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**Technological Innovation
Studies Program
Research Report**

**Programme des études sur les
innovations techniques
Rapport de recherche**

Marketing Barriers to Technological
Innovation in Small Business

by

Patricia Simmie, Ph.D.

York University
September 1984

#97



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ISSN 0226-3122

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The views and opinions expressed in this report are those of the authors and are not necessarily endorsed by the Department of Regional Industrial Expansion.

Marketing Barriers to Technological

Innovation in Small Business

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September, 1984

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Executive Summary

This report has three major objectives: to review briefly the findings of the literature on the diffusion of technological innovations; to look at the adoption process used by a number of small firms in purchasing technological innovations; and to develop a framework which could be used to analyse the barriers to technological innovation in small business.

Following the literature review and the case studies we develop the hypothesis that the avoidance of risk is a strong motivating factor for small businesses. We identify seven different risks: financial risk, product risk, competitive risk, information risk, market risk, management risk and strategic risk. Each of these risks represents a specific area of uncertainty for which the small businessman requires assistance.

The marketing tools available to overcome these barriers to technological innovation are the standard ones: product, price, promotion and channels of distribution. But in addition the activities of facilitating agencies such as governments and financial institutions must be included because of their interests in technological innovation. Some examples of how these marketing tools can be used to overcome barriers to technological innovation provide the conclusion of the study.

1.0

Introduction

The objective of this research is to study the factors affecting the adoption of technological innovations in small business. The issue of productivity growth and the potential contribution of new technology to this growth is one which has received extensive study in recent years (see Economic Council of Canada 1983, for example). Here we focus attention on the small business sector which is the source of most job growth in recent years in Canada (see for example, Ernst & Whinney, 1984), and attempt to determine whether small business differs from larger organizations in its approach to how innovations are introduced to the organization.

The design and marketing of new products has been an area of increasing concern to both managers and researchers. The costs to an organization of developing a new product (or service) and bringing it to market can be very high. The successful diffusion of that product or service requires a thorough knowledge of the buyers and their needs and processes for adopting a new product.

A multi-stage process as a basis for evaluating and improving new product design is suggested by a number of researchers and consultants (see e.g. Urban and Hauser, 1980; Booz Allen and Hamilton, 1982). These five stages include idea generation, market analysis, product design, testing, and commercialization (Urban

& Hauser, 1980). One study (Booz Allen and Hamilton, 1968) found that fifty-seven new product ideas were required to develop one commercially successful new product. Another study (National Science Foundation, 1969) found that the typical distributions of costs in several successful product innovations was research (idea generation) 5-10%, design 10-20%, tooling and start-up 45-75%, and marketing start-up 10-25%. A more recent study of companies in the consumer goods area found that a much larger proportion than previously of company time and expenditures was being spent at the design phase of the process, in particular in trying to determine what characteristics of the product the consumer is interested in and how to design the product to serve those needs (Booz Allen and Hamilton, 1982). This study will deal with both the design and marketing of the technological innovation and the factors which affect how the small business evaluates the new product.

The industrial new product design process has generally received less attention than that for consumer goods (see Choffray and Lilien, 1980a for a recent treatment of this research). An important field of research in industrial marketing has been the study of organizational buyer behaviour (see e.g. Webster and Wind, 1972; Sheth, 1973; Webster, 1979). This research has been an attempt to develop an understanding of how the organization makes purchase and product adoption decisions, analogous to the study of buyer behaviour in the consumer area.

A policy objective of increasing the rate of diffusion of technological innovations requires an understanding of how this diffusion process occurs. If we can improve our understanding of the organizational buying process, we can include this knowledge in the design stage of the new product development process as well as the commercialization stage. A better knowledge of how the customer decides whether to adopt a new product, and the factors which affect these decisions, would provide a useful framework for implementing policies which might assist the diffusion of new technology.

The study is directed at understanding how small businesses adopt technological innovation. Rather than taking a survey approach and looking at the statistical incidence of various factors, we have chosen to look carefully at the process involved in a few companies which have adopted technological innovations. Through these case studies, we will determine if there is a set of procedures and influences in new technology adoption which appear to be general, and others which appear to be company-product specific. More importantly we will look to see which factors are most important to small businesses, and where these factors may differ from those we see in larger organizations.

In order to study the adoption of technological innovations in small business we must look at both the organizational buying process (i.e. how are decisions made and by whom), and the nature of the organization itself. This information in turn can be of great value to the company which is marketing the innovation in both

the design and commercialization stages of its new product development process. A market may be segmented by the structure of the purchasing process (Choffray and Lilien, 1980b) as well as by buyer types. If indeed small businesses have a different type of purchasing process than larger organizations as is suggested by some authors, then this research could provide some insight into that difference.

The format of the paper is as follows. First a brief review of some of the literature in the diffusion of innovations and adoption of technological innovations fields. Then a series of case studies of small businesses adopting technological innovations. Finally, an evaluation of what we have discovered from the literature and the case studies, and the development of a framework for improving the rate of diffusion of new technology.

2.0

Diffusion of Innovations

In studying innovation, there are two primary actors of interest, the firm or individual which develops the innovation and wishes to market it, and the adopting firm or individual. The innovation itself, and its characteristics, provides the means by which the two sets of actors interact. In this study we are primarily interested in the adopting firm and its potential reactions to the characteristics of the innovation and the marketing activity of the innovating firm.

Research into innovation in the social sciences is largely based on the pioneering work of Rogers and his colleagues who developed much of the basic theory through their early studies of the diffusion of agricultural innovations (Rogers and Shoemaker, 1971). Since then, literally thousands of studies have been published relating to the theory and process of diffusion of innovations, looking at such factors as the characteristics of the product or service, the characteristics of the innovator, communication patterns, etc.

Economists have developed theories of innovation which are not dissimilar to those of the sociologist or marketer. In all of these fields of research, an s-shaped diffusion curve is hypothesized (see figure 1), representing the rate at which individuals or firms adopt the new product. This curve illustrates the concept of a slow

introductory period, followed by rapid growth, then a levelling off as the market matures. The objective of a marketing organization would be to increase the speed of diffusion, and increase the height of the curve or sales level at which sales growth levels off.

A review of the literature will indicate the theoretical and experimental findings associated with the diffusion of innovations. No attempt has been made to thoroughly review all diffusion research. Rather, the highlights of what is known and how this knowledge might be used to increase the rate of diffusion of innovations to small business is sought. With this in mind, we omit interesting but non-germane areas of the research, and concentrate on potentially actionable information.

2.1

Rogers' Research into Diffusion of Innovation

There are four basic building blocks in the traditional approach to adoption and diffusion research:

- a consumer adoption process
- taking place within a social environment
- at different rates and at different points in time for different individuals
- all influenced by the characteristics of the innovation and its marketing methods (Fenwick et al, 1984).

The consumer adoption process has been hypothesized to follow a hierarchical process by a number of researchers (e.g. Ryan and Gross, 1943; Lavidge and Steiner, 1961). According to these theories, there are a number of steps in the adoption process which an individual (or an organization) will follow. The five stages of Ryan and Gross' model (1943) are awareness, interest, evaluation, trial and adoption. This model assumes that all potential adopters will follow this pattern, and research concern has focussed on how product attributes will be evaluated, how an individual will become aware of a product, etc.

More recent research (Campbell, 1966) has incorporated a problem-solving approach into the hierarchy model. Campbell's model starts with a perceived problem, followed by an awareness of a product as a potential problem solver, then evaluation and trial, in both of which stages an innovation may be rejected for various reasons, and finally product adoption may occur. The difference between this model and the previous one is in the view of the consumer as an active problem solver at the beginning of the process, rather than a passive recipient of new product information.

The value of these models in looking at the technology adoption decisions of a small business will be in enabling us to determine at what stage an effective effort may be made to speed the diffusion process. Do small businesses perceive the problems of not adopting new technologies? Or is the adoption process slowed because the evaluation criteria of businesses lead to rejection of risky

options? Can factors in the environment be changed to assist the small business to overcome these barriers? These are the issues which must be understood if an increase in technological diffusion is desired.

The rate of diffusion of an innovation is also dependent on the characteristics of the product itself. Not all new products are adopted at the same rate; two innovations serving the same industry may diffuse at surprisingly different rates. In trying to determine the marketing barriers to technological innovation it is useful to understand what factors affect the perception of new products among potential adopters.

Rogers (1962) presented five characteristics of new products which are thought to affect how people evaluate the "newness" of the product: relative advantage, compatibility, complexity, trialability and communicability. While these characteristics tend to be highly correlated, and there has been little empirical proof of the validity of the five characteristics in describing adoption behaviour (Rogers and Shoemaker, 1971), they nevertheless provide a framework for studying innovations. An important issue to be aware of in this study is that we must determine the potential adopter's perceptions of the product on these characteristics. A customer's perception of the relative advantage of a product may not be the same as the producer's perception. In addition, a small business may evaluate the relative advantage of a product differently than a larger enterprise.

Relative advantage measures the extent to which a product is superior to an existing product or process. Superiority may be measured on purely economic terms (section 2.3), or may relate to improved methods of doing a job, such as providing time savings or increased safety. The economic factors tend to be more important to those with the ability to evaluate the potential outcomes of adoption (Rogers and Shoemaker, 1971). Among small business operators, the ability to evaluate the potential returns of an investment may be limited for a number of reasons such as lack of experience of adopting innovations, or simply lack of training in financial analysis. In addition, the evaluation of the risk of a new technology may lead to a perception of lower relative advantage than actually is provided by the product. A smaller business may be more risk averse than larger businesses, for a number of perfectly valid reasons.

Compatibility measures the extent to which an innovation is "consistent with existing values and past experience of adopters" (Rogers, 1962, p.126). New technology which will change the functioning of an organization tends to be resisted. This characteristic might also suggest that organizations which have adopted one or a few technological innovations may be less resistant to subsequent innovations.

Complexity relates to how difficult to understand an innovation may be. Communicability describes how difficult it may be to communicate the advantages of the technology. And trialability

represents the extent to which the technology may be tried with relatively low risk. These last three characteristics of innovation will affect how well an organization will be able to evaluate a new technology which they may wish to adopt.

2.2

Economic Models of Diffusion of Innovation

2.2.1 Temporal Model of Diffusion

The temporal model of diffusion hypothesizes an S-shaped logistic function as best representing the diffusion process. In the early stages of the process, few organizations are willing to accept the risks associated with the innovation, but profits are high for the successful adopters. Over time, as the innovation gains acceptance, the number of producers in the market place increases, competition intensifies, profit margins decrease, and the focus shifts to cost reduction, longer production runs, and the requirement for cheaper labour. More formally, Mansfield (1968) developed the following model where the rate of diffusion is determined by two variables: the profitability of the innovation to the potential adopter, and the investment required to adopt the innovation as a per cent of the total assets of the firm.

$$P_{ij}(t) = \frac{1}{1 + e^{-(U_j + \alpha_{ij} t)}}$$

$P_t(t)$ = proportion of firms which have adopted at time t

$$P_t = b_0 + b_1 I_t + b_2 S_t + Z_t$$

I_t = profitability of the innovation in the industry

S_t = required investment

Z_t = error

b_1 = rate of innovation

Bass (1969) found that this logistic curve was able to represent the diffusion patterns of selected consumer durables. In the Rogers tradition, Bass saw the innovation process as a two step flow of communication from early adopters to later adopters or imitators. This distinction between innovators and late adopters has been extensively studied, with much of the focus on the characteristics of innovators (to be discussed in section 2.2.3). The Bass research has inspired a number of studies in such areas as retail trade and industrial innovation as well as a number of studies of the effects of marketing variables on the diffusion process (Dodson and Muller, 1978).

2.2.2 Spatial Models

The spatial model of diffusion was studied by a number of researchers (e.g. Hagerstrand, 1965; Berry, 1972). Hagerstrand conceptualized the innovation adoption process across the landscape as a learning and communication process. The spread of messages is a function of the innovation disseminator's contact network. Geographical, social and economic variables assist or intervene with

this diffusion process. Two main types of resistance were cited - social differences in values and economic practicalities which inhibit adoption. Using a Monte Carlo simulation approach, he modelled the adoption process based on interactions between adoptors. Adoption is said to take place after the message has been received a number of times. This number is governed by the adopter's resistance to change, and the geographic terrain which channels information flow. He found that innovations tend to filter through a system of urban centers to the neighbouring hinterland. This sort of filtering process may affect the way in which small businesses become aware of innovations, since in many cases a small business will locate on the outskirts of an urban area to take advantage of lower costs.

The rural sociology research also dealt with communication patterns and the social system of a potential adopter (Rogers, 1962; Rogers, 1976). The classic study of social networks was performed by Coleman, Katz and Menzel, 1957) in which diffusion of the drug "gammanym" among physicians in four midwestern communities is examined. They found that socially integrated doctors tended to adopt earlier, while less socially integrated doctors were later adopters. The timing and volume of interpersonal communication concerning the innovation was a crucial factor in when the doctors adopter the innovation.

The norms of the social systems surrounding potential adopters are also a major factor. Studies of the importance of proximate groups in affecting timing of innovation have found that most communications interactions occur within an individual's immediate, limited environment, involving friends who are very similar (Rogers, 1973). As a result, the diffusion of an innovation tends to be rapid within the group, but blocked from wider circulation. Individuals or firms who belong to more than one group (bridges) are vital for widespread diffusion.

It is clear that communication plays a major role in both the economic and sociological theories of diffusion. In studying diffusion of technological innovation to small business we must focus both on the economic aspects (return on investment, risk), and on the social factors of communication, personal or company characteristics, and industry norms. In taking this approach the researcher runs the risk of treating each situation as unique since so many different variables are being studied. The attempt to avoid this problem by discovering generalizable characteristics of early adopters has had a great deal of research attention.

2.2.3 Characteristics of Early Adopters

The findings on characteristics of firms which would lead to early adoption must be qualified by looking at the nature of the innovation to be adopted. Globerman (1974) found that the risks of premature adoption are lower for larger firms, since the larger firm

can try out an innovation with a relatively smaller commitment of resources than a smaller firm. He found that this financial and risk advantage of the larger firm encourages the diffusion of innovations in industries with significant economies of scale. However, some competitive pressure (e.g. imports, threat of entry of new firms) must be present in order to encourage these larger firms to adopt. Mansfield (1968) suggests that diffusion will be faster in less concentrated industries where competitive pressures will encourage innovation.

Webster (1969) developed a framework for analysing new product adoption in industrial markets. He presented the following four points as a summary of his framework.

- (a) For innovations requiring net new investment or commitment of resources and involving some risks of negative outcomes, earliness of adoption has a positive relation to the size of the firm, liquidity, trend of the profit rate, sales growth and market share.
- (b) For innovations requiring little or no investment, little risk of negative outcomes and no significant commitment of resources, earliness of adoption is positively related to the trend of the profit rate, sales growth and market share.
- (c) Earliness of adoption is positively related to the relative advantage (profitability) of the product to the firm.

- (d) Earliness and speed of adoption are negatively related to the size of the firm where the selling firm also provides information of value to the adopters. But this information has the greatest value to the small firms who do not have the resources to generate the information on their own, and therefore may lead the smaller firm to adopt earlier.

Nabseth and Ray (1974) found information to be a crucial factor in the speed of diffusion. The cost, real or perceived, to the firm of obtaining the required information about a new product or service and evaluating it once obtained can be a major stumbling block to the diffusion of an innovation. In addition, evaluation of such information as potential profitability tends to be subjective, with some firms stressing risk and uncertainties, and others the potential benefits. The personality of the firm is thus an issue as well. Globerman (1974) found mixed empirical evidence that the age and education of the head of the firm (both crucial to the firm's personality) are important factors in diffusion. Webster (1979) found that the managerial and technical progressiveness of the firm is an important factor in how early innovations are adopted.

Cox (1967) and Ehrlich and Lee (1969) viewed management response from the perspective of dogmatism. Highly dogmatic individuals, they suggested, were generally less receptive to innovation because of their propensity to resist change and their tendency to accept judgement based on a respectable source rather than independent evaluation of the message.

Robertson (1971) discussed the nature of innovation by how readily it may be received. The continuous innovations involve little change in the adopters' behaviour pattern and are most readily adopted. The dynamically continuous innovations require some modification to behaviour but do not involve entirely new responses. Discontinuous innovation on the other hand requires entirely new behavioural patterns. Technological innovations, Robertson claims, fall into this category. It follows from this school of thought that the study of facilitators to technology adoption is a study of corporate behaviour modifications and enhancement to the firm's receptive capacity.

All these characteristics of firms or management are factors which would affect the purely rational economic evaluation process which businesses are thought to employ. The source of funds available rather than just the availability of funds (Nabseth and Ray, 1974), the rate of growth of the firms (Mansfield, 1968; Davies, 1979) and the nature of the competition (Gruber and Marquis, 1969) all affect how a firm will react to an innovation. Our knowledge of this process is clearly incomplete. Globerman (1974) found that more than 50% of interfirm variation in diffusion rates are unexplained in industry models.

One other factor which researchers have found to be of importance in studying this diffusion process is that the nature of a technological innovation changes over time (Globerman, 1974). The experience of the first firm to employ an innovation, with start-up

problems, etc., tends to be much different from that of the tenth or hundredth firm, with the result that studying an innovation over time can be problematic. In addition, evaluating the relative profitability of a new machine which does not perform exactly the same tasks as the machine it replaces is very difficult. Brown (1981) found that the rate of diffusion is faster for machinery which is an addition to the current plant than it is for replacement machinery because of the problem of sunk costs.

2.3

Other Industrial Innovation Research

Industrial market researchers have studied innovation by firms as a part of the overall buying function of the organization. The purchasing activities of a firm range from the routinized repurchase of established products and services on a regular basis to the decision to adopt a new product or technology. Webster and Wind (1972) and Sheth (1973) have developed general frameworks for the study of industrial buyer behaviour. Figure 2 shows the Sheth model. It is clear that even a general model of buyer behaviour contains a large number of variables. Sheth includes the search process, the company's own decision-making process, and situational factors as major variables in the decision model. Webster and Wind (1972) see the environment, the organizational climate, the buying center functions, and the individual participants themselves as the major influences of the buying process.

There has been a great deal of activity in the industrial marketing field in recent years (see for example Industrial Marketing Management, various volumes). An understanding of the new product purchasing decision has been an important research priority. Among the variables of interest in evaluating rate of diffusion has been firm size. Cohn (1980) found no difference between small and large firms in the impact of presidential preferences on technology adoption, although theory would suggest that the head of a small firm would be much more closely involved in decisions than the head of a larger firm. Brown (1981) found that larger firms have an advantage in their ability to raise capital, and in their managerial and technical specialists, but that these factors vary in their importance with the size of the innovation. A study by the OECD (1982) found that smaller firms have several advantages when it comes to innovation. Among these are that contacts with the environment are informal in the small firm and managers are therefore quicker to see changing needs or openings in the market; the small firm's lack of organizational barriers tends to facilitate communications and lead to rapid decisions and a strategy understood by all; larger firms tend to make profits from economies of scale and therefore are interested in improving existing products; and finally, members of a small organization tend to have more identification with the organization. The disadvantages of the small firm, according to the OECD are that the cost of R&D and other phases of product development and marketing is high, the cost of obtaining information is high, obtaining funds is more difficult,

and smaller size leads to lower bargaining power in dealing with the environment.

2.4

Conclusions and Implications

The study of the diffusion of innovations has attracted many researchers over the years. The sheer volume of research produced has led to surprisingly little in terms of results. One might characterize the field as one where theories are easily developed but hard to test.

The central problem of research in this field is that there are at least three separate aspects which must be studied: the individual or organization which is marketing the innovation, the innovation itself, and the adopting individual or organization. Some authors (e.g. Brown, 1981) feel that "diffusion agencies" should be included in this scheme as significant actors. Among potential diffusion agencies are government departments, financial institutions, etc. However, even sticking with the simplest model leads to a very complex problem for research.

Research in this area requires a contingency approach. Evidence of the value of this approach can be seen in Webster's (1969) categorization of innovations, and Brown's (1981) evaluation of the characteristics of early and later adopters as the size of the innovation changes. However, when we introduce all the factors

of interest in the study of innovation, a contingency approach rapidly becomes unmanageable.

This research focusses the problem somewhat by concentrating on small business. However, with small business many authors feel that personalities and other characteristics of managers become more important that is the case in larger firms. The findings in this area have been reviewed, but there appear to be few generalizable conclusions.

The next section will present eight case studies of small businesses adopting technological innovations. Following that, we will use the findings of the literature review and the insights of the case studies to develop a framework for analysis.

3.0

Research Design

This research is based on a small sample study of firms who had adopted new technologies in the recent past. The firms of interest were defined as "small businesses who had adopted technological innovations". Needless to say, this provided a rather large range of firms from which to choose.

The first step was to find an acceptable definition of "small business". Bulloch and Heitz (1982) review the definitions of small business employed in seventy-five different countries. They come to the conclusion that a reasonable internationally acceptable definition of a small business would be:

"A small business is an independently owned business whose workforce does not exceed 50 persons."

Bulloch and Heitz, 1982, p.16

Similarly,

"A medium-sized business is an independently owned business whose workforce is between 51 and 500 persons."

Bulloch and Heitz, 1982, p.17

Based on these definitions, our sample is in fact split between small businesses and what might be termed smaller medium-sized businesses. Our main criteria for inclusion in this study was that the firm be independently owned, and in fact all our firms are owner-managed operations.

The second major decision in the choice of sample was whether to concentrate on a specific industry or sector, or whether to study a wide range of organizations and technologies. Because this research is exploratory in nature, it was decided to study a broad range of company types in order to determine whether the adoption process differs among different types of industries. We also decided to divide the sample between firms in the service sector and those in the manufacturing sector, based on the increasing importance of the service sector in the Canadian economy. The companies in the sample were chosen to illustrate a range of industries and a range of technological innovations adopted.

We also looked for geographic diversity. The sample was split between companies operating in Western Canada and companies operating in Ontario. It was felt that firms outside the southern Ontario industrial and commercial belt might be faced with different types of problems than a Toronto firm when it came to the adoption of new technology.

The breakdown of our sample is as follows:

- 4 from Western Canada
- 4 from Ontario

- 4 service and consulting
- 4 manufacturing

3.1

Case Studies

Simpson Benefits Marketing, Ltd. is a Western Canadian firm specializing in providing employee benefit schemes. The operation consists of five professional and four clerical employees on a full-time basis, supplemented by part-time clerical assistance. The annual gross income of the organization is almost one million dollars.

The firm operated for almost twenty years as a sole proprietorship, contracting out any computer work to the organization which administers the employee benefit schemes. As the type of product being sold became more complex, and the number of customers grew, the need for more and better information as well as more effective administration became clear. The programs which had been designed for the then administrator's computer were not sufficiently flexible to provide the types of information required for a growing operation. Nevertheless, the firm continued to work with the existing system for two more years before moving to develop their own system.

In beginning the development of an administration program and management information system the company moved very carefully. A consultant developed a detailed plan of all the types of information - administrative, financial, marketing, etc. - that could be required over the next five years. This thorough early development

resulted in no problems of accessibility of information for analysis, at least to this point in time. The firm was able to avoid many of the pitfalls of office automation through prior planning.

The computer programming was done by a local systems house, which also provided the computer time for processing. A computer purchase was not considered because of the risk involved in an unknown technology and the administrative systems required to integrate it into the office. The president of the organization preferred the smallest number of employees possible.

By December 1983, the monthly cost of their contracted-out computer time had risen from \$1,000 to \$3,500, with the possibility it could reach \$5,000 or \$6,000 within a year. The time share firm was charging on a per record basis and refused to renegotiate to a flat rate. In addition, response times (for on-line enquiries) had slowed down appreciably, and interruptions to service were reasonably frequent. The company then decided to purchase a computer and have complete control of the operation in their office.

The Vice President had maintained contacts in the used computer market so that he had some idea of costs. They also approached IBM who at that point were having a big push on the System 36. The System 36 was compared to what was available in the used market, and the System 36 was chosen for a variety of reasons: potential total capacity, service and installation assistance, guaranteed delivery of all components within one month, early purchase discounts, and

ease of migration of data and programs from the time-share firm's IBM System 34. The total cost of the system was about \$70,000, which is being paid off at \$1,500 per month for five years. Given the projected cost of \$7,000 per month for time sharing, the bank was more than willing to lend the money, although doubts about obtaining funds for the purchase had been a prime deterrent in the past.

The purchase of the computer has led to plans for expanding the current business and introducing new products. A major problem which occurred prior to the purchase of the computer and continued subsequent to bringing the computer in-house was the lack of availability of good programmers. This problem may have to be solved by hiring a full-time programmer into the company. Adding staff is a serious decision for an organization which has always avoided becoming involved in personnel problems in the past.

The President of the company is in his 60's, and obtained an honours BA in the nineteen-thirties. Prior to starting this company he worked for a number of large insurance companies in their Western Canadian headquarters. The Vice President is in his thirties with university-level education. He started in this family company right out of University and has worked there for ten years.

Halperin and Son, Ltd. is a small Western Canadian office and industrial sanitation and cleaning services company. The office has three managerial and professional staff and two clerical staff, and there is a sales force of about ten people. The company markets cleaning services, and other sanitation products such as industrial hand care equipment, and a line of industrial sanitation chemicals. The heavy competition in the office and plant cleaning industry, which was their original product, forced this company to move into a number of related product lines.

The company has always kept up with the latest in cleaning and polishing equipment as required by the competitive nature of the industry. There are two large national companies in the market (Woods and Dustbane) and a large number of small regional or local operations. Where this particular organization has gained its strength is through membership in a national buying group. This group of four companies started off as an informal information network and has developed in to a major buying group and developer of new products. The group members also belong, individually, to an international trade association which is the source of many new ideas.

A recent innovation of the company was the adoption of video cassettes for the marketing of the company's cleaning services and equipment. The company has a fully equipped video taping studio which it uses to make the marketing cassettes at a cost of about \$3,000 each. There are small video players available to the sales

force to use in sales presentations.

The owner of the firm first became aware of the video marketing equipment at the annual industry convention where the manufacturer was demonstrating its uses. Because the firm sells a product whose effectiveness can best be demonstrated visually (clean polished floors, for example), but is not selling to a market for which television advertising might be used, this type of video marketing has a great potential value. The owner of the firm was finding that the cleaning service market was too well covered by the large number of local firms, and had decided that the only way to make the sales process more efficient was to move to fewer sales calls, and concentrate on larger accounts. He saw this as a way to approach larger accounts such as school boards and hospitals.

The owner of the firms could be characterized as a person who is innovative and interested in new gadgets. Rather than simply buying the video player units which fit in a briefcase and can be carried on sales calls, he also bought the full equipment to furnish a video studio. His objective was to supplement the marketing and training tapes which are available from the international association with his own sales and training programs. All the tapes which he has are also shared among the other members of the buying group.

The major factor which the owner cites as instigating his innovation moves, of which the video marketing is only the latest, is his membership in the national buying group. This group provides an information network, product support, and links to international markets where these new technologies become available. Through this group, a small businessman is able to deal effectively with the competition of the biggest international firms.

Kleen Systems Mfg. produces systems for the food processing industry. There are four partners who own and manage the company, with the largest shareholder acting as CEO. Sales are between \$10 and \$20 million annually. The staff size varies between 150 and 200, depending on business volume.

The acquisition of new technology for this company, which usually is in the form of new products which are then marketed to a third party, is an ongoing process. In order to maintain the desired direction of the company, all the owner-managers are involved in the decision to purchase new technology. A recent acquisition was the licence for the manufacture of technology to sterilize liquids, in particular milk-based liquids, without affecting the taste. The adoption of this technology resulted from the search efforts of the Executive Vice President (Sales). This new technology is superior to processes currently available and therefore has a large potential market as a replacement for current equipment. The firm must first integrate the production of the

process into their organization, and then determine the correct approach for the marketing of the equipment for which they have the world wide license.

The original idea for acquiring the technology was picked up at a conference in North Carolina attended by the Executive Vice President (Sales). While this company was negotiating to purchase the process, a Canadian food processing firm was also interested in adopting it. Arrangements were made whereby this company acquired the license for the technology, and the food processor became their major customer.

The purchase price of the technology, approximately \$1 million, was financed entirely from the firm's resources, with no need to go to either banks or the government for further financing. The major government benefit comes from the deductability of the R and D expenses. The firm stated that they did not perform any stringent payback analysis since their objective is long term profits which only come from innovation and investment.

The firm has found that the food processing industry is one where a great deal of information on new products is available. Sources such as salespeople, trade journals, trade shows, conferences, etc. provide information and opportunities on a regular basis. The challenge to this firm is in taking the time to screen the information and choosing what might be suitable for the company. The firm is continually searching for new technologies in order to maintain their position and finance growth.

The owners and managers of the firm are all in their mid-to-late forties, have high school educations, and have worked in the industry for a number of years. The technical expertise required for the business is supplied by the technical directors of product lines, rather than residing in the owner-managers. The strength of the owner-managers appears to be in the ability to bring a new technology to a state of being useful in the market.

Fredericks and Smith Ltd. is larger than is normally considered to be a "small business", but is included because it is an owner-operated company. It is a privately held company owned by a portion of the over 500 employees. Staff who have stayed with the company for over five years and have made both positive contributions and long-term commitments are invited to purchase shares in the organization. Shareholders include both engineering and administrative staff.

This firm adopted a computer assisted design (CAD) system three years ago. The engineering consulting business is extremely competitive in North America and world-wide. The company bids all over the world, and must constantly improve its productivity in order to remain competitive. The CAD system was approached with the objective of not necessarily doing more business, but doing what they do more cheaply, better, and quicker.

The purchase process for the system was very structured. They screened two hundred thirty-two suppliers based on twenty parameters, with a weight attached to each of the parameters. After narrowing the choice down to twelve firms, they talked to them and sent out final tender calls to six vendors. Their main source of information on the systems available and the type of criteria important in the system is a newsletter published by Harvard University dealing with what is the most up-to-date information on computer graphics. Trade journals were a second source of information. They eventually chose the best equipment from two different suppliers. Payment from the system was entirely from equity, although the company did manage to get a small training grant from the government.

The implementation of a system of this type can pose major problems. This organization set up a task force with a representative from each division to discuss training and other policies regarding implementation. The representatives then go back to their divisions to share their training and receive feedback from their colleagues. This process, and the awareness of competitive pressure, has enabled the company to introduce day and night shifts into the organization despite some opposition from some staff.

The senior management of the firm are all engineers by training, with the exception of the chief financial officer. The company is run on the assumption that communication is of the essence. Members of the management committee work hard at ensuring

that individuals in the organization know why decisions are being made, and what the objectives of particular decisions are. There are no surprises, which can be very important in a highly competitive environment. When this company introduced the system three years ago, they were among the first in the country. Now all their competitors have either installed one or are considering installing one. They feel that any firm which does not install a CAD system will be out of business.

Harris and Sons is a family business with a father and three sons as joint owners. The Canadian operation is a wholly owned subsidiary of the U.S. parent company. The combined U.S. and Canadian companies have approximately 250 employees, and sales of approximately \$20 million. Their main business is tooling.

The Canadian company adopted a CAD/CAM system six years ago. The particular system purchased was from a company located near their U.S. headquarters. The reason they purchased from this firm was because it is a heavy and strong system which can withstand the kind of stress to which it is subjected by the firm. Service was also a major criterion, because minimal downtime is required. Most of the information they had about the system came from company salesmen.

In looking at what sort of system would be useful, this company, like many others, relies on trade journals to a large extent. They also learn from other manufacturers in other industries. Prior to purchasing their current system, they visited companies all over North America.

The initial impetus for purchasing this system came from competitive pressure. This firm is relatively new in the industry (1962), and needed to offer something extra in order to take orders from their competitors. The two major competitive factors in the industry are cost and delivery time, and the automated factory really helped in this area. Since the company installed the CAD/CAM system, three or four competitors have gone out of business because of their inability to adapt.

As mentioned, service and engineering were the key factors in choosing a system. Financing at the time was not important, but at current interest rates financing would be a major concern. No government funds were employed. The owner feels that there is very little help available for a small firm doing a reasonable business.

Implementation of the system was gradual because of the amount of learning required by the workshop employees. Many were afraid of the completely different way of doing things. The employees had to be regrouped to work the machines, and some had to be re-classified to fit some of the new skills involved. But only one employee had to be let go because he was unable to cope with the new system.

All the family members/owners of the company have engineering degrees and MBA's. The engineers which are employed by the company are sent to the work floor as soon as they arrive, to learn what problems there are, and to understand how the system works. Any subsequent technological innovation would have to be compatible with the current systems, so in effect the adoption of this initial innovation has defined the course of technological development in the company for a number of years to come.

M-J Tool and Die is an owner-operated firm in the tool and die business. The over 100 employees produce machinery for the aerospace, nuclear and military industries, as well as large manufacturing firms. The owner and his wife occupy the positions of President and General Manager in charge of finance, personnel and general administration. Other managers are tool designers and tool makers with technical or community college training.

This firm is particularly interesting, not so much because of the advanced manufacturing technology (CAD/CAM) which they have implemented and updated over the years, but more for the management technology which the company has introduced. The owner feels that what makes this company special (and the winner of productivity awards) is their ability to create a type of working environment where people can work happily and effectively, thus increasing productivity.

The owner of this firm has found that adopting new management technology is not as simple or as straightforward as adopting new machine technologies. As a participant in a highly competitive industry, which they service internationally, productivity improvement was necessary for survival. The CAM and CNC (Computerized Numerical Control) systems which they installed several years ago help, but do not solve the productivity problem. In addressing this problem, the President began by developing a plant which would meet his criteria of a pleasant and well-designed place to work.

Information about the design of the new management system came from keeping an eye on competitors, talking to salesmen, getting new ideas from trade journals and talking to suppliers. Although the President now says he would address the problem differently if he had to do it again, his first step was to design a building. The very common sense approach taken by the President was not understood by architects, bankers, or building inspectors. He was forced to study the building code to satisfy the inspectors, and in addition, fire his architect and find one who understood what he was trying to achieve.

The mortgage lenders would not lend the money because the new approach was generating a single user building with no use to anyone else. The Federal Development Bank was more understanding, and lent the money to finance construction. However, no other grants or tax breaks were available for this particular innovative activity.

The President of the company is an immigrant with little formal education in the toolmaking business. His management style appears to be very open and flexible, concentrating on the need for everyone to understand why particular decisions are being made. His company philosophy is that they have to produce products that people want, organize the environment so that people will work well, and concentrate on quality. You also need the banks and other institutions to support you, a factor which he feels is a problem in Canada at the moment.

Can-Car Inc. is a Western Canadian company which has several divisions in the automotive aftermarket, primarily automotive service. The annual sales of the company's various divisions are approximately \$3-\$5 million.

A recent innovation of this organization was the implementation of an order control and inventory management system for one of the divisions. At a dealers meeting arranged by one of the major suppliers, the owner met a number of friends in the same business in Vancouver who had developed an order control and inventory management software for a TRS80 computer. The owner of this software system was a former employee of the Vancouver operation who had returned to UBC to take a B.Comm. In order to finance his education he wrote the program using his own TRS80 system.

The President of this company paid \$2,500 plus hardware costs, and also arranged for one of the Vancouver users to come and assist in installation and implementation of the system in his organization. The key problem that he saw being solved by this system was that of inventory management, since any stock outs could only be handled quickly by purchasing the parts from his competitors at their standard retail mark-up. The new system also allows the installer to prepare estimates of order costs, thus replacing a skilled clerk to perform other duties in the organization. In addition, the system is used for bill preparation and parts substitutions.

The President's criteria for purchase included the overall cost of the system, user support availability through a technician in the business, purchase from a small independent business with no financial interest in the main business, and a reduced need for labour. The President first became aware of the availability of this system in October 1983, and installed it in January of 1984.

Subsequent to this, the same system designer has been asked to design a system for another division of the company with closely related problems. A third division of the company, with quite different problems, was approached by a local systems house with a package designed for that industry, but turned them down. The President asked the systems designer in Vancouver to develop a system for this other division using the TRS80 computer. The cost of this new system was similar to the original one, but there were a

great many implementation bugs.

The impact of this system on the company has been very interesting. They are now able to produce financial statements monthly rather than on an annual basis. These monthly statements have enabled them to determine why margins were eroding despite increasing sales. They were able to control costs and avoid the losses resulting from small materials and equipment which weren't being charged to any of their customers. The regular supply of operating information has assisted the managers in improving the productivity of these divisions.

The President of the company is a self-made millionaire in his forties who has a number of investments in different businesses. His senior manager is a university graduate and CA with very good connections to the business community. The President believes in on-the-job experience, not education, thus his rejection of the system developed by the systems consultants was understandable. He currently takes an active role in promoting the order/inventory system to others in the same business in different areas of the country.

Michalski Machinery is a standard metal machine company with a predominately local market operating in a mid-sized western Canadian city. The owner/manager is in his mid-40's and has an engineering background.

In early 1982 the company purchased the first of three Computer Numerical Controlled lathes (CNC). The owner felt that success in the industry in the future was going to require more and more of these CNC products. His travelling to other parts of Western Canada and Ontario led him to believe that medium and long-term survival depended on this innovation. Each machine cost \$200,000 and the company currently has over \$500,000 in CNC equipment. It was the first company in the city to purchase the equipment.

Prior to purchasing the equipment the company was regularly visited by sales representatives of manufacturers. Their job is to build awareness and perhaps interest. Once a buyer expresses interest, a factory specialist takes over the process. The main criteria for choosing a supplier are manufacturer's quality record, and the availability of people for set-up and training. The company wanted equipment which would reduce their skilled labour requirements and enable them to expand into new markets. The Federal DREE provided significant funding for this investment project.

Among the problems which the firm encountered in introducing this new technology was the need for experienced skilled labour. Since no other local company used the equipment, the firm was forced to go further afield to find employees. They were also forced to find new markets since their existing small customers were not really interested in the new capabilities. They began to sell to larger local companies which were currently being serviced from

outside the province. Because of this, they discovered that they had a whole new group of competitors which they were forced to deal with.

The results for the company include significant new sales for this division, which now accounts for one third of the company's sales and half the company profit. Other firms in the area have been forced to acquire the equipment in order to compete. And they have found that more sophisticated senior management is needed as a result of the restructuring of the labour component of the company.

4.0

Conclusions

The purpose of this study is to evaluate the marketing barriers to the diffusion of technological innovation in small business with the objective of determining how some of these barriers might be overcome by marketers of technology. We began this process by looking at a number of small businesses who have adopted new technologies in the recent past. The hope was that we would find some commonalities among the companies in the experience of adopting a new technology, and that we could generalize to a broader view to guide future actions or study.

The eight cases represent very different companies engaged in the adoption of a wide range of technologies. However, even with such a diverse group of adoption occasions, some common threads of experience can be seen in the various companies. While it would be very unwise to try to generalize these issues too far, there are nevertheless some tentative findings which can be used to generate hypotheses for future study.

A first important factor appears to be the existence of a communication network which is able to provide the manager with usable and trusted information. The network may exist through an association membership as we see with Halperin and Son, Ltd. and Kleen Systems Mfg. Or it may be a by-product of professional education, where certain journals provide the necessary information

for those who are able to read them such as the management at Fredericks and Smith.

Without the ability to find out what is going on in their own industry, and to see what technologies are available or have been adopted by similar firms in other geographical areas, many of the small businesses studied here would perhaps not have been as innovative as they currently are. Both Halperin and Son and Can-Car Inc. obtained their primary information about the technology adopted through non-competing companies in the same business. This would perhaps suggest that there is a limit to the value of formal or informal information networks, since information about innovations which might lead a business to grow and become a competitor might be slower to diffuse than less threatening information. For example, Michalski Machinery has found that the adoption of its CNC lathes has forced it to deal with different markets and a different set of competitors than prior to the adoption. Some informal information networks may break down as innovations which threaten to change the economies of the firm are introduced to the industry.

A second theme which appeared in a number of companies was the pressure of competition which was pushing them to innovate. Not surprisingly, those who deal in larger markets are more aware of competitive pressure and feel more threatened by it. Both Harris and Sons and Fredericks and Smith Ltd. compete internationally with a large number of competitors, and their attitude is that they must

innovate or be forced to go out of business. Halperin and Sons originally became involved in the national trade organization which is its major information source because of a need to compete for national accounts against the two large national competitors. Among the other firms, while potential competition was an issue, it appeared to be secondary to the need for growth, or for improved productivity.

A third interesting result is the variation in the nature of the decision process. The larger and internationally-competing firms have fairly structured processes for the evaluation of potential purchases of technological innovations (e.g. Fredericks and Smith). As we move down to smaller companies, particularly those which deal with a primarily local market we see more marked differences in the decision process. One hypothesis might be that if the firm has experience in purchasing innovations, then subsequent innovations become somewhat more routine. Halperin and Son is an example of this, where the company has had to keep up with innovations in its main business, and as a result put very little time and analysis into the acquisition of its new marketing technology. At the opposite extreme is Simpson Benefits Marketing, which had little experience in the acquisition of technological innovations, and as a result spent over two years in the decision process prior to purchasing their computer. Michalski Machinery and M.J. Tool and Die are other examples of companies which have moved slowly and sought the advice of outside experts in their decision process. Of course there are exceptions to this hypothesis, with

Can-Car being an example of a firm which very rapidly adopted a potentially useful technology.

A very interesting result was the nature of the financial arrangements for the purchase of these technological innovations. One firm took out a bank loan, another received money from the government in the form of a DREE grant, and all the others financed the purchases from internal funds. Whether the purchase would have been made if outside funds had been required is an interesting question, but purely hypothetical in these cases.

4.1

Framework for Future Analysis

Although it is dangerous to attempt to generalize too broadly based on a literature review and eight cases, a structure to aid further research and analysis has been developed. The primary focus of this structure is the concept of risk. The hypothesis that risk reduction is a major objective of small business is not a new one. However, in looking at these companies, and in particular their financial arrangements, it became apparent that, as a group, they were not about to take unnecessary risks such as borrowing money to finance the purchase of machinery. They only spent what they had, with the exception of Simpson Benefits Marketing, which was replacing \$5,000 a month in time-sharing fees with a \$1,500 bank loan to buy a computer. Reduction of risks other than financial could also be seen as an objective, and could be considered the

overall theme for developing a structure for further study.

Figure 3 is a representation of the various risks facing a firm when considering adopting a technological innovation. The financial risk is considered by many researchers to be of prime importance in the innovation adoption decision. However, for all businesses there are a number of other risks which will impact their decision, and these other risks will be particularly important in a small business setting.

In Figure 3, seven types of risk are identified in an attempt to cover the major issues facing a small firm.

1. Financial risk is represented by the standard economic approach to the analysis. Such measures as return on investment or payback period for the innovation are included here. In addition the source of the funds for paying for the innovation is an important risk factor. Many small businesses are reluctant to approach financial institutions to borrow money because of either bad experiences in the past or a perception that the banks, etc., are not interested in "the little guy". As a result many firms will only spend what they have, as we saw in many of the cases, and do very little in the way of sophisticated financial analysis prior to making an investment.
2. Product risk includes all the issues of whether in fact the product will do the job it is designed to do, and whether it is an improvement on the current technology. Much of the Rogers

research into the characteristics of products which speed their diffusion would appear to be operative in the context of small business. In many cases, the evaluation of a technological innovation by a small business would more closely match the individual model than the process employed by larger organizations.

3. Competitive risk represents the current activities of competitors, specifically related to the innovation. Have the competition already adopted or are they considering adopting? What impact will the innovation have on the firm's ability to compete? Many small businesses are involved in industries where one competitor who is able to cut costs or provide faster delivery for example, could be a major threat to the other small operations through price cutting or other activities.
4. Information risk describes the risk to the firm of not being a part of the information network for the industry. The ability to obtain reliable and useful information about innovations in a timely fashion is extremely important in any industry where technological change is to have an impact. The small business must determine which sources are reliable and able to provide the information about new products and services available to the industry.

5. Market risk is the effect on current markets of introducing the technological innovation. Are the current markets willing or able to absorb the results of technological innovation such as larger volumes or higher costs for higher quality? If the firm will be forced to move into new markets as a result of the innovation, this introduces a whole new dimension of competitive risk.
6. Management risk includes the problems of integrating the innovation into the firm. Will existing employees have to be let go, or will there have to be additional employees? Many small businessmen want to avoid managing large groups of people, so may avoid innovations which lead to many more employees.
7. Strategic risk addresses the question of to what alternative uses the resources (money, time, personnel) committed to a technological innovation could be put in the organization. Many large organizations routinely evaluate the strategic alternatives available to them. Smaller organizations are at risk if they do not orient their analysis to the study of a variety of alternatives rather than simply evaluating (or ignoring) each option which appears.

4.2

Overcoming Marketing Barriers

We have suggested that a primary objective of the small businessman is to avoid risk, whether it be financial risk, or any of the other seven risks outlined above. The problem for either the marketer of a technological innovation or any of the agencies which may want to facilitate the diffusion of these technological innovations is to show the small business how to reduce the risk involved.

The marketing firm has four basic variables which can be varied to encourage a sale: the product, the price, the channel of distribution (location of sales outlets, etc.) and the promotional activities. If we address the issues involved in using each of these factors to reduce each of our seven risks the discussion may never end. However, a few examples will serve to illustrate the potential usefulness of looking at the specific risk faced by the small business.

If the small business sees the market risk as a major factor in their decision, the marketing firm or a facilitating agency could attempt to reduce this risk in a number of ways. Evaluation of the current market in terms of strength of competition, alternate sources of supply for customers, likely customers for increased production, etc., are all pieces of information which a large organization would require prior to committing themselves to a

technological innovation. Many small businessmen do not have the resources to do this sort of analysis and are unable to assess the choices in an objective manner. Either the marketing organization or a facilitating agency could plan to provide some of this sort of information.

Financial risk relates to whether the technology will be a good investment or not. Microcomputers are changing the way small businesses are able to evaluate financial data, but there is still a large gap between availability of the microcomputer and ability to use it effectively. Specific information about the ROI for example experienced by other companies would be useful. Alternatively providing the small businesses with price/financing method/financing source scenarios which would enable the owner to evaluate the pros and cons of different approaches may be useful. The marketing firm must evaluate the value of a sale today through providing financing for the purchase themselves or through outside sources versus a sale two years from now when the firm has some cash on hand. Dealing with the financial risk is not simply an issue of providing more information.

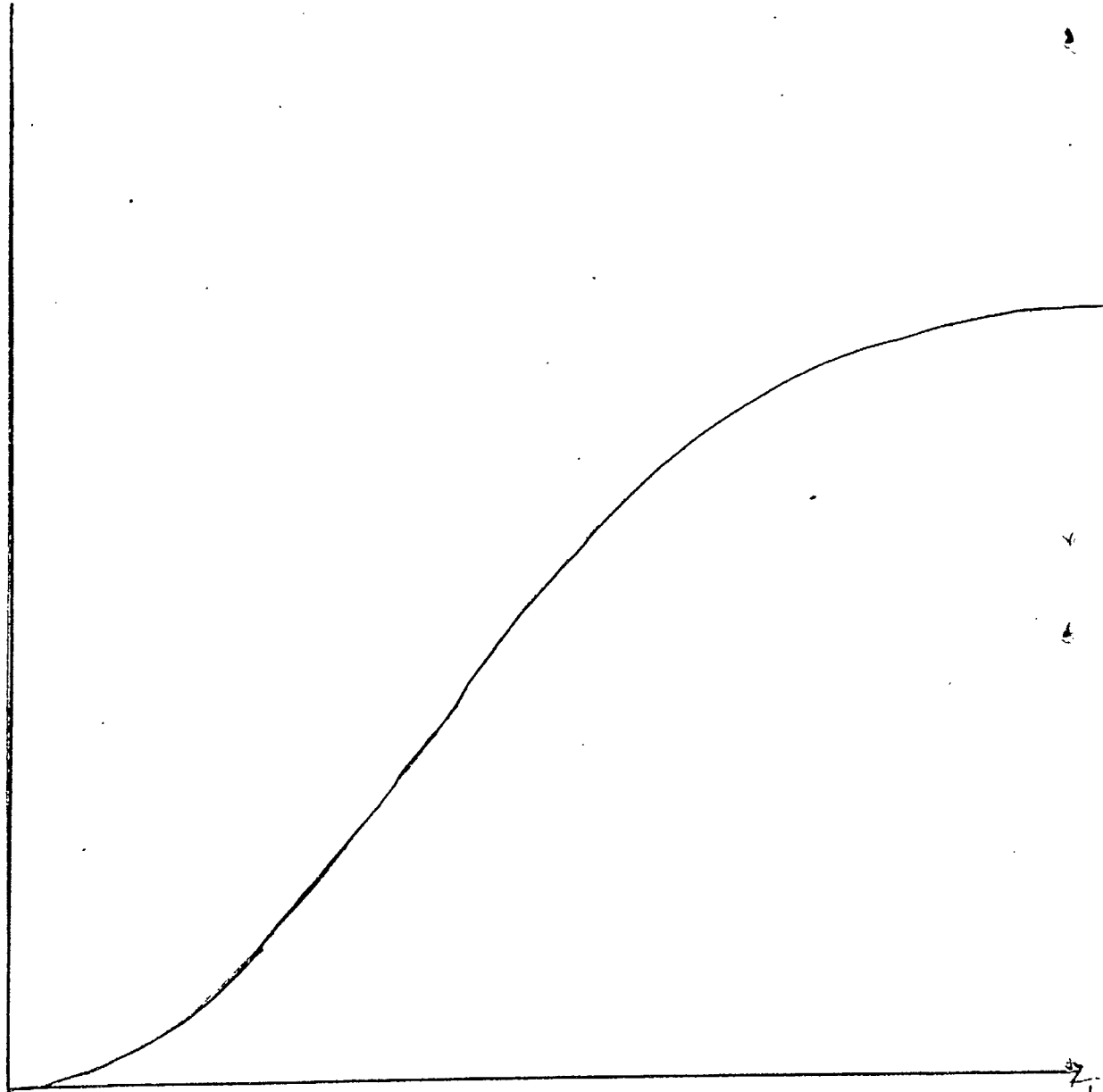
These two examples provide just the beginning of the types of analysis which could be integrated into the risk model of small business adoption of technological innovation. The important thing to stress is that both the marketing firms and the facilitating organizations have a variety of tools at their disposal to help break down the barriers to technological innovation. However, these

tools must be directed at the specific risk or risks which they would be most effective in reducing.

Figure 1

S shaped Diffusion Curve

Sales



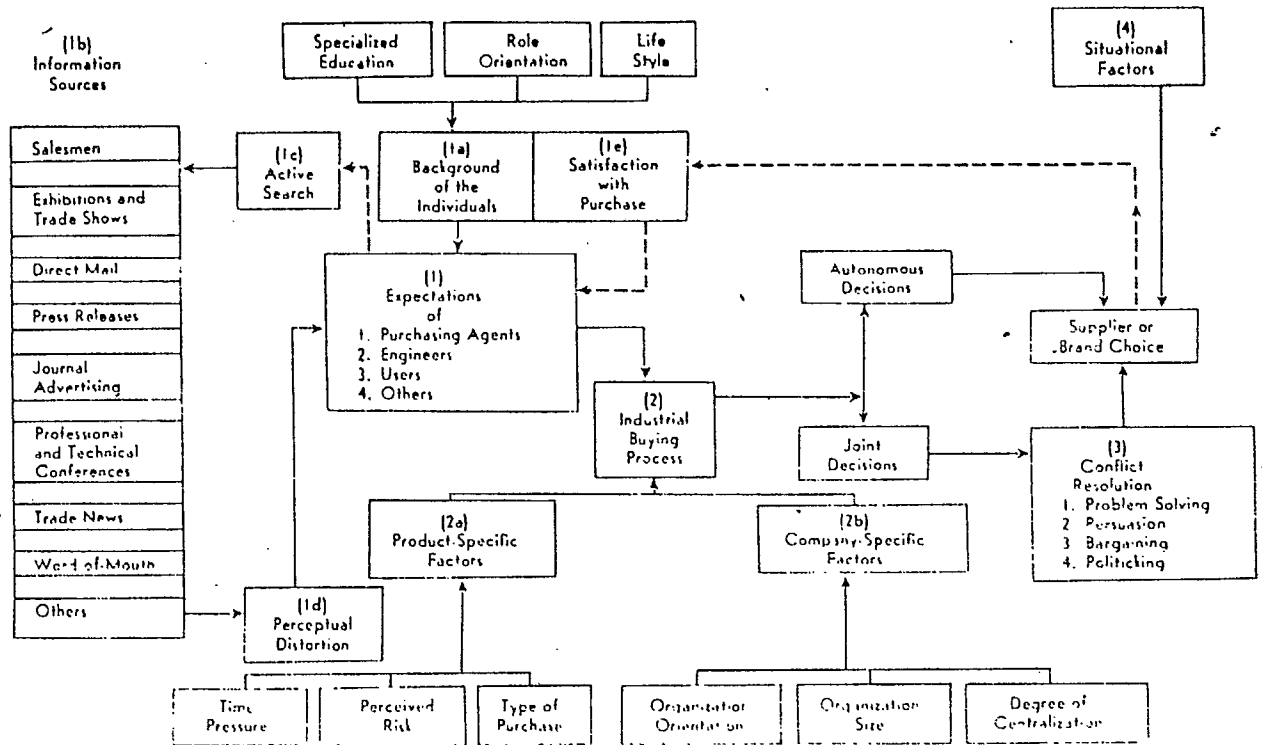
Introduction

Growth

Maturity

Figure 2

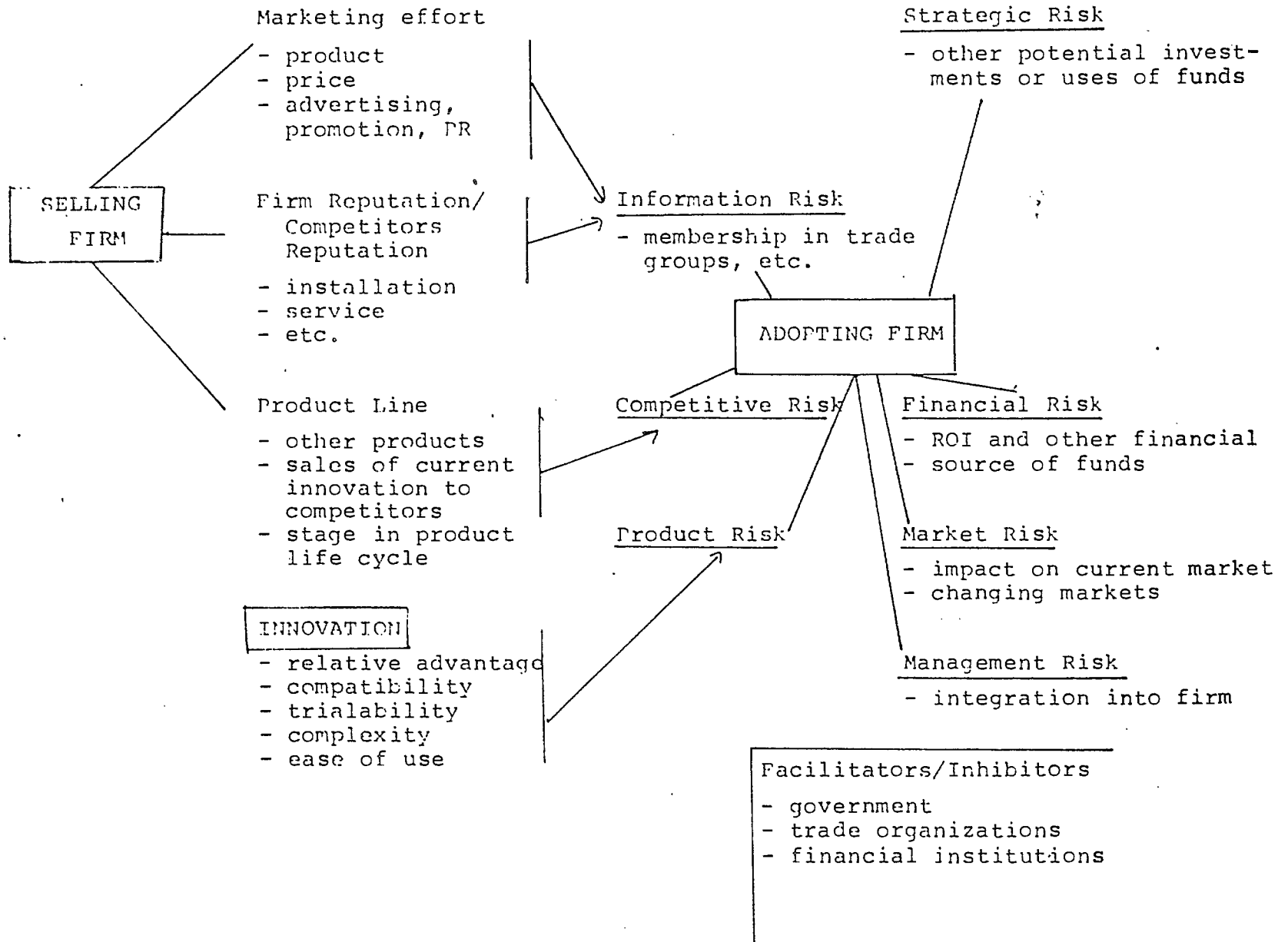
An Integrative Model of Industrial Buyer behavior



Source: Jagdish N. Sheth "A Model of Industrial Buyer Behavior" Journal of Marketing Vol.37 (October 1972), pp.50-56.

Figure 3

The Risks of Innovation



References

- Bass, Frank M. (1969). A new product growth model for consumer durables. Management Science 15 (January), pp.215-227.
- Berry, B.J.L. (1972). "Hierarchical Diffusion - The Basis of Bone's Developmental Filtering and Spread in a System of Growth Centres" in English, P.S. and Mayfield R.C., eds., Man, Space, and Environment. New York, Oxford University Press.
- Booz, Allen and Hamilton (1982). New Products for the 1980's. Booz-Allen and Hamilton, Inc.
- Brown, Lawrence A. (1981). Innovation Diffusion: A New Perspective. Methuen and Co., Ltd.
- Bulloch, John F. and Dr. Leah Heitz (1982). "An Internationally Acceptable Small Business Definition" paper delivered to the International Small Business Congress. Madrid (October).
- Campbell, Rex R. (1966). A suggested paradigm of the individual adoption process. Rural Sociology 31 (December), pp.458-466.
- Choffray, Jean-Marie and Gary L. Lilien (1980a). Market Planning for New Industrial Products. Wiley, New York.
- Choffray, Jean-Marie and Gary L. Lilien (1980b). "Industrial Market Segmentation by the Structure of the Purchasing Process". Industrial Marketing Management 9, pp.331-342.

Cohn, Steven F. (1980). "Industrial Product Adoption in a Technology Push Industry". Industrial Marketing Management 9, pp.89-95.

Coleman, James, Elihu Katz, and Herbert Menzel (1957). The diffusion of an innovation among physicians. Sociometry 20 (December), pp.253-270.

Cox, William E. Jr. (1967). "Product Life cycles as Marketing Models". Journal of Business (October), pp.375-384.

Davies, S. (1979). The Diffusion of Process Innovations. Cambridge, Cambridge University Press.

Dodson, Joe A. and Eitan Muller (1978). "Models of New Product Diffusion Through Advertising and Word of Mouth" Management Science 15 (November), pp.1568-1578.

Economic Council of Canada (1983). The Bottom Line Technology, Trade, and Income Growth, Ottawa.

Ehrlich, H.J. and Lee, D. (1969). "Dogmatism, Learning and Resistance to Change: A Review and A New Paradigm" Psychological Bulletin Vol.71, pp.249-260.

Ernst and Whinney (1984). "Characteristics of Successful Companies Financed by Canadian Venture Capital Sources". Study conducted for the Association of Canadian Venture Capital Companies.

Fenwick, Ian, Patricia Simmie and Roger Heeler (1984). "Early Adopters of Energy Conservation Products in Winnipeg: A Case Study". Policy Research, Analysis and Liaison Directorate, Policy Coordination Bureau, Consumer and Corporate Affairs Canada.

Globerman, Steven (1974). "Technological Diffusion in Canadian Manufacturing Industries". Research Report No.17, Technological Innovation Studies Program. Ottawa, Dept. of ITC.

Gruber, William H. and D.G. Marquis (1979)(eds.). Factors in the Transfer of Technology, MIT Press.

Hagerstrand (1965). "Aspects of a Spatial Structure of Social Communicator and the Diffusion of Information" in P.W. English and R.C. Mayfield (eds.) Man, Space and Environment. New York, Oxford University Press.

Lavidge, Robert J. and Gary A. Steiner (1961). A model for predictive measurements of advertising effectiveness. Journal of Marketing 25 (October), pp.59-62.

Mansfield, Edwin (1968). "The Economics of Technological Change". New York, Norton.

Nabseth, L. and G.F. Ray (eds.) (1974). The Diffusion of New Industrial Processes. National Institute of Economic and Social Research. Cambridge University Press.

- National Science Foundation (1969). Successful Industrial Innovations. NSF 69-17, Washington, D.C.
- OECD (1982). Innovation in Small and Medium Firms. Organization for Economic Cooperation and Development. Paris.
- Robertson, T.S. (1971). Innovative Behavior and Communications. New York: Holt, Rinehart and Winston.
- Rogers, E.M. (1962). Diffusion of Innovations. New York, Free Press.
- Rogers, E.M. (1973). Communication Strategies for Family Planning. New York, Free Press.
- Rogers, E.M. (1976). New product adoption and diffusion. Journal of Consumer Research 2 (March), pp.290-301.
- Rogers, E.M. and F. Shoemaker (1971). Communication of Innovations. New York, Free Press.
- Ryan, B. and N.C. Gross (1943). The diffusion of hybrid seed corn in two Iowa communities. Rural Sociology 8 (March), pp.15-24.
- Sheth, Jagdish N. (1973). "A Model of Industrial Buyer Behavior". Journal of Marketing Vol.37 (October), pp.50-56.

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