson (1989) provides similar scales for measuring price intensity, demand uncertainty and information exposure and these scales will be adopted for use in the current study.

Industry structure is measured by the perceived market share of the three largest firms. Price intensity means the importance of price as a factor of competition and the frequency of price-cut. Demand uncertainty is reflected by the stability of the market for the firm's main products and the difficulty in anticipating demand. Information exposure measures the frequency of international conventions and trade shows held by the industry and the numbers of industry-related periodicals read by the respondents. To assess the domestic availability of the technology, it is measured by the existence of similar technology developed locally and the availability for the firm to use as well as the quality of such domestically developed technology.

5.3.3.6 Strategic Choice

Strategic Choice means the opportunity costs of investing in the prospective technology. This is measured by the existence of some perceived investment opportunities or alternatives available to the company which can yield a better return than to invest in the adoption of the foreign technology.

5.3.3.7 Perceived benefit

Perceived benefit is the likelihood that the decision-maker will consider the application of the foreign technology to be beneficial to personal well beings and/or that of the firm. Hence, there are two aspects to the perceived benefit function of the International Model For Technology Adoption; that is, perceived benefit for both the organisation and the individual.

From the firm's perspective, benefits derived from the imported technology can take the form of enhancement of competitiveness, improvement of production efficiency or performance and augmentation of technology capability. Respondents will be asked to reveal their perceptions in several statements concerning the extent to which they believe the foreign technology could provide utility to the firm in terms of the efficiency, effectiveness and competitiveness issues.

From the individual's perspective, it has been found that for an individual to favour the adoption of foreign technology it is necessary for the technology to improve the individual's job performance which, as a result, may provide certain rewards to the individual (Davis et al 1989).

In addition, as mentioned in Chapter Four, benefits can also be derived from having the opportunity to use "state-of-the-art" technology. Such an intrinsic satisfaction associated with the advanced technology has caused firms in developing countries to adopt the most advanced technologies without considering the appropriateness of the technology (Cortes 1982; Nabseth and Ray 1974; Rogers 1983; Stobaugh and Wells 1984; James and Watanabe 1985).

Another consideration, as mentioned in Chapter Four, is the relative advantages of adopting the technology which can be obtained from improvement in quality or productivity and provision of solutions to production or technical problems.

5.3.3.8 Perceived difficulty

Perceived difficulty, as illustrated by the term itself, is the extent to which the decision-maker will expect the transfer and adoption of the foreign technology to be free from difficulties. This can be measured in terms of the difficulties facing the adopting firm in the process of transferring and utilising the technology. The degree of ease can vary according to the perceived probability of the occurrence of technical problems and the length of time associated with the learning process for adopting the technology.

5.3.3.9 Compatibility

Compatibility of the foreign technology means how compatible is the new technology with the current internal environment of the firm. The current internal environment is measured by the firm's production equipment and inputs used for production and the general production environment.

5.3.3.10 Enhanced Value

Benefits derived from the adoption of technology may not only be related to the decision-maker or the company alone, they can also generate extra values to consumers, thereby, indirectly benefiting the adopting firm.

Hence, enhanced value is measured in terms of the perceived additional value that consumers will place on the products manufactured through the new technology.

5.3.3.11 Adoption Experiences

Adoption experiences means the adopter's prior experiences with either similar technology or the supplier of the technology or both. To measure this construct, respondents are asked whether they have had past experience with the technology or the supplier of the technology.

5.3.3.12 Supplier's Commitment

Supplier's commitment can be either supportive or restrictive. Supportive commitments are anticipated to come from the provision of resources support. On the other hand, the supplying firm may impose restrictions on the conditions under which the transferred technology can or must be used.

Resources support can be in the form of equipment maintenance, product and production design, on-site assistance, human resource support, and marketing supports. It is measured by asking respondents to rate the importance of the services which can be provided by the supplier in the transfer and application process of the technology.

Likewise, transfer restrictions can be tied purchases clauses, export restrictions and restrictions on transferring the technology to other domestic producers. Tied purchases clauses require the recipient firm to exclusively purchase from the supplier of the technology raw materials, spare components, peripheral equipment, or equipment replacement. Export restriction simply means an restriction to export part or the whole finished products or the technology outside the recipient's country. By the same token, the supplier may also restrict the transfer of the technology, either in part or as a whole, to other domestic firms as well.

5.3.4 Reliability and Validity of Measures

Carmines and Zeller (1979) defined measurement as a "process of linking abstract concepts to empirical incidents" (p.10). In other words, measurement is both a conceptual and empirical process which composes of two qualities: validity and reliability.

While validity assesses the degree to which an instrument can truly measure the constructs which it purports to measure, reliability investigates the extent to which a measure is free from error and can provide consistent results (Churchill 1995; Peter 1979). Also, reliability is just a necessary, but not a sufficient, condition for assuring the validity of a measure (Church 1995).

5.3.4.1 Reliability

It is very important for researchers to ensure that the measures developed to empirically examine the conceptual framework of their model are, in the first place, reliable. The reliability issue is especially crucial to this research because of the exploratory nature of this study.

According to reliability theory, there are two types of variances to the scores of an observed scale: the true variance and the error variance. True variance means the systematic variance and the error variance is the random variance. Systematic variance does not affect either the rank order or the distance between subjects but random variance does; therefore, random variance may lower the reliability of the measure (Peter 1979).

To assess the reliability of a measure, correlation is calculated between the scores obtained from a scale and those obtained from some types of replication of that particular scale. When the correlation is high between these scores, the scales can provide consistent results; hence, a reliable measure.

There are two popular ways to assess reliability: stability and equivalence (Churchill 1995). “Stability” can be measured by the “test-retest” and “alternative forms” methods and “equivalence” can be measured by the “internal consistency” method.

Because of 1) the difficulties in developing two measurement forms which are identical, and 2) the problems in determining the interval period between successive administration of the instrument under the test-retest method, the internal consistency method is chosen for this study (Churchill 1995).

One of the most common methods used to evaluate internal consistency of an instrument is Cronbach’s coefficient alpha (1951). The Cronbach’s alpha is calculated to determine the mean reliability coefficient for all possible ways of splitting a set of items in half. Since this research utilises multiple-item scales, the application of the coefficient alpha as a measurement of reliability is considered appropriate (Peter 1979).

5.3.4.2 Validity

Validity is synonymous with accuracy. The validity of a measuring instrument is defined as "the extent to which any measuring instrument measures what it is intended to measure" (Carmines and Zeller 1979, 17). In short, it implies the development of measurements which are actual representations of the true characteristics of the matter or phenomenon under which the researcher is attempting to measure. Despite its clear objective, the development of a valid measure is much harder to do than to say. The problem is derived from the establishment of an accurate measure which can capture the characteristics of interest. In fact, this is never established unequivocally but, instead, is always inferred (Churchill 1995).

There are three types of validity which are of particular interest to researchers: 1) content validity; 2) criterion-related, that is, predictive, validity; and 3) construct validity (Churchill 1995).

Criterion-related validity refers to the use of an instrument "to estimate some forms of behaviour which is external to the measuring instrument itself (the criterion)" (Nunnally 1978, 87). Hence, it depends upon the correlation between the scale scores with one or more criteria which are external to the measuring instrument. However, not all measurements are applicable to the criterion validation procedures because appropriate criterion variables may not exist. In addition, the more abstract the concept is, the more difficult it is to identify a relevant criterion (Carmines and Zeller 1979). Because of the exploratory and behavioural nature of the current study, together with the fact that the purpose of this study does not attempt to predict a particular criterion external to the study, criterion-related validity is not considered. In addition, criterion-related validity is rarely the most essential kind of validity since researchers are, more often than not, concerned with what actually the measure is in fact measuring rather that the accuracy of the measure's predictability (Churchill 1995, 534).

Content validity "focuses on the adequacy with which the domain of the characteristic is captured by the measure" (Churchill 1995, 534). Adequacy is measured in terms of the sampling adequacy. Content validity is usually measured based on judgement (Kerlinger 1986). In fact, because of this characteristic of assessing content validity, it is sometimes called "face validity" for the reason that it is "assessed by examining the measure with an eye toward ascertaining the domain being sampled (Churchill 1995, 535). In most cases, content validity is ensured by the careful construction of the research instrument (Nunnally 1978). To achieve this, as mentioned in Chapter 4, an expert panel is invited to judge on each and every item of the instrument to assure relevance to the property under measurement is attained during the measurement construction stage of this research.

In addition, content validity can be further established by constructing the measurement after carefully reviewing literature and instruments which have been empirically tested. As revealed in Chapter 4 and Section 5.3, the model of this research and the corresponding instrument subsequently constructed is developed after a thorough review of the relevant literature. Hence, this process has further given rise to the development of measures which are more relevant to the content of the constructs before they are subjected to the scrutiny of the expert panel.

Construct Validity is the extent to which an unobservable construct is actually measured by a proposed operational measure (Churchill 1995). Hence, it is mostly directly related to the question of what the measure is measuring. In other words, construct validity indicates the fitness between the conceptual property and the operational measures of the constructs (Nummally 1978). There are two aspects to the construct validity: convergence and discriminability of the instrument. These two aspects are referred to as the "convergent validity" and "discriminant validity" (Campell and Fiske 1959).

Convergence implies that evidence collected from different sources through different means provides the same or similar meaning of the construct. On the other hand, discriminability means the ability to differentiate constructs should such difference be anticipated.

A traditional method to establish the convergent and discriminant validity of a measure is the multitrait-multimethod matrix approach (Campbell and Fiske 1959). Under this approach, maximally different methods are employed to measure the same construct. However, this is not a common approach in international studies; perhaps due to the difficulty of obtaining maximally different measures for one construct (Albaum and Peterson 1984).

Instead, two separate methods are adopted to assess the convergent and discriminant validity for the current study. To evaluate the convergent validity of the measure, the structural equation modelling methodology is utilised. This method is supported by Bagozzi et al (1979) who indicated that this method can provide more information than the multitrait-multimethod matrix approach for two reasons.

First, the power of the causal modelling methodology is coming from its ability to scrutinise the entire pattern of correlation among measures and asserts that 1) there should be high intercorrelation between measures for the same construct and 2) the correlation should, generally, be greater than the correlation of measures across constructs. Second, more explicit statistics can be provided for the evaluation of the convergent validity of the measures (Bogozzi et al 1979). EQS for Windows (Bentler and Wu 1995) is utilised to perform the procedures necessary for the establishment of the convergent validity. As for discriminant validity, factor analysis is used to determine the uniqueness of the constructs (Bagozzi et al 1979). These combined procedures are adopted to ensure the construct validity of measurement scales of the instrument.

5.3.5 The Questionnaire

Before starting to complete the questionnaire, respondents are asked to read an instruction sheet which lays down instructions for completing the questionnaire. In order to help respondents establish a frame of reference on the prospective foreign technology to be adopted, the instruction sheet also asks respondents to write down on the space provided:

1. the manufacturing technology or equipment which immediately come to their mind when their read the term “technology transfer”; and

2. the foreign company or country which can best supply this technology or equipment.

Then, respondents are asked to use this information as their terms of reference when completing the questionnaire. This procedure is adopted in this study because the current research is a cross-sectional study; hence the relevant technology to be perceived by respondents is different. By asking the respondents to write down their own perceived foreign technology and the targeted country for the transfer, the relevancy of the research to the respondents can be increased; thereby, improving the chances of achieving a high response rate.

The questionnaire for this study is divided into seven parts. The first part relates to the "Domestic Availability" and "Adoption Experience" factors. This part has six questions in total. There are three questions on the domestic availability and adoption experience factors, respectively.

The second part of the questionnaire contains fourteen questions. The first twelve questions relate to the "Material Incentives", "Perceived Benefit", and "Enhanced Value" factors of the model. With the exception of the perceived benefit factor, which has six questions, all the other factors have three questions. In addition, included in this part is also one question to measure the behaviour intention of the respondents to adopt the foreign technology as well as one other question to measure the strategic choice available to the prospective adopter.

Part three relates to the “Perceived Difficulty” and “Compatibility” factors. There are two questions for both the perceived difficulty and the compatibility factors.

Parts four and five of the questionnaire are composed of the positive and negative influences relating to the “Supplier Commitment” factor. Part four comprises seven supports from the supplier and Part five lists six obstacles imposed by the supplier.

Hence, together with the twelve and four questions included in Part two and three of this questionnaire, respectively, there are twenty nine questions, in total, to measure the attitudinal factor of the International Model For Technology Adoption.

Questions pertaining to the remaining four factors of the model are covered by Part six of the questionnaire. Each of the following three factors has one question: 1) “Industry Structure”, 2) “Demand Uncertainty”, and 3) “Price Intensity”; with the “Information Exposure” factor having two questions. Finally, Part seven of the questionnaire asks the demographic particulars of the respondents.

5.4 Sample Design

5.4.1 Sample Size Determination

It is important that the sample is sufficient in size to facilitate the necessary statistical techniques required to analyse the data. A general rule of thumb in the determination of sample size is to use a sample as large and as representative as possible. In fact, for regression analysis, Kerlinger and Pedhazer (1973) suggested that in analyses involving several independent variables, the sample size should be at least 100 subjects and preferably 200 or more. Of course, this is a very crude estimate.

In addition, since factor analysis is also utilised in this study, Hair et al (1987) indicated that the sample size should not be less than 50 observations and, again, preferably greater than 100 observations. The general rule of thumb in determining the optimal sample size is to take into consideration the number of variables used in the factor analysis. There should be four to five times as many observations as compared with the number of variables included in the factor analysis (Hair et al 1987). However, Hair et al (1987) also mentioned that this is a rather conservative ratio. In many studies, researchers had utilised a 2 to 1 ratio when factor analysis was used.

Furthermore, as this study utilises the structural equation modelling technique, the use of maximum likelihood estimation (MLE) requires a minimum sample size of 100. As the sample size increases beyond this value, the MLE method rises in its sensitivity to detect differences among the data. When sample size is very large, normally exceeding 400 to 500, the MLE method can become "too sensitive" to detect any difference in the models; thereby making all goodness-of-fit measures indicate a poor fit (Carmines and McIver 1981; Marsh, Balla and McDonald 1988; Tanaka 1987). Since there is no precise rule on the best sample size, it has been recommended that the "critical sample size" should be approximately 200 (Jöreskog and Sörbom 1988).

5.4.2 Sample Elements

Churchill (1995) suggested that the sample element selection procedure is affected by the type of sample and the data collection procedures. The actual number of subjects invited to participate in this research is dependent upon the anticipated response rate which is also conditioned by the nature of the data collection techniques adopted in a particular study.

As mentioned and explained in Section 5.2, the survey research method is chosen as the data collection method for the current study. In particular, a mail survey is adopted for this research. The major advantage of postal surveys are geographic flexibility, the ability to incorporate a large sample size at a moderate cost, respondent convenience, and nature of anonymity, hence the provision of confidentiality (Churchill 1995, Zikmund 1994).

However, it is also recognised that there are some limitations in utilising postal survey technique. The major problem relates to a low response rate. Response rates could be as low as 5% to 10% and normally not higher than 30% (Alreck and Settle 1985). However, there may be ways to improve the response rate. Techniques such as the offering of monetary or non-monetary incentives, use of a well designed covering letter as well as questionnaire, assuring anonymity, providing confidentiality, using deadline statements, providing prepaid return envelopes, and incorporating follow-up procedures have been suggested to be effective means to boost response rates (Churchill 1995; Walker et al 1987; Yu and Cooper 1983).

Based on the assumption of a 10 percent response rate and having considered the “critical sample size” of 200, as discussed in Section 5.4.1, the minimum number of respondents invited to participate in this study should be at least 2000.

The sample is drawn from the Directory of Hong Kong Industries. This Directory is published by the Hong Kong Productivity Council of the Hong Kong Government. There are information on 6465 companies contained in the 1996 Directory of Hong Kong Industries. Every alternate company listed in the Directory is to be included as the sample for this survey; hence 50% of the companies in this Directory were used. This gives a sample size of 3233 companies.

The Directory of Hong Kong Industries is adopted as the sampling frame for this research was because this Directory is the best publication and source in Hong Kong to provide the most comprehensive and up-to-date information on manufacturing industries in Hong Kong. In 1995, there were 31,114 manufacturing establishments in Hong Kong. There was no published information available to the public in Hong Kong which includes the company profile of all these manufacturing establishments. The information was held by Hong Kong government's Census and Statistics Department which classified the information as confidential, and hence, not accessible by the public. The Directory of Hong Kong Industries is the best publication one can get which includes information on major manufacturing companies in Hong Kong. The Directory is compiled on the basis of the latest list of local manufacturing establishments maintained by the Census and Statistics Department. The information on the companies listed in the Directory is further collected through an extensive mail survey, followed by telephone interviews, conducted by the Hong Kong Productivity Council.

In addition, since the topic of this research is on technology adoption, it is more likely for larger companies to be engaged in this kind of activities. Of the 31,114 manufacturing firms in Hong Kong in 1995, 29,821 firms were small establishments which employed less than 50 persons. Hence, there were only 1,293 manufacturing firms, across all industries in Hong Kong, which employed more than 50 persons. With the Directory of Hong Kong Industries covers 6465 major companies, including all large manufacturing establishments in Hong Kong, it is expected that the Directory provides a good representation of companies which are more likely to engage in technology adoption activities; hence, the topics of the research.

5.4.3 Non-respondent Issues

In order to reduce the problems relating to non-response error, the following procedures are put in place:

1. Comparison of early versus late respondents (Anderson and Narus 1984; Campbell 1987)

2. Comparison of respondents to the initial mailing versus respondents receiving the follow-up mailings (Karuppan 1986)

The rationale behind comparing early with late respondents is that it is suggested that non-respondents are more similar to late respondents than early respondents. Alreck and Settle (1985) indicate that the majority of all respondents are expected to respond within three weeks from the initial mailing. Using this as the benchmark and the postmarked date on the return envelope as a base, early respondents are classified as those who respond within 14 days after the first mailing. Likewise, late respondents are those who respond after the 14 days yardstick. It has been suggested that the responses of non-respondents can be assumed to be similar to those of the respondents if significant differences are not found to exist between early and late responses.

The second method mentioned above to control non-response errors is to compare the responses between respondents from the initial mailing and those from the follow-up mailing. It is anticipated that the responses from follow-up mailing are more likely to resemble non-responses than those of the initial mailing (Karruppan 1986).

5.5 Data Collection

The data is collected through mail questionnaire surveys for the current study. Each prospective respondent receives a survey packet which includes a covering letter, a survey questionnaire, and a stamped self-addressed return envelope. The survey packet will be sent to the Director of the company or to someone with an equivalent capacity. Since the names of the contact persons are included in the Directory of Hong Kong Industries, a personalised letter will be used in this survey.

Two rounds of follow-up surveys are to be conducted at three-week intervals. The first follow-up mailing is sent to all non-respondents three weeks after the initial mailing. In all follow-up mailings, the survey packet includes a reminder, a questionnaire and a self-addressed prepaid envelope. The second follow-up survey is to be conducted three weeks after the first round of follow-up mailing.

To improve the response rate, the covering letter also suggests that a souvenir will be given to each respondent as a token of appreciation. In addition, the following procedures are used to foster the response rate:

1. The importance of the research to the respondents is stated in the covering letter. (Churchill 1995; Peterson 1982).

2. The legitimacy and objectivity of the study are stressed through:
   a. the utilisation of the Open Learning Institute of Hong Kong (OLI), the largest and the only government-established distance and adult education provider in Hong Kong, letterhead for all correspondence.
   b. the professional printing of the questionnaire
   c. the use of the OLI's address in the return envelope
   d. a statement that this study is part of a doctoral thesis (Churchill 1995; Kinnear and Taylor 1987).

3. The use of follow-up procedures.

4. Confidentiality and anonymity are guaranteed in the covering letter (Churchill 1995).

5. The provision of pre-paid, self-addressed return envelops (Alreck and Settle; Churchill 1995).

5.6 Data Analysis Procedures

Data analysis means the use of selected statistical techniques to reduce and summarise the amount of data details so as to present the most salient facts and relationships within the data set (Alreck and Settle

1985). For the current study, the following analytical methods are adopted:

1. descriptive statistical analysis;
2. correlation analysis;
3. Structural Equation Modelling

5.6.1 Descriptive Statistical Analysis

Descriptive statistics are used to provide quantitative measures for the characteristics of the sample.

5.6.2 Correlation Analysis

Correlation analysis is used to determine the relationships between a variable and the predictors. The correlation coefficients are useful in describing the strength and direction of the relationships. The Pearson product-moment correlation coefficients are calculated in order to test certain basic hypotheses of this study.

These hypotheses are H_1 through to H_9 which include the relationships between the endogenous and exogenous variables.

5.6.3 Structural Equation Modelling

The Structural Equation Modelling technique is an evolution of multiequation modelling developed mainly in econometrics and combined with the principles of measurement from psychology and sociology. The main characteristics of structural equation modelling are twofold:

1. accommodating multiple interrelated dependence relationships; and
2. the ability to represent unobserved constructs in these relationships.

Accommodating multiple interrelated dependence relationships simply means that the structural equation modelling is capable of providing estimates of a series of separate but interdependent multiple regression equations simultaneously. This is achieved by specifying a "structural model" which expresses the exact relationships among dependent and independent variables, even when one dependent variable develops into an independent variable under other relationships.

These relationships are then converted into a series of structural equations for each dependent variable. These structural equations are quite similar to multiple regression equations. This distinctive feature of structural equation modelling makes it different from the other multivariate analyses which can only allow a single relationship between dependent and independent variables.

In addition to the ability to estimate multi-interrelated dependence relationships, structural equation modelling can also allow the inclusion of latent variables into the analysis. A latent variable is a concept which cannot be observed directly and can only be estimated indirectly through some other observable or measurable indicators. This is very useful in this research because part of the International Model For Technology Adoption involves some abstract concepts such as the adopter's attitudes towards the foreign technology.

Besides the practical justification, there is also a theoretical justification. In all multivariate techniques but structural equation modelling, it has been assumed that the independent variables are "error-free" (Blalock 1985). However, it is clear that some degree of "measurement error" exists in any analysis because researchers cannot perfectly measure a concept. In order to deal with the measurement error problem, the structural equation modelling incorporates the "measurement model" which specifies the relationships between manifest (observable indicators) and latent variables. In the measurement model, both the contribution of each variable as well as the fitness of the variables to measure the concept (reliability) can be incorporated into the estimation of the structural equations.

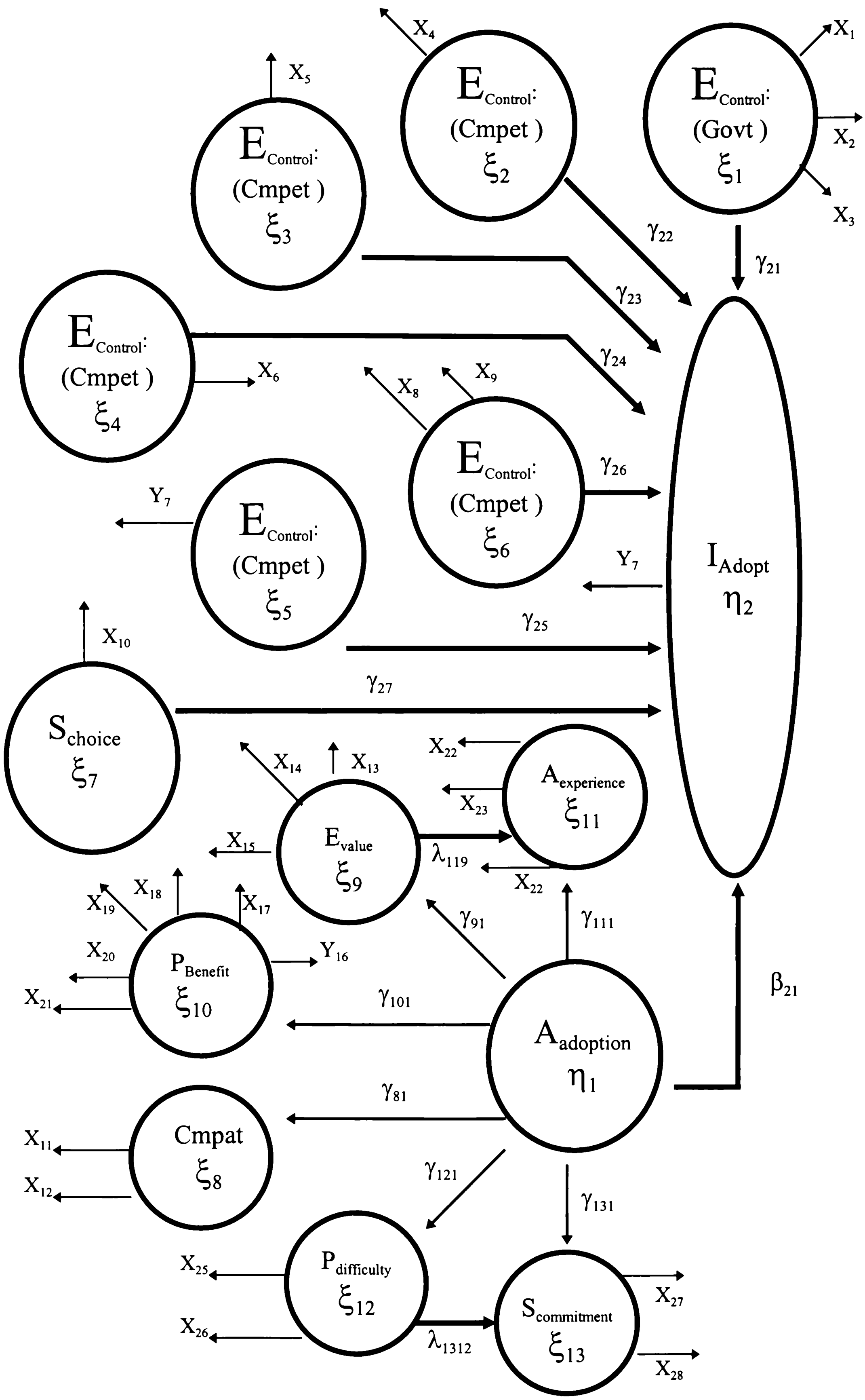
Hence, the benefit of using structural equation modelling comes from the value of operating the structural and measurement models simultaneously.

5.6.3.1 Path Analysis

The first step for conducting an overall analysis using the structural equation modelling technique is to conduct a path analysis. Path analysis is based on calculating the strengths of the causal relationships from the correlations or covariances among the constructs. The bivariate correlation between any two constructs can be delineated as the aggregate of the compound paths of causal relationships connecting to these constructs. In short, the path analysis uses the simple correlations between constructs to estimate the causal relationships between the exogenous and endogenous variables of a conceptual model.

To express the conceptual model, the relationships among the constructs are portrayed in a "path diagram". The path diagram for this research is presented in Figure 5.1. All constructs of a path diagram can be classified into either "exogenous" and "endogenous". Exogenous constructs (ξ) are the source variables or the independent variables and cannot be predicted by any other variables within the model. For endogenous variables (η), they are those predicted by other constructs within the model, in other words the dependent variables.

Figure 5.1: Path Diagram For The Conceptual Model



In addition, endogenous constructs can be used to predict other endogenous constructs, but an exogenous construct can only be causally related to endogenous constructs.

A note of caution. These two terms used in the structural equation modelling should not be confused with the same terms used in the International Model For Technology Adoption discussed in Chapter Four. The terms “endogenous” and “exogenous” used in the conceptual model in Chapter Four simply means “internal” and “external”, respectively.

After the path model has been constructed, the next step is to convert the path diagram into a series of structural equations. To develop the structural model for this study, each endogenous construct is the dependent variable in each individual equation. All the other variables relating to the endogenous constructs are exogenous constructs (predictors) of the equations. Now the links between variables in the structural model are shown below:

Endogenous Constructs	=	Exogenous Constructs	+	Endogenous Constructs	+ Error
		$\xi_1 \cdots\cdot \xi_{13}$		$\eta_1 \cdots \eta_2$	
η_1	=	$\gamma_{81}\xi_8 + \gamma_{91}\xi_9 + \gamma_{101}\xi_{10} + \gamma_{111}\xi_{11}$			
		$+ \gamma_{121}\xi_{12} + \gamma_{131}\xi_{13}$			$+ \varepsilon_2$
η_2	=	$\gamma_{21}\xi_1 + \gamma_{22}\xi_2 + \gamma_{23}\xi_3 + \gamma_{24}\xi_4 + \gamma_{25}\xi_5$			
		$+ \gamma_{26}\xi_6 + \gamma_{27}\xi_7$	+	$\beta_{21}\eta_1$	$+ \varepsilon_2$

Where:

η_1 = Attitude Towards Adoption	η_2 = Intention To Adopt
ξ_1 = Government Influence	ξ_2 = Industry Structure
ξ_3 = Price Intensity	ξ_4 = Demand Uncertainty
ξ_5 = Domestic Availability	ξ_6 = Information Exposure
ξ_7 = Strategic Choice	ξ_8 = Compatibility
ξ_9 = Enhanced Value	ξ_{10} = Perceived Benefit
ξ_{11} = Adoption Experiences	ξ_{12} = Perceived Difficulty
ξ_{13} = Supplier Commitment	

5.6.3.3 Measurement Model

When the structural equations have been specified, the measurement of each construct have to be defined. The measurement model for this study is shown in Tables 5.1a and 5.1b

Table 5.1a: Measurement Model Equations

Exog	Exogenous Constructs													
Ind.	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	ξ_7	ξ_8	ξ_9	ξ_{10}	ξ_{11}	ξ_{12}	ξ_{13}	+ Er
X_1 =	$\lambda_{11}\xi_1$													$+\delta_1$
X_2 =	$\lambda_{21}\xi_1$													$+\delta_2$
X_3 =	$\lambda_{31}\xi_1$													$+\delta_3$
X_4 =		$\lambda_{42}\xi_2$												$+\delta_4$
X_5 =			$\lambda_{53}\xi_3$											$+\delta_5$
X_6 =				$\lambda_{64}\xi_4$										$+\delta_6$
X_7 =					$\lambda_{75}\xi_5$									$+\delta_7$
X_8 =						$\lambda_{86}\xi_6$								$+\delta_8$
X_9 =						$\lambda_{96}\xi_6$								$+\delta_9$
X_{10} =							$\lambda_{107}\xi_7$							$+\delta_{10}$
X_{11} =								$\lambda_{118}\xi_8$						$+\delta_{11}$
X_{12} =								$\lambda_{128}\xi_8$						$+\delta_{12}$
X_{13} =									$\lambda_{139}\xi_9$					$+\delta_{13}$
X_{14} =									$\lambda_{149}\xi_9$					$+\delta_{14}$
X_{15} =									$\lambda_{159}\xi_9$					$+\delta_{15}$
X_{16} =										$\lambda_{1610}\xi_{10}$				$+\delta_{16}$
X_{17} =										$\lambda_{1710}\xi_{10}$				$+\delta_{17}$
X_{18} =										$\lambda_{1810}\xi_{10}$				$+\delta_{18}$
X_{19} =										$\lambda_{1910}\xi_{10}$				$+\delta_{19}$
X_{20} =										$\lambda_{2010}\xi_{10}$				$+\delta_{20}$
X_{21} =										$\lambda_{2110}\xi_{10}$				$+\delta_{21}$
X_{22} =											$\lambda_{2211}\xi_{11}$			$+\delta_{22}$
X_{23} =											$\lambda_{2311}\xi_{11}$			$+\delta_{23}$
X_{24} =											$\lambda_{2411}\xi_{11}$			$+\delta_{24}$
X_{25} =												$\lambda_{2512}\xi_{12}$		$+\delta_{25}$
X_{26} =												$\lambda_{2612}\xi_{12}$		$+\delta_{26}$
X_{27} =													$\lambda_{2713}\xi_{13}$	$+\delta_{27}$
X_{28} =													$\lambda_{2813}\xi_{13}$	$+\delta_{28}$
ξ_{11} =									$\lambda_{119}\xi_9$					$+\delta_{29}$
ξ_{13} =												$\lambda_{1312}\xi_{12}$		$+\delta_{30}$

Table 5.1b: Measurement Model Equations

Exog Ind.	Endogenous Constructs η_1	η_2	+ Er
Y_1 =	$\lambda_{81}\eta_1$		$+ \varepsilon_1$
Y_2 =	$\lambda_{91}\eta_1$		$+ \varepsilon_2$
Y_3 =	$\lambda_{101}\eta_1$		$+ \varepsilon_3$
Y_4 =	$\lambda_{111}\eta_1$		$+ \varepsilon_4$
Y_5 =	$\lambda_{121}\eta_1$		$+ \varepsilon_5$
Y_6 =	$\lambda_{131}\eta_1$		$+ \varepsilon_6$
Y_7 =		$\lambda_{72}\eta_2$	$+ \varepsilon_7$

5.6.3.4 Estimation Of the Parameters

The completed specification of the EQS model needed for estimation of the International Model For Technology Adoption has been determined. Together with the specifications of the model, the correlation matrix for the thirty-five observable variables is computed as the input into the EQS package. The maximum likelihood estimation procedure is to be used for the estimation of the parameters of the model.

5.7 Summary

This chapter describes the methodology used in establishing the International Model For Technology Adoption. This research utilises survey research methods as the means to collect the needed information. Measurements for the constructs of this model as well as the reliability and validity issues are developed and assured according to suggestions of related literature.

In short, the International Model For Technology Adoption is hypothesised to be affected by two endogenous variables and thirteen exogenous variables. The two endogenous variables are 1) Intention to Adopt, and 2) Attitude towards Adoption.

The thirteen exogenous variables are 1) Strategic Choice, 2) Material Incentive, 3) Compatibility, 4) Industry Structure, 5) Price Intensity, 6) Demand Uncertainty, 7) Information Exposure, 8) Domestic Availability, 9) Perceived Benefit, 10) Enhanced Value, 11) Adoptive Experience, 12) Supplier Commitment and 13) Perceived Difficulty. Finally, the relationships between these exogenous and endogenous variables are to be tested by using the structural equation modelling techniques.

In particular, the relationships between these exogenous and endogenous variables are given as follows:

A) Intention to Adopt is dependent on the following three variables:

1. Strategic Choice.
2. Environmental Control: Government Influence.
3. Environmental Control: Competitive Influence I.
4. Environmental Control: Competitive Influence II.
5. Environmental Control: Competitive Influence III.
6. Environmental Control: Competitive Influence IV.
7. Environmental Control: Competitive Influence V.
8. Attitude towards Adoption.

By using the standardised notations for structural equation modelling, the relationships can be expressed as follows:

$$\eta_2 = \gamma_{21}\xi_1 + \gamma_{22}\xi_2 + \gamma_{23}\xi_3 + \gamma_{24}\xi_4 + \gamma_{25}\xi_5 + \gamma_{26}\xi_6 + \gamma_{27}\xi_7 + \beta_{21}\eta_1 + \varepsilon_2$$

B) Attitude Toward Adoption is dependent on the following two variables:

1. Compatibility.
2. Enhanced Value.
3. Perceived Benefit.
4. Adaptive Experiences.
5. Perceived Difficulty.
6. Supplier Commitment

By using the standardised notations for structural equation modelling, the relationships can be expressed as follows:

$$\eta_1 = \gamma_{81}\xi_8 + \gamma_{91}\xi_9 + \gamma_{101}\xi_{10} + \gamma_{111}\xi_{11} + \gamma_{121}\xi_{12} + \gamma_{131}\xi_{13} + \varepsilon_2$$

Chapter Six: Data Analyses and Results

6.1 Introduction

The purpose of this chapter is to provide a thorough discussion of the data analyses and to present the result findings of this study. In this data analysis stage of the present study, the theoretical model of this research, that is, the International Model For Technology Adoption, is verified through the data collected from the respondents described in the previous chapters. The chapter begins with a description of the survey responses. Following the display of descriptive statistics is the evaluation of the reliability and validity of the measures. The chapter continues by discussing the procedures of the hypotheses testing and finally the statistically analyses are explained.

6.2 Survey Response Analysis

There are information on 6465 companies contained in the 1996 Directory of Hong Kong Industries. Every alternate company listed in the Directory was included as the sample for this survey; hence 50% of the companies in this Directory were used. A data cleaning procedure was first adopted before actually encompassing them into the sample. All the 3233 companies were contacted by telephone to establish an initial contact. This procedure served the following purposes:

1. An invitation was extended to all companies at this stage. All companies unwilling to participate could be identified. The reasons for non-participation were solicited at this stage as well. The main reason at this phase for refusal to participate was that the companies were not involved in the activities of technology adoption; thus, were not interested in participating.

2. Secondly, the name of the contact person, the address of the company and the name of the company listed for the Directory of Hong Kong Industries could be verified. Therefore, companies already out of business or those which had moved to a new location could be determined.

After this data cleaning procedure, the total number of companies which were willing to express an initial interest in this survey were 2198, constituting 68% of the original sample size. Hence, 2198 questionnaires were sent out. A majority (58%) of the remaining 32% of the companies were actually out of business because the telephone lines of these companies were disconnected.

A total of 298 completed questionnaires were returned; giving a response rate of 13.56%. This response rate was higher than the 10% response rate initially anticipated for this survey. Even though an initial invitation was extended, consistent with other surveys in Hong Kong, the response rate was close to the 10% benchmark for survey research in Hong Kong. Five percent of the non-respondents were contacted and asked for the reasons for their refusal to participate. The main reason provided was that they were too busy or the topic, after a further reading of the questionnaire was not of particular interest to them.

An interesting finding here was that even though an initial contact was established earlier by telephone, more often than not, the person who answered the telephone was the receptionist or a junior clerk of the company. So, the details of the particulars for the companies were fully identified and verified. Hence, in most cases, the invitation was not extended to “contact person” listed on the Directory.

In addition, since the majority of the “contact persons” were either the owner and manager or senior executives of the companies, even the name of the “contact person” was asked for during the call, that person, more often than not, would either not be at the office or a secretary would have answered the call.

This phenomenon helps explain why the response rate was only 13.56% when 68% of the initial respondents did not seem to have expressed an unwillingness to participate when they were first contacted.

Of the 298 questionnaires, 39 of the responses were unusable with missing date. This gave a total of 259 usable questionnaires and an effective response rate of 11.78% which was still higher than the expected response rate of 10%; thereby providing an adequate number of responses for the model building.

6.2.1 Non-Response Analysis

As discussed in the previous chapter, non-response analysis on the representativeness of the sample frame was conducted by making comparisons between responses from:

1. early and late respondents, and
2. initial mailing and following-up mailing.

ANOVA analyses were adopted in this study to analyse whether the difference in the responses were statistically significant at the 10% level. Early respondents were classified as those who completed and returned the questionnaires within the first seven days of the mailing date. Hence, late respondents were those who returned on the eighth day onwards.

About 40% of the respondents returned the questionnaires within the first seven days. Demographic data on age, gender, number of employees, current position within the company and education level were compared. The results of the ANOVA analyses on all these demographic variables showed that no significant difference could be found in all variables between early and late respondents, with the p-value ranging from 0.3148 to 0.9283.

In addition, the ANOVA tests were also conducted to determine whether the responses on each attitudinal statement were different between early and later respondents. The ANOVA results also indicated that all responses between these two groups of respondents were not statistically significant at the 10% level, with a p-value ranging from 0.2726 to 0.9795.

With respect to the ANOVA analyses on initial mailing and follow-up mailing, respondents were first classified according to the colour-coded returned questionnaires. Approximately 66% of all returned questionnaires were from the initial mailing. ANOVA tests were again conducted on all demographic variables and on all attitudinal statements. The results of the ANOVA tests were similar to those on the early and late respondents. All ANOVA results failed to identify any statistical difference, at the 10% level, between respondents from initial and follow-up mailings in their demographic profiles (p-value ranging 0.1913 to 0.7507) and in their responses to the attitudinal statements (p-value ranging from 0.4307 to 0.9806.)

6.3 Characteristics of the Sample

This section reports on the characteristics of the sample for this study. Firstly, the mean age of the respondents was 41.5 years old. Nearly seventeen percent of all respondents were aged at or below 30; 37.1% were aged between 31 and 40; 22.0 were aged between 41 and 50; 16.6% were aged between 51 and 60; and 7.7% were aged above 61.

As to the gender of the sample, 80.7% of them were male and 19.3% were female. Regarding the average size of the responding company, the median number of people employed was 65; with a range between 1 to 5000 employees. Almost forty six percent of the responding companies employed less than 50 staff; 13.1% employed between 50 to 99 staff; 27.0% employed between 100 to 499 staff; 8.5% employed between 500 and 999 staff; and 5.4% employed 1000 staff and above. In addition, when all manufacturing establishments were categorised according to company size and compared the total number of Hong Kong manufacturing establishments in each size category in 1995 with the number of responding firms in each respective category, it clearly indicated that this survey had already covered a majority of the larger manufacturing establishments in Hong Kong, as indicated in Table 6.0. Given the topic of this research is on technology adoption and it is more likely for larger firms to engage in technology transfer activities, such a response pattern can be considered as a good representation of the views on this topic from the manufacturing sector in Hong Kong.

Table 6.0: Percentage of Respondents to Number of Manufacturing Firms by Size of Establishments

Size of Establishments	1995#	This Survey	Percentage
1 - 49	29821	119	0.4
50 - 99	771	34	4.4
100 - 499	170	70	41.2
500 - 999	39	22	56.4
1000 or above	13	14	107.7

 # Source: Census and Statistics Department

As mentioned in Section 5.5, the questionnaires were sent to the Directors of the companies. However, only a majority of the respondents

(77.2%) reported that they held the position of Director or a similar title in the company. Apparently, the Director might have passed the questionnaire to a sub-ordinate for reply. The next most frequently cited position of the respondents was in the Marketing and Sales area (13.1%). However, all of the respondents were in the management level of the company; and carried titles ranging from manager in one of the key functional area of a company such as marketing, engineering or Accounting and Finance to Managing Director.

In order to determine whether there was any significant difference in the attitude towards technology adoption from respondents with different positions in a company, additional statistical analyses were carried out. In particular, ANOVA tests were conducted to determine whether there was any significant difference in responses to each attitudinal statement of the questionnaire between respondents who held general management positions and those who held functional positions. Given the majority of the respondents were holding general management positions and the functional positions held by the remaining respondents were quite diverse, it was decided that respondents were to be classified into two categories: that is, those in general management positions and those in functional positions. The results of the ANOVA tests found that no significant difference existed, at the 10% level, in the responses between these two groups of respondents on all statements (with a p-value ranging from 0.1273 to 0.9959), except for one statement (with a p-value of 0.0337) which asked the respondents whether or not they agreed the new technology was compatible with other manufacturing equipment they were currently using. For respondents holding a general management position, 46.5% of them agreed with the statement while only 32.1% of respondents holding a functional position agreed. In addition, the percentage of disagreement between these two groups were 18% and 28.7% for general managers and functional managers, respectively. Given the difference was only found in one statement between these two categories of respondents and given the majority of respondents in these two categories agreed with this statement (the difference was only in terms of the percentage of support), it was concluded that no major difference was found in the responses provided by these two categories of respondents. Hence, the attitude of the respondents was not affected by their position in the company. Therefore, it was unnecessary to accommodate differences in responses from respondents working in a variety of functional disciplines as the ANOVA tests indicated that no such difference could be found.

Regarding the number of years with the company, the average years of employment with the responding company was close to 10 years (9.943); with 65.6% of the respondents working with the company for 10 or less years; 27.4% working between 11 to 20 years; and 7.0% working with the company for more than 20 years.

Finally, in relation to the education level of the respondents, 28.6% of them had completed secondary school; 29.7% had post-secondary qualification not up to a bachelor's degree level; 33.6% had a bachelor's or a higher degree; and the remaining 8.1% held other qualifications such as a professional qualification.

6.4 Validity and Reliability of the Scale

The validity and reliability of the measurement scale for this study are discussed in this section. First, this section looks at the reliability issues and then reports on the validity of the scale.

6.4.1 Reliability of the Measures

Cronbach's (1951) coefficient alpha was employed to determine the internal consistency reliability of scales with more than two items. As suggested by Churchill (1995), Cronbach's "coefficient alpha routinely should be calculated to assess the quality of measure" (p. 542). If the coefficient is low, this outcome suggests that "some items do not share equally in the common core"; hence, indicating some of these items "are not drawn from the appropriate domain and are producing error and unreliability." (Churchill 1995, p.542) In other words, a low coefficient alpha is highly suggestive of items which are poor indicators to capture the constructs they intend or suggest to measure.

Coefficient alphas of the measurement scale of the International Model For Technology Adoption are depicted in Tables 6.1a and b. In addition, the Cronbach's alpha for the scale when a particular item of the scale is deleted is also included. This extra information is useful to reveal different dimensions within the scale when it shows that there will be a great change in the alpha if a particular item is deleted. Since it is not very meaningful to calculate the Cronbach's alpha for scales with less than two items, only scales with three or more items for the International Model For Technology Adoption were subjected to the reliability analysis. The SPSS for Windows was utilised to calculate the reliability statistics.

Table 6.1a	**Reliability Analysis**	
Scale	**Coefficient Alpha**	**Alpha if Item Deleted**
Government Influence	0.88	
Item 1		0.82
Item 2		0.77
Item 3		0.87
Enhanced Value	0.84	
Item 1		0.83
Item 2		0.73
Item 3		0.75
Adaptive Experience	0.72	
Item 1		0.57
Item 2		0.73
Item 3		0.40
Supplier's Support	0.86	
Item 1		0.84
Item 2		0.82
Item 3		0.82
Item 4		0.86
Item 5		0.84
Item 6		0.83
Item 7		0.85

Table 6.1b	Reliability Analysis	
Scale	**Coefficient Alpha**	**Alpha if Item Deleted**
Supplier's Restriction	0.71	
Item 1		0.70
Item 2		0.69
Item 3		0.69
Item 4		0.63
Item 5		0.67
Item 6		0.66
Perceived Benefit	0.89	
Item 1		0.87
Item 2		0.87
Item 3		0.86
Item 4		0.89
Item 5		0.86
Item 6		0.87

It has been suggested that the acceptable Cronbach's alpha should be at least 0.70 (Nunnally 1978). As indicated in Tables 6.1a and b, all scales yielded a Cronbach's alpha larger than this threshold, ranging from 0.71 to 0.89. Hence, there scales were considered to be reliable measures of the constructs under investigation.

6.4.2 Validity of the Measures

As mentioned in Chapter 5, the content and construct validity of the scale measurements used in this study were to be examined.

In this study, content validity was ensured by the careful construction of the research instrument (Nunnally 1978). To achieve this, as mentioned in Chapter 4, an expert panel was invited to judge each item of the instrument to assure relevance to the property under measurement was attained during the measurement construction stage of this research.

In addition, content validity was further established by constructing the measurement only after carefully reviewing the literature and instruments which had been empirically tested to be valid in previous studies. As revealed in Chapter 4 and Section 5.3, the model of this research and the corresponding instrument subsequently constructed was developed after a thorough review of the relevant literature. Hence, this process had further given rise to the development of measures which were more relevant to the content of the constructs before they were subjected to the scrutiny of the expert panel.

To further investigate the content validity of these measurement scales, the homogeneity of the scale items was scrutinised. Cronbach and Meehl

(1955) propose the use of correlation analysis of individual item scores with the overall criterion scale score so as to determine the homogeneity of the scale in the aggregate level. This is sometimes referred to as the "item-to-total correlation analysis" which is often use to establish the internal validity of the scale. The basic principle is that, if an item of a scale contributes to the measure of the same construct as the total scale, statistically, the product-moment correlation for this item should be positively and significantly correlated with the total score of the scale.

Tables 6.2a and b present the item-to-total correlations for all items of the scales for the International Model For Technology Adoption.

Table 6.2a[1]	Item-to-total Correlation Analysis
Scale	**Correlation**
Government Influence	
Item 1	0.7542
Item 2	0.8178
Item 3	0.7034
Enhanced Value	
Item 1	0.6387
Item 2	0.7379
Item 3	0.7174
Adaptive Experience	
Item 1	0.5518
Item 2	0.4507
Item 3	0.6543
Supplier's Support	
Item 1	0.6026
Item 2	0.7517
Item 3	0.7500
Item 4	0.4393
Item 5	0.6469
Item 6	0.6574
Item 7	0.5671

[1] All correlation coefficients are statistically significant at 0.01 level.

Table 6.2b[2]	Item-to-total Correlation Analysis
Scale	**Correlations**
Supplier's Restriction	
Item 1	0.3661
Item 2	0.3836
Item 3	0.3773
Item 4	0.5801
Item 5	0.4710
Item 6	0.5028
Perceived Benefit	
Item 1	0.7022
Item 2	0.7112
Item 3	0.7554
Item 4	0.6095
Item 5	0.7426
Item 6	0.7116

As revealed in Tables 6.2a and b, all correlation coefficient were statistically significant at the 0.01 level. Such a result suggested the existence of internal consistency of items to the total scale score. These findings, together with the results from the reliability analysis presented in the previous section, provided further support for the content validity of the scales adopted in this study to establish an International Model For Technology Adoption.

After establishing the content validity for the measurement scales, the next step was to determine the construct validity. Construct Validity is the extent to which an unobservable construct is actually measured by a proposed operational measure (Churchill 1995). Hence, construct validity indicates the fitness between the conceptual property and the operational measures of the constructs (Nummally 1978).

As mentioned in Chapter 5, construct validity can be divided into two aspects, that is, the convergence and discriminability of the measurement instrument. These two aspects are referred to as the “convergent validity” and “discriminant validity” (Campell and Fiske 1959).

In this study, to evaluate the convergent validity of the measure, the structural equation modelling methodology was utilised. The use of this method to establish convergent validity was supported by Bagozzi et al (1979).

EQS for Windows (Bentler and Wu 1995) was utilised to perform the procedures necessary for the establishment of the convergent validity. As for discriminant validity, factor analysis was used to determine the

[2] All correlation coefficients are statistically significant at 0.01 level.

uniqueness of the constructs (Bagozzi et al 1979). These combined procedures were adopted to ensure the construct validity of measurement scales of the instrument.

6.4.2.1 Convergent Validity

Convergent validity was measured by a goodness of fit of the data to the model under investigation, that is, the International Model For Technology Adoption, in this study (Bagozzi et al 1979). When utilising the EQS for Windows statistical package, the goodness-of-fit of the data in explaining the model was depicted by several statistics reported for a number of goodness-of-fit indices; with these indices all relating to the overall fitness of the model as a whole.

The first of these indices reported was the Independence Chi-square statistic. This figure represented the likelihood ratio test of the Bentler and Bonett (1980) null model. This null model was conceptualised to be one in which all variables were independent; that is, all correlations among variables were set equal to zero. When a large sample was utilised, such as the case for this study, this null model could be considered as a good baseline model to judge the goodness-of-fit for alternative models (such as the International Model For Technology Adoption Model in this study). The goodness-of-fit was evaluated by the gain in improved fit of the IMTA model in comparison with the null model. Given a sound theoretical framework, it was natural to envisage an extremely large independence chi-square value for the null model; hence, indicative of excessive malfitness. For the present study, the independence chi-square value was 2762.554 on 406 degrees of freedom. This was fairly large when compared with the chi-square value reported for the International Model For Technology Adoption.

Application of the data to the IMTA model yielded a chi square of 594.130 with 367 degrees of freedom and a p-value of less than 0.001. Hence, this chi-square value of this model represented a substantially better fit to the data than the null model. However, the probability value of less than 0.001 suggested that the chi-square generated for this model was insignificant as well. But, this result was not too surprising at all, given the well known sensitivity of the chi-square likelihood ratio test to large samples (Byrne 1994; Dillon and Goldstein 1984; Joreskog and Sorbom 1989). In order to deal with the sensitivity issues, numerous studies have been conducted over the past 20 years to evaluate various attempts to develop alternative indices of fit (Gerbing & Anderson 1993; Marsh, Balla & McDonald 1988; MsDonald & Marsh 1990; Tanaka 1993). Despite these attempts, it had been suggested that most of these criteria for determining model fitness were subjective indices of model fitness.

A better index was subsequently proposed by Bentler and Bonett (1980), the Normed Fit Index (NFI). Since then, the NFI has become one of the most popular practical criterion of choice (Byrne 1994; Bentler 1992b; Bentler & Bonett 1987). Later, the NFI was further improved to take into account the sample size effect and the development of the Comparative Fit Index (CFI) by Bentler (1990a). With the development of the CFI, Bentler (1990b) had suggested that the CFI should be the index of choice as far as judging the goodness-of-fit of the model is concerned.

The values of the Comparative Fit Index range from zero (0) to unity (1). The index is determined by a comparison of the chi-square of hypothesised model with that of the null model; as such, the CFI provides a measure of the data's complete covariation. The general rule of thumb for using this CFI as a measurement of goodness-of-fit is that any value larger than 0.90 suggests an acceptable fit of the model to the data (Bentler 1992b).

The CFI for the International Model For Technology Adoption was 0.914. Judging from the CFI, the IMTA was found to fit the data and support the convergent validity of the constructs. This conclusion was supported by another piece of information related to the overall fitness of the model.

The next step was to consider the iterative summary of the model. The iterative summary provided a summary of the number of iterations required for a convergent solution for the model and the mean absolute change in parameter estimates relating to each iteration. In fully iterated estimation, when the average of the absolute values of elements of the parameter change vector is greater than 0.001, that is, the convergence criterion adopted for this study, the iterative process fails to provide a converged solution.

The best case is one which generates a very small number of iterations required to produce a convergent solution. For the present study, it only took three iterations to reach convergence and the change in parameter estimates were quite stable and remained at a minimal during the iteration process. Hence, the fact that the estimates converged after only three iterations and with negligible change in parameters was a good indication that the model specification for the IMTA was on target; which implied the elements in the residual covariance matrix were small.

6.4.2.2 Discriminant Validity

Besides looking at the convergent validity, the construct validity of the scale measurement was established through investigating the discriminant validity. As mentioned in the previous sections, discriminant validity represents the uniqueness of a construct in comparison with the other constructs of the same theoretical model when the construct under investigation is conceptually distinctive. In a sense, it is a measurement of the dimensionality of the International Model For Technology Adoption adopted for the current study.

Under the International model For Technology, there were sixteen proposed constructs: that is, 1) Intention to Adopt, 2) Strategic Choice, 3) Material Incentive, 4) Compatibility, 5) Industry Structure, 6) Price Intensity, 7) Demand Uncertainty, 8) Information Exposure, 9) Domestic Availability, 10) Perceived Benefit, 11) Enhanced Value, 12) Adoptive Experience, 13) Perceived Difficulty, 14) Supplier Commitment -- Resources Support, 15) Supplier Commitment -- Supplier's Restriction I, and 16) Supplier Commitment -- Supplier's Restriction II.

All the 40 scale items were subjected to a principal components factor analysis. Since initial factors were often very difficult to interpret, rotation of the initial solution was necessary and the varimax orthogonal rotation procedure was adopted for this study. The purpose of the factor analysis was to find out whether the uniqueness of the constructs could be empirically verified. This was done through the application of a basic principle which established that the items or parameters designed to capture certain constructs in a theoretical model should be highly loaded with similar items or parameters which were supported to be measuring the same construct but not others (Churchill 1995).

In order to conduct a factor analysis, another decision had to be made. The number of factors to be rotated had to be determined. One common method is to use the eigenvalue as the criterion. Under this method, it is suggested that only factors that account for variances greater than 1; that is, the eigenvalue greater than 1, should be included. However, sometimes, in order to develop a deeper understanding of the factor structure, this is not always the best solution (Tucker et al 1969).

If the eigenvalue criterion was to be adopted, 13 factors would be chosen. Since this was lower than the 16 constructs proposed by the model and the main purpose for conducting the factor analysis at this stage was to determine the discriminant validity of the measurement scale, 16 factors were chosen to avoid under or over factor analysing at this stage. In doing so, a more meaningful and interpretable factor structure could be determined.

This 16-factor structure represented 76.53% of the total variance of the 40 items. This means that 76.53% of the information contained in the 40 items had been captured by the 16 factors. The items with a loading of higher than 0.5 on each of the 16 factors were included in the interpretation of the factor structure. The variance for each extracted factor can be found in Table 6.3.

The next step was to investigate the factor structure, with the results displayed in Tables 6.4 and 6.5a to 6.5c. The investigation of the factor structure solution was done through the interpretation and labelling of the factors according to the theoretical framework of the proposed conceptual model, that is, the International Model For Technology Adoption in this case. A summary of the dimensions of the factor solution is displayed in Table 6.4

The interpretation of the dimensions of the factor structure solution for the International Model For Technology Adoption was made according to the factor loadings for each factor. Tables 6.5a to 6.5c present the results of the varimax factor solution which indicates the respective item loadings for the extracted dimensions (constructs) of the model.

It is noteworthy that the factor analysis illustrated a perfect match of the conceptual dimensionality of the International Model For Technology Adoption in terms of discrete factors as described in Chapters 3 and 4. Hence, the results of the factor analysis, as shown in Tables 6.5a to 6.5c, demonstrate clear support for the discriminant ability of the constructs described in the International Model For Technology Adoption as the factor loadings were highly suggestive of the uniqueness of the 16 constructs of the model. Therefore, after analysing the factors loadings of the factor structure, it can be concluded that discriminant validity was established for the measurement scales adopted for the current study.

Table 6.3	Eigenvalue and Percentage of Variance of factors	
Factor item	**Eigenvalue**	**Percentage of variance**
1	5.970	14.925
2	3.564	8.910
3	2.857	7.413
4	2.395	5.988
5	2.036	5.090
6	1.969	4.923
7	1.703	4.258
8	1.579	3.948
9	1.366	3.415
10	1.231	3.078
11	1.217	3.043
12	1.180	2.950
13	0.997	2.493
14	0.880	2.200
15	0.855	2.138
16	0.811	2.028
Total Variance		**76.525**

Table 6.4	Dimensions of the IMTA
Factor item	**Dimensions**
1	Perceived Benefit
2	Compatibility
3	Supplier's Restriction I
4	Material Incentive
5	Adaptive Experience
6	Supplier's Restriction II
7	Enhanced Value
8	Perceived Difficulty
9	Information Exposure
10	Strategic Choice
11	Demand Uncertainty
12	Price Intensity
13	Intention To Adopt
14	Industry Structure
15	Supplier's Support
16	Domestic Availability

Table 6.5a		Factor Analysis of the Sample			
Factor 1: Perceived Benefit		Factor 2: Compatibility		Factor 3: Supplier's Restriction I	
Item	Loading	Item	Loading	Item	Loading
1	0.7318	1	0.7179	1	0.7978
2	0.7504	2	0.5798	2	0.7625
3	0.7925			3	0.6992
4	0.6278				
5	0.6841				
6	0.6523				
Factor 4: Material Incentive		Factor 5: Adoptive Experience		Factor 6: Supplier's Restriction II	
Item	Loading	Item	Loading	Item	Loading
1	0.7726	1	0.6840	1	0.5597
2	0.8194	2	0.6249	2	0.7290
3	0.7752	3	0.7782	3	0.7162

Table 6.5b		Factor Analysis of the Sample			
Factor 7: Enhanced Value		Factor 8: Perceived Difficulty		Factor 9: Information Exposure	
Item	**Loading**	**Item**	**Loading**	**Item**	**Loading**
1	0.7180	1	0.7729	1	0.7085
2	0.7516	2	0.7449	2	0.6626
3	0.7140				
Factor 10: Strategic Choice		**Factor 11: Demand Uncertainty**		**Factor 12: Price Intensity**	
Item	**Loading**	**Item**	**Loading**	**Item**	**Loading**
1	0.7056	1	0.6699	1	0.7521

Table 6.5c		Factor Analysis of the Sample			
Factor 13: Intention To Adopt		Factor 14: Industry Structure		Factor 15: Supplier's Support	
Item	Loading	Item	Loading	Item	Loading
1	0.7468	1	0.7521	1	0.5357
				2	0.6782
				3	0.7521
				4	0.4937
				5	0.7195
				6	0.7418
				7	0.6278
Factor 16: Domestic Availability					
Item	Loading				
1	0.6737				

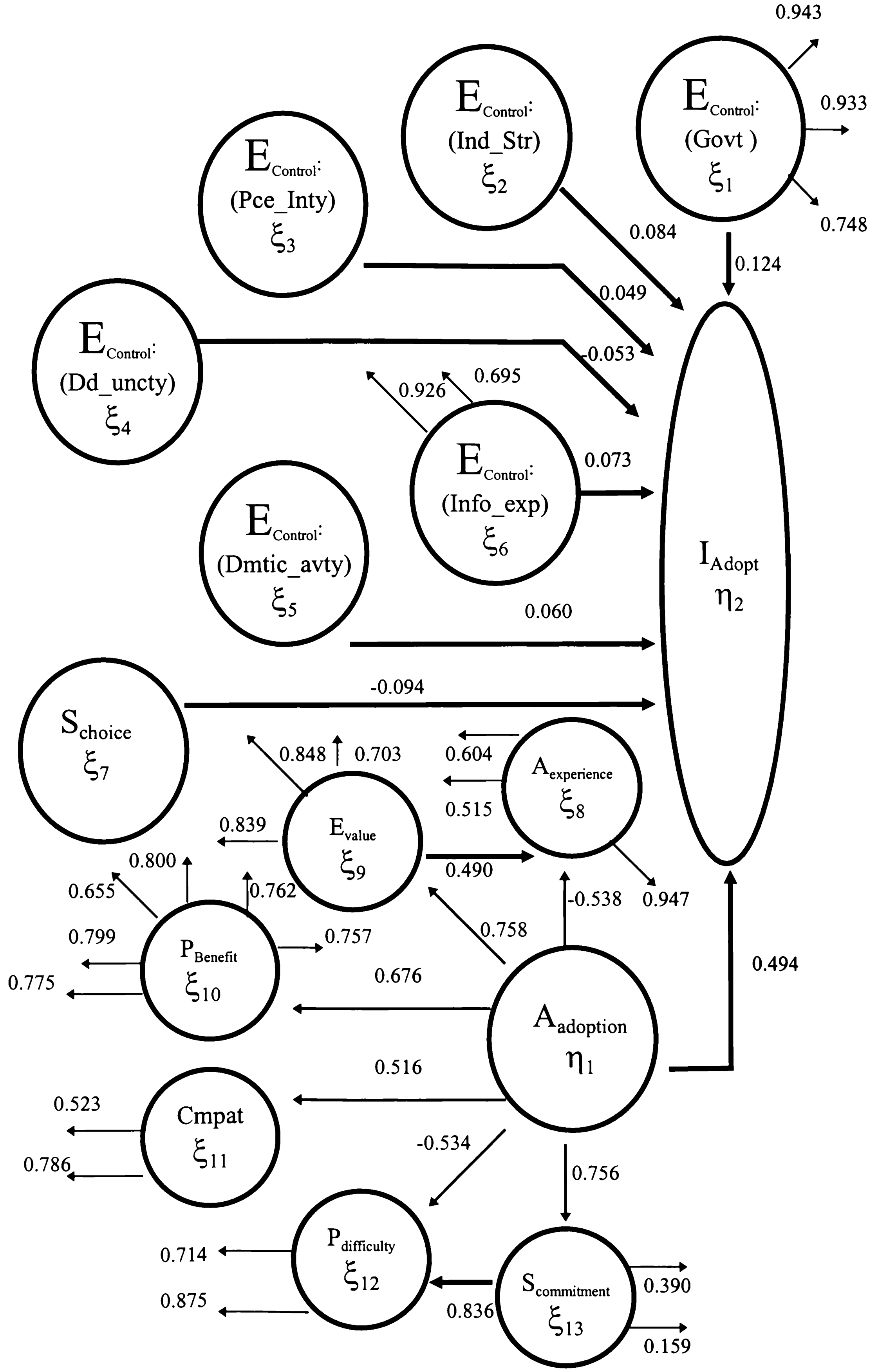
To summarise, the above analysis illustrates the measurement scales developed for the International Model For Technology Adoption of the present research demonstrates construct validity. In particular, the two elements of construct validity; that is, convergent validity and discriminant validity, of the constructs were examined and the results supported the existence of both convergent and discriminant validity.

The convergent validity was secured through the analyses conducted by the structural equation modelling technique while the discriminant validity of the constructs was supported by the factor analysis which clearly demonstrated the existence of the uniqueness among various constructs of the model.

6.4.3 Hypotheses Testing

The hypotheses put forward in Chapter 4 are discussed in this section. In particular, eighteen hypotheses were tested. The significance level adopted for the present study was at the 5% level. The structural equation modelling technique was adopted to test these group of hypotheses. This was done through the application of a path analysis to a combination of simultaneous equations which defined these specific relationships. The path coefficients for the model were actually expressed by a series of multiple regressions, and the path coefficients were displayed as the regression coefficients. The results of the path analysis is shown in Figure 6.1.

Figure 6.1: Results of the Path Analysis For The Conceptual Model



In addition, Tables 6.6a to 6.6c show the standardised factor loadings for the constructs and indicator coefficients for both the measurement and structural model.

Table 6.6a		**Measurement Model Results (Standardised Factor Loadings)**			
Factor 1: Perceived Benefit		**Factor 2: Compatibility**		**Factor 3: Supplier's Commitment**	
Item	**Loading**	**Item**	**Loading**	**Item**	**Loading**
1	0.757	1	0.523	1	0.390
2	0.762	2	0.786	2	0.159
3	0.800				
4	0.655				
5	0.799				
6	0.775				
Factor 4: Government Influence		**Factor 5: Adoptive Experience**		**Factor 6: Enhanced Value**	
Item	**Loading**	**Item**	**Loading**	**Item**	**Loading**
1	0.943	1	0.604	1	0.703
2	0.933	2	0.515	2	0.848
3	0.748	3	0.947	3	0.839

Table 6.6b		Measurement Model Results (Standardised Factor Loadings)			
Factor 7: Perceived Difficulty		Factor 8: Information Exposure		Factor 9: Attitude	
Item	**Loading**	**Item**	**Loading**	**Item**	**Loading**
1	0.714	1	0.695	1	0.676
2	0.875	2	0.926	2	0.758
				3	0.516
				4	-0.538
				5	0.676
				6	-0.534

Table 6.6c	Structural Model Results
Model Path	**Standardised Path Coefficient**
Government Influence → Intention	0.124
Information Exposure → Intention	0.073
Strategic Choice → Intention	-0.094
Industry Structure → Intention	0.084
Price Intensity → Intention	0.049
Domestic Availability → Intention	0.060
Demand Uncertainty → Intention	-0.053
Attitude → Intention	0.494

Again, it should be remembered that the results of the structural equation modeling analysis discussed earlier had demonstrated the overall fitness of the International Model For Technology Adoption. Hence, the overall structure of the IMTA had already been confirmed. The hypotheses testings were conducted to identify the relationships between these individual constructs.

6.4.3.1 Hypothesis One

The first hypothesis concerned the relationship between attitude and intention of the adoption behaviour. The hypothesis is shown below:

H_1: There exists a positive relationship between attitude towards adoption and behavioural intention to adopt.

As shown in Figure 6.1 and Table 6.6b, there was a positive relationship between attitude and the behaviour intention to adopt. The standardised coefficient was 0.494 and the coefficient was significant at the 5% level. Therefore, since the direction of the coefficient was positive, as expected, and the relationship was significant, it can be concluded that hypothesis one cannot be rejected. Hence, the results suggested that the attitude of the prospective adopter had a positive impact on the behaviour towards adoption. This is consistent with the prediction of the Theory of Planned Behaviour.

6.4.3.2 Hypothesis Two

Hypothesis Two investigated the perceived difficulty factor from two perspectives. First, as described in Chapter 4, it was expected that the perceived difficulty of adoption was related to the positive interaction between both the suppliers and receivers of the technology. Hence, it was hypothesised that the "perceived difficulty" factor was affected by the perceived support provided by the supplier. The following hypothesis was then tested:

H_{2a}: Suppliers' commitment has a positive impact on the perceived difficulty of the technology.

Regarding this hypothesis, it was found that the coefficient was 0.836. Thus, there appeared to be a positive relationship between supplier's commitment and perceived difficulty. However, the strength of this relationship was only moderate because such a relationship was found to be insignificant at the 5% level.

In order to understand the meaning behind this figure, the design of these two measurement scales needed to be investigated. In the design of the scales, the higher the value in the supplier's commitment scale, the lesser the impact of this factor on the decision to adopt. In addition, the higher the figure in the perceived difficulty scale, the lower the level of anticipated difficulty for adoption.

Hence, a positive relationship meant that the higher the level of perceived difficulty from the adoption process, the more the perspective adopter valued the commitment of the supplier of the technology. But, since the relationship was not statistically significant, it can only be concluded that this relationship was only a moderate one as the standardised coefficient was quite high (0.836).

Second, to consider the more important hypothesis of the model in relation to the perceived difficulty factor, that is, the one related to the attitude towards adoption, it was conceptualised in Chapter 4 that the perceived difficulty factor could also have a direct effect on the attitude towards adoption. Thus, it was further hypothesised that:

H_{2b}: Perceived difficulty has a negative impact on attitude towards adoption.

As to this second hypothesis, the standardised factor loading was -0.534, as displayed in Table 6.6. Again, the coefficient was not significant at the 5% level. However, the direction was the same as predicted in the hypothesis. Hence, it can be concluded that the level of perceived difficulty of adoption had a negative impact on the attitude towards adoption, though this impact might only be a moderate one.

Although the strength of the relationship was not as strong as anticipated, the direction of both coefficients was the same as hypothesised. Thus, the more difficulty the prospective adopter encountered during the adoption process, the more likely the adopter valued the assistance from the technology supplier and the less likely this person favoured the adoption of the technology.

6.4.3.3 Hypothesis Three

The next hypothesis was concerned with the relationship between the formation of an attitude towards adoption and the level of experience of the prospective adopter. It was hypothesised that:

H_3: The adaptive experience of the prospective adopter has a positive impact on the attitude towards adoption.

As discussed in Chapter 4, the adaptive experience was measured by both the experience of the prospective adopter and the adopter's company with similar technology; and the working experience of the prospective adopter with the supplier of the technology.

The factor loadings for these three parameters on the adoptive experience construct were, 0.604, 0.515 and 0.947 and all estimated parameters were significant at the 5% level. Hence, it can be concluded that all these three parameters had a positive and significant impact on the adaptive experience of the prospective adopter.

Looking at the hypothesis of this section, the standardised factor loading of adaptive experience on the attitude of adoption was -0.538 and this loading was significant at the 5% level. This result seemed to be a bit awkward at first glance. But, a careful investigation on the formation of the scale revealed that this was actually correct.

In all other constructs hypothesised to have an impact on the formation of an attitude towards adoption, only the adaptive experience construct used the actual number of years of experience as the raw data. The other remaining constructs adopted a 5-point Likert scale to measure the attitude formation of the decision-maker, with "1" labelled as the favourable attitude and "5" as the unfavourable one, except for the perceived difficulty construct which had an opposite effect.

Hence, there existed a negative relationship between the adaptive experience and the other constructs. When a confirmatory factor analysis was applied to all these constructs to determine the attitude of adoption, it was not surprising that the adaptive experience construct showed a negative value. Hence, a negative value was, in fact, supportive of the hypothesis and it can be concluded that the hypothesis cannot be rejected and the adaptive experience had a positive impact on the attitude towards adoption. So, the more experience a prospective adopter had, the more likely that a favourable attitude towards adoption would be formulated.

6.4.3.4 Hypothesis Four

Hypothesis Four looked at the relationship between attitude towards adoption and the perceived commitment from the supplier of the technology. Supplier's commitment, as indicated in Chapter 3, was made up of two aspects, supports and restrictions.

From the view point of support, it was anticipated that the more extensive the perceived support provided by the supplier of the technology, both before and after the technology transfer, the more positive would be the degree of perceived supplier's commitment. Thus, it was hypothesised that:

H_{4a}: The more extensive perceived resources support from the supplier of the technology, the greater is the perceived suppliers' commitment.

In the Path analysis, the standardised factor loading for the supplier's support factor was 0.390. For this parameter, the path coefficient was constrained to a fixed variance of 1.0. This is necessary in order to resolve the identification problem in estimating the structural equation model (Byrne 1994) and in fact, this is a generic principle of identification (Bentler 1995).

In explaining this generic principle, Bentler (1995) suggested that the main purpose for the identification of parameters, equation, and model through the structural equation modelling technique was to specify a structural model which has unique parameters. Bentler (1995) further elucidated that "[i]f the parameters are subject to any arbitrariness, it would be difficult to speak of them as true parameters that are to be estimated, since a wandering target would be involved" (pp17-18).

To deal with this problem, Byrne (1994) suggested that "[t]he rule of thumb with respect to residuals is that one can either constrain the path coefficient to some fixed value (say, 1.0) and allow the variance to be freely estimated or, alternatively fix the variance (to say, 1.0) and estimate the path coefficient. However, the free estimation of both types of parameters is not possible; the result will be an underidentified model" (p16).

Hence, in order to establish the measurement model through linking the unmeasured latent variable (that is, supplier's commitment in this case) onto its related parameter, the "requisite is satisfied by constraining one of a set of factor loadings to some known variable (typically 1.0)" (Byrne 1994, p 16), and allowing the rest of this set of factor loadings, that is, the regression path, to be freely estimated (Byrne 1994).

According to this rule of thumb, the factor loading of the supplier's support was fixed to 1.0, and thus, the level of significance of this coefficient was unable to be estimated. But, from the standardised solution, it could be seen that suppliers support had a positive effect to the perceived level of supplier's commitment and therefore, providing a "prima facie" support to the hypothesis.

Besides providing resources support, in certain circumstances, the supplying firm might impose some restrictions on the conditions through which the transferred technology was to be used. In doing so, the supplier could strengthen its position to control the technology. However, these restrictions could decrease the perceived usefulness of the technology by the recipient of the technology as some operations adjustments might be required which, in turn, led the adopter to create a negative perception on the level of supplier's commitment. Therefore, it was hypothesised that:

H_{4b}: There is a negative impact of supplier's restrictions on the perceived suppliers' commitment.

The standardised factor loading of this was 0.159 and this path coefficient was not significant at the 5% level. At first glance, the positive direction sign of the factor loading seemed to have contradicted the hypothesis. However, referring back to the wording of the related questions and the scale adopted, both the scales used for supplier's support and supplier's restrictions used "1" as the affirmative scale.

Therefore, since the questions for the supplier's restriction parameter asked whether the existence of certain restrictions carried a negative impact on the perceived attitude formation process, it is not surprising to find a positive direction from the supplier's restriction coefficient, suggesting the existence of a negative impact. It can be concluded that though a negative impact was detected, this was only a moderate one.

Finally, the more important hypothesis, that relating to the impact of supplier's commitment on the formation of attitude towards adopting the foreign technology is considered. Based on the rationale set forth in Chapter 4, it was further hypothesised that:

H_{4c}: There is a positive relationship between attitude towards adoption and the perceived suppliers' commitment.

The path coefficient for the supplier commitment indicator, as revealed in Figure 6.1, was 0.756. Furthermore, this coefficient was significant at the 5% level; thus, an indication of a statistically significant strength of this coefficient. Therefore, it can be concluded that hypothesis H_{4c} cannot be rejected and there was a positive relationship between attitude towards adoption and the perceived suppliers' commitment.

6.4.3.5 Hypothesis Five

The next hypothesis is related to the relationship between perceived benefit and attitude towards adoption. Perceived benefit was defined as the adopter's belief of the likelihood that the adoption of the technology could improve the economic benefits of the organisation, such as productivity enhancement, quality improvement, cost reduction, and gain in competitiveness. Hence, it was hypothesised that perceived benefit was positively related to the attitude towards adoption and the following hypothesis was tested:

H_5: Perceived benefit is positively related to the attitude towards adoption

As indicated in Chapter 4, the perceived benefit was a latent variable which had been conceptualised to be determined by six indicators relating to the economic benefits of the technology to the company. The factor loadings for these indicators, as displayed in Figure 6.1, were 0.757, 0.762, 0.800, 0.655, 0.799, and 0.775. All the estimated parameters were significant at the 5% level.

As to the total effect on the attitudinal factor of this International Model For Technology Adoption, the factor loading was 0.676. Again, this was the path coefficient which had been fixed to 1.0 for the purpose of identification for the attitudinal construct. Hence, the level of significance was unknown. However, given 1) the positive direction of the factor loading of the perceived benefit construct in relation to those of the other five constructs of the attitudinal factor and 2) the relatively high factor loading figure (0.676, which was the third highest loading) in comparison with the other constructs, it seemed that the perceived benefit was likely to be positively related to the attitude towards adoption.

6.4.3.6 Hypothesis Six

This hypothesis deals with the compatibility construct of the attitudinal factor. As mentioned in Chapter 4, the compatibility parameter was treated as a perceived issue in this study. It has been argued that the more a foreign technology is perceived to be compatible with existing technology, the higher is confidence of mastering the new technology and the more positive attitude will be derived. Hence, it was hypothesised that:

H_6: Perceived compatibility of the technology can positively affect attitude towards adoption.

The compatibility construct was measured by two indicators with standardised factor loadings of 0.523 and 0.786. The estimated parameter was significant at the 5% level. As to the direct effect between the attitude towards adoption and the compatibility factors, the factor loading was 0.516 which again was also statistically significant at the 5% level. Therefore, it can be concluded that hypothesis H_6 cannot be rejected and the perceived compatibility of the technology could positively affect attitudes towards adoption.

6.4.3.7 Hypothesis Seven

The seventh hypothesis looks into the relationship between enhanced value and the attitude towards adoption. As discussed in Chapter 4, enhanced value was another form of benefit to the adopting firm such as the generation or enhancement of a quality image or a novelty perception from adopting the technology. These benefits meant additional value to the consumers. Hence, the attitude towards adoption might not merely relate to the firm's utilisation point of view, but also could incorporate the firm's perception of the extra (enhanced) value carried by the new technology to the consumers. It was, therefore, hypothesised that:

H_{7a}: Enhanced value is positively related to the attitude towards adoption.

Again, the enhanced value construct was conceptualised to be measured by three indicators which had factor loadings of 0.703, 0.848 and 0.839. All the estimated parameters were significant at the 5% level. In addition, to consider the main effect of the enhanced value construct on the attitude towards adoption, it was found that the factor loading was 0.758, and this factor loading was also significant at the five percent level. Therefore, it can be concluded that hypothesis H_{7a} cannot be rejected and that enhanced value was positively related to the attitude towards adoption.

As indicated in Chapter 4, there was a second hypothesis to this construct. It was further hypothesised that the more the experience a prospective adopter has with foreign technology, the better the understanding the adopter would have on the additional value carried by the foreign technology to the consumers. Therefore, the following hypothesis was also tested:

H_{7b}: There is a positive relationship between enhanced value and the adoption experience of the perspective adopter.

The path coefficient from the enhanced value construct to the adaptive experience construct was 0.490 and this coefficient was significant at the five percent level. Hence, it can be concluded that this coefficient was significantly different from zero. While the coefficient was significant, the direction of the parameter did not seem to conform to the prediction of the hypothesis because a lower scale (1 or 2) on the enhanced value factor represented a positive belief that the transfer could create consumer value but a higher figure in the adaptive experience variable meant more experience. So, there should be a negative sign between these two factors in order to confirm the prediction of the hypothesis.

A further analysis of the composition of these two factors provided the explanation. It was found through crosstabulation analysis that the positive sign exhibited on the path coefficient was due to the fact that the majority of the respondents, more that 60%, believed that the adoption of foreign technology would create additional value to consumers (that is, those who had chosen "1" and "2" on the scale). Including those who were indifferent, that is, the respondents who chose "3" on the scale, the percentage exceeded 90%.

Hence, the positive direction shown in the coefficient was merely an indication of how strongly the respondents believed the products manufactured by the proposed adopted technology could carry extra value to the consumers. Therefore, this positive and significant coefficient can be interpreted as 1) most respondents, in spite of the years of adaptive experience, believed that consumers would give extra value to products manufactured by foreign technology, and 2) firms with less experience tended to have a stronger belief in the foreign technology than those with more adaptive experience.

This may be due to the fact that firms with less experience of foreign technology were more inclined to overestimate the extra value of foreign technology. As firms acquired more experience in adopting and using foreign technology, they would start to develop a more realistic view on the benefits of adopting foreign technology.

Along this line of reasoning, it can be concluded that the hypothesis cannot be rejected outright and there seemed to be a positive relationship between the enhanced value and the adoption experience of the perspective adopter.

6.4.3.8 Hypothesis Eight

Government policies can provide an incentive for companies to engage in technology transfers (James and Watanabe 1985). However, the effectiveness of these policies may not be universal under different economies.

For the present study, the concern was on how firms react to the various government policy incentives in their behaviour to adopt. It was expected that the more the incentive provided by the government, the better equipped, financially or operationally, the prospective adopter would perceive themselves to be; hence the higher the perceived control over the environment.

All forms of assistance from the national governments can serve as "sweeteners" to facilitate the perceived "appropriate" transfer of technology so as to ensure the country can benefit from the adoption of the technology. Hence, it was hypothesised that:

H_8: The existence of economic benefits offered by a government have a positive impact on the intention to adopt.

As suggested in Chapter 4, the economic benefits factor was designed to be composed of three indicators. The factor loadings of these indicators were 0.843, 0.993 and 0.748. All these loadings were significant at the five percent level. Such a result was highly suggestive of the existence of an incentive effect to technology adoption from positive government influence. In particular, firms were very responsive to government material incentives such as subsidies, provision of loans and tax benefits.

As revealed by Figure 6.1, the path coefficient from the government influence factor to the intention to adopt factor was 0.124; which was, again, significant at the 5% level. Hence, as manifested by the path coefficient, there existed a positive and significant relationship between the intention to adopt factor and the positive government influence factors. Therefore, it can be concluded that the hypothesis that the existence of economic benefits offered by a government would have a positive impact on the intention to adopt could not be rejected.

6.4.3.9 Hypothesis Nine

In this research, the competitive influence was classified as five control factors; which were hypothesised to affect the firm's competitive environment individually: 1) Industry Structure, 2) Price Intensity, 3) Demand Uncertainty, 4) Information Exposure, 5) Domestic Availability.

6.4.3.9.1 Industry Structure

Hypothesis 9a deals with the industry structure which was defined in Chapter 4 as measured by the market shares controlled by the top three firms operating in the industry. It was suggested in Chapter 4 that the intention to adopt was posited to be higher in more concentrated industries because of the difference in the anticipated benefits arrived from the adoption of the technology and their perceived ability to control the adoption process.

Therefore, the fewer the number of players in an industry, the lower is the perceived competitive pressure and the greater is the firm's perceived ability to control and adopt the technology. Hence, it is hypothesised that:

H_{9a}: The degree of industry rivalry has a negative effect on the firm's intention to adopt.

The path coefficient for the industry rivalry factor was 0.084. Apparently, the direction of path coefficient was not the same as stipulated by hypothesis 9a. However, a careful look at the scale measurement revealed that this was not exactly correct.

First consider the industry rivalry factor. The factor was measured by the perceived market share of the top three players in the industry. The higher this number, the lower was the level of rivalry. However, when the analysis was conducted, in order to reveal the competitive level of the industry, the data was transformed by minus 100 from the original figure. For example, when the top three companies control 90% of the market share, the data, after transformation, used for the analysis was 10 (that is, 100 - 90); thereby indicating a lower level of competitive rivalry. For the intention to adopt factor, due to the instrumental design of this scale, a lower integer meant a higher degree of intention to adopt. Therefore, a positive coefficient would be interpreted as the existence of a negative relationship between the degree of industry rivalry and the firm's intention to adopt.

Having established the direction of the coefficient, the next step was to consider the strengthen of this direction. The path coefficient was found to be statistically significant at the 5% level; hence, it can be concluded that the hypothesis that the degree of industry rivalry had a negative effect on the firm's intention to adopt cannot be rejected.

6.4.3.9.2 Price Intensity

The next hypothesis looked at the second element affecting the competitive environment. It has been argued in Chapter 4 that firms engaged in price competition might only focus on cost reduction. A cost reduction strategy could be pursued by either attaining comparative or competitive advantages. Firms in the low to medium technology spectrum or firms which were smaller in size might choose to acquire comparative advantages, such as lower labour and/or material costs, to reduce their costs of production; as in the case for Hong Kong manufacturers.

When competing on price, firms might be faced with enormous competitive pressure and, therefore, had little control over their ability to adopt new technology. So, it was hypothesised that:

H_{9b}: The price intensity within an industry has a negative effect on the firm's intention to adopt.

The path coefficient for the price intensity factor was 0.049, which was not a very high loading. Obviously, this coefficient was not significant at the 5% level. Even though the direction of the coefficient was positive, which suggested that there was a positive relationship between the degree of intensity for price competition and the intention to adopt. However, given the low coefficient and its insignificance from the statistical point of view, it can be argued that the price intensity did not have any effect on the intention to adopt; hence, providing evidence to reject hypothesis 9b.

One possible reason to explain this result was that since Hong Kong is only a small open economy and most of the manufacturers are small in nature (for example, more than 86% of the respondents reported that they employed less than 500 staff), they have already got used to a highly competitive environment in which price is a given factor (for example, over 88% of the respondents reported that occasional price-cutting took place in their industries, with more than 61% of these group of respondents indicating the existence of frequent price-cutting activities in their industries); that is, they have little control over the price of the products. Rather than dictating the price, Hong Kong manufacturers are price takers. Hence, when they consider whether to adopt foreign technology or not, the intensity of price does not affect their decision making process.

6.4.3.9.3 Demand Uncertainty

The third element was the demand uncertainty factor. As explained in Chapter 4, demand uncertainty could intensify competition because when operating under demand uncertainty, firms were likely to seek out additional marketing information and to assume more risks. All these activities could greatly intensify the level of competition and, hence, lower the level of perceived control and the intention to adopt. Thus, it was hypothesised that:

H_{9c}: The higher the demand uncertainty, the lower the intention to adopt.

The path coefficient for the demand uncertainty on the intention to adopt was -0.053. Again, this path coefficient was not significant at the 5% level. Therefore, it can be concluded that the direction of the coefficient was the same as predicted by the hypothesis; which suggested that the higher the demand uncertainty, the lower the intention to adopt. However, since the coefficient was not statistically significant and given the very low loading of the coefficient, hypothesis 9c could not be accepted.

6.4.3.9.4 Information Exposure

The next element to consider is the information exposure factor. It has been discussed in Chapter 4 that firms more active in searching and exchanging information with members within the social system were more willing to adopt innovation.

Of particular interest in this process is the exposure to information from sources external not only to the firm's environment but also to the home country where the firm is operating. The more open is the firm to external information, the better the firm's ability to assess and judge the utility of the technology. The better is the firms' ability to evaluate the benefits of the new technology, the higher is the firms' capacity to process the information. Hence, the degree of openness of an industry to information can affect the firms' perception of their ability to control the environment. Hence, the hypothesis being tested was:

H_{9d}: The greater is the information exposure of the adopting firm, the higher is the intention to adoption.

The path coefficient was 0.073 and was not significant at the 5% level. Hence, like the previous three hypotheses, hypothesis 9d was not supported by the results of the statistical analysis. Following this analysis, it can be concluded that there was no relationship between the degree of the information exposure of the adopting firm and the intention to adopt foreign technology.

6.4.3.9.5 Technology Availability from Domestic Sources

The final element to examine was the factor of domestic availability. As discussed in Chapter 4, perhaps the most obvious reason for adopting technology from overseas sources was the unavailability of such technology from domestic sources. Hence, it was hypothesised that:

H_{9e}: There is a relationship between domestic availability of similar technology and intention to adopt the technology.

The path coefficient for this factor to the intention to adopt was 0.060 and was also insignificant at the 5% level. The results suggested that there was no relationship between the domestic availability of the technology and the intention to adopt foreign technology.

One explanation for this outcome was that for places like Hong Kong which is not known for its high technology development, local firms have already got used to adopting foreign technology as it has always been difficult to find local sources. Hence, since local firms do not perceive opportunities for getting the right technology from the local environment (this is supported by the fact that more than 73% of the respondents reported that they believed Hong Kong did not develop their needed technology) and have always relied on foreign sources for the required technology, the availability of domestic technology is not the concern of Hong Kong manufacturers when deciding on whether foreign technology should be adopted. The main question for them may be quite simple -- the choice is on whether to adopt a new technology, but not on the source of supply; that is, adopting the technology from a local source is seldom an option for Hong Kong manufacturers.

6.4.3.10 Hypothesis Ten

Finally, it is argued in Chapter 4 that the ultimate aim of any business decision is to maximise profit and this assumption is considered a valid one in the current study. Hence, the fundamental objective for decision-makers in judging whether or not to adopt a foreign technology is the bottom-line effect of such a strategy. The decision to adopt would only be made after evaluating all business investment opportunities because decision-makers must convince themselves that the adoption decision has to provide a big enough opportunity to cover the loss of opportunity cost in not doing other things in that same period of time. Strategic choice was, then, measured in terms of the perceived availability of other external investments at the time of the adoption decision. Thus, it was hypothesised that:

H_{10}: The existence of strategic choices can negatively affect the behavioural intention to adopt.

The path coefficient was -0.094. A negative coefficient indicated that responding firms which appeared to have better investment alternatives other than technology transfer were less inclined to adopt foreign technology and vice versa. However, the path coefficient was also not significant at the 5% level. So, the hypothesis that the existence of strategic choices can negatively affect the behavioural intention to adopt cannot be fully accepted. However, a point of clarification needs to be made here. If a less stringent measure was used, that is, when a 10% level of significance was adopted, this hypothesis would not have been rejected.

6.5 Summary

The purpose of this chapter is to use the data collected in the survey to test the conceptual framework of the International Model For Technology Adoption and the hypotheses derived from the model.

As illustrated in Chapter 4, the International Model For Technology Adoption was developed to conceptualise the cognitive process that determined the attitudes and intention towards technology adoption and was hypothesised to compose of two elements: the exogenous factors and the endogenous process.

In particular, the behavioural intention to adopt was hypothesised to be affected by three forces: 1) Environmental Control, 2) Strategic Choice and 3) Attitude Towards Adoption. Of these three forces, "Attitude Towards Adoption" was described as the endogenous process while the remaining two were construed as exogenous factors, one of which resembles the Perceived Behavioural Control factor of the Theory of Planned Behaviour.

In the International Model For Technology adoption, this exogenous control variable was referred to as the "Environmental Control" factor, which was further categorised into two control influences: 1) Government Influence, and 2) Competitive Influence. Government influence was hypothesised to be a function of "material incentives" while competitive influence was classified into five elements: "industry structure", "price intensity", "demand uncertainty", "information exposure", and "domestic availability". As for the strategic choice factor, it was suggested to represent the investment alternatives available to the firm apart from adoption of the foreign technology.

Furthermore, the cognitive process which determined the "attitude towards adoption" was, again, found to be affected by another six beliefs: 1)

Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4) Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment.

The results of the analysis suggested that the fitness of the International Model For Technology Adoption was good. When compared with the null model, which was used by the EQS as a baseline model to judge the overall fitness for the IMTA, the IMTA yielded a value of 0.914 in the Comparative Fit index; hence, indication of a good fit model.

In addition, the results of the principal component analysis also illustrated that the 16-factor International Model For Technology Adoption was an adequate model to capture the information collected during the survey. The results shown that this 16-factor structure represented nearly 77% of the total variance of all items. A further analysis of the factor structure, again, revealed that there existed a perfect match between the conceptual dimensationality of the International Model For Technology Adoption and the empirical data collected in the survey.

In general, the data of this study supported the overall structure of the International Model For Technology Adoption. The next step was to consider the individual relationships between various constructs stipulated under the IMTA. This was done through the testing of the ten hypotheses conceptualised in this study.

The results in the hypotheses testing were mixed. While not all the magnitude of these ten hypotheses was statistically significant, almost all pointed to the direction conceptualised by the IMTA. In particular, the results of the individual hypotheses testing were depicted in Tables 5a and 5b:

Table 6.7a: A Summary of the Hypotheses Testing Results

Hypothesis	Variables	Results
H_1	1) Attitude towards adoption 2) Intention to adopt	Supported
H_{2a}	1) Supplier's commitment 2) Perceived difficulty	Rejected
H_{2b}	1) Perceived difficulty 2) Attitude towards adoption	Rejected
H_3	1) Adopter's experience with technology 2) Attitude towards adoption	Supported
H_{4a}	1) Resources support 2) Suppliers' commitment	Fixed to 1
H_{4b}	1) Suppliers' restrictions 2) Suppliers' commitment	Rejected
H_{4c}	1) Suppliers' commitment 2) Attitude towards adoption	Supported
H_5	1) Perceived benefit 2) Attitude towards adoption	Supported
H_6	1) Perceived compatibility 2) Attitude towards adoption	Supported

Table 6.7b: A Summary of the Hypotheses Testing Results

Hypothesis	Variables	Relationships
H_{7a}	1) Enhanced Value 2) Attitude towards adoption	Supported
H_{7b}	1) Enhanced Value 2) Adoptive experience	Rejected
H_8	1) Government Influence 2)Intention to adopt	Supported
H_{9a}	1) Industry rivalry 2) Intention to adopt	Supported
H_{9b}	1) Price intensity 2) Intention to adopt	Rejected
H_{9c}	1) Demand uncertainty 2) Intention to adopt	Rejected
H_{9d}	1) Information exposure 2) Intention to adopt	Rejected
H_{9e}	1) Domestic availability 2) Intention to adopt	Rejected
H_{10}	1) Strategic Choice 2) Intention to adopt	Rejected, supported (10%)

Table 6.7c: A Summary of the Hypotheses Testing Results By Constructs

Constructs	Relationships
Environmental Control → Intention	**Mixed**
Governmental Influence	Supported
Competitive Influence	Rejected
Attitude Towards Adoption → Intention	**Supported**
Compatibility	Supported
Enhanced Value	Supported
Perceived Benefits	Supported
Adaptive Experience	Supported
Supplier's Commitment	Supported
Perceived Difficulty	Rejected
Strategic Choice → Intention	**Supported at 10% level**

As revealed by Table 5c, a majority of the path coefficients were significant at the 5% level and supported the major hypotheses conceptualised in this study.

From these results, it can be interpreted that the intention to adopt was greatly affected by the attitude of the prospective adopters, the influence of the government and the degree of industry rivalry. However, the impact of the overall competitive influence factor on the intention to adopt was not supported by the results. Again, the existence of investment alternatives was also not a serious concern for the prospective adopters. The following initial explanations can be offered for these results. A more detailed discussion of the implications of these results for the policy issues for the Hong Kong government to consider are provided in the next chapter of this thesis.

First, since Hong Kong is a small open economy, the manufacturing sector is dominated by small companies. In our sample, about 60% of the responding manufacturers employed less than 100 people and approximately 95% employed less than 1000 people. These companies were all small in size when compared with the world's standard. Hence, for these small companies, the competitive environment was, in most of the cases, given to them; that is, they did not have any control over the competitive environment. They could only respond to the environment reactively.

In addition, once the competitive environment had been changed, they had no choice but to follow and adopt. Further, since most of the Hong Kong manufacturers were using low to medium levels of technology in their production process, their concerns might be more related to the cost issues rather than to the other competitive issues. Therefore, these small manufacturers might be quite passive to the competitive environment and whenever there was a change in the competitive situation, they would try to look for a low cost production alternative, that is, maintaining their comparative advantage, rather than considering adopting more advanced technology in order to trade at the upper segment of the market.

With respect to the existence of investment alternatives, since most of the respondents were small manufacturers, they might only have limited experience in other industries; and hence, a lack of other investment alternatives. Furthermore, the results of the hypothesis testing did confirm the direction of the hypothesis, that is, the existence of a negative coefficient. This result indicated that responding firms which were perceived to have no better investment alternatives other than technology transfer, were more inclined to adopt foreign technology.

This hypothesis was rejected because the coefficient was not significant at the 5% level, but could have been accepted at the less stringent 10% significance level. Hence, the results revealed that there might exist a general tendency for firms to adopt foreign technology when they perceived there to be a lack of alternative investment opportunities. However, the majority of the respondents might not relate the existence of alternative investment opportunities with the decision to adopt foreign technology. Such a result might indicate the lack of alternative investment opportunities for these manufacturers; thus, no need to consider these opportunities when making the adoption decision.

In conclusion, while the results of the structural equation modelling analysis provided an overall support to the International Model For Technology Adoption, the results of individual constructs of the Model revealed that some constructs had a larger impact than others in the decision making process to adopt foreign technology. In particular, it was found that the "attitude towards adoption" and the "government influence" factors were the major determinants in the behavioural formation process for the intention to adopt foreign technology. The policy issues of these results are discussed in the final chapter of this thesis.

Chapter Seven: Conclusion and Policy Implications

7.1 Introduction

This chapter, the final chapter of this thesis, presents the conclusions of this research. In addition, it discusses the implications of the results for theoretical development in the area of international technology adoption. Finally, policy implications of the research are developed.

7.2 Concluding Remarks

In addressing the concluding remarks, the rationale of this research is reiterated. The methods and the major findings are highlighted. The contributions of the study to the field of technology transfer, and in particular, technology adoption behaviour, are discussed. Finally, the limitations of the work as well as suggestions for future research are considered.

7.2.1 Rationale for the Study

The current problem of the Hong Kong manufacturing sector is the inability to move up the technology ladder. As suggested in earlier chapters, there has been little serious research in Hong Kong to investigate why Hong Kong is lagging behind its counterparts, that is, the other three "little dragons," in upgrading her technological capabilities. There is merely impressionistic evidence that the lack of direct government support could be the most important reason for this phenomenon. However, this may over-simplify the case. Given the smaller size of Hong Kong manufacturers, other reasons could be 1) the very limited experience of Hong Kong manufacturers in the development of applied and pure research, 2) the lack of a linkage between the universities and the industrial sector, as well as 3) the passive financial support from the Hong Kong government and 4) the option of relocating to lower cost areas in China.

Hence, the main purpose of this research is to understand the factors which would enter into the mind of Hong Kong manufacturers when they were considering a technology adoption decision. In particular, this research is designed to develop and test a behavioural model of technology adoption which investigates the constructs influencing adoption behaviour and how the interactions between these constructs and the external variables impact on the decision making process. The model developed to conceptualise the linkages and relationships between and among these variables is called the "International Model For Technology Adoption" (IMTA).

7.2.2 The Model

Under the IMTA, the behavioural intention to adopt is not only determined by the endogenous attitudinal factor, but is also a function of two other exogenous variables, 1) Strategic Choice, and 2) Environmental Control. The Environmental Control factor is further categorised by two exogenous factors, namely, a) Government influence, and b) Competitive Influence. In addition, it is suggested that the Competitive Influence factor can be classified into five forces: namely: Industry Structure, Price Intensity, Demand Uncertainty, Information Exposure, and Domestic Availability.

In addition, the cognitive process which forms the attitude to adopt is, in turn, hypothesised to be affected by six other endogenous beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4)Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment.

7.2.3 Methods of the Study

A survey research method was adopted for the current study because this is a commonly used method in studies of attitudes and behavioural intentions. Likert-scales were utilised for the construction of the research instrument to detect the attitudinal predisposition of individual decision-makers on the issue of technology adoption. The internal consistency method, and in particular, Cronbach's coefficient alpha, was chosen for this study to establish the reliability of the scale. In addition, content validity was ensured by the use of an expert panel to judge on each and every item of the instrument to assure relevance to the property under measurement was attained during the measurement construction stage of this research. Two separate methods were adopted to assess the convergent and discriminant validity for the current study. To evaluate the convergent validity of the measure, the structural equation modelling methodology was utilised. As for discriminant validity, factor analysis was used to determine the uniqueness of the constructs. These combined procedures were adopted to ensure the construct validity of measurement scales of the instrument.

The instrument for this research was a questionnaire which was divided into seven parts. The first part related to the "Domestic Availability" and "Adoption Experience" factors. This part had six questions in total. There were three questions on domestic availability and adoption experience factors, respectively.

The second part of the questionnaire contained fourteen questions. The first twelve questions related to the “Material Incentives”, “Perceived Benefit”, and “Enhanced Value” factors of the model. With the exception of the perceived benefit factor, which had six questions, all the other factors had three questions. In addition, included in this part was one question designed to measure the behaviour intention of the respondents to adopt foreign technology as well as one other question to measure the strategic choice available to the prospective adopter.

Part three related to the “Perceived Difficulty” and “Compatibility” factors. There were two questions for both the perceived difficulty and the compatibility factors. Parts four and five of the questionnaire were composed of the positive and negative influences relating to the “Supplier Commitment” factor. Part four comprised seven supports from the supplier and Part five listed six obstacles imposed by the supplier.

Hence, together with the twelve and four questions included in Parts two and three of this questionnaire, respectively, there were twenty nine questions, in total, to measure the attitudinal factor of the International Model For Technology Adoption.

Questions pertaining to the remaining four factors of the model were covered by Part six of the questionnaire. Each of the following three factors had one question: 1) "Industry Structure", 2) "Demand Uncertainty", and 3) "Price Intensity"; with the "Information Exposure" factor having two questions. Finally, Part seven of the questionnaire asked the demographic particulars of the respondents.

The Directory of Hong Kong Industries was adopted as the sampling frame for this research. In order to reduce the problems relating to non-response error, the following procedures were put in place:

1) Comparison of early versus late respondents; and
2) Comparison of respondents to the initial mailing versus respondents receiving the follow-up mailings.

For the current study, the following analytical methods were adopted:

1. descriptive statistical analysis;
2. correlation analysis; and
3. Structural Equation Modelling.

Descriptive statistics were used to provide quantitative measures for the characteristics of the sample. The Pearson product-moment correlation coefficients were calculated in order to test certain basic hypotheses of the study. The overall validity and structural analysis of the model were determined by using the structural equation modelling technique.

7.2.4 Major Findings of the Study

Based on the results of the structural equation modelling and the ANOVA analyses, the data collected provided overall support for the model. In particular, it was found that the major determinants of the formation of a behavioural intention towards adoption were the government influence factor and the attitude towards adoption. These two factors were found to be significant at the 5% level.

In relation to the competitive environmental control factors, it was found that the five competitive forces, with the exception of the industry rivalry factor, were not significant at the 5% level. These results were similar to the findings of Gatignon and Robertson (1989). In their study, Gatignon and Robertson found that adoption of foreign technology was more likely to happen in an industry with a high degree of concentration. The explanation provided was based on the stronger financial ability of firms under an oligopoly or monopoly situation.

The strategic choice factor was found to be insignificant at the 5% level but significant at the 10% level. Therefore, given that the direction of the coefficient matched that predicted by the model, it could be argued that the existence of a strategic alternative could moderately affect the intention to adopt.

One possible explanation for this result could be that a gradual reshuffle in the manufacturing sector has occurred in Hong Kong for the past 15 years. The relative importance of the manufacturing sector has been shrinking; for example, from a contribution of 23.7% to the total production value of the territory in 1980 to 11.1% in 1993, and from providing 40.0% of total employment for the territory in 1961 to 17.1% in 1994 (Census and Statistics Department 1995 & 1996.) Hence, many previous manufacturers who had found other investment opportunities to be more attractive, such as property development, might have exited the industries leaving behind the hard-core industrialists in the manufacturing sector. This group of industrialists might have a strong sentiment towards the manufacturing sector and be more inclined to stay in the manufacturing than those who had left.

7.2.5 Contributions and Limitations of the Study

The present study provides an analytical framework to unlock the initial, and also the most covert, stage of the technology transfer process at the firm's level; that is, the process under which a technology adoption decision is being made. In fact, this is an essential element of the entire technology transfer process because it is at this stage that decisions to adopt a foreign technology are made; or otherwise, the entire technology transfer process will not take place.

A major contribution of this research is that it initiates an inter-disciplinary inquiry into how environmental and organisational attributes intertwine to affect international technology adoption behaviour. In particular, the present study includes an examination of governmental influence, economic infrastructure, organisational influences, industrial characteristics and individual decision makers' idiosyncracies. This approach has embraced the fields of economics, technology and innovation, organisational management, international business and strategic management; thereby addressing technology adoption from an interdisciplinary perspective.

The development of a comprehensive behavioural model and the subsequent empirical testing of the model have furthered our understanding of the international technology adoption process. In particular, this study put forward an international technology adoption model which addresses the fundamental issue of the topic, that is, the interactions between external environmental and organisational variables and the cognitive processes that dictate the attitude and behavioural intention of decision makers.

By investigating the decision making process of international technology adoption, the current study made a major contribution to the common body of knowledge in the international technology transfer literature. The information collected in this research has explicated the relationships between perceptions of external and internal environmental factors and the decision to adopt international technology. This information serves to uncover the selection process of decision makers in the adoption of new technology; thereby facilitating international technology transfer.

Furthermore, research into the innovation diffusion process among organisations requires an in-depth and process approach to allow researchers to unveil the nature of the innovation process in organisations (Rogers 1983). What is more, limited previous attempts have been conducted to explore the decision behaviour of a recipient firm to adopt or reject a new technology. Thus, this study has developed a behavioural model which is able to capture the key attributes influencing the adoption intention of decision makers. The results of this study have heightened our knowledge of organisational adoption versus rejection behaviour.

The use of a behavioural model to unlock the adoption decision process is the major contribution of this study. However, as with all research frameworks, it should be noted that there are limitations as well. The major limitation of this study is that it uses the intention of the respondents to predict their actual behaviour. Despite the fact that this method is well grounded and empirically supported by the Theory of Planned Behaviour, there is always a chance that actual behaviour may deviate from the original intention. Hence, the actual behaviour may never be absolutely determined. However, careful consideration was given to this consideration before this research approach was adopted. Given the importance of small firms in Hong Kong industry and a propensity of Hong Kong manufacturers to exploit comparative advantages, it was impractical to investigate firms which are currently engaged in technology adoption because the number of larger firms which are interested in technology transfer in Hong Kong is quite small (only 13 manufacturing establishments employed more that 1000 people or above in 1995.) In fact, initial contracts with manufacturers' associations in Hong Kong in the earlier stage of the research had established that the majority of manufacturing establishments were not contemplating investing in foreign technology at the time of the research. Hence, this research can only investigate this phenomenon either by studying the intention of the respondents or relying on the memory of respondents.

Since the relationship between intention and behaviour has been empirically supported by a well established pool of research in the social science discipline and the general concern in the marketing discipline over the use of data derived from memory of respondents, this study has been designed to investigate the adoption behaviour through studying the behavioural intention of respondents.

7.2.6 Implications For Future Research

This study has applied behavioural theories to develop a decision-making model of international technology adoption. The theoretical behavioural framework in this research is constructed by integrating concepts and findings from innovation diffusion and international technology transfer studies.

In particular, building upon the Theory of Planned Behaviour (Ajzen 1992) and improving on the framework of the Technology Acceptance Model (Davis 1986), this study attempts to build an International Model For Technology Adoption (IMTA) which explores an organisation's decision to adopt technology from a foreign source. The IMTA has also incorporated and expanded the external factors identified by Gatignon and Robertson (1989) into the structure developed to recognise the driving forces behind the formation of an intention to adopt foreign technology.

Integrated with the findings from other studies on organisation innovation diffusion issues, the results presented here provide the potential for the development of a more comprehensive understanding of the process of organisational adoption. This research has identified the initial stage of the technology diffusion process in the industrial market, future studies will need to further investigate how the initial decision to adopt foreign technology can trigger the process of technology adoption and how the decision to adopt penetrates into the whole organisation. In addition, it will also be interesting to find out whether the different attitude to adopt from different stakeholders will affect the success of the final adoption and diffusion process, and whether the initial attitude to adopt from different stakeholders will be altered during the penetration process, and if so, how will it influence the ultimate success of the diffusion process.

Again, this study found that the individual external environmental forces did not significantly influence the formation of a behavioural intention to adopt. Future research to investigate whether and how these external factors influence the subsequent diffusion process may be useful in order to develop a better understanding of the impact of the external environment on innovation diffusion in the industrial market.

Finally, it should be stressed that this research only investigates the adoption behaviour of decision makers and examines only the micro element of the transfer process. This only forms part of the technology transfer process. This research has not addressed the forces which influence the diffusion process, and which focus on the macro element of the transfer process. Hence, caution should be exercised when the findings of this research are used to extrapolate the forces which affect and shape the transfer process. Further research into the area of the diffusion process is needed to determine appropriate government policies to encourage foreign technology transfer.

7.3 Policy Implications

The development of policy implications follows a four-step framework. First, the new role of Hong Kong in the Greater China region is explored as Hong Kong is now under Chinese sovereignty. Second, the options for Hong Kong companies to remain competitive in the world market under this new identity are investigated. Third, the best possible option is chosen and fourth, associated with this option, policies are developed, at both the firm and government levels.

The role of Hong Kong after 1997 is always an interesting topic to discuss. No other place in the world has the same experience of Hong Kong: emerging from an extremely poor and unimportant fishing port used originally by the British for smuggling opium into the imperial China to become one of the world's most sophisticated and wealthiest cities in less than 150 years. Then, carrying all its success and glory, Hong Kong was returned, as the most capitalistic place in the world, to China, the biggest communist country in the world on 1 July, 1997.

Since 1997, the future of Hong Kong, particularly its economic future, has been subject to much discussion. This discussion can be summarised under three scenarios:

1. Hong Kong as Hong Kong;
2. Hong Kong as just another Chinese city; and
3. Hong Kong as a hybrid city, that is, somewhat like Singapore.

The "Hong Kong as Hong Kong" scenario represents a view that Hong Kong will remain largely the same as before with respect to the rule of law; a small local government; preservation of individual freedom;

substantial economic autonomy; and a level playing field for all to prosper. The “Hong Kong as just another Chinese city” scenario involves a severe disruption of the way of life and the fundamental economic system of Hong Kong. The “Hong Kong as Singapore” scenario describes the future of Hong Kong as half way between “Hong Kong as Hong Kong” and “Hong Kong as just another Chinese city.” This scenario represents a place where there will be more restrictions and less freedom but still preserves the rule of law and enjoys a relatively high level of economic autonomy from the Central government.

After a year under Chinese rule, the future of Hong Kong is still uncertain. However, one thing is clear: the Central government in Beijing has been very careful in not allowing any one to interfere with Hong Kong. So far, they have been extremely honest in preserving the autonomy of Hong Kong and the “one country two systems” model. But, it is still too early to predict the future of Hong Kong with absolute certainty. From this year of experience, it is likely that the “Hong Kong as Hong Kong” scenario is the most promising scenario to describe the future of Hong Kong. Hence, the discussions follow in the remaining part of this section is based on the assumption that Hong Kong would still remain largely the same as before.

What does this “Hong Kong as Hong Kong” scenario lead us into? Under this scenario, Hong Kong will continue to be a leading international centre in Asia for business services, financial activities, and MNCs. With its new status as a Special Administrative Region (SAR) of China, Hong Kong will operate in a much closer interaction with the motherland as well as play a leadership role in the fast growing South China economy. This will see Hong Kong as the principal city in the fastest growing region of the fastest growing country in the world. If this is the scenario, what should be the role of Hong Kong? Behind this optimistic atmosphere, there should be concerns over how Hong Kong could evolve to ensure a leading role not only within China but also within the Asia Pacific region if not the world.

Under this scenario, as perhaps the most cosmopolitan city in China, people may argue that Hong Kong just needs to rely on internal demand generated from the Chinese mainland for growth rather than from external demand from physical trade as the formula for future success. There are always questions on whether Hong Kong really needs to develop an industrial base for future development. Given Hong Kong's proximity to the Southern region of China which has developed into an industrial region and given the competitive advantage of Hong Kong is her ability to provide speedy responses to environmental changes, what Hong Kong needs may be the development of capability to manage technology rather than the capability to adopt technology? Hong Kong has always been a broker or a bridge where east meets west. Perhaps, what Hong Kong companies need to develop is an information processing capability to help counterparts in China to develop capability and access to international technology and reduce barriers for them in adopting these technology.

For many, this is perhaps the best alternative for the future economic development of Hong Kong where she has a unique role in the Greater China region; given that Taiwan has already developed as a capital intensive high technology manufacturing region and the Chinese mainland is firmly established as a labour intensive manufacturer. Also, given the vast population of China, the focus on labour intensive manufacturing process may not need to change even in the first quarter of the next millennium or longer. Again, what both Taiwan and the Chinese Mainland lack is a developed services sector. Hence, the current competitive advantage of Hong Kong is, in fact, well placed if she wishes to fill the gap between these two manufacturing giants. Remember, David defeated the giant not through direct confrontation but through skilful attack on the vulnerable weakness of the giant. Is there a lesson for Hong Kong to learn?

Following from this logic, the natural development of Hong Kong should be further development of the service sector. The future direction will, then, be the extension of Hong Kong's position as a regional service centre in the Asia Pacific region to the South China region. Hong Kong has already developed a cluster of expertise in trading services, financial services, accounting and law services, distribution and marketing services and other services for the international business community in the Asia Pacific region. With more and more MNCs planning to invest in China and setting up regional headquarters in Hong Kong to organise such activities, the role of Hong Kong as a regional service centre has never been stronger. However, in order to allow Hong Kong to continue providing these services with high efficiency, the adoption of high technology is still essential. Hong Kong needs to have continuous technological development in telecommunications, computing and information technology to maintain her leading-edge position in the region. This can be achieved through strategic alliances with overseas firms which can provide these technologies.

Hong Kong's attractiveness lies in her strength in understanding the Chinese market. Throughout the past 20 years of China's opening to the west, Hong Kong businessmen have accumulated a huge amount of knowledge and experience of doing business with China. Hong Kong companies have been extremely successful in operating in China. No companies from any other country have such a wide presence in so many diverse regions in China as Hong Kong. Hong Kong is, by far, the leading investor in every province and city in China. Such an immense knowledge of China, coupled with long developed experiences with the West, provide Hong Kong with a leading-edge in developing herself as a regional services centre. However, there are potential problems with this development strategy.

Currently, Hong Kong investments are heavily concentrated mainly on three areas: 1) the exporting processing of light manufacturing products; 2) property development; and 3) infrastructure development. But, as China continues to develop and the economy becomes more mature, investments will need to shift to other areas and the most likely opportunities will be coming from the more sophisticated industrial sector such as capital goods which Hong Kong companies are less familiar with. In addition, given the continuous economic development in China, and especially in the South China region, it will not for long before manufacture of these products replaces imports, given the level of scale economies that could be gained. Again, this is an area where Hong Kong companies do not currently have a competitive advantage. In fact, this could undermine the role of Hong Kong as an international logistic and distribution centre for overseas investors in China.

Furthermore, as China is becoming more open and foreign firms are gaining more experience with the market, there is an increasing potential for these firms to bypass Hong Kong altogether; thereby threatening the role of Hong Kong as an international services centre for foreign investments into China. Of course, the possibility for all these to happen in the immediate future may seem to be quite remote. But, given Hong Kong's over-reliance on the services sector (more than 80% of the GDP), a certain degree of diversification may be needed to ensure the future prosperity of Hong Kong.

Hence, given that the future demand in China, and especially the South China Region, is likely to be coming from industrial demand, there may be a need to rethink the role of the manufacturing industry in the Hong Kong economy. There is always a misconception that the importance of Hong Kong's manufacturing sector has been shrinking dramatically in recent decades. Indeed, this is not the true picture.

It is indisputable that the contribution of the manufacturing sector to the gross domestic product has been dropping to less than 10% of the GDP in recent years. But, the true story goes beyond this figure. Such an apparent dramatic drop in the importance of the manufacturing sector is due to the fact that Hong Kong manufacturers have been moving their production operations to China for the past 20 years. This has allowed Hong Kong manufacturers to develop and operate a network of manufacturing activities in many parts of China.

This transformation has inevitably expanded the manufacturing capability of Hong Kong manufacturers to a scale beyond their reach when only local resources (both physical and human) were used. For example, in 1990, the estimated number of migrant workers in just the Guangdong Province of China was between 5 and 6 million, that is, almost the entire population of Hong Kong. In addition, it is estimated that by 1997, Hong Kong manufacturing firms could employ up to 5 million workers in their plants in Hong Kong and China. This figure is five times the workforce of Hong Kong even at its peak in 1984 (Far Eastern Economic Review, January 9, 1997).

In this respect, Hong Kong manufacturers have developed a network of production systems which far exceeds the production capability of Hong Kong. If these resources can be put into a chain of higher value adding activities, there could be a revitalization of Hong Kong's manufacturing sector. This could transform the manufacturing sector into a highly profitable and eminently strategic position if this network were to operate to its fullest potential. Even at the current moment of an over-emphasis on the "low-tech" pattern of industrial development in Hong Kong, it is estimated that the value added to Chinese exports to the United States by Hong Kong manufacturers producing in China is 20 to 25% (Berger and Lester 1997.) Hence, the current problem of the Hong Kong manufacturing sector is the inability to move up the technology ladder. Given that Hong Kong's manufacturing sector is dominated by small companies, technology adoption may be the fastest way to help the sector to move up the technology ladder.

The results of the structural equation modelling analysis of this study provide overall support for the International Model For Technology Adoption. A more detailed investigation of the overall results on the individual constructs of the International Model For Technology Adoption revealed that the "attitude towards adoption" and the "government influence" factors were the major determinants in the decision process of the intention to adopt.

In other words, when deciding on whether to adopt foreign technology into their production process, Hong Kong manufacturers did not consider the competitive environment very fully. In this respect, Hong Kong manufacturers may have adopted a passive attitude towards the competitive environment. This may be a reflection of the fact that when facing a more competitive environment, Hong Kong manufacturers look for other alternatives relating more to the maintenance of comparative advantage rather than the creation of competitive advantage. This is supported by the continuous shrinking of the manufacturing sector in Hong Kong and the dominant role of Hong Kong manufacturers as China's largest foreign investment provider.

The reason for Hong Kong manufacturers adopting this passive behaviour may be due to their relatively small size when compared with other international players. As small manufacturers, they have become quite reactive to the competitive environment. Rather than confronting the changing competitive environment through better equipping themselves with more advanced technology, they have chosen to deal with the changing environment through relocating their production facilities to a low cost environment and through the continuous utilisation of existing technology. This is evidenced by the fact that the majority of Hong Kong manufacturers has relocated their plants to China for the past 15 years (Hong Kong Industry Department 1996.)

The development of such a passive attitude towards the competitive environment may also be the direct result of the lack of active government involvement in fostering industrial development in Hong Kong. The Hong Kong government is famous for its "positively non-interventionist" policy.

Another reason may be the lack of exposure on the side of small Hong Kong manufacturers to the latest developments of technology in the international environment and the lack of an understanding of the advantages of adopting these advanced technology.

These may be the heart of the problem faced by the manufacturing sector in Hong Kong. As small business operators who develop an over-reliance on comparative advantages, Hong Kong manufacturers have trapped themselves in a vicious circle. This dependence on comparative advantages to compete forces them to focus largely or in some cases, solely, on cost reduction and control. The over-emphasis on cost control together with their relatively small size pushes them to relocate their production in low cost sites with the adoption of low to medium level technology. This is evidenced by the vast movement of Hong Kong manufacturing establishments to China in pursuant of lower costs of production. Such a strategy drives them to rely heavily on price competition which, in turn, leaves them vulnerable to excessive competitive pressure (Berger and Lester 1997.)

Growing competitive pressure has sharply reduced their profit margins. The gradual and continuous drop in profit margins has further reduced their ability to revitalise production capability to prepare for a transition to a high technology sector; thereby forcing these manufacturers to stay in their current position and remain in the low technology sector with a focus on comparative advantages. This is exactly the situation facing the manufacturing sector in Hong Kong. The problem with the over-reliance on comparative advantages is that companies will be forced to keep on relocating to lower cost locations in order to stay competitive. This is, in fact, happening to these Hong Kong manufacturers operating in China already. They find that costs of production in South China are rising so rapidly that it is no longer profitable to operate there, but have to move to the inner part of China to stay competitive. However, the distribution and logistic systems in the inner regions of China are still very under-developed; thereby, raising the total costs of production and making it less attractive (Berger and Lester 1997.)

Since the results of this study revealed that the "government influence" factor was one of the two major determinants in the decision process of the intention to adopt foreign technology, the Hong Kong government may need to put in place a system which helps pull small manufacturers out from this situation. This may be achieved through the encouragement of more technology transfer. In order to foster the transfer of foreign technology, one critical element for government is to understand the factors affecting the adoption behaviour of companies.

In particular, the results of the current study suggest that when deciding on the adoption of foreign technology, firms in Hong Kong tend to look to the support provided by government. Hence, the results suggest that in order to foster technology transfer into Hong Kong's manufacturing sector, the role of the government is very important. The Hong Kong government needs not only to develop policies which provide direct material support to the industry, but also establish an environment which can influence the attitude of Hong Kong manufacturers towards adopting foreign technology.

On the issue of providing material government support, the Hong Kong government is clear about its role in assisting industrial development in Hong Kong. Rather than it picking winners, the Hong Kong government argues that this should be the job of the market. The role of the Hong Kong government is simply to provide an appropriate environment for companies to develop their competitiveness. Hence, in line with the philosophy of the Hong Kong government, to foster technology adoption, the recommendations of the current study on the policy issues relate to the building of a technological infrastructure to shape an appropriate environment for the formation of a more positive attitude towards adopting foreign technology by small manufacturers in Hong Kong.

However, one point of clarification is needed relating to the issue of material support from the government in Hong Kong. There has been a wrong perception that Hong Kong at present offers no tax incentives to encourage companies to acquire new technology. Under Sections 16B and 16C of the Inland Revenue Ordinance, certain tax incentives are provided. Under Section 16B, a tax deduction is allowed for the following activities:

1. payments to an approved research institute for undertaking business-related scientific research or for expenses and capital expenditure included; and

2. payment to approved universities or similar institutions for business- related technical education.

In addition, under Section 16C, a deduction is also allowed for expenditure incurred for the purchase of patent rights or rights to any know-how for use in Hong Kong. However, it must be stressed that these measures only provide a level playing field for manufacturing firms in Hong Kong and are, at best, neutralising some of the tax advantages offered by other governments in the region and cannot be considered as "incentives."

In order to adopt policies which can influence the attitude of adoption, it is necessary to investigate the results of this research on the formation of an attitude towards adoption. According to the International Model of Technology Adoption, attitude is hypothesised to be affected by six other endogenous beliefs: 1) Compatibility; 2) Enhanced Value; 3) Perceived Benefits; 4) Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment. The results of the structural equation modelling analysis and the subsequent testing of the respective hypotheses relating to the attitude formation process confirmed that attitudes towards adoption were influenced by five of these six endogenous beliefs, with the exception of the perceived difficulty factor. However, though statistically not significant at the 5% level, the coefficient of the perceived difficulty factor did have the correct sign as predicted by the IMTA. Hence, it was concluded that a moderate level of support was found for the hypothesis relating to the perceived difficulty factor.

The results of this study on the part of the attitude formation process reveal a salient element in the technology transfer process. The results seem to point to technology adoption being co-generated by foreign technologists, who focused on the technological and research aspects of the process (that is, the Adaptive Experiences, the Perceived Difficulty and the Suppliers' Commitment beliefs factors), and the commercial adopters and users, who focused on the application aspects of the process (that is, the Compatibility, the Enhanced Value and the Perceived Benefits belief factors.)

In this respect, the key to facilitate a more positive formation of attitudes towards the adoption of foreign technology lies in the need for government to develop appropriate policies which can facilitate the transfer process between the foreign technologists and the local commercial adopter. Consequently, as the focus of this research is on the adoption process, these six components are further investigated to determine the linkages between these two processes from the viewpoint of the adopters. As revealed in the IMTA, these six components, which are hypothesised to affect the formation of an attitude towards adoption, can also be interpreted alternatively from another two similar aspects. These two aspects, both from the perspective of the technology adopters, relate to 1) the utility of the technology, and 2) the supportive services provided for the technology transfer.

The utility aspect includes these three beliefs: 1) Compatibility; 2) Enhanced Value; 3) and Perceived Benefits. The remaining three beliefs with respect to the supportive services dimension are: 4)Adaptive Experiences, 5) Perceived Difficulty; and 6) Suppliers' Commitment.

Hence, the results suggest that the key to success in this integrated process of technology transfer and adoption requires mulitdisciplinary supports in the areas of science, technology as well as marketing. Knowledge of science and technology can allow adopters to conduct more in-depth evaluations on the issues of compatibility and perceived difficulty as well as the extent to which suppliers' commitment is needed.

Knowledge in marketing, again, helps prospective adopters to understand their consumers better; thereby providing them with more market and consumer information for a comprehensive analysis on the issues of enhanced value and perceived benefits. In addition, with a more profound understanding of the costs and benefits relating to an adoption decision, prospective adopters may be in a healthier position to make a better educated decision; hence, more inclined to adopt the foreign technology after forming a clearer picture of the calculated risks involved. With a deeper understanding of both the technological and commercial aspects of the adoption process, there will be a lesser impact of the adaptive experience on the decision to adopt.

It is expected that small manufacturers may not possess such a high level of integrated skills. To facilitate technology transfer, the government may be required to provide assistance in these areas. This is especially important for Hong Kong as a small open economy because it will always depend on foreign sources for advanced technology. The only question remains is what is the role of government. It is unlikely that government intervention can facilitate the development of these skills. Hence, the focus of the government should be the provision of a learning environment in which people can acquire these skills through a continuous education process. In recent years, the government has established the Open University of Hong Kong to provide channels for adult learners to continuously upgrade their skills and knowledge. In addition, the government, through the Industry Support Fund, has allocated $5 million dollars to the Hong Kong Baptist University to develop subsidised training programmes on total quality management for companies in order to enhance small businesses awareness on the current management practices for quality improvement. Furthermore, the government has introduced tax relief of $30,000 against tuition fees paid each year for individuals who are studying in programmes for professional and personal development. What the government needs to do is to facilitate more cooperation of this kind between manufacturers' or commercial associations and the universities for the development of study programmes which can help develop these skills for the business community at large.

Moreover, the findings of this research have also suggested the need for the government to serve as a bridge between the foreign technologists and the local commercial adopters. Previous studies (Aubert 1984; Cusumano and Elenkov 1994; Chen 1995; Hiraoka 1995) have shown that the cultivation of technology incubators could provide some assistance. However, it should be noted that the policy recommendations discussed below go beyond the research findings of this study. The current research merely focuses on the adoption behaviour of firms and looks at the technology transfer at the micro level. However, the policy recommendations are anchored by other research in the field of innovation diffusion.

The possible linkage between the findings of this research and the policy recommendations is derived from the fact that the results of this study clearly indicated that the most salient factor affecting the behavioural intention of small firms in Hong Kong to adopt foreign technology was "government influence." Further, this research also found that the level of information exchange and dissimulation among the manufacturing sector was minimal, as revealed by the fact that "information exposure" was found to be an insignificant factor affecting technology adoption. Therefore, the findings of this research clearly suggest that there may be a role for government in fostering technology adoption behaviour through the provision of a supportive environment for industries to acquire foreign technology. These policy recommendations are derived from a pool of research in the area of technology incubators. Technology incubators can be in the form of innovations centres, science parks, and technology centres.

The primary role of these technology incubators should be to help local manufacturers to interpret, adapt and facilitate the adoption of technology from foreign sources and the development of an understanding of the needs of the consumers. This is supported by literature studying the importance of the role of public technology incubators as a major tool for diffusing technology to local firms; thereby, contributing to the remarkable success of the post-war economic development in Japan, Korea and some other successful cases among the small open economies and newly industrialised countries (Aubert 1984; Cusumano and Elenkov 1994; Chen 1995; Gerstenfeld and Sumiyoshi 1980; Hiraoka 1995; Kim 1984; MacDowall 1984; Nabseth and Ray 1974; Saxonhouse 1982; Whiting 1984; Zysman 1983; Zysman and Tyson 1983.)

In order to enhance the role of technology incubators, it may be appropriate to allow the development of a certain degree of commercialisation behaviour within these technology incubators so as to ensure a market-driven focus is adopted. The purpose of the commercialisation element reassembles the invisible hand in the market economy and is adopted to sanction the creation of a private interest for the development of a social purpose, that is, the provision of better products for consumers of the society. However, this is not going to be easy.

To achieve this end, it is important to determine when public funding should be substituted by private funding during the conceptualisation and development of the products. The critical point should be earmarked by the revitalisation of the market mechanism in the technology transfer process. Remember the argument for government intervention is the existence of a market failure. Hence, public funding should cease to support any project when the market starts to work again.

However, it is still very important to involve the private sector at this conceptualisation stage of the project to ensure the technology under development is shaped by market needs. The close interaction between the public agents and the private companies, as well as the supply of public funding is essential up to the point where the technology adopted has passed through the prototype stage for the adoption of pure research or the completion of the transfer process for the adoption of applied technology.

The provision of public funds at the early stage of the adoption process, or the pre-commercial stage, is very necessary in the Hong Kong manufacturing environment. In Hong Kong, many manufacturers are small in size. Therefore, many of them lack firstly, the financial capability and secondly, the technology management skills to initiate the adoption. The recent Asian financial turmoil has highlighted the magnitude of these problems when the economic and operating environments faced by these small manufacturers have greatly deteriorated (Capital, June, 1998.) The development of such a co-operative mechanism can provide the necessary impetus for the formation of a positive attitude towards adoption by small manufacturers.

In fact, the Hong Kong government has already initiated some of these processes. The establishment of the Hong Kong Industrial Technology Centre Corporation in 1993 was a manifesto of the government to advance new technology. Subsequent measures, such as the establishment of the Applied Research Council and the Industrial Support Fund, coupled with the existing support from the Hong Kong Productivity Council, see the Hong Kong government injecting more than HK$ 650 million into supporting the manufacturing sector of Hong Kong.

However, since these are only recent efforts initiated by the government to foster technology transfer and applied R&D in the industries, they are still at the embryo stage. To be successful, these technology incubators must have the ability to draw on a combination of generic business and technology skills and the capabilities to communicate with the users. In addition, the success of a transfer is likely to be moulded by the ability to attend to the needs of the adopter; and in turn the needs of the users. In view of the six internal beliefs affecting the formation of attitude towards adoption, the specific roles of the technology incubators should encompass the following:

1. education for small manufacturers to focus on quality and performance based technology rather than on price competition as price competition would only encourage manufacturers to relocate their production plants to other low cost countries while a focus on quality and performance would revitalise the transfer process and industry development with new technology in Hong Kong;

2. provision of technology information such as describing technology and services provided by the agent and/or other public institutes

3. establishment of a network of manufacturers for the purposes of instituting contacts for co-operation and supervision of technology adoption process; including the strategic development process of identifying problems, search for information, liaison with appropriate experts, devise project management planning as well as provision of technology management inputs.

4. introduction of a technology counsellor system to furnish information and training on issues such as project finance, technology management concepts and skill enhancement approaches.

5. minimisation of transfer bottlenecks or costs as compared to the value of the output; and

6. institutionalisation of the transfer of technological human resources such as the provision of technical expertise from foreign sources as well as the placement of students and/or graduates, in the form of a sandwich programme, to small manufacturers.

A note of caution is needed. Even though previous experience in the developed world has shown that technology incubators can initiate a positive impact on increasing the chances of firm survival, broader economic research is still lacking on the full impact of these incubators on the diffusion process. It is still unclear whether the cost of public support is justifiable. Future research is needed to investigate the performance implications of technology incubators on firm and job creation, technology diffusion, as well as entrepreneurship cultivation. The experience in the United States and in Europe could help illustrate the possible role of technology incubators in the process of technology transfer. Technology incubators in both continents have helped revitalise declining industrial regions through the development of clusters of technology-based firms, promotion of job-creating innovative firms as well as commercialisation of university research (OECD 1997.) However, further research is needed in this area to ascertain whether the same experience of these countries can be applied to the Hong Kong environment where both the size and sophistication of the business operators are very different.

In addition, it should be recognised that direct government intervention is, in many cases, a second-best solution. It may be more appropriate to improve the macroeconomic and regulatory environment in order to overcome obstacles to high-risk investments in the area of advanced technologies. The major risk in government intervention comes from the possibility of poorly designed government initiatives which can lead to inappropriate investments at substantial public costs. Government programmes could unintentionally subsidise or even help maintain ventures which could not otherwise attract private capital because they are second-best investment opportunities. These public programmes may also create distortions when these investment decisions are not based on pure economic criteria.

Another important finding of this research was that the behavioural intention to adopt was significantly affected by the attitude towards adoption from the decision-makers' perspective. In turn, the study also found that the most salient factors affecting the attitude towards adoption were: 1) adaptive experience; 2) perceived supplier's commitment; 3) perceived benefits, 4) perceived compatibility; and 5) enhanced value. All these factors shaping a positive attitude towards technology adoption can be fully cultivated within the industrial community of small manufacturers in Hong Kong when these firms can develop a co-operative atmosphere through active exchanges of information and experiences of technology adoption. However, as mentioned earlier, this study also pointed out another salient factor which could help explain the lack of international technology transfer activities in Hong Kong; that is, small manufacturers in Hong Kong did not actively engage in information exchanges; and hence; lack a forum for networking which is especially important for SMEs.

Handicapped by the size and scale, and after all, perhaps most importantly, fragmentation, Hong Kong manufacturers may require the development of a networking capability and experience so as to foster a spirit of international technology co-operation. Networking and networks are both means and ends; possesses and outputs. The success of this relies heavily on the building up of a blend of formal and informal communication channels among business, professional, social and personal contacts. The establishment of these relationships is important for the development of a system of technology innovation, acquisition and diffusion. Therefore, this requires a change in fundamental attitude from the firm's perspective.

Currently, there is a lack of serious research in the area of business networking and innovation as well as technology transfer within the Chinese culture. This is especially important to unlock the secret of how technology transfer can take place in the Greater China region without the need for active government intervention, as is the case of Hong Kong. At present, technology transfer only occurs in places where there is active government intervention, such as Taiwan and Singapore. This is, indeed, an important topic for future research as the majority of countries in the South-east Asian region are heavily influenced by the Confucius doctrine which is the core spirit of the Chinese culture.

This kind of study is interesting because the Chinese culture is embedded in traditions which can foster as well as hinder the process of networking. The indisputable power of "Guanxi" in maintaining successful business relationships with Chinese companies has fascinated western business investors. The very nature of guanxi is networking. It is believed that the Chinese rely heavily on personal business networks. However, the Confucius doctrine also preaches Chinese to be discreet and "selfish." The concept of "family" has influenced the thinking of individuals that there should be a distinction between family members and non-family members. The findings of this research suggest that Hong Kong SMEs lack established networks for cooperation and a stable system for networking. Further research is needed in this area if one has to investigate factors affecting the diffusion process of international technology in Hong Kong.

Finally, an element of the current study is the basic underlining assumption that Hong Kong must develop her technology capability in order to survive in the intense competitive environment in the next millennium. There seems to be a logic behind this thinking in that the current Asian financial crisis has manifested that the over-reliance (over 80%) on the services sector for the Hong Kong economy can be detrimental or even fatal to the survival of Hong Kong should anything like the current crisis strike again.

Bibliography

Abernathy, William J. and James M. Utterback (1978), "Patterns of Industrial Innovations," Technology Review, 80 (June/July), 41-47.

Abo, Tetsuo (1995), "A Comparison of Japanese 'hybrid Factories' in U.S., Europe, and Asia," Management International Review, Vol. 35, Iss. 1, 79-93.

Achrol, Ravi, (1991), "Evolution of the Marketing Organisation: New Forms for Turbulent Environments," Journal of Marketing, Vol. 55 (October), 77-93.

Acs, Z and Audretsch, D.B. (1988), "Innovation in Large and Small Firms: An Empirical Analysis," American Economic Review, Vol. 78, No. 4, 678-690.

_____ and _____ (1990), Innovation and Small Firms. Cambridge, MA: MIT Press.

Agmon, Tamir and Mary Ann Von Glinow (1991), Technology Transfer in International Business. Oxford University Press: New York, NY.

Aharoni, Yair (1991), Education and technology transfer: Recipient point of view. In T. Agmon and M. A. Von Glinow (Eds.) Technology Transfer in International Business, 79-102. Oxford University Press. New York, NY.

Ahmad, Aqueil, and Arthur S. Wilke (1986), Technology transfer in the new international economic order: Options, obstacles, and dilemmas. In The political economy of international technology transfer ed. John R. McIntyre and Daniel S. Papp, 77-94. New York: Quorum Books.

Ajzen, I. (1980), Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice-Hall.

_____ (1988), Attitudes, Personality and Behavior. Chicago: The Dorsey Press.

_____ (1991), "The Theory of Planned Behaviour," Organisational Behavior and Human Decision Process, Vol. 50, 179-211.

_____ and M. Rishbein (1977), "Attitude-Behavior Relations: A Theoretical Analysis and Review of Empirical Research," Psychological Bulletin, Vol. 84, No. 5, 888-918.

_____ and Madden (1986), "Prediction of goal-directed behaviour: attitudes, intentions and perceived behavioral control," Journal of Experimental Social Psychology, Vol 22, 453-474.

Al-Ali, Salahaldeen (1995), "Developing Countries and Technology Transfer," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 704-713.

Albaum, Gerald and Robert A. Peterson (1984), "Empirical Research in International Marketing," Journal of International Business Studies, (Spring/Summer), 161-73.

Al-Ghailani, Hamed Hashim and William C. Moor (1995), "Technology Transfer to Developing Countries," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 687-703.

Allen, R. C. (1983), "Collective Invention," Journal of Economic Behaviour and Organisation, Vol.4, 7-17.

Allvine, Fred C. (1968), "Diffusion of a Competitive Innovation," in Robert L. King (ed.), Marketing and the New Science of Planning. Proceedings of the National Conference, American Management Association, 341-351.

Alreck, Pamela L. and Robert B. Settle (1985), The Survey Research Handbook. Homewood, IL: Richard D. Irwin.

Ambrosio, Enrique M. (1995), "Technological Management and Transfer of Technology," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 665-675.

Anderson, John F. and Douglas R. Berdie (1975), "Effects on Response Rates of Formal and Informal Questionnaire Follow- Up Techniques," Journal of Applied Psychology, 60 (No.2), 255-257.

Anonymous (1995), "The Relationship between Environmental Barriers and Modes of Technology Transfer: A Study of United States," Journal of International Business Studies, Vol. 26 (3rd Quarter), Iss. 3, 690-691.

Archibugi, Daniels, Evangelista, Rinalo and Roberto Simmonetti (1995), "Concentration, Firm Size and Innovation: Evidence from Innovation Costs," Technovation, Vol. 15, iss. 3, 153-163.

Arnould, Eric J. (1989), "Toward a Broadened Theory of Preference Formation and the Diffusion of Innovations: Cases from Zinder Province, Niger Republic," Journal of Consumer Research, Vol. 16 (September), 239-67.

Arthur, B. (1989), "Competing Technologies and Lock-in by Historical Events," Economic Journal, Vol. 99.

Asheghian, Parviz and Bahman Ebrahimi (1990), International management. New York: Harper & Row Publishers.

Attewell, Paul (1992), "Technology Diffusion and Organizational Learning: The Case of Business Computing," Organization Science, Vol. 3 (February), 1-19.

Au, K. M. Alan and Alan C. B. Tse, (1995), The Development of Science and Technology Indicators for Hong Kong, An Unpublished Report Commissioned by the Hong Kong Government Industry Department.

Autio, Erkko and Tomi Laamanen (1995), "Measurement and Evaluation of Technology Transfer: Review of Technology Transfer Mechanisms and Indicators," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 643-664.

Baba, Yasunori and Hiroyuki Hatashima (1995), "Capability Transfer in the Pacific Rim Nations: The Case of Japanese Electrical and Electronics Firms," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 732-746.

Bagozzi, Richard P. (1980), Causal Models in Marketing. New York: John Wiley and Sons.

_____ (1982), "A Field Investigation of Causal Relations among Cognitions, Affect, Intentions and Behavior," Journal of Marketing Research, 19, 562-84.

_____, Alice M. Tybout, C. Samuel Craig, and Brian Sternthal (1979), "The Construct Validity of the Tripartite Classification of Attitudes," Journal of Marketing Research, Vol. 16 (February), 88-95.

Baker, Michael J. and Stephen T. Parkinson (1977), "Information Source Preference in the Industrial Adoption Decision," in Barnett A. Greenberg and Danny N. Bellenger (eds.), Proceedings of the American Marketing Association. Chicago: American Marketing Association, 258-261.

Baker, N. R., J. Siegman, and A. H. Rubenstein (1967), IEEE Transportation and Engineering Management, EM-14 156 (December).

Baldridge, J. Victor (1971), Power and Conflict in the University. New York: John Wiley.

_____ and Robert A. Burnham (1975), "Organizational Innovation: Individual, Organizational, and Environmental Impacts," Administrative Science Quarterly, 20 (June), 165-176.

Baldwin, Richard (1990), "Factor market barriers are trade barriers," European Economic Review, 34: 831-850.

Bar-Zakey, S. N. (1971), "Technology Transfer Model," Technological Forecasting and Social Change, 2(3/4), 321-337.

Baranson, J. (1977), "Technology transfer through the international firm," American Economic Review, May.

Baranson, J. (1978), Technology and the Multinationals, Lexington, MA: Lexington Books.

Barnett, Homer G. (1953), Innovation: The Basis of Cultural Change, New York: McGraw-Hill.

Barney, J. B. (1991), "Firm Resources and Sustained Competitive Advantage," Journal of Management, Vol. 17, 99-120.

Baron, Seymour (1990), "Overcoming barriers to technology transfer," Research-Technology Management, 33(1), 38-43.

Bartholomew, D. J. (1976), "Continuous Time Diffusion Models with Random Duration of Interest," Journal of Mathematical Sociology, 4 (No. 2), 187-199.

Bartol, Kathryn M. (1979), "Professionalism as a Predictor of Organizational Commitment, Role Stress and Turnover: A Multidimensional Approach," Academy of Management Journal, 22 (December), 815-821.

Barton, John H. (1984), "Coping with technological protectionism," Harvard Business Review, 62(6), 91-97.

Bass, Frank M. (1969), "A New Product Growth Model for Consumer Durables," Management Science, 15 (January), 215-27.

Bateman, T. S. and Ferris, G. R. (eds.) (1984), Method and Analysis in Organizational Research. Reston, VA: Reston.

Bates, Kimberly A. and E. James Flynn (1995), "Innovation History and Competitive Advantage: A Resource-based View Analysis of Manufacturing Technology Innovations," Academy of Management Journal, Iss. Best Papers Proceedings 1995, 235-239.

Baumgarten, Steven (1951), "The Innovative Communicator in the Diffusion Process," Journal of Marketing Research, Vol. 12 (February), 12-18.

Beal, George M. and Everette M. Rogers (1957), "Informational Sources in the Adoption Process of New Fabrics," Journal of Home Economics, Vol. 49, No. 8, 630-34.

Becker, Selwyn W. and Thomas L. Whisler (1967), "The Innovative Organization: A Selective View of Current Theory and Research," The Journal of Business, 40 (October), 462-465.

Becker, Marshall H. (1970), "Sociometric Location and Innovativeness: Reformulation and Extension of the Diffusion Model," American sociological Review, 35 (June), 267-282.

Benvignati, Anita M. (1983), "International technology transfer patterns in a traditional industry," Journal of International Business Studies, 14(3), 63-75.

Bentler, Peter M.(1990a), "Comparative Fit Indexes in Structural Models," Psychological Bulletin, Vol. 107, 238-246.

_____ (1990b), "Fit Indexes, Lagrange Multipliers, Constraint Changes, and Incomplete Data in Structural Models," Multivariate Behavioral Research, Vol. 25, 163-172.

_____ (1992a), "EQS: Structural Equations Program Manual, Los Angeles, BMDP Statistical Software.

_____ (1992b), "On the Fit of Models to Covariances and Methodology to the Bulletin," Psychological Bulletin, Vol. 112, 400-404.

_____ (1995), EQS Structural Equations Program Manual, Encino, CA, Multivariate Software, Inc.

_____ and D. G. Bonett (1987), "This Week's Citation Classic," Current Contents (Institute for Scientific Information), No. 9, 16.

_____ and Eric J. C. Wu (1995), EQS for Windows User's Guide, Encino, CA, Multivariate Software, Inc.

Berger, Suzanne and Richard K. Lester (Eds.) (1997), Made By Hong Kong, New York, Oxford University Press.

Bertsch, Gary K. ed. (1988), Controlling East-West Trade and Technology Transfer: Power, Politics, and Policies, Duke University Press.

Bhalla, A. S. and James, D. (Eds.) (1988), New Technologies and Development: Experiences in "Technology Blending". Boulder, CO: Rienner.

Bigoness, William J. and William D. Perreault, Jr. (1981), "A Conceptual Paradigm and Approach for the Study of Innovators," Academy of Management Journal, 24 (March), 68-82.

Bishop, Y. M. M., S. E. Feinberg and P. W. Holland (1975), Discrete multivariate analysis: Theory and practice. Massachusetts: MIT Press.

Blake, David H. and Robert S. Walters (1983), Chapter Six, The Politics of Global Economic Relations, second edition, Englewood Cliffs, NJ: Prentice-Hall, Inc., 148-66.

Blalock, H. M., Jr (1985), Causal Models in Panel and Experimental Designs, New York, Aldine.

Blau, Judith R. and William McKinley (1979), "Ideas, Complexity, and Innovation," Administrative Science Quarterly, 24 (June), 200-219.

Blondel, Daniele (1995), "Efficiency Criteria for Intermediaries Involved in the Innovation Process," International Journal of Technology Management, Vol. 10, Iss. 4-6, 478-488.

Bock, Jurgen (1994), "Innovation as Creative Destruction: The Role of Small Businesses in the Commonwealth of Independent States (CIS)," International Journal of Technology Management, Vol. 9, Iss. 8, 856-863.

Boneau, C. Alan (1961), "A Note on Measurement Scales and Statistical Tests," American Psychologist, 10 (May), 260-261.

Borgatta, Edgar F. and George W. Bohrnstedt (1981), "Level of Measurement: Once Over Again," in George W. Bohrnstedt and Edgar F. Borgatta (eds.), Social Measurement: Current Issues. Beverly Hills, CA: Sage Publications, 23-37.

Brancheau, J.C. and Wetherbe, J.C.(1990), "The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-user Computing," Information Systems Research, Vol. 1, No. 2, 115-143.

Brandner, Lowell and Bryant Kearl (1964), "Evaluation for Congruence as a Factor in Adoption Rate of Innovations," Rural Sociology, 29(3), 288-303.

Brasseur, R. E. (1976), "Constraints in the Transfer of Knowledge," International Development Review, 18(3), 12-19.

Bridges, E, A. Coughlan and S. Kalish (1991), " New Technology Adoption in an Innovative Marketplace: Micro and Macro Level Decision Making Models," International Journal of Forecasting, 3, 23-33.

Brown, Lawrence A., Edward J. Malecki, and Aron N. Spector (1976), "Adopter Categories in a Spatial context: Alternative Explanations for an Empirical Regularity," Rural sociology, 41 (Spring), 99-118.

Bruun, Peter (1995), "Case Study of Productivity and Quality Aspects in Production Technology Transfer to China," International Journal of Production Economics, Vol. 41 (October), Iss. 1-3, 109-114.

Bughin, J and Jacques, J. (1994). "Managerial Efficiency and the Schumpeterian link between Size, Market Structure and Innovation Revisited," Research Policy, Vol. 23, Iss. 6, 653-659.

Burgleman, R. A. (1983), "A Process Model of Internal Corporate Venturing," Administrative Science Quarterly, Vol. 28, No. 2, 223-244.

_____ and Maidique, M. A. (1988), Strategic Management of Technology and Innovation. Homewood, IL: Irwin.

Burke, D. J. (1953), "Additive Scales and Statistics," Psychological Review, 60 73-75.

Burns, Tom and G. M. Stalker (1971), The management of innovation. London: Tavistock Publications.

Burt, R. S. (1973), "The Differential Impact of Social Integration on Participation in the Diffusion of Innovations," Social Science Research, 125-144.

Byrne, Barbara (1994), Structural Equation Modeling with EQS and EQS/Windows, Thousand Oaks, SAGE Publishing.

Cainarca, G. M. Colombo and S. Mariotti (1990), "Firm Size and the Adoption of Flexible Automation," Small Business Economics, Vol. 2, Iss. 2, 129-140.

Calantone, Roger and Cooper, Robert G. (1981), "New Product Scenarios: Prospects for Success," Journal of Marketing, Vol. 45 (Spring), 48-60.

_____, Ming-Tung Lee and Andrew C. Gross (1988), "A Comparative Model of Systematic Forces on International Technology Transfer," Proceedings of the International Conference on Comparative Management, National Sun Yat-Sen University, Taiwan, 198-208.

_____, (1990), "Evaluating International Technology Transfer in a Comparative Marketing Framework," Journal of Global Marketing, Vol. III, No. 3 (June), forthcoming.

Cammann, Cortlandt, Mark Fichman, G. Douglas Jenkins, Jr., and John R. Klesh (1983), "Assessing the Attitudes and Perceptions of Organizational Members," in Stanley E. Seashore, et al. (eds.), Assessing Organizational Change: A Guide to Methods, Measures, and Practices. New York: John Wiley and Sons, 71-138.

Campbell, Donald T. and Donald W. Fiske (1959), "Convergent and Discriminant Validity by the Multitrait-Multimethod Matrix," Psychological Bulletin, 56 (March), 81-105.

Capital, June, 1998.

Capon, Noel and Rashi Glazer (1987), "Marketing and Technology: A Strategic Coalignment," Journal of Marketing, 51 (July), 1-14.

Carmines, Edward G. and Richard A. Zeller (1979), Reliability and Validity Assessment. Beverly Hills, CA: Sage Publications.

Carmines, Edward G. and Richard A. Zeller (1991), Reliability and validity assessment. Quantitative Applications in the Social Sciences series. Newbury Park: Sage.

Carroll, Jean (1967), "A Note on Departmental Autonomy and Innovation in Medical Schools," Journal of Business, 49, 531-534.

Cavusgil, S. Tamer (1985), Multinational corporations and the management of technology transfer. In Technology transfer: Geographic, economic, cultural, and technical dimensions, ed. A. Coskun Samli, 217-29. Connecticut: Quorum Books.

Cavusgil, S. Tamer and Ugur Yavas (1984), "Transfer of Management Knowhow to Developing Countries: An Empirical Investigation," Journal of Business Research, 12, 35-50.

Census and Statistics Department (1996), Hong Kong Government:
Hong Kong Trade Statistics;
Annual Report of Gross Domestic Product Estimates;
Reports of Employment, Vancancies and Payroll Statistics; and
Surveys of Industrial Production.

Chakrabarti, A. K. (1974), "The Role of Champion in Product Innovation," California Management Review, 17 (No. 2), 58-62.

_____ and Hauschildt (1989), "The Division of Labour in Innovation Management," R&D Management, Vol. 19, No. 2, 161-171.

Chandrashekaran, Murali and Sinha, Rajiv, (1995) "Isolating the Determinants of Innovativeness: A Split-Population Tobit (SPOT) Duration Model of Timing and Volume of First and Repeat Purchase," Journal of Marketing Research, Vol 32, Iss 4, 444-456.

Chatterjee, R. and J. Eliashberg (1990), "The Innovation Diffusion Process in a Heterogeneous Population: A Micromodeling Approach," Management Science, 36, 1057-1079.

Chen, Min (1995), "Technological Transfer to China: Major Rules and Issues," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 747-756.

Cherian, Joseph and Rohit Deshpande (1985), "The Impact of Organizational Culture on the Adoption of Industrial Innovation," American Marketing Association Proceedings, Vol. 51, 31-34.

Chiu, W.K., K.C. Ho and Tai-lok Lui (1997), City-States in the Global Economy: Industrial Restructuring in Hong Kong and Singapore, Boulder, Colo: Westview Press.

Churchill, Gilbert A. (1992), Basic Marketing Research. Chicago: The Dryden Press.

_____ (1995), Marketing Research: Methodological Foundations. Chicago: The Dryden Press. Sixth Edition.

Clark, Terrance (1968), "Institutionalization of Innovations in Higher Education," Administrative Science Quarterly, 13, 1-25.

Cohen, Jacob and Patricia Cohen (1983), Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. Hillspale, New Jersey: Lawrence Erlbaum Associates.

Cohen, Steven F. and Romaine M. Turyn (1980), "The Structure of the Firm and the Adoption of Process Innovations," IEEE Transactions on Engineering Management, EM-27 (November), 98-102.

Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation," Administrative Science Quarterly, Vol. 35, 128-152.

Coleman, James, Elihu Katz, and Herbert Menzel (1957), "The Diffusion of an Innovation Among Physicians," Sociometry, 20 (December), 253-270.

_____, _____, and _____ (1966), Medical Innovation: A Diffusion Study, Indianapolis: Bobbs-Merrill.

Contractor, Farok J. (1980), "The composition of licensing fees and arrangements as a function of economic development of technology recipient nations," Journal of International Business Studies (winter), 47-62.

_____ (1980), "The 'Profitability' of Technology Licensing by U.S. Multinationals: A Framework for Analysis and An Empirical Study," Journal of International Business Studies, (Fall), 40-63.

_____ (1983), "Technology Licensing Practice in U.S. Companies: Corporate and Public Policy Implications," Columbia Journal of World Business, (Fall), 80-88.

_____ (1984), "Choosing between Direct Investment and Licensing: Theoretical Considerations and Empirical Tests," Journal of International Business Studies, 15(3), 167-188.

_____ (1990), "Ownership patterns of U.S. joint ventures abroad and the liberalization of foreign government regulations in the 1980s: Evidence from the Benchmark surveys," Journal of International Business Studies (first quarter), 55-73.

_____ and Peter Lorange (1988), "Competition vs. Cooperation: A benefit/cost framework for choosing between fully-owned investments and cooperative relationships," Management International Review (March), 5-18.

_____ and Tagi Sagafi-nejad (1981), "International Technology Transfer: Major Issues and Policy Responses," Journal of International Business Studies 12(2), 113-135.

_____ and V. K. Narayannan (1990), "Technology Development in the Multinational Firm: A Framework for Planning and Strategy," R & D Management 20(4), 305-322.

Cooper, Charles (1972), "Science, Technology and Production in Underdeveloped Countries: An Introduction," The Journal of Development Studies, (October), 1-18.

Cooper, Robert G. (1979), "The Dimensions of Industrial New Product Success and Failure," Journal of Marketing, 42 (Summer), 93-103.

Correa, Carlos M. (1981), "Transfer of Technology in Latin America: A Decade of Control," Journal of World Trade Law, Vol. 15, No. 5, 388-409.

Correa, Carlos M. (1995), "Innovation and Technology Transfer in Latin America: A Review of Recent Trends and Policies," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 815-846.

Cortes, Mariluz (1982), "The Transfer of Petrochemical Technology to Less Developed Countries," in Devendra Sahal (ed.), The Transfer and Utilization of Technical Knowledge, Lexingt6on, MA: Lexington Books.

Corwin, Ronald G. (1972), "Strategies for Organizational Innovativeness: An Empirical Comparison," American Sociological Review, 37, 441-454.

Coughlin, Cletus C. (1983), "The Relationship between Foreign Ownership and Technology Transfer," Journal of Comparative Economics 7, 400-414.

Crane, D. (1972), Invisible Colleges. Chicago: University of Chicago Press.

Creighton, J. W., Jolly, J. A. and Buckles, T. A. (1985), "The Manager's Role in Technology Transfer," Journal of Technology Transfer, 10(1), 65-80.

Cronbach, L. J. (1951), Coefficient Alpha and the Internal Structure of Tests. Psychometrika. 16: 297-334.

Crow, Michael and Shrilata Nath (1992), "Technology Strategy Development in Korean Industry: An Assessment of Market and Government Influences," Technovation, Vol. 12, No. 2, 119-136.

Cummings, L. (1965), "Organizational Climates and Creativity," Academy of Management Journal, 8, 220-227.

Cusumano, Michael A. and Detelin Elenkow (1994), "Linking International Technology Transfer with Strategy and Management: A Literature Commentary," Research Policy, Vol. 23 (March), Iss. 2, 195-215.

Daft, R. L. (1989), Organization theory and design. New York: West.

_____ and Lengal, R.H. (1986), "Organisation Information Requirements, Media Richness, and Structural Design," Management Science, Vol. 32, 554-571.

_____, _____, and Trevino, L.K. (1987), "Message Equivocality, Media Selection,and Manager Performance: Implications For Information Systems," MIS Quarterly, Vol. 11, September, 334-366.

Damanpour, Fariborz (1996), "Organisational Complexity and Innovation: Developing and Testing Multiple Contingency Models," Management Science, Vol. 42, Iss. 5, 693-716.

Daniels, J. D. and Radebaugh, L. H. (1992), International Business: Environments and Operations, Seventh Edition. Reading, MA: Addison-Wesley.

Danko, William D. and James M. MacLachlan (1983), "Research to Accelerate the Diffusion of a New Invention," Journal of Advertising Research, 23 (June/July), 39-43.

Dasgupta, P. and J. Stiglitz (1980), "Uncertainty, Industry Structure, and the Speed of R&D," The Bell Journal of Economics, 11 (Spring), 1-28.

Daugherty, Patricia J., Richard Germain and Cornelia Droge (1995), "Predicting EDI Technology Adoption in Logistics Management: The Influence of Context and Structure," Logistics & Transportation Review, Vol. 31 (December), Iss. 4, 309-324.

David, P.A. and T. Olsen (1984), "Anticipated Automation: A Rational Expectations Model of Technology Diffusion," Centre for Economic Policy Research, Stanford University, Publication No. 24.

Davidson, William H. (1980), Experience Effects in International Investment and Technology Transfer. UMI Press: Ann Arbor, MI.

_____ (1983), "Structure and Performance in International Technology Transfer," Journal of Management Studies, 20(4), 453-465.

Davidson, William H. and Donald G. McFetridge (1985), "Key Characteristics in the Choice of International Technology Transfer Mode," Journal of International Business Studies, 6(2), 5-21.

Davis, Fred D. (1986), "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results," Doctoral Dissertation, Sloan School of Management, Massachusetts Institute of Technology.

_____, Richard P. Bagozzi, and Paul r. Warshaw (1989), "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models," Management Science, Vol. 35, No. 8 (August), 982-1003.

De Vincenti, W. (1985), "Technological Knowledge Without Science," Technology and Culture, Vol. 25, 8-18.

Dean, Carol Carolson and Jane LeMaster (1992), "Barriers to International Technology Transfer: Perceptions of High-level Executives of U.S. Companies Conducting Business in Eastern Europe and Mexico," North American Business Journal, 1(1), 85-112.

Dean, J. W. (1987), Deciding to Innovate: How First Justify Advanced Technology, Cambridge, Mass: Ballinger.

DeBresson, Chris (1995), "Predicting the Most Likely Diffusion Sequence of a New Technology Through the Economy: The Case of Superconductivity," Research Policy, Vol. 24 (September), Iss. 5, 685-705.

_____ (1991), "Technological Innovation and Long Wave Theory: Two Pieces of the Puzzle," Journal of Evolutionary Economics, 1, 241-272.

_____ and J. Lampel, (1985), "Beyond the Life Cycle: Technological and Organisational Designs," Journal of Product Innovation Management, Vol. 3, 70-95.

Deshpande, Rohit and Frederick Webster, Jr (1989), "Organisational Culture and Marketing: Defining the Research Agenda," Journal of Marketing, Vol. 53 (January), 3-15.

Dewar, Robert and Jerald Hage (1978), "Size, Technology, Complexity, and Structural Differentiation: Toward a Theoretical Synthesis," Administrative Science Quarterly, 23, 111-136.

Dewar, R. D., D. A. Whetten, and D. Boje (1980), "An Examination of the Reliability and Validity of the Aiken and Hage Scales of Centralization, Formalization, and Task Routineness," Administrative Science Quarterly, 25, 120-128.

Dicken, Peter (1992), Global Shift: The Internationalization of Economic Activity. London: Paul Chapman Publishing Ltd, Second Edition.

Dickerson, Mary Dee and James W. Gentry (1983), "Characteristics of Adopters and Non-Adopters of Home Computers," Journal of Consumer Research, 10 (September), 225-235.

Dillon, William R. and Mathew Goldstein (1984), Multivariate Analysis: Methods and Applications, New York: John Wiley & Sons.

Dierickx, I and K. Cool (1989), "Asset Stock Accumulation and Sustainability of Competitive Advantage," Management Science, Vol. 35, 1504-1511.

Donaldson, L. (1990), "The Ethereal Hand: Organizational Economics and Management Theory," Academic of Management Review, Vol. 15, 369-381.

Dosi, G. (1988), The Nature of the Innovative Process. In Dosi, G., Freeman, C., Nelson, R., Silverberg, G. and Soete, L. (Eds.) Technical Change and Economic Theory, 221-238. London: Pinter.

_____, Freeman, C., Nelson, R., Silverberg, G. and Soete, L. (Eds.)(1988), Technical Change and Economic Theory. London: Pinter.

_____ and Orsenigo, L. (1988), Coordination and Transformation: An Overview of Structures, Behaviours, and Change in Evolutionary Environments. In Dosi, G., Freeman, C., Neson, R., Silverberg, G. and Soete, L. (Eds.) Technical Change and Economic Theory, 13-37. London: Pinter.

Downs, George W., Jr. And Lawrence B. Mohr (1976), "Conceptual Issues in the Study of Innovation," Administrative Science Quarterly, 21 (December), 700-714.

Dunning, John H. and A. Weiss (1979), "Organizational Learning: Implications for Organizational Design," in B. Staw (ed.), Research in Organizational Behavior. Greenwich, CN: JAI Press, Vol. 1, 75-123.

_____ (1981), Alternative Channels and Modes of International Resource Transmission. In Tagi Sagafi-Nejad, R. W. Moxon and H. V. Perlmutter, eds. Controlling International Technology Transfer: Issues, Perspectives and Policy Implications. Pergamon: New York, NY.

Ebadi, Yar M. and James M. Utterback (1984), "The Effects of Communication on Technological Innovation," Management Science, 30 (May), 572-585.

Engel, J. F., Keggerreis, R. J., and Blackwell, R. D. (1969), "Word of Mouth Communication by the Innovator," Journal of Marketing, Vol. 33 (July), 15-19.

Enos, John L. (1958), "A measure of the Rate of Technological Progress in the Petroleum Refining Industry," Journal of Industrial Economics, 6, 180-197.

Erdilek, A. and Rapoport, A. (1985), Conceptual and Measurement Problems in International Technology Transfer: A Critical Analysis. In Samli, A. C. (Ed.) Technology Transfer: Geographic, Economic, Cultural, and Technical Dimensions, 249-261. Westport, CT: Quorum Books.

Ettlie, John E. (1983), "Organizational Policy and Innovation Among Suppliers to the Food Processing Sector," Academy of Management Journal, 26 (March), 27-44.

_____ and William P. Bridges (1982), "Environmental Uncertainty and Organizational Technology Policy," IEEE Transactions on Engineering Management, EM-29 (February), 2-10.

Evan, William (1965), "Superior-Subordinate Conflict in Research Organizations," Administrative Science Quarterly, 10:52-64.

_____ and R. Black (1967), "Innovation in Business Organizations: Some Factors Associated with Success or Failure of Staff Proposals," Journal of Business, 40, 519-530.

Farrell, Joseph and Garth Saloner (1985), "Standardization, Compatibility, and Innovations," Rand Journal of Economics, 16 (Spring), 70-83.

Fast Eastern Economic Review, January 9, 1997

Feder, Gershon and Gerald T. O'Mara (1982), "On Information and Innovation Diffusion: A Bayesian Approach," American Agricultural Economics Association Proceedings, (February), 145-147.

Fennell, Mary L. (1984), "Synergy, Influence, and Information in the Adoption of Administrative Innovations," Academy of Management Journal, 27 (March), 113-129.

Fidler, Lori A. and J. David Johnson (1984), "Communication and Innovation Implementation," Academy of Management Review, 9 (No. 4), 704-711.

Fishbein, M. and I. Ajzen (1975), Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research, Reading, MA: Addison-Wesley.

Fliegel, F. C. and J. E. Kivlin (1966), "Attributes of Innovations as Factors in Diffusion," American Journal of Sociology, 72 (November), 235-248.

Forsyth, David J. C. (1985), "Government Policy, Market Structure and Choice of Technology in Egypt," in Jeffrey James and Susumu Watanable (eds.), Technology, Institutions and Government Policies, New York: St. Martin's Press, 137-82.

Foster, R. (1986), Timing Technological Transitions. In M. Horwitch (Ed.), Technology in the Modern Corporation: A Strategic Perspective. Paragon Press Inc. New York.

Frame, J. Davidson (1983), International Business and Global Technology, Lexington, Massachusetts: Lexington Books.

Frank, Ronald E., William F. Massy, and Donald G. Morrison (1964), "The Determinants of Innovative Behavior with Respect to a Branded, Frequently Purchased Food Product," in L. George Smith (ed.), Proceedings of the American Marketing Association. Chicago: American Marketing Association, 312-323.

Freeman, C. (1987), Technology Policy and Economic Performance, London, Printer.

_____ (1988), Evolution, Technology and Institutions: A Wider Framework for Economic Analysis. In Dosi, G., Freeman, C., Nelson, R., Silverberg, G. and Soete, L. (Eds.) Technical Change and Economic Theory, 9-12. London: Pinter.

Fulk, J., Rogers, E. M. and Von Glinow, M. A. (1987), Communication Technologies for Development in Third World Countries: Perspectives from Organizational Change Management. Unpublished paper, University of Southern California.

Gaito, John (1980), "Measurement Scales and Statistics: Resurgence of an Old Misconception," Psychological Bulletin, 87, 564-567.

Gatignon, Hubert and Thomas S. Robertson (1985), "A Propositional Inventory for New Diffusion Research," Journal of Consumer Research, 1 (March), 849-867.

_____ and _____ (1989), "Technology Diffusion: An Empirical Test of Competitive Effects," Journal of Marketing, 53 (January), 35-49.

_____ and Xuereb, Jean-Marc (1997), "Strategic Orientation of the Firm New Product Performance," Journal of Marketing Research, Vol. 34, Iss. 1, 77-90.

Gerbing, D. W. and J. C. Anderson (1993), "Monte Carlo Evaluations of Goodness-of-Fit Indices for Structural Equation Models," in Bollen, K. A. and J. S. Long (Eds.), Testing Structural Equation Models, Newbury Park, Sage, 40-65.

Germain, Richard; Droge, Cornelia and Tatricia Daugherty (1994), "A Cost and Impact Typology of Logistics Technology and the Effects of its Adoption on Organizational Practice," Journal of Business Logistics, Vol 15, iss. 2, 227-248.

_____ (1996), "The Role of Context and Structural in Radical and Incremental Logistics Innovation Adoption," Journal of Business Research, Vol. 35, Iss. 2, 117-127.

Gerwin, Donald (1981), "Relationships Between Structure and Technology," in Paul C. Nystrom and William H. Starbuck (eds.), Handbook of Organizational Design, Vol 2. Oxford University Press, 3-38.

Georgantzas, Nicholas C. and Christian N. Madu (1990), "Cognitive Processes in Technology Management and Transfer," Technological Forecasting and Social Change, 38, 81-95.

Gilbert, Joseph (1996), "Managing Innovation: The Role of the General Manager," Review of Business, Vol. 17, Iss. 3, 12-17.

_____ (1996), "Reducing the Risks from Innovation," Journal of Systems Management, Vol. 47, Iss. 1, 12-15.

Gilbert, Myrna and Cordey-Hayes, Martyn (1996), "Understanding the Process of Knowledge Transfer to Achieve Successful Technological Innovation," Technovation, Vol. 16, Iss. 6, 301-312.

Glenn, E. S. and Glenn, C. G. (1981), Man and Mankind: Conflict and Communication Between Cultures. Norwood, NJ: Ablex.

Gold, Bela, William S. Pierce, and Gerhard Rosegger (1970), "Diffusion of Major Technological Innovations in U. S. Iron and Steel Manufacturing," Journal of Industrial Economics, 18, 218-241.

Goodman, P. S. and T. L. Griffith (1991), "A Process Approach to the Implementation of New Technology," Journal of Engineering and Technology Management, Vol. 8, 261-285.

Gordon, Gerald, Edward V. Morse, Sue M. Gordon, Jean de Kervasdoue, John R. Kimberly, Michael Moch, and Donald G. Swartz (1974), "Organizational Structure, Environmental Diversity, and Hospital Adoption of Medical Innovations," in Arnold D. Kaluzny, John T. Gentry, and James E. Veney (eds.), Innovation in Health Care Organizations. Chapel Hill, NC: Department of Health Administration, 54-75.

Govindarajan, V (1989), "Implementing Competitive Strategies at the Business Unit Level: Implications of Matching Managers to Strategies," Strategic Management Journal, Vol. 10, 251-269.

Griffin, Abbie, Hauser, John (1996), "Integrating R&D and Marketing," Journal of Product Innovation Management, Vol. 13, Iss. 3, 191-215.

Griliches, Zvi (1957), "Hybrid Corn: An Exploration in the Economics of Technological Change," Econometrica, 25, 501-22.

Gupta, Ashok K., S. P. Raj, and David Wilemon (1986), "A model for Studying R&D-Marketing Interface in the Product Innovation Process," Journal of Marketing, 50 (April), 7-17.

Hage, Jerald (1965), "An Axiomatic Theory of Organizations, "Administrative Science Quarterly, 10, 289-320.

Hagedoorn, John (1990), "Organizational Modes of Inter-Firm Co-operation and Technology Transfer," Technovation, 10(1), 17-30.

Hagedoorn, John (1995), "Strategic Technology Partnering during the 1980s: Trends, Networks and Corporate Patterns in Non-core Technologies," Research Policy, Vol. 24 (March), Iss. 2, 207-231.

Hagerstrand, T. (1965), "A Monte Carlo Approach to Diffusion," Archives Europeennes de Sociologie, 6 (No. 1), 43-67.

_____ and Michael Aiken (1967), "Program Change and Organizational Properties: A Comparative Analysis," American Journal of Sociology, 72, 503-519.

_____ and _____ (1970), Social Change in Complex Organizations. New York: Random House.

_____ and Robert Dewar (1973), "Elite Values Versus Organizational Structure in Predicting Innovation," Administrative Science Quarterly, 18, 279-290.

Hair, Joseph F., Jr., Ralph E. Anderson, and Ronald L. Tatham (1995), Multivariate Data Analysis: With Readings. New York: MacMillan Publishing Company. Fourth Edition.

Hall, G. R. and R. E. Johnson (1970), "Transfer of United States Aerospace Technology to Japan," in Raymond Vernon (ed.), Technology Factor in International Trade, New York: National Bureau of Economic Research, 305-58.

Hall, Richard H. (1972), Organizations: Structure and Process. Englewood Cliffs, NJ: Prentice-Hall.

_____ (1977), Organizations: Structure and Process. Englewood Cliffs, NJ: Prentice-Hall.

_____, J. Eugene Haas, and Norman J. Johnson (1967), "Organizational Size, Complexity, and Formalization," American Sociological Review, 32, 903-912.

Hallen, Lars and Jan Johanson (1985), "Industrial Marketing Strategies and Different National Environments," Journal of Business Research, 13, 495-509.

Hansen, Robert A., Cathie Tinney, and William Rudelius (1983), "Increase Response to Industrial Surveys," Industrial Marketing Management, 12, 165-169.

Hamel, G. (1991), "Competition For Competence and Inter-partner Learning within International Strategic Alliances," Strategic Management Journal, Vol. 12, 83-103.

Hanel, Petr (1995), "Interindustry Flows of Technology: An Analysis of the Canadian Patent Matrix and Input-output Matrix for 1978-1989," Technovation, Vol. 14 (October), Iss. 8, 529-548.

Hannah, T. and J. McDowell (1984), "The Determinants of Technology Adoption: The Case of the Banking Firm," Rand Journal of Economics, Vol. 15, 328-335.

Harianto, Farid and Pennings, Johannes (1994), Technological Convergence and Scope of Organisational Innovation," Research Policy, Vol. 23, Iss. 3, 293-304.

Haour, Georges (1995), "Technology Flows in Switzerland," International Journal of Technology Management, Vol. 10, Iss. 1 124-130.

Hartwick, J. and H. Barki (1994), "Explaining the Role of User Participation in Information System Use," Management Science, V0l. 40, 440-465.

Harvey, M. D. (1984), "Application of Technology Life Cycles to Technology Transfers," Journal of Business Strategy, 5(2), 51-58.

Hatch, W. and K. Yamamura (1996), Asia in Japan's Embrace. Cambridge, Cambridge University Press, 96.

Hawes, Jon M. (1986), "Organizational Demographics and Innovation," in Thomas D. Jensen (ed.), Proceedings of the Southern Marketing Association. Fayetteville, AR: Southern Marketing Association, 259-261.

Hayes, R.H. and S. C. Wheelwright (1984), Restoring Our Competitive Edge: Competing through Manufacturing, New York, Wiley and Sons

Hayward, G. (1972), "Diffusion of Innovation in the Flour Milling Industry," European Journal of Marketing, 6 (July), 195-202.

Heeler, Roger M. and Thomas P. Hustad (1980), "Problems in Predicting New Product Growth for Consumer Durables," Management Science, 10 (October), 1007-1020.

Heller, P.B. (1985). Technology Transfer and Human Values. Lanham: University Press of America.

Herold, David M., Steven M. Farmer and Michele I. Mobley (1995), "Pre-implementation Attitudes toward the Introduction of Robots in a Unionized Environment," Journal of Engineering & Technology Management, Vol. 12 (December), Iss. 3, 155-173.

Hill, John S. and Richard R. Still (1980), "Cultural Effects of Technology Transfer by Multinational Corporations in Lesser Developed Countries," Columbia Journal of World Business, (Summer), 40-51.

Hiraoka, Leslie S. (1995), "Japan's Coordinated Technology Transfer and Direct Investments in Asia," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 714-731.

Hirschamn, Elizabeth C. (1980), "Innovativeness, Novelty Seeking, and Consumer Creativity," Journal of Consumer Research, 7 (December), 289-295.

_____ (1981), "Symbolism and Technology as Sources for the Generation of Innovations," in Kent Monroe (ed.), Advances in Consumer Research, Vol. 8, Ann Arbor, MI: Association for Consumer Research, 367-373.

_____ (1981), "Technology and Symbolism as Sources for the Generation of Innovations," in Andrew Mitchell (ed.), Advances in Consumer Research, Vol. 9, St. Louis, MO: Association for Consumer Research, 367-373.

_____ and Claes-Robert Julander (1979), "Behavioral Correlates of Service Innovation Adopters: A Cross-National Replication and Extension," in Advances in Consumer Research, 195-199.

Ho, Suk-ching and Ho-fuk Lau (1988), "Development of Supermarket Technology: The Incomplete Transfer Phenomenon", International Marketing Review, (Spring), 20-30.

Hofstede, Geert (1980a), Culture's Consequences: International Differences in Work-Related Values. Beverly Hills, CA: Sage.

Hofstede, Geert (1980b), "Motivation, Leadership and Organizations—Do American Theories Apply Abroad," Organization Dynamics, 9(1), 42-63.

Hofstede, G. and Bond, M. H. (1988), The Confucius Connection: From Cultural Roots To Economic Growth. Organizational Dynamics, 15(4), 4-21.

Hollenstein, Heinz (1996), " A Composite Indicator of a Firm's Innovativeness: An Empirical Analysis Based on Survey Data for Swiss Manufacturing," Research Policy, Vol. 25, Iss. 4, 633-645.

Holstius, Karin (1995), "Cultural Adjustment in International Technology Transfer," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 676-686.

Hong Kong Government Industry Department (1995), Techno-Economic and Marketing Research Study on Hong Kong's Textiles and Clothing Industries, Hong Kong Government.

Hong Kong Government Industry Department (1996), Hong Kong's Manufacturing Industries, Hong Kong Government.

Hutcheson, P, Pearson, A. and D. F. Ball (1996), "Sources of Technical Innovation in the Network of Companies Providing Chemical Process Plant and Equipment," Research Policy, Vol. 25, Iss. 1, 25-41.

Hunt, Shelby D., Richard D. Sparkman, and James B. Wilcox (1982), "The Pretest in Survey Research: Issues and Preliminary Findings," Journal of Marketing Research, 19 (May), 265-275.

Irwin, Harry and Elizabeth More (1995), "International Technology Transfer, Intercultural Communication and the Australian Aerospace and Telecommunications Industries," Human Systems Management, Vol. 14, Iss. 1, 39-50.

Jackson, B (1985), Winning and Keeping Industrial Customers, Lexington, Mass, Lexington Books.

James, Jeffrey and Susumu Watanabe (eds.) (1985), Technology, Institutions and Government Policies, New York: St. Martins's Press.

Jeannet, Jean-Pierre, and Bertil Liander (1978), "Some Patterns in the Transfer of Technology Within Multinational Corporations," Journal of International Business Studies, 9(3), 108-118.

Jöreskog, Karl G. and Dag Sörbom (1989), LISREL 7: A Guide to the Program and Applications, Second Edition, Chicago, IL: SPSS Inc.

Jovanovic, C. and S. Lach (1989), "Entry, Exit, and Diffusion with Learning by Doing," American Economic Review, Vol. 79.

Julien, Pierre-Andre and Louis Raymond (1994), "Factors of New Technology Adoption in the Retail Sector," Entrepreneurship: Theory & Practice, Vol. 18 (Summer), Iss. 4, 79-90.

_____, Estimé, M.F. and Drilhon, G. (1993). Small and Medium-sized Emterprises: Technology and Competitiveness. Paris: OECD.

Kahn, Kenneth (1996), "Interdepartmental Integration: A Definition with Implications for Product Development Performance," Journal of Product Innovation Management, Vol. 13, Iss. 2, 137-151.

Kaigler-Evans, Karen, Clark Leavitt, and Lois Dickey (1978), "Source Similarity and Fashion Newness as Determinants of Consumer Innovation," in H. Keith Hunt (ed.), Advances in Consumer Research, Vol. 5. Ann Arbor, MI: Association for Consumer Research, 738-742.

Kaluzny, A., J. Veney, and J. Gentry (1974), "Innovation of Health Services: A Comparative Study of Hospitals and Health Departments," Health and Society, (Winter).

Karuppan, Muthuraman (1986), "Diffusion of Computers in the Small Business Sector: An Empirical Investigation," unpublished dissertation. Fayetteville, AR: University of Arkansas.

Kamm, Judith Brown (1987), An Integrative Approach to Managing Innovation. Lexington, MA: D. C. Heath and Company.

Kanuk, Leslie and Conrad Berenson (1975), "Mail Surveys and Response Rates: A Literature Review," Journal of Marketing Research, 12 (November), 440-453.

Karmeshu and R. K. Pathria (1980), "Stochastic Evolution of a Nonlinear Model of the Diffusion of Innovation," Journal of Mathematical Sociology, 7, 59-71.

Katz, Elihu , M. L. Levin, and Herbert Hamilton (1963), "Traditions of Research on the Diffusion of Innovation," American Sociological Review, 28, 237-252.

Katz, Ralph, Eric S. Rebentisch and Thomas J. Allen (1996), "A Study of Technology Transfer in a Multinational Cooperative Joint Venture," IEEE Transactions on Engineering Management, Vol. 43 (February), Iss. 1, 97-105.

Keddie, James (1984), "More on Production Techniques in Indonesia," in Robert Stobaugh and Louis T. Wells, Jr. (eds.), Technology Crossing Borders: The Choice, Transfer, and Management of International Technology Flows, Boston, Massachusetts: Harvard Business School Press, 69-84.

Kedia, B. L. and Bhagat, R. S. (1988), "Cultural Constraints on Transfer of Technology Across Nations: Implications for Research in International and Comparative Management," Academy of Management Review, 13(4), 559-571.

Keller, Robert. And Ravi R. Chinta (1990), "International Technology Transfer: Strategies for Success," Academy of Management Executive, 4(2), 33-43.

Keller, Robert T. and Winford E. Holland (1983), "Communicators and Innovators in Research and Development Organizations," Academy of Management Journal, 26 (No. 2), 332-338.

Keller, Robert T. and Winford E. Holland (1983), "Communicators and Innovators in Research and Development Organizations," Academy of Management Journal, 26 (No. 2), 742-749.

Kelly, P. and M. Kransberg (eds.) (1978), Technological Innovation: A Critical Review of Current Knowledge, San Francisco, San Francisco University Press.

Kerlinger, Fred N. (1986), Foundations of Behavioral Research, Third Edition, New York: Holt, Rinehart, and Winston, Inc.

_____ and Elazar J. Pedhazer (1973), Multiple Regression in Behavioral Research. New York: Holt, Rinehart, and Winston, Incorporated.

Kerr, S., M. A. Von Glinow, and J. Schriesheim (1977), "Issues in the Study of 'Professionals' in Organizations: The Case of Scientists and Engineers," Organizational Behavior and Human Performance, 18, 329-345.

Kidder, Louise H. and Charles M. Judd (1986), Introduction to Factor Analysis: What It Is and How to Do It. Quantitative Applications in the Social Sciences Series. Beverly Hills: Sage.

_____ (1982), Factor Analysis: Statistical Methods and Practical Issues. Quantitative Applications in the Social Sciences Series. Beverly Hills: Sage.

Kim, Kee Young (1984), "American Technology and Korea's Technological Development," in Karl Moskowitz (ed.), From Patron to Partner: The Development of U.S.-Korean Business and Trade Relations, Lexington, MA: Lexington Books, 75-96.

Kim, Sang-Gon and Kong-Kyun Ro (1995), "A Strategic Technology Management Model under Different Technology Acquisition Modes between Developing Countries: The Case of Telecommunications in Korea and China.," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 767-776.

Kimberly, John R. (1975), "Environmental Constraints and Organizational Structure," Administrative Science Quarterly, 20, 1-9.

_____ (1976), "Organization Size and the Structuralist Perspective: A Review, Critique, and Proposal," Administrative Science Quarterly, 21, 571-597.

_____ (1978), "Hospital Adoption of Innovation: The Role of Integration into External Informational Environments," Journal of Health and Social Behavior, 19 (December), 361-373.

_____ (1981), "Managerial Innovation," in P. C. Nystrom and W. H. Starbuck (eds.), Handbook of Organizational Design. New York: Oxford University Press, 84-104.

_____ (1987), "Organizational and Contextual Influences on the Diffusion of Technological Innovation," in Johannes M. Pennings and Arend Buitendam (eds.), New Technology as Organizational Innovation: The Development and Diffusion of Microelectronics, Cambridge, MA: Ballinger Publishing Company, 237-59.

_____ and Michael J. Evanisko (1981), "Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations," Academy of Management Journal, 24, 689-712.

King, Charles W., Jr. (1963), "Fashion Adoption: A Rebuttal to the 'Trickle Down' Theory," in Stephen A. Greyser (ed.), Proceedings of the American Marketing Association. Chicago: American Marketing Association, 108-125.

_____ and John O. Summers (1970), "Overlap of Opinion Leadership Across Consumer Product Categories," Journal of Marketing Research, 7 (February), 43-50.

Kinner, Thomas C. and James R. Taylor (1987), Marketing Research, Third Edition. New York: McGraw-Hill.

Kirton, Michael (1976), "Adaptors and Innovators: A Description and Measure," Journal of Applied Psychology, 61 (No. 5), 622-629.

Kitchel, Susan (1995), "Corporate Culture, Environmental Adaptation, and Innovation Adoption: A Qualitative/Quantitive Approach," Journal of the Academy of Marketing Science, Vol. 23 (Summer), Iss. 3, 195-205.

Kivlin, Joseph E. and Frederick C. Fliegel (1967), "Differential Perceptions of Innovations and Rate of Adoption," Rural Sociology, 32 (March), 78-91.

Knight, K. (1967), "A Descriptive Model of the Intra-Firm Innovation Process," Journal of Business, 40 (No. 4), 478-496.

Koberg, Christine S. and Gerardo R. Ungson (1987), "The Effects of Environmental Uncertainty and Dependence on Organizational Structure and Performance: A Comparative Study," Journal of Management, 13(1), 725-737.

_____, Uhlenbruck, Nikolaus, Yolanda Sarason (1996), "Facilitators of Organisational Innovation: The Role of Life-cycle Stage," Journal of Business Venturing, Vol. 11, Iss. 2, 133-149.

Kogut, Bruce (1991), "Country Capabilities and the Permeability of Borders," Strategic Management Journal, 12, 33-47.

Kranzberg, Melvin (1986), The Technical Elements in International Technology Transfer: Historical Perspectives. In The Political Economy of International Technology Transfer. Ed. John R. McIntyre and Daniel S. Papp, 31-45.

Kumar, Brij N. and B. Neyer (1992), "International Technology Transfer: Patterns in the Context of German Industry," in Advances in International Comparative Management: A Research Annual, Prasad, S. Benjamin and Richard B. Peterson (Eds), Vol. 7, 23-40.

_____ (1995), "Partner-selection-criteria and Success of Technology Transfer: A Model Based on Learning Theory Applied to the Case of Indo-German Technical Collaborations," Management International Review, Vol. 35, Iss. 1, 65-78.

Labay, Duncan G. and Thomas C. Kinnear (1981), "Exploring the Consumer Decision Process in the Adoption of Solar Energy Systems," Journal of Consumer Research, 8 (December), 271-278.

Labovitz, Sanford (1967), "Some Observations on Measurements and Statistics," Social Forces, 46 (December), 151-160.

_____ (1970), "The Assignment of Numbers to Rank Order Categories," American Sociological Review, 35, 515-524.

Langley, Ann and Jean Traux (1994), "A Process Study of New Technology Adoption in Smaller Manufacturing Firms," Journal of Management Studies, Vol. 31 (September), Iss. 5, 619-652.

Lawrence, Paul R. and Jay W. Lorsch (1967), "Organizations and Environment -- Managing Differentiation and Integration in Complex Organizations," Administrative Science Quarterly, 12 (March), 1-47.

Lefebvre, Elisabeth, Louis A. Lefebvre and Marie-Josee Roy (1995), "Technological Penetration and Organizational Learning in SMEs: The Cumulative Effect," Technovation, Vol. 15 (October), Iss. 8, 511-522.

Lekvall, P. and C. Wahlbin (1973), "A Study of Some Assumptions Underlying Innovation Diffusion Functions," Swedish Journal of Economics, 75, 362-77.

Leonard-Barton, Dorothy (1985), "Experts as Negative Opinion Leaders in the Diffusion of a Technological Innovation," Journal of Consumer Research, 11 (March), 914-926.

_____ (1987), "Implementing Structured Software Methodologies: A Case of Innovation in Process Technology," Interfaces. Vol. 17, No. 3, 6-17.

_____ (1988), "Implementation as Mutual Adaptation of Technology and Organisation," Research Policy, Vol. 17, 251-267.

Lescraw, Donald J. (1984), "Choice of Technology in Thailand," in Robert Stobaugh and Louis T. Wells, Jr. (eds.), Technology Crossing Borders: The Choice, Transfer, and Management of International Technology Flows, Boston, MA: Harvard Business School Press, 85-108.

Levin, Richard C. (1978), "Technical Change, Barriers to Entry, and Market Structure," Economics, 45 (November), 347-361.

Leviy, S. and J. Meisel (1987), "A Dynamic Analysis of the Adoption of a New Technology: The Case of Optical Scanners," Review of Economics and Statistics, Vol. 12, 12-17.

Lewis-Beck, M. (1977), "Influence Equality and Organizational Innovation in a Third World Nation: An Additive-Nonadditive Model," American Journal of Political Science, 21, 1-11.

Likert, Rensis (1932), "A Technique for the Measurement of Attitudes," Archives of Psychology, 140.

Lillrank, Paul (1995), "The Transfer of Management Innovations from Japan," Organization Studies, Vol. 16, Iss. 6, 971-989.

Lin, Nan and Ronald S. Burt (1975), "Differential Effects of Information Channels in the Process of Innovation Diffusion," Social Forces, Vol. 54, 256-74.

Lippman, S. R. Rumelt (1982), "Uncertain Imitability: An Analysis of Interfirm Differences in Efficiency under Competition," Bell Journal of Economics, Vol. 13, 418-438.

Lorsch, Jay W., and John J. Morse (1974), Organizations and Their Members: A Contingency Approach. New York: Harper & Row.

Low, Linda (1995), "Transnational Corporations and Technology Transfer in Export Processing Zones and Science Parks," Asia Pacific Journal of Management, Vol. 12 (April), Iss. 1, 119-120.

Lundvall, B. A. (1988), "Innovation as an Interactive Process: from User-Producer Interaction to the National System of Innovation," In Dosi, G. C.

Freeman, R. Nelson, G. Silverberg and L. Soete (Eds.), Technical Change and Economic Theory, London, Printer.

Lynne, Gary D. , C. Franklin Casey, Alan Hodges and Mohammed Rahmani (1995), "Conservation Technology Adoption Decisions and the Theory of Planned Behavior," Journal of Economic Psychology, Vol. 16 (December), Iss. 4, 581-598.

MacDowall, Joseph (1984), "The Technology Innovation System in Japan," Journal of Product Innovation Management, 2, 165-72.

MacPherson, Alan D. (1994), "Industrial Innovation Among Small and Medium-sized Firms in a Declining Region," Growth & Change, Vol. 25 (Spring), Iss. 2, 145-163.

Madeuf, Bernadette (1984), "International Technology Transfers and International Technology Payments: Definitions, Measurement and Firms' Behavior," Research Policy, 13, 125-140.

Madu, Christian N. (1989), "Transferring Technology to Developing Countries -- Critical Factors for Success," Long Range Plannings, Vol. 22, No. 4, 33-43.

_____ and Rudy, Jacob (1989), "Strategic Planning in Technology Transfer: A Dialectical Approach," Technological Forecasting and Social Change, 35, 327-338.

Mahajan, Vijay and Eitan Muller (1979), "Innovation Diffusion and New Product Growth Models in Marketing," Journal of Marketing, 43 (Fall), 55-68.

______ and Robert A. Peterson (1978), "Innovation Diffusion in a Dynamic Potential Adopter Population," Management Science, 24 (No. 15), 1589-1597.

______ and ______ (1985), Models for Innovation Diffusion, Sage Publications, CA: Beverly Hills.

_____, _____, Arun K. Jain, and Naresh Malhotra (1979), "A New Product Growth Model with a Dynamic Market Potential," Long Range Planning, 12 (No. 4), 62-69.

_____, and Yoram Wind (1986), Innovation Diffusion Models of New Product Acceptance, Cambridge, MA: Ballinger Publishing Company.

_____ and _____ (1988), "New Product Forecasting Models: Directions for Research and Implimentation," International Journal of Forecasting, 4(3), 341-58.

_____, S. Sharma and R. Bettis (1988), "The Adoption of the M-Form Organizational Structure: A Test of Imitation Hypothesis," Management Science, Vol. 34, 1188-1201.

_____, Eitan Muller, and Frank M. Bass (1990), "New Product Diffusion Models in Marketing: A Review and Directions for Research," Journal of Marketing, Vol. 54, No. 1 (January), 1-26.

Malerba, France and Orsenigo, Luigi (1996), "Schumpeterian Patterns of Innovation are Technology-Specific," Research Policy, Vol. 25, Iss. 3, 451-478.

Malik, Dolly and Wilson, Donald (1995), "Factors Influencing Engineers' Perceptions of Organisational Support for Innovation," Journal of engineering & Technology Management, Vol. 12, Iss. 3, 201-218.

Mansfield, Edwin (1961), "Technical Change and the Rate of Imitation," Econometrica, 29 (October), 741-766.

_____ (1963), "Size of Firm, Market Structure, and Innovation," Journal of Political Economy, Vol. 71 (December), 556-576.

_____ (1968a), The Economics of Technological Change. New York: W. W. Norton.

_____ (1968b), Industrial Research and Technological Innovation. An Econometric Analysis. New York: W. W. Norton.

_____ (1971), Technological Change, New York: W. W. Norton & Co. Inc.

_____, Anthony Romeo, Mark Schwartz, David Teece, Samuel Wagner, and Peter Brach (1982), Technology Transfer, Productivity, and Economic Policy, New York: Norton.

_____ (1975), "International Technology Transfer: Forms, Resource Requirements, and Policies," American Economic Review, 65, 372-376.

_____, Anthony Romeo, Mark Schwartz, David Teece, Samuel Wagner and Peter Brach (1983), "New Findings in Technology Transfer, Productivity and Development," Research Management, March-April, 11-20.

_____ (1986), "Patents and Innovations: An Empirical Study," Management Science, Vol. 32, Iss. 2, 173-181.

_____ (1989), "The Diffusion of Industrial Robots in Japan and the United States," Research Policy, Vol. 18, Iss. 4, 183-192.

_____ (1991), "Academic Research and Industrial Innovation," Research Policy, Vol.20, Iss. 1, 1-12.

_____ (1993), "The Diffusion of Flexible Manufacturing Systems in Japan, Europe and the United States," Management Science, Vol. 39, Iss. 2, 149-159.

_____ (1993), "New Evidence on the Economic effects and Diffusion of FMS," IEEE Transactions on Engineering Management, Vol. 40, Iss. 1, 76-78.

_____ (1995), "Academic Research Underlying Industrial Innovations: Sources, Characteristics and Financing," Review of Economics & statistics, Vol. 77, Iss. 1, 55-65.

_____ and Lee, Jeong-Yeon (1996), "The Modern University: Contributor to Industrial Innovation and Recipient of Industrial R&D Support," Research Policy, Vol. 25, Iss. 7, 1047-1058.

_____ (1996a), "A Note on Estimating the Returns from New Technology: How Much Learning," International Journal of Technology Management, Vol. 11, Iss. 7/8, 814-820.

_____ (1996b), "The Economics of Growth and Technical Change: Technologies, Nations, Agents," Journal of Economic Literature, Vol. 34, Iss. 1, 179-181.

Mansour, Mohamed B. (1981), "Definitional Issues in Technology Transfer: Channels, Mechanisms and Sources," in Robert G. Hawkins and A. J. Prasad (eds.), Research in International Business and Finance: Technology Transfer and Economic Development, Greenwich, CT: JAI Press, Inc., 1-9.

Marquis, D. G. and Allen, T. J. (1966), "Communication Patterns in Applied Technology," American Psychologist, 21, 1052-1060.

Marsh, H. W., J. R. Balla and R. P. McDonald (1988), Goodness-of-fit Indexes in Confirmatory Factor Analysis: The Effects of Sample Size," Psychological Bulletin, Vol. 103, 391-410.

Marton, Katherin (1986), "Technology Transfer to Development Countries Via Multinationals," World Economy, December, 409-426.

McCardle, K. (1985), "Information Acquisition and the Adoption of New Technolgy," Management Science, Vol. 31, 1372-1389.

McDonald, R. P. and H. W. Marsh (1990), "Choosing a Multivariate Model: Noncentrality and Goodness-of-Fit," Psychological Bulletin, Vol. 107, 247-255.

McGinnis, Michael A. and Charles J. Hollon (1977), "Mail Survey Response Rate and Bias: The Effect of Home Versus Work Address," Journal of Marketing Research, 14 (August), 383-384.

MsKenney, J. L. and F. W. McFarlan (1982), "The Information Archipelago – Maps and Bridges," Harvard Business Review, Vol. 60, No. 5, 109-119.

McLntyre, John R. and Daniel S. Papp, ed. (1986), The Political Economy of International Technology Transfer. New York: Quorum Books.

Meredith, J. R. (1987), "The Strategic Advantages of New Manufacturing Technologies for Small Firms," Strategic Management Journal, Vol. 8, 249-258.

Metcalfe, J. S. (1988), The Diffusion of Innovation: An Interpretative Survey. In Dosi, G., Freeman, C., Nelson, R., Silverberg, G. and Soete, L. (Eds.) Technical Change and Economic Theory, 560-589. London: Pinter.

_____ and M. Gibbons (1989), Technology, Varity and Organisation: A Systematic Perspective on the Competitive Process," in Rosenbloom, R. and R. Burgleman (Eds.), Research in Technological Innovation, Management and Policy, Vol. 4.

_____ (1990), "The Diffusion, Investment and the Process of Technological Change." In Deiaco, Enrico, Erik Hornell and Graham Vickery (Eds.), Technology and Investment: Crucial Issues for the 1990s, London, Pinter Publisher, 17-37.

Meyer, Alan D. and James B. Goes (1987), "How Organizations Adopt and Implement New Technologies," in Frank Hoy (ed.) Proceedings of the Academy of Management. Athens, GA: Academy of Management, 175-179.

_____ and _____ (1988), "Organisational Assimilation of Innovations: A Multilevel Contextual Analysis," Academy of Management Journal, Vol. 41, No. 4, 897-923.

Meyer, Marshall W. (1972), "Size and the Structure of Organizations: A Causal Analysis," American Sociological Review, August, 434-441.

Midgley, David F. (1976), "A Simple Mathematical Theory of Innovative Behavior," Journal of Consumer Research, 3 (June), 31-41.

Midgley, David (1977), Innovation and New Product Marketing, New York: Halsted.

_____ and Grahame R. Dowling (1978), "Innovativeness: The Concept and Its Measurement," Journal of Consumer Research, 4 (March), 229-242.

Miller, Roger (1971), Innovation, Organization, and Environment. Sherbrooke, Canada: University of Sherbrooke Press.

Mintzberg, Henry (1979a), "An Emerging Strategy of "Direct" Research," Administrative Science Quarterly, 24, 582-589.

____ (1979b), The Structuring of Organizations. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Moch, Michael K. and Edward V. Morse (1977), "Size, Centralization and Organizational Adoption of Innovations," American Sociological Review, 42, 716-725.

Moenaert, Ruby, Souder, William, De Meyer, Arnoud and Dirk Deschoolmeester (1994), "R&D – Marketing Integration Mechanisms, Communication Flows and Innovation Success," Journal of Product Innovation Management, Vol. 11, Iss.1, 31-45.

_____, Caeldries, Filip (1996), "Architectural Redesign, Interpersonal Communication and Learning in R&D," Journal of Product Innovation Management, Vol. 13, Iss. 4, 296-310.

_____, Souder, William (1996), "Context and Antecedents of Information Utility at the R&D/Marketing Interface," Management Science, Vol. 42, Iss. 11, 1592-1610.

Mohr, Lawrence B. (1969), "Determinants of Innovation in Organizations," American Political Science Review, 63 (March), 111-126.

More, Elizabeth, Irwin, Harry (1995), "Technology Transfer: Technocultures, Power and Communication – The Australian Experience," Journal of Information Science, Vol. 21, Iss. 3, 149-159.

Moriarty, Rowland T., Jr. and Robert E. Spekman (1984), "An Empirical Investigation of the Information Sources Used During the Industrial Buying Process," Journal of Marketing Research, Vol. 21 (May), 137-147.

Morris, Michael H. and Jeanne L. Holman (1988), "Source Loyalty in Organizational Markets: A Dyadic Perspective," Journal of Business Research, 16(2), 117-31.

Myers, J. C. and Thomas S. Roberson (1972), "Dimensions of Opinion Leadership," Journal of Marketing Research, Vol. 9 (February), 41-46.

Myers, S. and D. G. Marquis (1969), Successful Commercial Innovations NSF 69-71. Washington, D. C.: National Science Foundation.

Myllyntaus, Timo (1990), "The Finnish Model of Technology Transfer," Economic Development and Cultural Change, 626-643.

Mytelka, Lynn K. (1985), Stimulating Effective Technology Transfer: The Case of Textiles in Africa. In N. Rosenberg and C. Frischtak (eds) International Technology Transfer: Concepts, Measures, and Comparisons, 77-126. Praeger, New York, NY.

Mukherjee, B. N. (1973), "Analysis of Covariance Structures and Exploratory Factor Analysis," British Journal of Mathematical and Statistical Psychology, 26 (November), 125-154.

Nabseth, L. and G. F. Ray (1974), The Diffusion of New Industrial Processes: An International Study, Cambridge University Press.

Naik, B. and Chakravarty, A.K. (1992), "Strategic Acquisition of New Manufacturing Technology: A review and Research Framework," International Journal of Production Research, Vol. 30, No. 7, 1575-1601.

Nevens, T. M., Summe, G. L. and Uttal, B. (1990), "Commercializing Technology: What the Best Companies Do," Harvard Business Review, May-Jung, 154-163.

Newfarmer, Richard (1984), "Multinationals and Marketplace Magic in the 1980s," in Charles K. Wilber, ed. The Political Economy of Development and Underdevelopment, third edition, New York: Random House, 182-207.

Noori, H. (1988), "Benefits Arising from New Technology Adoption: Small Vs. Large Firms," Journal of Small Business and Entrepreneurship, Vol. 5, No. 1, 8-16.

Nord, Walter R. and Sharon Tucker (1987), Implementing Routine and Radical Innovations. Lexington, MA: D. C. Heath and Company.

Normann, Richard (1971), "Organizational Innovativeness: Product Variation and Reorientation," Administrative Science Quarterly, 16, 203-215.

Norton, J. A. and F. M. Bass (1987), "A Diffusion Theory Model of Adoption and Substitution for Successive Generations of High-Technology Products," Management Science, Vol. 33, 1069-1086.

Nunnally, Jum. C. (1978), Psychometric Theory. New York: McGraw-Hill.

Nutt, P. C. (1984), "Types of Organisational Decision Processes," Administrative Science Quarterly, Vol. 25, 583-604.

O'Neal, Charles R., Hans B. Thorelli, and James M. Utterback (1973), "Adoption of Innovation by Industrial Organizations," Industrial Marketing Management, Vol. 2(3), 235-250.

O'Neal, C. R., H. B. Thorelli, and J. M. Utterback (1973), "Adoption of Innovations by Industrial Organizations," Industrial Marketing Management, 2 (June), 235-250.

Orlikowski, W.J. and Robey, D. (1991), "Information Technology and the Structuring of Organisations," Information System Research, Vol. 2, 143-169.

Ostlund, Lyman E. (1974), "Perceived Innovation Attributes as Predictors of Innovativeness," Journal of Consumer Research, 1 (June), 23-29.

_____ (1972), "Identifying Early Buyers," Journal of Advertising Research, 12 (April), 25-30.

OECD (1997), Technology Incubators: Nurturing Small Firms, Unclassified Document OCED/GD(97)202.

Ozanne, Urban G. and Gilbert A. Churchill, Jr. (1968), "Adoption Research: Information Sources in the Industrial Purchasing Decision," in Robert L. King (ed.), Marketing and the New Science of Planning. Proceedings of the National Conference, American Marketing Association, 352-359.

_____ and _____ (1971), "Five Dimensions of the Industrial Adoption Process," Journal of Marketing Research, Vol. 8 (August), 322-328.

Ozawa, Terutomo (1981), "Technology Transfer and Japanese Economic Growth in the Postwar Period," in R. G. Hawkins and A. J. Prasad, eds. Technology Transfer and Economic Development, Research in International Business and Finance, Vol. 2. Greewich, Conn.: JAI Press, 91-116.

Palumbo, Dennis J. (1969), "Power and Role Specificity in Organizational Theory," Public Administration Review, 29 (May-June), 237-248.

Parry, Thomas G. (1988), "The Multinational Enterprise and Restrictive Conditions in International Technology Transfer: Some New Australian Evidence," The Journal of Industrial Economics, 36(3), 359-365.

Pavitt, Keith (1985), Technology Transfer Among the Industrially Advanced Countries: An Overview. In N. Rosenberg and C. Frischtak (eds) International Technology Transfer: Concepts, Measures and Comparisons, 3-23. Praeger: New York, NY.

_____ (1984), "Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory," Research Policy, Vol. 13.

_____ and M. Robson and J. Townsend (1987), "The Size Distribution of Innovation Firms in the UK: 1945-1983," Journal of Industrial Economics, Vol. 35, No. 3, 297-316.

_____ (1990), "What We Know about the Strategic Management of Technology," California Management Review, Spring, 17-26.

Pennings, J. M. (1987), Technological Innovations in Manufacturing. In Pennings, J. M. and Buitendam, A. New Technology As Organizational Innovation, 197-216. Cambridge, MA: Ballinger.

Pennings, J. M. and Buitendam, A. (1987), New Technology As Organizational Innovation. Cambridege, MA: Ballinger.

Pepall, Lynne, Richards, Daniel (1994), "Innovation, Imitation and Social Welfare," Southern Economic Journal, Vol. 60, Iss. 3, 673-684.

Pessemier, Edgar A. (1982), Product Management: Strategy and Organization. New York: John Wiley & Sons.

Peter, J. Paul (1979),"Reliability: A Review of Psychometric Basics and Recent Marketing Practices," Journal of Marketing Research , Vol. 16 (February), 6-17.

_____ (1981), "Construct Validity: A Review of Basic Issues and Marketing Practices," Journal of Marketing Research, Vol. 18 (May), 133-45.

Peters, Thomas J. and Robert H. Waterman (1982), In Search of Excellence. New York: Harper & Row.

Peterson, Robert A. (1982), Marketing Research. Plano, TX: Business Publications, Inc.

_____ and Vijay Mahajan (1978), "Multi-Product Growth Models," in J. Sheth (ed.), Research in Marketing. Greenwich, CT: JAI Press, 201-231.

Pfaff, John F., Juan Garcia Sordo, Theodore Schwarz, Salvador Trevino, Cesar J. Sepulveda M. and Carlos G. Villarreal Dominquez (1993), "Technology Transfer in Mexico: Past Patterns and New Problems Related to the North American Free Trade Agreement," The International Executive, 35(2), 125-146.

Philips, Lynn W. (1981), "Assessing Measurement Error in Key Informant Reports: A Methodological Note on Organizational Analysis in Marketing," Journal of Marketing Research, 18 (November), 395-415.

Phillips, Lisa A., Roger Calantone, and Ming-Tung Lee (1994), "International Technology Adoption: Behavior Structure, Demand Certainty and Culture," Journal of Business & Industrial Marketing, Vol. 9, Iss. 2, 16-28.

Pierce, J. L. and A. L. Delbacq (1977), "Organizational Structure, Individual Attitudes, and Innovation," Academy of Management Review, 2 (January), 27-37.

Pilorget, Lionel (1995), "Evaluation of Two Support Programs Promoting International Technology transfer between SMEs," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 867-878.

Porter, M. E. (1980), Competitive Strategy: Techniques for Analyzing Industries and Competitors. New York: Free Press.

Porter, Michael J. (1986), Competition in Global Industries: A Conceptual Framework. In M. J. Porter Competition in Global Industries. Harvard Business School Press: Boston, Mass.

Porter, M. E. (Ed.) (1986), Competition in Global Industries. Boston: Harvard Business School Press.

Porter, M. E. (1990), The Competitive Advantage of Nations. New York: Free Press.

Premkimar, G, Ramamurthy, K and Sree Nilakanta (1994), "Implementation of Electric Data Interchange: An Innovation Diffusion Perspective," Journal of Management Informatin Systems, Vol. 11, Iss. 2, 157-186.

Price Linda L. and Nancy M. Ridgway (1983), "Development of A Scale to Measure Use Innovativeness," in Richard P. Bagozzi and Alice M. Tybout (eds.), Advances n Consumer Research, Vol. 10. Cincinnati: Association for Consumer Research, 679-684.

Pugel, T. A. (1981), "Technology Transfer and the Neoclassical Theory of International Trade," in R. G. Hawkins and A. J. Prasad, eds. Technology Transfer and Economic Development, Research in International Business and Finance, Vol. 2, Greenwich, Conn.: JAI Press.

Pugel, Thomas A. (1982), "Endogenous Technological Change and International Technology Transfer in a Ricardian Trade Model," Journal of International Economics, 13, 321-335.

Pugh, D. S., D. J. Hickson, C. R. Hinings, and C. Turner (1969), "Dimensions of Organization Structure," Administrative Science Quarterly, 13, 65-105.

_____, _____, _____, and _____ (1969), "The Context of Organizational Structure," Administrative Science Quarterly, 14, 115-126.

Pugh, D. S., D. J. Hickson, C. R. Hinings and C. Turner (1969), "The Context of Organization Structures," Administrative Science Quarterly, 14(1), 91-113.

Quinn, James Brian (1969), "Technology Transfer by Multinational Companies," Harvard Business Review (November/December), 147-161.

Radosevich, Raymond (1995), "A Model for Entrepreneurial Spin-offs from Public Technology Sources," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 879-893.

Raj, Aggarwal (1991), Technology Transfer and Economic Growth: A Historical Perspective on Current Development," in Agmon, Tamir and Mary Ann Von Glinow (Eds.), Technology Transfer in International Business, New York, Oxford University Press, 56-76.

Rajan, J. V., S. K. Seth, A. K. Subramanian and A. H. Rubenstein (1981), "Transfer of Indigenous Technology: Some Indian Cases," Research Policy 10, 173-194.

Ramiller, Neil C. (1994), "Perceived Compatibility of Information Technology Innovations among Secondary Adopters: Toward a Reassessment," Journal of Engineering & Technology Management, Vol. 11 (March), Iss. 1, 1-23.

Rebentisch,, Eric S. and Marco Ferretti (1995), "A Knowledge Asset-based View of Technology Transfer in International Joint Ventures," Journal of Engineering & Technology Management, Vol. 12 (July), Iss. 1 & 2, 1-25.

Reddy, A.C. and Rao, C.P. (1985), "Technology Transfer from Developed to Developing Countries: Needs, Problems and Suggestions," Issues in International Business, No. 2, 7-12.

Reddy, N. M. and Zhao, L.M. (1990), "International Technology Transfer: A Review," Research Policy, 19, 285-307.

Reinganum, Jennifer F. (1981), "Market Structure and the Diffusion of New Technology," Bell Journal of Economics, 12 (Autumn), 618-24.

Rice, R.E. (1987), "Computer-mediated Communication and Organisational Innovation," Journal of Communication, Vol. 37, Autumn, 65-94.

_____ and Shook, D.E. (1990), "Relationships of Job Categories and Organisational Levels to Use of Communications Channels, including Electronic Mail: A Meta-analysis and Extension," Journal of Managment Studies, Vol. 27, No. 2, 195-229.

Ricottilli, Massimo (1994), "Technical Progress, Innovative Activity and Development Policies," International Journal of Technology Management, Vol. 9, Iss. 3,4, 297-313.

Ridgway, Nancy M. and Linda L. Price (1984), "Use Innovativeness and Technology Integration: An Exploration of Personal Computers," in Russell W. Belk, et. Al. (eds), Proceedings of the American marketing Association. Chicago: American Marketing Association, 83-87.

Robertson, Thomas S. (1967a), "Consumer Innovators: The Key to New Product Success," California Management Review, Vol. 10 (Winter), 24.

_____ (1967b), "Determinants of Innovative Behavior," in Red Moyer (ed.), Proceedings of the American Marketing Association. Chicago: American Marketing Association, 328-332.

_____ (1967c), "The Process of Innovation and the Diffusion of Innovation," Journal of Marketing, Vol. 31 (January), 14-19.

_____ (1971), Innovative Behavior and Communication. New York: Holt, Rinehart, and Winston.

_____ (1976), "Low-Commitment Consumer Behavior," Journal of Advertising Research, 16 (April), 19-24.

_____ (1984), "Marketing's Potential Contribution to Consumer Behavior Research: The Case of Diffusion Theory," in Thomas C. Kinnear (ed.), Advances in Consumer Research, Vol. 9. Association for Consumer Research 484-489.

_____ and Gatignon (1986), "Competitive Effects on Technology Diffusion," Journal of Marketing, 50 (July), 1-12.

_____ and J. N. Kennedy (1968), "Prediction of Consumer Innovators: Application of Multiple Discriminant Analysis," Journal of Marketing Research, 5 (May), 64-69.

_____ and James H. Myers (1969), "Personality Correlates of Opinion Leadership and Innovative Buying Behavior," Journal of Marketing Research, 6 (May), 164-178.

_____, Joan Zielinski, and Scott Ward (1984), Consumer Behavior. Glenview, IL: Scott, Foresman and Company.

_____ and Yoram Wind (1980), "Organizational Psychographics and Innovativeness," Journal of Consumer Research, 7 (June), 24-31.

_____and _____ (1983), "Organizational Cosmopolitanism and Innovativeness," Academy of Management Journal, 26 (June), 24-31.

_____ and Hubert Gatignon (1986), "Competitive Effects on Technology Diffusion," Journal of Marketing, 50 (July), 1-12.

_____ and Gatignon, H. (1987), The Diffusion of High Technology Innovations. In Pennings, J. M. and Buitendam, A. New Technology As Organizational Innovation, 179-196. Cambridge, MA: Ballinger.

Robinson, Richard D. (1988), The International Transfer of Technology: Theory, Issues, and Practice. Cambridge, MA: Ballinger Publishing Company.

Robock, S. H. (1980), The International Technology Transfer Process. National Academy of Sciences: Washington, DC.

Robock, Stefan H., Kenneth Simmonds and Jack Zwick (1977), International Business and Multinational Enterprises. Homewood, IL.: Irwin.

Rogers, Evertt M. (1958), "The Importance of Personal Influence in the Adoption of Technological Changes," Social Forces, Vol. 36, 24.

_____ (1962), Diffusion of Innovations, New York: Free Press of Glencoe.

_____ (1969), Diffusion of Innovations. New York: Free Press.

_____ (1976), "New Product Adoption and Diffusion," Journal of Consumer Research, Vol. 2 (March), 290-301.

_____ (1983), Diffusion of Innovations. New York: Free Press, 3rd Edition.

_____ and D. Lawrence Kincaid (1981), Communications Networks: Toward the New Paradigm for Research. New York: The Free Press.

_____ and F. Floyd Shoemaker (1971), Communications of Innovations: A Cross Cultural Approach. New York: Free Press.

Roscoe, A. Marvin, Dorothy Lang, and Jagdish N. Sheth (1975), "Follow-Up Methods, Questionnaire Length, and Market Differences in Mail Surveys," Journal of Marketing, 39 (April), 20-27.

Rosenberg, Nathan and Claudio Frischtak, (eds.) (1985), International Technology Transfer: Concepts, Measures and Comparisons. New York: Praeger Publishers.

Rosner, Morris (1968), "Administrative Controls and Innovations," Behavioral Science, 13, 36-43.

Rothwell, R. and P. Gardner (1985), "Invention, Innovation, Re-Innovation and the Role of the User: A Case Study of British Hovercraft Development," Technovation, Vol. 3.

Rowe, Lloyd A. and William B. Boise (1974), "Organizational Innovation: Current Research and Evolving Concepts," Public Administration Review, 34 (May/June), 284-293.

Ryan, Bryce and Neal Gross (1943), "The Diffusion of Hybrid Seed Corn in Two Iowa Communities," Rural Sociology, Vol. 8 (March), 15-24.

Ryan, Michael J. and E. H. Bonfield (1975), "The Fishbein Extended Model and Consumer Behavior," Journal of Consumer Research, Vol. 2 (September), 118-36.

Saloner, Garth and Andrea Shepard (1995), "Adoption of Technologies with Network Effects: An Empirical Examination of the Adoption of Automated Teller Machines," Rand Journal of Economics, Vol. 26 (Autumn), Iss. 3, 479-501.

Samli, A. C. (Ed.) (1985), Technology Transfer: Geographic, Economic, Cultural and Technical Dimensions. Westport, CT: Quorum Books.

Samli, A. Coskun (1985), Technology Transfer: The General Model. In Technology Transfer: Geographic, Economic, Cultural and Technical Dimensions, ed. A Coskun Samli, 3-15. Connecticut: Quorum Books.

Samli, Coskun and Rustan Kosenko (1982), "Support Service is Key for Technology Transfer to China," Industrial Marketing Management, 11, 95-103.

Sanchez, Angel Martinez (1994), "R&D and Firm Size: Some Evidence from Spain," Technovation, Vol. 14 (March), Iss. 2, 63-69.

Saplosky, Henry (1967), "Organizational Structure and Innovation," The Journal of Business, 40, 385-392.

Saxonhouse, Gary (1982), "Evolving Comparative Advantage and Japan's Imports of Manufactures," in Kozo Yamamura (ed.), Policy and Trade Issues of the Japanese Economy: American and Japanese Perspectives, Seattle, WA: University of Washington Press, 239-70.

Schumpeter, J. A. (1934), The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Cambridge, MA: Harvard University Press.

Schumpeter, J. A. (1939), Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process, vol. 1. New York: McGraw-Hill.

Simon, Denis F. (1991), International Business and the Transborder Movement of Technology: A Dialectic Perspective. In T. Agmon and M. A. Von Glinow (eds.) Technology Transfer in International Business, 5-28. Oxford University Press: New York, NY.

Smircich, Linda and Charles Stubbart (1985), "Strategic Management in an Enacted World," Academy of Management Review, Vol. 10, No. 2, 724-746.

_____ (1983), "Concepts of Culture and Organizational Analysis," Administrative Science Quarterly, Vol. 28 (September), 339-358.

Smith, C. H. (1981), Japanese Technology Transfer to Brazil. Ann Arbor, MI: UMI Research Press.

Solo, R. A. (1972), Technology Transfer: A Universal Process. In Solo, R. A. and Rogers, E. M. (Eds) (1972) Inducing Technological Change for Economic Growth and Development, 3-51. East Lansing: Michigan State University Press.

Solo, R. A. and Roger, E. M. (Eds) (1972), Inducing Technological Change for Economic Growth and Development. East Lansing: Michigan State University Press.

Song, Michael, Neeley, Sabrina and Yuzhen Zhao (1996), "Managing R&D – Marketing Integration in the New Product Development Process," Industrial Marketing Management, Vol. 25, Iss. 6, 545-553.

Soni, Praveen, Gary Lilien and David Wilson (1993), "Industrial Innovation and Firm Performance: A Re-Conceptialization and Exploratory Structural Equation analysis," International Journal of Research in Marketing, Vol. 10 (Dec.), 365-380.

Souder, William E. (1987), Managing New Product Innovations. Lexington, MA: D. C. Heath and Company.

_____ and Padmanabhan, V. (1989), "Transferring New Technologies from R&D to Manufacturing," Research and Technology Management, Vol. 32, No. 5, 38-43.

_____ and Song, Michael (1997), "Contingent Product Design and Marketing Strategies Influencing New Product Success and Failure in U.S. and Japanese Electronics Firms," Journal of Product Innovation Management, Vol. 14, Iss. 1, 21-34.

Spencer, Daniel Lloyd (1970), Technology Gap in Perspective. Spartan Books: New York, NY.

Starik, Mark (1995), "Corporate Environmentalism in a Global Economy: Societal Values in International technology Transfer," Academy of Management Review, Vol. 20 (October), Iss. 4, 1105-1107.

Staudt, Erich, Jurgen Bock and Peter Muhlemeyer (1994), "Technology Centres and Science Parks: Agents or Competence Centres for Small Businesses?" International Journal of Technology Management, Vol. 9, Iss. 2, 196-212.

Steele, Lowell W. (1974), "Barriers to International Technology Transfer," Research Management, (January), 17-21.

Stobaugh, Robert and Louis T. Wells, Jr., ed. (1984), Technology Crossing Borders: The Choice, Transfer, and Management of International Technology Flows, Boston, Massachusetts: Harvard Business School Press.

Stoneman, P. (1981), "Intra-Firm Diffusion, Bayesian Learning, and Profitability," The Economic Journal, 91 (June), 375-388.

_____ (1984), The Economic Analysis of Technological Change, London, Oxford University Press.

Stoneman, Paul (1983), The Economic Analysis of Technological Change, Oxford University Press.

Stoneman, Paul and Paul Kiederen (1994), "Technology Diffusion and Public Policy," Economic Journal: The Journal of the Royal Economic Society, Vol. 104 (July), Iss. 425, 918-930.

Strutton, David, Lumpkin, James and Scott Vitell (1994), "An Applied Investigation of Rogers and Shoemaker's Perceived Innovation Attribute Typology when Marketing to Elderly Consumers," Journal of Applied Business Research, Vol. 10, Iss. 1, 118-131.

Supapol, Atipol Bhanich and Fredric William Swierczek (1994), "The Role of Intellectual Property Rights in Stimulating Commercialization in ASEAN: Lessons from Canada," Technovation, Vol. 14 (April), Iss. 3, 181-195.

Sutherland, Alister (1959), "The Diffusion of an Innovation in Cotton Spinning," Journal of Industrial Economics, Vol. 7 (March), 118-26.

Swan, Jacky A. and Sue Newell (1994), "Managers' Beliefs About Factors Affecting the Adoption of Technological Innovation: A Study Using Cognitive Maps," Journal of Managerial Psychology, Vol. 9, Iss. 2, 3-11.

Swan, Peter L. (1970), "Market Structure and Technological Progress: The Influence of Monopoly on Product Innovation," Quarterly Journal of Economics, 84 (4), 627-38.

Tanaka, J. S. (1987), "How Big is Enough? Sample Size and Goodness-of-fit in Structural Equation Models with Latent Variables," Child Development, Vol. 58, 134-146.

_____ (1993), "Multifaceted Conceptions of Fit in Structural Equations," in Boller, J. A. and J. S. Long (Eds), Testing Structural Equation Models, Newbury Park, CA, Sage, 10-39.

Tang, H. K. and K. T. Yeo (1995), "Technology, Entrepreneurship and National Development: Lessons from Singapore," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 797-814.

Tang, Zongshun (1987), Transfer of Patented Technology to China. In Robinson, R. D. (Ed.) Foreign Capital and Technology in China, 75-79. New York: Praeger.

Taylor, James R. Eric G. Moore and Edwin J. Amonsen (1994), "Profiling Technology Diffusion Categories: Empirical Tests of Two Models," Journal of Business Research, Vol. 31 (October/November), Iss. 1 & 2, 155-162.

Taylor, James W. (1974), "The Role of Risk in Consumer Behavior," Journal of Marketing, 38 (April), 54-60.

Teece, David. J. (1976), The Multinational Corporation and the Resource Cost of International Technology Transfer. Ballinger: Cambridge, MA.

_____ (1977), Technology Transfer by Multinational Firms. Ballinger: Cambridge, MA.

_____ (1977), "Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-how," Economic Journal, 87 (June).

_____ (1980), "The Diffusion of an Administrative Innovation," Management Science, Vol. 26, 464-470.

_____ (1981), "The Market for Know-how and the Efficient International Transfer of Technology," Annals of the American Academy of Political and Social Science, 458, December, 81-96.

_____ (1988), "Capturing Value from Technological Innovation: Integration, Strategic Partnering, and Licensing Decisions," Interfaces, 18 (May/June), 46-61.

_____ (1996), "Firm Organisation, Industrial Structure and Technological Innovation," Journal of Economics Behaviour & Organisation, Vol. 31, Iss. 2, 193-224.

Tezuka, Hiroyuki (1997), "Success as the Course of Failure? Competition and Cooperation in the Japanese Economy," Sloan Management Review, Vol. 38, Iss. 2, 83-93.

The Economist, March 6, 1996.

Thompson, James D. (1967), Organizations in Action. New York: McGraw-Hill.

Thompson, Victor A. (1965), "Bureaucracy and Innovation," Administrative Science Quarterly, 10 (June), 1-20.

Tsang, Eric W. K. (1995), "The Implementation of Technology Transfer in Sino-foreign Joint Ventures," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 757-766.

Tse, David K., Kam-hon Lee, Llan Vertinsky, and Donald A. Wehrung (1988), "Does Culture Matter? A Cross-Cultural Study of Executives' Choice, Decisiveness, and Risk Adjustment in International Marketing," Journal of Marketing, Vol. 52, No. 4 (October), 81-95.

Tushman, Michael L. (1977), "Special Boundary Roles in the Innovation Process," Administrative Science Quarterly, 22, 587-605.

_____ (1979), "Managing Communication Networks in R&D Laboratories," Sloan Management Review, 20 (Winter), 37-49.

Tyre, M. J. and W. J. Orlikowski (1994), "Windows of Opportunity: Temporal Pattern of Technological Adaptation in Organizations," Organization Science, Vol. 5, 98-118.

U.N. Centre on Transnational Corporations (1987), Transnational Corporations and the Electronics Industries of ASEAN Economies, UNCTC Current Studies, Series A, No. 5. New York: United Nations.

Utterback, James M. (1971), "The Process of Technological Innovation Within the Firm," Academy of Management Journal, 14 (March), 75-88.

_____(1974), "Innovation in Industry and the Diffusion of Technology," Science, Vol. 183 (February), 620-626.

_____ (1986), "Invasion of a Stable Business by Radical Innovation," in Kleindorfor P. (Eds.), The Management of Productivity and Technology in Manufacturing, New York, Pleweus Press.

Valentin, F. (1989), "Where Companies Learn: Innovations and the Generation of Knowledge in Small and Medium Sized Danish Companies," Institute of Industrial Research and Social Development, Copenhagen.

Vavakova, Blanka (1995), "Building 'Research-Industry' Partnerships through European R&D Programmes," International Journal of Technology Management, Vol. 10, Iss. 4-6, 567-586.

Venkatraman, N. Lawrence Loh and Jeongsuk Koh (1994), "The Adoption of Corporate Governance Mechanisms: A Test of Competing Diffusion Models," Management Science, Vol. 40 (April), Iss. 4, 496-507.

Vishwasrao, Sharmila (1994), "Intellectual Property Rights and the Mode of Technology Transfer," Journal of Development Economics, Vol. 44 (August), Iss. 2, 381-402.

Von Glinow, M. A., Schnepp, O., and Bhambri, A. (1987), Managerial Perspectives on Technology Transfer to China, paper presented to the Academy of International Business, Chicago, IL, November 1987.

Von Hippel, Eric (1984), "Novel Product Concepts from Lead Users: Segmenting Users by Experience," working paper no. 84-109, Marketing Science Institute, Cambridge, MA.

_____ (1988), The Sources of Innovation, London, Oxford University Press.

Walker, Bruce J., Wayne Kirchmann, and Jeffrey S. Conant (1987), "A Method to Improve Response to Industrial Mail Surveys," Industrial Marketing Management, 16 (November), 305-314.

Walz, Uwe (1996), Transport Costs, Intermediate Goods and Localised Growth," Regional Science & Urban Economics, Vol. 26, Iss. 6, 671-695.

Warner, Kenneth E. (1974), "The Need for Some Innovative Concepts of Innovation: An Examination of Research on the Diffusion of Innovations," Policy Sciences, 5, 433-451.

Webster, Frederick E., Jr. (1979), Industrial Marketing Strategy. New York: John Wiley and Sons.

_____ and Yoram Wind (1972), Organizational Buying Behavior. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Weiss, Allen M. (1994), "The Effects of Expectations on Technology Adoption: Some Empirical Evidence," Journal of Industrial Economics, Vol. 42 (December), Iss. 4, 341-360.

Wenk, Edward, Jr. (1989), "The Politics of Technology and the Technology of Politics: Issues for the U.S. Congress's Third Century," Technological Forecasting and Social Change, 36, 171-83.

Wernerfelt, B. (1984), "A Resource-Based View of the Firm," Strategic Management Journal, Vol. 5, 171-180.

Whiting, Van R. Jr. (1984), The Politics of Technology Transfer in Mexico, Research Report Series, No. 37, Center for U.S.-Mexican Studies, University of California, San Diego.

______ (1991), "Mexico's New Liberalism in Foreign Investment and Technology," Columbia Journal of World Business, XXVI(2), 42-58.

Wildemuth, Barbara, M. (1990), "A Method for Inducing Process Models from Qualitative Data," Library and Information Science Research, Vol. 12, 329-340.

_____ (1992), "An Empirically Grounded Model of the Adoption of Intellectual Technologies," Journal of the American Society for Information Science, Vol. 3, No. 3, 210-224.

Williams, David (1984), "Choice of Technology and Parastatal Firms," in Robert Stobaugh and Louis T. Wells, Jr. (eds.), Technology Crossing Borders: The Choice, Transfer, and Management of International Technology Flows, Boston, MA: Harvard Business School Press, 129-56.

Wind, Yoram (1970), "Industrial Source Loyalty," Journal of Marketing Research, 7 (November), 450-57.

_____ (1981), "A Framework for Classifying New-Product Forecasting Models," in Yoram Wind, Vijay Mahajan and Richard N. Cardozo (eds.), New-Product Forecasting: Models and Applications, Lexington, MA: Lexington Books, 3-42.

Wong, John K. (1995), "Technology Transfer in Thailand: Descriptive Validation of a Technology Transfer Model," International Journal of Technology Management, Vol. 10, Iss. 7 & 8, 788-796.

Yu, Julie and Harris Cooper (1983), "A Quantitative Review of Research Design Effects on Response Rates to Questionnaires," Journal of Marketing Research, 20 (February), 36-44.

Zahra, Shaker A., Rajendra S. Sisodia and Sidhartha R. Das (1994), "Technological Choices within Competitive Strategy Types: A Conceptual Integration," International Journal of Technology Management, Vol. 9, Iss. 2, 172-195.

Zaltman, G., Robert Duncan, and Jonny Holbek (1973), Innovation and Organization. New York: John Wiley & Sons, Inc..

_____ and Ronald Stiff (1973), "Theories of Diffusion," in Scott Ward and Thomas S. Robertson (eds.), Consumer Behavior: Technical Sources. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 416-468.

Zeithaml, Carl, P. and Valerie A. Zeithaml, (1984), "Environmental Management: Revising the Marketing Perspectives," Journal of Marketing, Vol. 48 (Spring), 46-53.

Zmud, Robert W. (1982), "Diffusion of Modern Software Practices: Influence of Centralization and Formalization," Management Science, 12 (December), 1421-1431.

Zysman, John (1983), Government, Markets, and Growth: Financial Systems and the Politics of Industrial Change, Cornell University Press.

Appendix

The English Version of this Instruction is at the back of this page
只須填寫中文或英文版本

國際技術引進調查

請務必回答下列甲、乙兩題
才繼續回答問卷其他部份的問題。

在這問卷內，「國際技術轉移」一詞是指任何製造技術或設備從一家或多家外國公司輸入或引進給香港的公司。

請先回答下列問題：

〔甲〕 **「國際技術轉移」**
當你看見「國際技術轉移」一詞時，即時想到那一項製造技術或製造設備？〔請盡可能明確〕

____

〔乙〕 根據上述答案，你認爲那一個國家或一家**外國**公司最能爲香港的公司提供該項技術或設備？

____

請切記: 本問卷 所指的「技術」或「新技術」，乃是閣下在甲題填寫的技術或設備。本問卷所指的「該國家」或「該公司」是上述乙題的答案，即某某國家或公司。

國際技術引進調查

1 你覺得香港有沒有相類似的技術或設備？〔如沒有，請轉至第二題〕

有 ________

〔1.1〕 貴公司在香港可否取得該種技術？
非常可能 1 2 3 4 5 非常不可能

〔1.2〕 與該項技術比較，香港該項技術質素是。
明顯佳 較佳 差不多 較差 明顯差

沒有 ______

2 你曾否接觸過任何類似的技術或設備？

有，已有 ________ 年 沒有 ________

3 據你所知，貴公司曾否引進類似的技術或設備？

有，已有 ________ 年 沒有 ________

4 你曾否在所述的國家或外國公司工作？

有，已有 ________ 年 沒有 ________

如果貴公司決定引進該新技術:

		非常可能				非常不可能
1	政府會資助購置該項技術。	1	2	3	4	5
2	政府會提供借貸給我們。	1	2	3	4	5
3	政府會提供稅項優惠給我們。	1	2	3	4	5

如果貴公司決定引進該新技術:

		非常可能				非常不可能
4	我們的產品質素將會提高。	1	2	3	4	5
5	我們的生產數量會增加。	1	2	3	4	5
6	我們的生產能力會提升。	1	2	3	4	5
7	一些現存的生產問題將可解決。	1	2	3	4	5
8	公司的整體業績會有所改善。	1	2	3	4	5
9	我們的產品更富競爭力。	1	2	3	4	5
10	我相信消費者會察覺我們的產品<u>價值</u>較競爭對手的產品爲高。	1	2	3	4	5
11	我相信消費者會認爲我們的產品<u>質素</u>較競爭對手的產品爲高。	1	2	3	4	5
12	我打算建議公司引進此項外國的新技術。	1	2	3	4	5
13	與投資引進外國技術比較，有其他更佳的投資方案。	1	2	3	4	5
14	我相信消費者會覺得我們的產品較競爭對手的產品更能符合他們的需要。	1	2	3	4	5

請表示你對下列句子的同意或不同意的程度：

		非常同意				非常不同意
1	我相信很難才能從外國引進該項技術。	1	2	3	4	5
2	我們需要一段長時間才能從外國引進該項技術。	1	2	3	4	5
3	新技術能與現有的生產設備相容配合。	1	2	3	4	5
4	引進新技術後，現存的生產材料仍可使用。	1	2	3	4	5

下面列出的服務能否吸引你作出引進該項技術的決定：

		非常 同意				非常 不同意
1	設備的運送。	1	2	3	4	5
2	設備的裝置。	1	2	3	4	5
3	設備的維修保養。	1	2	3	4	5
4	廠房設計。	1	2	3	4	5
5	到廠提供技術支援。	1	2	3	4	5
6	零件的運送。	1	2	3	4	5
7	員工的培訓。	1	2	3	4	5

請評估下列限制會否對你作出引進該項技術的決定帶來負面的影響：

		非常 同意				非常 不同意
搭配購置〔貴公司以後必須向該公司購置下列配套〕：						
	- 原材料	1	2	3	4	5
	- 零件	1	2	3	4	5
	- 附帶設備	1	2	3	4	5
2	貴公司以後會面對以下的出口或產品的限制：					
	- 把全部或部份技術出口的限制	1	2	3	4	5
	- 該技術所製成的產品之出口限制	1	2	3	4	5
	- 轉移技術至其他公司的限制	1	2	3	4	5

下列問題是有關貴公司的行業競爭情況。依你的估計：

1 同行的公司數目有多少間: 約____________________間。

2 行業中最大三間公司所佔的市場佔有率合共約爲約____________%。

3 行業中是否經常出現減價戰?

經常 長期 有時 甚少 沒有

4 你是否能估計公司主要產品的未來需求?

非常困難 1 2 3 4 5 非常容易。

5 在香港每年有關你們行業的國際會議會舉行約多少次? 約___________ 次。

6 在香港每年會舉行多少次有關你們行業的國際商貿展? 約___________ 次。

7 你每月閱讀多少有關你們行業的期刊物? 約___________ 份。

下列問題只作分類用途。 所提供的答案對本研究很重要，一切個人資料，將會絕對保密。

1 出生年份 ______________。 2 性別 男_____女_____。

3 公司僱員總人數 ______________。 4 職位 ______________。

5 在現公司的工作年數 ______________。

6 你有否直接或間參接與有關國際技術轉移的項目? 有______ 沒有______。

7 你所有的學歷﹝按情況可選多於一項﹞
預科畢業或以下 ______ 學士學位或以上 ______
證書/文憑 ______ 其他﹝請註明﹞ ______

8 假設你現在有以下兩個選擇
甲 即時獲得 1,000 元
乙 參加一個可贏取 100,000 元的遊戲

請問選擇乙的遊戲中獎百分率最少要有多高，你才會參加該遊戲而放棄選擇甲呢？
中獎百分率﹝ 0% - 100% ﹞: _________%

問卷在此完結，十分多謝你幫忙！

The Open Learning Institute of Hong Kong

School of Business and Administration

親愛的高級行政人員

技術引進傾向調查

本人是公開進修學院商業管理學院市場學部主任。現誠邀閣下參與一項有關技術引進的調查。正如閣下所深知，成功的國際技術轉移能增強公司的競爭力，而公司引進技術的傾向正是成功轉移技術過程的重要關鍵。本人現進行研究調查，以深入剖析此重要過程。

爲達至上述的研究目的，特別設計調查問卷一份。懇請閣下騰出時間填寫附上的問卷〔全份問卷可在 15 分鐘內完成。〕是項調查亦是本人所修讀新西蘭宏卡陶大學〔University of Waikato〕國際管理學博士課程的要求之一。閣下的意見及參與極爲重要，對本研究的有效性具直接之影響。

閣下所提供的資料將會絕對保密。本問卷以不記名方式搜集您的意見，絕對不會洩露填寫人所交回問卷的資料。所有問題的答案並無分對或錯，所選答案只表示閣下對該問題的看法。爲感謝閣下擲回填妥問卷，本人將會送上精美紀念品乙份。懇請填妥紀念品表格以及問卷，並放入附奉的回郵信封交回本人。

十分多謝您的協助。如有任何問題，敬請致電 2768-6916 (辦公室) 或 2391-9095 (傳眞機) 與本人聯絡。誠意等待閣下的回覆。順祝　閣下業務蒸蒸日上。

市場學部主任

區啓明 上

The Open Learning Institute of Hong Kong

School of Business and Administration

此函旨在再次邀請閣下擲回問卷。
若閣下已寄返問卷，請毋須理會此信！
十分多謝幫忙！

親愛的高級行政人員

三星期前，本人誠邀閣下參與一項有關技術引進的問卷調查。該調查旨在探討公司引進外國技術的傾向。閣下之參與對是項調查實至爲重要。若閣下尚未寄返問卷，本人現再懇請閣下騰出不多於 15 分鐘的時間完成此問卷。隨函附上相同之問卷乙份，以方便閣下。

閣下所提供的資料將會絕對保密。本問卷以不記名方式搜集閣下意見，絕對不會洩露填寫人所交回問卷的資料。爲感謝閣下填妥及擲回問卷，本人將會送上精美紀念品乙份。懇請填妥紀念品表格以及問卷，並放入附奉的回郵信封交回本人。

十分多謝您的幫助。如有任何問題，敬請致電 2768-6916 (辦公室) 或 2391-9095 (傳真機) 與本人聯絡。誠意等待閣下回覆。順祝閣下業務蒸蒸日上。

市場學部主任

區啓明 上

注意：因是項研究以不記名方式進行，故即使閣下已擲回問卷，仍會收到此催函。

The Open Learning Institute of Hong Kong

School of Business and Administration

此函旨在再次邀請閣下擲回問卷。 若閣下已寄返問卷，請毋須理會此信！ 十分多謝幫忙！

親愛的高級行政人員

六星期前，本人誠邀閣下參與一項有關技術引進的問卷調查。該調查旨在探討公司引進外國技術的傾向。閣下之參與對是項調查實至爲重要。若閣下尙未寄返問卷，本人現再懇請閣下騰出不多於 15 分鐘的時間完成此問卷。隨函附上相同之問卷乙份，以方便閣下。

閣下所提供的資料將會絕對保密。本問卷以不記名方式搜集閣下意見，絕對不會洩露塡寫人所交回問卷的資料。爲感謝閣下塡妥及擲回問卷，本人將會送上精美紀念品乙份。懇請塡妥紀念品表格以及問卷，並放入附奉的回郵信封交回本人。

十分多謝您的幫助。如有任何問題，敬請致電 2768-6916 (辦公室) 或 2391-9095 (傳眞機) 與本人聯絡。誠意等待閣下回覆。順祝閣下業務蒸蒸日上。

市場學部主任

區啓明 上

注意：因是項研究以不記名方式進行，故即使閣下已擲回問卷，仍會收到此催函。

Souvenior Form

To express my gratitude for your kind assistance, please fill in the following information and I will send you a University of Waikato Aluminum Business Card Holder with Solar Calculator as soon as possible.

Name : ______________________________

Address : ______________________________

____

紀念品表格

爲感謝閣下的幫助，懇請填妥下列資料，本人將盡快送上新西蘭宏卡陶大學的鋁質名片盒連太陽能計算機，以表謝意。

名字 : ______________________________

地址 : ______________________________

____

Please Complete the English Version or the Chinese Version Only

Survey on International Technology Adoption

Please answer these two questions before you start filling in the questionnaire:

(1) **"INTERNATIONAL TECHNOLOGY TRANSFER'**

What particular type of manufacturing technology or equipment first comes to your mind when you see this term?
(Please be as specific as possible)

____

(2) Further to your answer in Question (1) above, which particular **foreign** country or company do you believe can best supply the technology or equipment?

____

Please do not continue until you have answered these questions

Okay! You can start answering the other questions now.

Please refer to the technology or equipment which you write down as the answer to the first question in above when you read the term "the technology" or "new technology" in this questionnaire.

Again, please refer to the country or company which you write down as the answer to the second question in above when you read the term "this company" or "this overseas country" in this questionnaire

Survey on International Technology Adoption

1. Do you think a similar technology or equipment has being developed in Hong Kong? (*If your answer is "NO", skip to question 2) YES ___________ NO ___________

   a. Can this technology be obtained by your company in Hong Kong?

   Very Likely 1 2 3 4 5 Very Unlikely

   b. In your opinion, the quality of this technology is ___________ that developed in overseas.

   ___________ Significantly better than ___________ Better than ___________ Similar to ___________ Worse than ___________ Significantly worse than

2. Do you have any experience with any similar technology or equipment before? YES, for _____ years NO ___________

3. As far as you know, has your company used any similar technology or equipment before? YES, for _____ years NO ___________

4. Have you ever worked with people from this overseas country or company before? YES, for _____ years NO ___________

If your company <u>decide to adopt</u> the new technology:

		Very Likely				Very Unlikely
1.	The government will subsidize us on this purchase.	1	2	3	4	5
2.	The government will provide loans to us for the importation of this foreign technology.	1	2	3	4	5
3.	The government will provide us certain tax benefits.	1	2	3	4	5
4.	Our product quality will be improved.	1	2	3	4	5
5.	Our production capacity will be increased.	1	2	3	4	5
6.	Our productivity will be raised.	1	2	3	4	5
7.	Some of our current production problems can be solved.	1	2	3	4	5
8.	Our company's overall performance will be enhanced.	1	2	3	4	5
9.	Our products will be more competitive.	1	2	3	4	5

If your company <u>decide to adopt</u> the new technology:

	Strongly Agreed				Strongly Disagreed
10. I believe consumers would perceive our products offer better value than those of our competitors.	1	2	3	4	5
11. I believe consumers would consider our products are superior in quality to those of our competitors.	1	2	3	4	5
12. I intent to recommend the aoption of this new technology to the company	1	2	3	4	5
13. I have better alternative to invest my money in than to use it for adopting foreign technology	1	2	3	4	5
14. I believe consumers would think our products better fit their needs than those of our competitors.	1	2	3	4	5

Please indicate how strongly you agree or disagree with the statements

	Strongly Agreed				Strongly Disagreed
1. I believe it will be difficult to transfer this technology from foreign sources.	1	2	3	4	5
2. I think it will take a long time to transfer this technology from foreign sources.	1	2	3	4	5
3. The new technology is compatible with other manufacturing equipment we are currently using.	1	2	3	4	5
4. Current production materials can still be used when this new technology is adopted.	1	2	3	4	5

How likely are the presence of these supports positively affect your decision to adopt:

		Very Likely				Very Unlikely
1.	Delivery of Equipment	1	2	3	4	5
2.	Installation of Equipment	1	2	3	4	5
3.	Maintenance of Equipment	1	2	3	4	5
4.	Plant Design	1	2	3	4	5
5.	On-Site Assistance in Technical Supports	1	2	3	4	5
6.	Spare Parts Delivery	1	2	3	4	5
7.	Staff Training	1	2	3	4	5

How likely are the presence of these restrictions negatively affect your decision to adopt?

		Very Likely				Very Unlikely
1.	Requirements to purchase from the technology supplier:					
	- Raw Materials	1	2	3	4	5
	- Spare Parts	1	2	3	4	5
	- Peripheral Equipments	1	2	3	4	5
2.	Restrictions from:					
	- export all or part of the technology	1	2	3	4	5
	- export of products of the technology	1	2	3	4	5
	- transfer technology to other companies	1	2	3	4	5

The following questions relates to the competitive environment in which your company is operating.

1. What is your estimate on the number of companies in your industry? __________ companies
2. What is your estimate on the combined market share of the top three firms in your industry? _______ %
3. How often does price-cutting take place in your industry?

__________	__________	__________	__________	__________
Always	Frequently	Occasionally	Seldom	Never

4. How difficult is it for you to predict demand for your main products?

Very difficult 1 2 3 4 5 Not difficult at all

5. How many international conventions are held in your industry each year? _______
6. How many international trade shows are held in your industry each year? _______
7. How many industry-related periodicals do you read each month? _______

The following questions are for classification purposes only. Answers to the following questions are important for our research, and will be kept strictly confidential.

1. Your year of birth: ________ 2. Your gender: Male _____ Female _____
3. How many people do your company employ? ____________________________
4. What is your current position in your company? ____________________________
5. How long have you been with the company? _________ years.
6. Have you directly or indirectly participated in any international techonlogy transfers activities?

   Yes ________ No ________

7. Please indicate all your qualifications (Tick more than one if appropriate).

   Secondary Schooling or below _____ Bachelor's Degree or above _____
   Certificate/Diploma _____ Others (Please specify) ____________________________

8. If you were given the following choices:

   A: Received $1,000 in cash now
   B: Participate in a game which can allow you to win $100,000 in cash

   For you to choose <u>Choice B</u>, what is the minimum probability of winning you will accept?

   Probability of Winning (0% - 100%): __________%

This is the end of the questionnaire. Thank you very much for your help!

The Open Learning Institute of Hong Kong

School of Business and Administration

[Date]

[Name]
[Company Name]
[Address]

Dear [Name]

Re: Survey on Technology Adoption Intention

I am a lecturer and the Programme Leader (Marketing Strand) with the School of Business and Administration at the Open Learning Institute of Hong Kong. As you may be well aware that competitiveness can be enhanced through successful international technology transfers, a critical component in the process of a successful transfer is the behavioural intention of the adopting firms. I am, currently, conducting a research project with an aim to uncover this critical process.

In order to achieve this research aim, I would like to invite senior executives, like you, to participate in this project. All you have to do is to complete the enclosed questionnaire. The tasks you are requested to perform will not take more than 40 minutes. I hope you will participate in this research project, which, in fact, is part of the requirements for my Ph.D. degree in international management at the University of Waikato in New Zealand. Your response to this survey is extremely critical because it can severely affect the validity of this research.

Please be assured that all responses will be kept strictly confidential. The questionnaire is anonymous and the information collected is not sufficiently detailed to identify you or your firm. Also, please note that there is no right or wrong answers to these questions. It is your opinion that we are interested in. ***As a token of appreciation, I would like to give you a souvenir for completing the questionnaire.*** Please complete the souvenir form and questionnaire and return them by using the enclosed prepaid return envelope.

Thank you very much for your kind assistance. If you have any questions you are most welcome to contact me at 2768-6916 (office) or 2391-9095 (fax). I look forward to receiving your response.

Yours sincerely

Alan Au
Programme Leader in Marketing

The Open Learning Institute of Hong Kong

School of Business and Administration

This Is A Survey Reminder. If You Have Sent In Your Completed Questionnaire, Please Ignore This Letter. Many Thanks!

Dear (Name),

You were invited to participate in a questionnaire survey three weeks ago. The survey aims to uncover the behavioural intention of firms to adopt foreign technology. Your response to this survey is extremely critical. If you have not returned the questionnaire, I would like to invite you, once again, to participate in this project which will not take more than 15 minutes of your time. In case you have misplaced the original questionnaire, I have enclosed another copy for your use.

Again, you are assured that all responses will be kept strictly confidential. The questionnaire is anonymous; hence, the information collected is not sufficiently detailed to identify you or your firm. ***As a token of appreciation, I would like to give you a souvenir for completing the questionnaire.*** Please complete the souvenir form and questionnaire and return them by using the enclosed prepaid return envelope.

Thank you very much for your kind assistance. If you have any questions you are most welcome to contact me at 2768-6916 (office) or 2391-9095 (fax). I look forward to receiving your response.

Yours sincerely

Alan Au
Programme Leader in Marketing

Note: Because This Survey Is Anonymous, You Will Receive This Reminder Even If You have Sent In Your Questionnaire.

The Open Learning Institute of Hong Kong

School of Business and Administration

This Is A Survey Reminder. If You Have Sent In Your Completed Questionnaire, Please Ignore This Letter. Many Thanks!

Dear (Name),

You were invited to participate in a questionnaire survey six weeks ago. The survey aims to uncover the behavioural intention of firms to adopt foreign technology. Your response to this survey is extremely critical. If you have not returned the questionnaire, I would like to invite you, once again, to participate in this project which will not take more than 15 minutes of your time. In case you have misplaced the original questionnaire, I have enclosed another copy for your use.

Again, you are assured that all responses will be kept strictly confidential. The questionnaire is anonymous; hence, the information collected is not sufficiently detailed to identify you or your firm. ***As a token of appreciation, I would like to give you a souvenir for completing the questionnaire.*** Please complete the souvenir form and questionnaire and return them by using the enclosed prepaid return envelope.

Thank you very much for your kind assistance. If you have any questions you are most welcome to contact me at 2768-6916 (office) or 2391-9095 (fax). I look forward to receiving your response.

Yours sincerely

Alan Au
Programme Leader in Marketing

Note: Because This Survey Is Anonymous, You Will Receive This Reminder Even If You have Sent In Your Questionnaire.

Souvenior Form

To express my gratitude for your kind assistance, please fill in the following information and I will send you a University of Waikato Aluminum Business Card Holder with Solar Calculator as soon as possible.

Name : ______________________________

Address : ______________________________

____

紀念品表格

爲感謝閣下的幫助，懇請填妥下列資料，本人將盡快送上新西蘭宏卡陶大學的鋁質名片盒連太陽能計算機，以表謝意。

名字 : ______________________________

地址 : ______________________________

____

The Open Learning Institute of Hong Kong

School of Business and Administration

[Date]

[Name]
[Company Name]
[Address]

Dear [Name]

Re: Survey on Technology Adoption Intention

Thank you for your kind assistance to our research project on technology adoption behaviour. As a token of appreciation, please find enclosed an aluminum business card holder with solar calculator as a souvenir for completing the questionnaire.

If I can be of further assistance to you in the future, you are most welcome to contact me at 2768-6916 (office) or 2391-9095 (fax).

Once again, my heart-felt gratitude for your kind support.

Yours sincerely

Alan Au
Programme Leader in Marketing

Souvenior Form

To express my gratitude for your kind assistance, please fill in the following information and I will send you a University of Waikato Aluminum Business Card Holder with Solar Calculator as soon as possible.

Name : ______________________________

Address : ______________________________

____

紀念品表格

爲感謝閣下的幫助，懇請填妥下列資料，本人將盡快送上新西蘭宏卡陶大學的鋁質名片盒連太陽能計算機，以表謝意。

名字 : ______________________________

地址 : ______________________________

____