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SPIN-OFFS AND NEW FIRM FORMATION:
ENTREPRENEURSHIP AND HIGH TECHNOLOGY
IN THE OTTAWA AREA

A thesis presented to the School of Graduate
Studies, University of Ottawa, in partial
fulfilment of the requirements of the degree
of Master of Arts in Geography.

University of Ottawa

1985

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UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

ABSTRACT

Promoting indigenous technical entrepreneurship has become a key element of the modern approach to regional development. The thesis provides insight into the pattern of spin-offs, and the nature of indigenous technical entrepreneurship arising within the Regional Municipality of Ottawa-Carleton (RMOC). It identifies the incubator organizations, traces the movement of the new entrepreneurs from those incubator organizations and establishes the motives, timing and background to their movement. The thesis focuses on 82 locally owned or controlled software and hardware firms (as identified by the Commercial and Industrial Development Corporation) established since 1965, and still in existence in 1982, and on 113 founders or co-founders.

The thesis has six chapters: an introduction covering objectives, survey data, approach and analytical techniques used in the study; a review of recent literature on Ottawa's high technology development and evolution of the Technology Oriented Complex (TOC); a review of literature on geography and new firm formation, and the nature of the technical entrepreneur; a survey based analysis of technical entrepreneurship in the RMOC, and identification of certain roles of local incubator firms in the new firm formation process; a discussion of hypotheses and relationships concerning the technical entrepreneur and new firm formation; and a summary and conclusion regarding the significance of the study's findings.

Ottawa's high technology industry is characterized by many

small firms and a very few large firms. The success of new locally owned firms does not appear to be related to the background of the entrepreneurs nor the motivational factors behind the establishment of the firm. This is of interest, as most studies have unearthed linkages between the antecedent influences upon the entrepreneur and the new firm's success. Two thirds of Ottawa's high technology firms have been founded by groups of founders rather than single founders. The success of these firms does not appear to be any greater than that of firms with a sole founder.

Foreign born entrepreneurs have played a large role in the complex. However, they have not proved any more successful on average than Canadian born entrepreneurs in Ottawa's high technology industry. Foreign entrepreneurship has been the main discriminant of technical entrepreneurship in our study. Foreign entrepreneurs are: more technically oriented than their Canadian counterparts, both in their work and educational backgrounds; slightly more international in scope, as revealed by their working careers and their firm's sources of competition; and more closely associated with medium to large size firms.

The federal government played a significant role in the earlier development of Ottawa's Technology Oriented Complex. It has had a very minor role, however, according to the founders, in the formation of recently established high technology firms. The thesis identifies several incubator organizations, the main ones being Northern Telecom, Computing Devices and the federal government. Notably absent are the universities and the National

Research Council. A hierarchy of incubator organizations has evolved in Ottawa's high technology community and the pattern of spin-offs now reaches into the third or fourth generation.

A composite picture of a high technology entrepreneur, emerging from the data provided by this survey, is a thirty-five year old engineer who has: a) worked outside of the Ottawa area some time in his career; b) worked at an average of 3.5 jobs; c) lived in Ottawa for an average of eleven years before founding his firm, and d) attained a bachelor level degree. Roughly a third of the entrepreneurs were born outside of Canada. And a third have a father who was self-employed.

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CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Ottawa has attracted high technology firms since the late 1940's but only since the late 1960's has its private industrial sector become dominated by such firms. The number of high technology firms has grown rapidly since the late 1960's with presently close to three hundred manufacturing and service establishments located in the area. Although some other cities in Canada have attracted high technology industry, it is in Ottawa, known as Silicon Valley North, that the industry has particularly flourished.

Why has Ottawa provided the 'seed-bed' for growth in the high technology industry? Several factors are acknowledged as being influential in the growth of the industry in Ottawa: accessibility to the federal government; a well-developed science and technology community; several post-secondary educational institutions; and the labs of Bell Northern Research are amongst them. These factors are important in determining why firms both from within the Ottawa area and outside locate in the region; however we need to know more about the processes generating such indigenous growth of high technology firms.

Do many of the firms arise as spin-offs from other local enterprises? Spin-offs are new companies that are established by entrepreneurs departing from such technical institutions as university or commercial laboratories. Has the technical entrepreneur spent several years between his departure from the

university or some technical organization and the formation of his new enterprise? Are spin-off firms started by a group of founders from the same parent company or technical institution? How often is a spin-off company in direct competition with its parent, or does it draw upon technological developments the parent does not choose to commercialize? An incubator organization is generally recognized as that institution with which the founder(s) was (were) last associated. Are there several well-established public and private-sector incubator organizations in Ottawa, including the universities and the National Research Council?

1.2 SCOPE AND OBJECTIVES

This thesis attempts to provide insight into a key element of regional development, the pattern of spin-offs and nature of high technology entrepreneurship arising within the Regional Municipality of Ottawa-Carleton. The main focus of the thesis is on the nature of the entrepreneur and the form of the spin-off process. Studies have shown that the antecedent influences upon the entrepreneur affect the timing and motivations when founding a firm, and ultimately its success. This thesis examines entrepreneurial characteristics in the founding of new firms in the Ottawa area and whether the nature of Ottawa's technical entrepreneurs differs significantly from that studied elsewhere.

Studies maintain that the main feature that distinguishes spin-offs from other new firms is the level of technology used and the significance of research ideas rather than marketing and

production knowledge, in the formation of the firm. It is assumed that the technology upon which an entrepreneur bases his new firm is transferred from his incubator organization. Certain entrepreneurial characteristics appear to affect the level and nature of technology transfer from the incubator organization. The extent to which these entrepreneurial characteristics affect the transfer of technology to Ottawa firms and the role the local incubator organizations play in this process are examined, and any differences with other study results commented upon.

The extent of foreign born entrepreneurship is frequently noted in Canadian entrepreneurial studies. This thesis studies this phenomenon in Ottawa's high technology complex and comments upon differences between foreign born and Canadian born entrepreneurs and the firms they found.

1.3 SURVEY DATA AND APPROACH

The thesis focuses on locally owned or controlled software and hardware firms established since 1965, and still in existence in 1982. The firms were identified through four publications: the CIDC(Commercial and Industrial Development Corporation of Ottawa-Carleton) 1983 High Technology Directory; the CIDC survey of hardware firms for 1983; the 1982 edition of the CATALOG (a publication of the Canadian Advanced Technology Association) and "Canada in the World of Electronics," a publication of the federal Department of Industry, Trade and Commerce.

To compile a list of new firms for this study some guidelines were set forth and a preliminary survey, based on the

lists from the above-mentioned agencies, was undertaken to identify hardware and software firms. A firm's eligibility was decided by whether there was a positive response to two questions; Was this firm established since 1965? and Is this firm owned and/or controlled locally? In many cases this information could not be readily ascertained from published sources so a questionnaire was sent to the company to evaluate whether it met the survey criteria.

A questionnaire was the main data source (see Appendix A). It included 23 open-ended or multiple-choice questions. A follow-up to the questionnaire was arranged where answers from the questionnaire needed clarification or additional information was necessary. Questionnaires were sent out to 247 firms in the area. A six week waiting period was allowed for their return. Firms that did not respond to the first round of questionnaires were then sent a second questionnaire. There were 147 responses to the questionnaire allowing for a 59 per cent response rate. However of the 147 questionnaires received 65 had to be rejected for one or other reason; in many cases there were too many incomplete answers; in some the firms were started previous to 1965 or the firms were started outside of the Ottawa area or the original founders were no longer with the company and could not be located.

Subsequently a co-founding survey was launched on the basis of the response to the first question in the original survey. Seventy-two questionnaires were sent to co-founders. There were 31 responses giving a response rate of 43 per cent. The thirty-

one responses represented twenty-four firms, twelve of which gave full co-founder response.

1.4 DESCRIPTIVE TECHNIQUES AND QUESTIONNAIRE DESIGN

The questionnaire used in this study was designed to reveal three main components of new firm formation: the antecedent influences upon the entrepreneur (founder characteristics); the incubator organization; and the new high technology firm. The antecedent influences upon the entrepreneurs includes the family, educational and work background of the entrepreneur; the personal characteristics of the founder (his age and location of birth); and the motivating factors that led the entrepreneur to the establishment of a firm. The incubator organization was identified as being the last firm the entrepreneur worked for before establishing his firm. The identification of the incubator organization was attained by gaining information about the work history of the entrepreneur. Unfortunately the size of the incubator organization was not included in the question, therefore a spin-off rate could not be calculated for the incubator organization. The questions asked with respect to the new high technology firm were designed to disclose the characteristics of a successful firm as of 1982: the level of employment; the nature of the firm's competitors, the number of founders, and the age of the firm. The only objective assessment made of the firm's success was its level of employment. Net or gross earnings were not ascertained. At the time of the research it was hoped that a differentiation between the development of

hardware and software firms could be made.) However, due to an omission on the questionnaire, as well as to indecisive labels on the directory used in obtaining the names of the high technology firms, no differentiation could be made.

Some respondents did not answer all questions, hence in later chapters the tables vary in the total number of responses. The total number of responses also varies where the questions allowed the respondent to give more than one answer. For some questions the focus was on characteristics of the firm (82 responses). Others required a response from both the founder and co-founder(s) (113 responses). Lastly, there are several questions in which responses were sought from the co-founder(s) and founder; and in three cases a founder whose firm was excluded from the main analysis of the data due to incomplete answers, was included in the tabulation for these particular questions (116 responses).

1.5 ANALYTICAL TECHNIQUES

For the purposes of analysis many of the questions were divided into several binary variables, comprising a total of 85 variables. dBaseII was used to format the data allowing it to be read by Statpak (a basic language statistical package). Cross-tabulations and chi-squared statistics form the basis of the analysis for the thesis. These statistical methods are the forms of analysis most frequently used by other researchers interested in new firm formation. A regression analysis was also undertaken

but not included in the thesis. Problems arose for such analysis primarily due to the lack of suitable dependent variables derived from the questionnaire. The regression analysis did not reveal any information that the cross-tabulations and chi-squared statistics had not already disclosed.

1.6 CONCLUSION

The purpose of this thesis is to determine the nature of technical entrepreneurship and new firm formation in the R.M.O.C. Particular attention is paid to the relationships between the entrepreneurial antecedent influences and motivations, the incubator organization and the nature of high technology firms and their success. The study is based on a survey conducted in late 1982. The analytical tools chosen for the thesis were those most frequently used by other researchers in new firm formation.

CHAPTER TWO: OTTAWA'S DEVELOPMENT AS A TECHNOLOGY ORIENTED COMPLEX

2.1 INTRODUCTION

The purpose of this chapter is to outline briefly Ottawa's development as a technology oriented complex (TOC) as revealed by some recent studies. These studies indicate the process has been a long and involved one, with several forces providing the impetus for new firm formation. What has been Ottawa's advantage, enabling it to attain relatively greater growth of high technology industry than other larger and more complex Canadian cities in recent years? Has it been more than just some geographical advantages that have given Ottawa such a foothold in Canada's high technology industry?

Ottawa's success as a high technology center is of particular interest, and not only taken in a Canadian context, based as it is on a high degree of indigenous enterprise. By examining this indigenous enterprise in Silicon Valley North this thesis will provide some insight into the mechanisms of regional development now of great interest in many parts of the developed world.

Ewers and Wettman in their discussion of innovation-oriented regional policy emphasize that acknowledged methods of attracting industry to underdeveloped regions are not practical (nor successful) in these times of economic restraint, and that regions can only be helped if regional policy is directed towards building on indigenous potential (Ewers and Wettman,

1980, 164). With the decrease of funds for regional development it is of increasing importance to understand the indigenous and spin-off growth process. Indigenous and spin-off growth has tended to be more successful than those elements of the regional grant programmes designed to attract footloose industry to an area.

This chapter will review three main recent pieces of literature concerned with the subject of Ottawa's development as a technology oriented complex. The first is a M.A. thesis submitted by Audrey Robinson which seeks to understand the impact of the federal government's research and development policies and program on the development of the high technology industry. The second is an article by Steed and DeGenova tracing Ottawa's development as a technology-oriented complex. This article includes the results of a survey designed to determine Ottawa's locational advantages as a high technology center. The final part of the literature review looks at Keri Sweetman's description of the development of the high technology industry in Ottawa.

2.2 AUDREY ROBINSON: A MANAGEMENT PERSPECTIVE

This study addresses the use and impact of the federal government's Research and Development policies and programs by seventeen high technology companies in Ottawa-Carleton. Robinson interviewed twenty-one senior executive officers, whose comments, perceptions and attitudes constitute the base of the study. It

is with Audrey Robinson's discussion of Ottawa's high technology industry development and the perceived advantages and disadvantages of the Ottawa-Carleton region that we are primarily concerned.

Audrey Robinson outlines a three stage process for the development of the high technology industry in Ottawa (Robinson, 1982 8-10). She argues that during the first stage companies established themselves in Ottawa because of the federal government and the defence related industry. These companies were locally owned and controlled. Stage two companies were the first set of entrepreneurial 'spin-off' companies spawned by the stage one group. Stage two entrepreneurs decided to locate in the region for a number of reasons. A combination of financial expediency and personal preference was the primary reason. The principals already lived in the region and it was too costly to consider establishing themselves elsewhere. The availability of contract work with the federal government and their 'erstwhile' employers, in conjunction with the technological developments in the federal laboratories were the secondary reasons. The third stage of technology industry developed in the late 1970's and continues to the present. Two groups of companies make up the growth of industry in this stage. The first group constitutes companies spawned from those created in the second stage (second tier spin-offs). The second group of companies moved deliberately into the region because of the presence of the high technology community and the technology 'push' which encompasses it.

Four main advantages to the Ottawa region were revealed by

the members of the high technology industry during their interviews (Robinson, 1982, 12-15). The development of a vertical industry is seen as being a major advantage as the accessibility to subcontractors and suppliers is of major importance. The attractiveness (aesthetic) of the region and its lifestyles is of immense value as it helps to guarantee the presence of a highly qualified 'pool' of labour from which to draw employees. The critical mass of highly skilled individuals also helps to sustain the intellectual and technical levels in the industry.

According to the executives interview by Robinson, the region also has its disadvantages. For many firms, Ottawa's poor transportation connections have proved to be a considerable problem. The members of the high technology community revealed that Ottawa's inferior air service has caused marketing problems for several of their firms. Air transportation is needed if Ottawa-based firms want to remain in contact with world purchasers, which is necessary if they want to remain competitive (Robinson, 1982, 14). Constant communication with other technological organizations is needed if Canadian firms want to stay abreast of the industry. The poor air transportation affects the industry in two ways: (1) it affects the travelling time of the Ottawa entrepreneur, particularly to the United States, which is considered one of the major high technology markets; and (2) it affects the proficiency of each company to attract potential customers to their plants in order to advance sales (Robinson, 1982, 14).

In her conclusion, Audrey Robinson states that in general the size of federal government support has been marginal (Robinson, 1982, 30). The proximity of the federal government is only a benefit for its contracting out policy and not for its industrial development programs. When a company does use a program it seems to do quite well and continues to use the programs. The high technology firms cannot rely on the federal government for support, Audrey Robinson suggests, and they must adopt a 'market niche' strategy. The exploitation of particular niches of larger markets is necessary if Canada's firms are to compete successfully in the international market.

2.3 STEED AND DEGENOVA: OTTAWA'S TOC

Steed and DeGenova conducted a study complimentary to Robinson's and over the same time period but using mail survey techniques and covering a broader number of firms. They refer to research in the mid 1970's of 12 TOC's in Western Europe and North America, which revealed four distinct models of technology oriented complexes (TOC). These four models take the form of 1) a TOC where growth is principally the product of locally initiated firms and spin-offs; 2) a research-oriented TOC usually restricted to a park site; 3) a TOC initiated by the location of new manufacturing facilities by existing firms based elsewhere and 4) a TOC resulting from very large expenditures of government funds at a development facility (Steed and DeGenova, 1983, 265).

Steed and Degenova's paper looks at which model of TOC

Ottawa's most readily corresponds with; then focus, through the use of a postal survey questionnaire, on the anatomy of the TOC. They also consider in more detail than Robinson the role of federal government proximity as an element of the local environment conducive to the emergence of new firms. They contend that the federal role has changed as the Ottawa TOC has passed through several phases, and the model of TOC to which Ottawa's most readily corresponds has changed accordingly.

Steed and DeGenova conducted their survey in 1981. A questionnaire was sent to those 64 high technology firms that had been identified by various means as being manufacturers in the Regional Municipality of Ottawa-Carleton. Forty-five of the sixty-four responded allowing for a response rate of 70 per cent.

The firms surveyed could be characterized as being relatively young. Sixty per cent of the firms were founded in 1971 or after, a third of them founded in 1976 or after (Steed and DeGenova, 1983, 268). Thirty seven of the forty-five firms were independent domestically owned firms. Only four of the forty-five firms had founders who lacked strong local associations with the region. The high technology industry is characterized by not only very young firms but very small firms as well. Seventy-three per cent of the sample had a hundred employees or fewer.

The companies included in the study were asked to give three factors they considered to be key in stimulating their companies' initial development within the area. The presence of the federal

government was rated the highest, with 47 per cent of the sample identifying it as a key factor. Thirty-three per cent of the firms surveyed said the fact the founders were resident in the area was of major importance. The existence of the high technology agglomeration was also identified as being a significant factor in the development of the firm within the area. Different sizes of firms gave different weightings to these factors. The youngest and smallest firms emphasized local residency, the largest, oldest and foreign owned gave more stress to the presence of the federal government (Steed and DeGenova, 1983, 270).

Respondents were asked to indicate on a five point scale just how important they considered their proximity to the federal government. Fifty-seven per cent (26 firms) of the respondents felt that their proximity to the federal government was crucial or significant. These twenty six firms also identified contact linkages with particular government departments or agencies which they considered to be most important, revealing approximately 69 links. The departments most often mentioned were; the Department of National Defence; Department of Supply and Services; the National Research Council and Industry, Trade and Commerce (Steed and DeGenova, 1983, 272). Steed and DeGenova found not all of the firms were enamoured by the federal presence. One of the problems they identified was the difficulty in competing with the federal government's salaries and job security to attract the requisite labour force.

Steed and DeGenova asked the respondents which other cities

might prove very satisfactory, acceptable, or unacceptable (on a five point rating scale) given their current locational requirements. They asked this question in order to determine whether the firms could operate elsewhere, as well as to determine the degree of geographic "footlooseness" in the high technology manufacturing sector. Ottawa came out on top in this exercise. It was rated very satisfactory as a location by 63 per cent of the firms. Toronto was the best alternative with 38 per cent of the firms rating it very satisfactory. Focussing on the two top ratings, more than three quarters of the firms rated Toronto relatively high. Steed and DeGenova concluded that although there is room to speculate on the economic and personal reasoning behind the figures, they reveal substantial differences between Canadian cities in their acceptability as locations for high technology firms (Steed and DeGenova, 1983, 276). The results also indicate that a number of these firms feel they could operate satisfactorily in at least several quite dispersed cities.

Examination by Steed and DeGenova of Ottawa's technological development enabled them to clarify the role of the federal government through the early stages of Ottawa's TOC development. It is their contention that Ottawa's TOC most closely coincided with archetypes 4) and 2) at the beginning, as an abundance of government funds were given to the National Research Council for research purposes essentially. Model 3) became the important prototype after the end of the war as new plants, including one by Northern Electric (later known as BNR)

located in the Ottawa area. At present Ottawa's TOC most closely represents archetype 1) the initiation of indigenous enterprise and spin-offs. The federal government's role has thus changed through the years. Recently it has played the important role of providing proximity advantages to firms entering the complex (Steed and DeGenova, 1982, 276).

2.4 KERI SWEETMAN: OTTAWA'S DEVELOPMENT HISTORY

Sweetman(1981) provides further detail on the corporate history of high technology development in the region. In 1948 Computing Devices became the first high technology company to be established in the Ottawa area. Depending on its sales of military hardware, Computing Devices achieved a steady growth pattern. It was not until 1958 that Northern Electric, the predecessor of Bell Northern Research, decided to start a research complex in Ottawa.

Development of high technology firms continued to be slow even until the early 1970's, when such companies as Epitek, Mitel, Lumonics and Gandalf, were created. The closure of Microsystems International Limited (MIL) and the merger of Systems Dimensions Ltd. with Datacrown Ltd. proved to be two of the most significant occurrences in Ottawa's technological development (The Citizen, March 24, 1981, 49-68). Each of these occurrences caused many talented people to become unemployed or dissatisfied enough with new management to encourage them to

create their own high technology firms. Several other firms have become incubator organizations, giving rise to spin-offs such as Mitel, Leigh Instruments, Elinca, Norpak, Siltronics and Epitek (Sweetman, 1981, 55).

Ottawa's high technology center has continued to grow into the 1980's. By 1981 there were more than 250 hardware and software firms in the area (The Citizen, 1981, 55). These new firms in 1981 employed about 20,000 people in the Ottawa area. Projections of growth rates at the time indicated suggest the high technology workforce might number 50,000 by 1985 and perhaps double that by 1990 (Sweetman, 1982, 20). Firms indicated they found relatively little problem attracting personnel from outside the area as Ottawa has many 'lifestyle' advantages: ski-hills within a seventy mile drive; easily accessible lakes and forests; clean air and water; cultural and recreational activities and reasonably priced housing. However there were some fears of a shortage of technological manpower (Sweetman, 1982, 26).

2.5 CONCLUSION

The three studies reviewed here provide some insight into the development of Ottawa's high technology complex as it has grown over the last forty years. It is within the last fifteen years however that the majority of firms in this complex have been established, and a three stage process of firm development has become discernible. The role of the federal government has changed over the course of development of Ottawa's high

technology complex. Initially it provided funds to form a national research facility. More recently it has played the role of contractor to newly established high technology firms, and has provided proximity advantages of a variety of types. Ottawa's high technology agglomeration is now seen as a major advantage to resident firms, as are its technical institutions and universities, which act mainly as purveyors of technology and trained manpower.

NOTES

1. One of the key private sector institutions to be attracted to the Ottawa area is Bell Northern Research Denis Hall, a former president of BNR cited the following reasons for locating in Ottawa.

"We wanted a town that had access to universities and to information, through the National Library and the National Science Library, it was close to Montreal, where Bell Canada and Northern Electric had their headquarters, and it was reasonably close to Toronto. It just seemed to fit."

(Sweetman, March 1982, 24)

CHAPTER THREE: TECHNICAL ENTREPRENEURS, SPIN-OFFS AND NEW FIRMS; LITERATURE

3.1 INTRODUCTION

The purpose of this chapter is to define some terms and identify some issues regarding spin-offs and new firm formation, and to indicate the findings of several related studies, on technical entrepreneurship and new firm formation in the United States, Great Britain, Sweden and Canada.

The literature reviewed here appears to represent the main recent work on technical entrepreneurship and new firm formation. Most of the studies are concerned with the characteristics of the entrepreneur and how they affect the transfer of technology and the composition of the new firm. They also focus on the incubator organization, its identity and the role it plays in entrepreneurial motivation as well as the transfer of technology to the spin-off firm. Although these studies have been conducted in a variety of environments, they do not, for the most part, discuss the effect their environments have on technical entrepreneurship and new firm formation.

3.2 COOPER: SPIN-OFFS AND TECHNICAL ENTREPRENEURSHIP

In a 1971 paper, Cooper focussed on the role that the incubator organization plays in new firm formation. Cooper's study of spin-offs and technical entrepreneurship also notes the role of technology transfer. He found that quite often a spin-off company is directly competitive with its parent organization,

utilizing the same technology and serving the same markets (Cooper, 1971, 2).

Cooper's study was based on 250 new firms started in Palo Alto, California since 1960. He did not include part-time ventures, firms offering only management consulting, computer software, or wholesaling or selling services. Cooper identifies the last firm worked for prior to founding as the incubator organization (Cooper, 1971, 3). He assumes that the last firm worked for has provided the necessary skills and impetus to the founder, or the founder would have taken the initiative to establish his own firm previous to joining the incubator organization. His definition seems to exclude the possibility that other firms employing the entrepreneur may have played a more significant incubator function.

In order to calculate the effects of organizational size on stimulating spin-offs, Cooper developed an incubator success index called the spin-off rate (Cooper, 1971, 3). This index is calculated by dividing the number of new firm founders from the organization by the total number of employees engaged by the firm.

He found substantial variations in the spin-off rates among organizations. A number of companies, particularly small ones, had no spin-offs. Among firms that had three or more spin-offs, the range in spin-off rates was from $1/3100$ to $1/14$ (Cooper, 1971, 3). The spin-off rate for the high technology companies as group was $237/77600$ or $1/306$.

By using the spin-off rate Cooper discovered that small incubator organizations (those with fewer than 500 employees) had ten times the propensity for spin-offs than did establishments with greater than five hundred employees (Cooper, 1971, 3). Cooper offered four reasons as to why a small firm provides a better environment for potential entrepreneurs: by working for a small firm the entrepreneur may learn how to organize and develop ideas that can be used by a small firm; professional employees in a small firm are exposed to many facets of business and therefore are more likely to handle not only the technical section of a new organization but learn to manage it efficiently as well; those who choose to work for small and new firms are the most prone to be entrepreneurially inclined; and large firms employ a higher percentage of non-professional employees, people who do not have technical or managerial expertise (Cooper, 1971, 4).

Cooper conducted a subsequent study determining the success of non-profit organizations as incubator organizations. There are three main non-profit organizations in Palo Alto: Stanford University, the Stanford Research Institute, and the Ames Research Center of NASA. A list of spin-offs from these three organizations since 1960 was completed, and senior personnel were contacted for follow-ups.

The spin-off rate for the non-profit research institute was found to be the same as for large companies as a group. The rate for the government laboratory was very low. The university spin-off rate varied from 1/122 to 1/736 depending on whether the base

was the engineering faculty and associates or faculty, research associates, and graduate students in engineering, physical sciences and business. As a whole, these non-profit organizations served as incubator organizations for slightly less than 3 per cent of the new technology based firms in the area (Cooper, 1971, 5).

Conversations with entrepreneurs and professors associated with Stanford suggested its principal contributions have been: a) providing a continual flow of technically trained people to companies in the area; b) providing technical expertise through consulting and c) providing the opportunity for continuing education for professional employees (Cooper, 1971, 5).

Cooper offers two explanations as to why the spin-off rate for the government laboratory was so low. First, the work being done in the laboratory did not appear to have great commercial applicability. Secondly, the typical professional employee was described as more scientifically oriented and less commercially and entrepreneurially oriented than his industrial counterpart (Cooper, 1971, 5).

3.3 ROBERTS: ENTREPRENEURSHIP AND TECHNOLOGY TRANSFER

The purpose of this study was to look at the personal role of the innovator in the transfer of technology from the laboratory into use. Roberts was primarily concerned with innovators who had created new companies.

His data base was comprised of two companies founded by ex-

employees of several Massachusetts Institute of Technology (M.I.T.) laboratories and academic departments, a government laboratory, a non-profit corporation, and an industrial electronic systems contractor. At the time of the survey the companies in the sample were on average four to five years old. The average size of these companies was small, though the companies were rapidly growing. Most of the companies studied had their start as government contractors or in selling products to the defense/space market. A tendency toward non-government sales increases significantly during each year of company history especially in the case of the more successful companies.

Roberts' study of entrepreneurs showed that over 50 per cent of the founders had come from homes in which the father was self-employed. He regards the home environment as very important as in many cases it helps to breed the entrepreneurial instinct particularly through the demonstration effect (Roberts, 1966, 229). Generally the entrepreneurs were well educated, with the average level of education being the Master of Science degree. Most of the entrepreneurs surveyed were in their early thirties although the range went to much younger than this to one man who was in his late sixties (Roberts, 1966, 230). He found the entrepreneurs in this sample much more development oriented than research oriented; and that development activities, or a combination of hardware scientific/engineering knowledge, encouraged the process of technical entrepreneurship. Roberts' study also indicated that founders with a very high level of education tended to have firms that rated as poor or mediocre

performers (Roberts, 1966, 230). He suggests that entrepreneurs with a Ph.D. level degree have developed an attitude not conducive to success in the business world.

Analyses of the development of high technology industry have revealed the importance that spin-offs have played in technology transfer. Roberts, in his study of United States' companies, claims the spin-off not only refers to the entrepreneur moving from the incubator organization or parent firm but the transfer of the technology it is based on as well (Roberts, 1966, 220). He further claims that the stream of entrepreneurs out of advanced technical establishments into their own firms can create a significant technology transfer (Roberts, 1966, 228).

Roberts identifies four determinants of technology transfer: direct transfer, partial transfer, vague and non-transfer (Roberts, 1966, 231). Direct technology transfer occurs in those cases in which the new company could not have been founded and employed in his company. A partial transfer is when the technology from the source laboratory was important but there was also important information from other sources. When the technology transferred consists of general skills rather than specific ideas or devices a vague transfer exists. Non-transfer involves no transmittal of technical knowledge, although Roberts assumes that the new enterprise would be affected by managerial know-how and other skills acquired through previous jobs. Roberts notes that the older the entrepreneur the less source technology that is transferred into the new firm (Roberts, 1966,

232).

In his conclusion Roberts suggests that there are four main ingredients needed in order to create and control a successful firm. A high level of technology transfer is needed from the prior laboratory work of the entrepreneur. The founder of the firm should have a moderately high level of education, no higher than the M.S. degree. He recognizes the need for specific business skills, primarily those in the management area (Roberts, 1966, 235).

3.4 ROBERTS AND WAINER: SOME CHARACTERISTICS OF TECHNICAL ENTREPRENEURS

The purpose of this study is to determine the factors that contribute to the emergence of an entrepreneur. Three factors were considered in this study, that of family background, educational levels attained, and goal orientation and motivation. Sixty-nine individual entrepreneurs who were former employees of the Instrumentation Laboratory and Lincoln Laboratory of M.I.T. were used as the data base.

An equal percentage of technical entrepreneurs were sons of professional and managerial fathers as were sons of labourers, salesmen and farmers. Fifty per cent of the founders had fathers who had their own business. It was found that a larger percentage of the professional (33 per cent) and managers (80 per cent) had their own businesses than the salesmen (25 per cent), skilled and unskilled labourers (35 per cent) (Roberts and

Wainer, 1971, 102).

The level of education of the entrepreneur was found to be a little high compared to the results of other studies. The suggested explanation for this was that the laboratories at M.I.T. required a person to at least obtain a B.S. level degree in order to be considered for a position. The median level of education for this sample was the M.S. degree (Roberts and Wainer, 1971, 106).

Roberts and Wainer ran a chi-squared test to determine the influence of the entrepreneur's father's level of achievement on his educational achievement. They found that employees had at least a B.S. degree and not more than an M.S. with a few extra courses and that this was related to the level of achievement the father attained (Roberts and Wainer, 1971, 107). The suggested explanation for this finding was that the entrepreneurs whose fathers were self-employed planned to go into business at an earlier age. These entrepreneurs might have planned to educate themselves to the level they felt necessary to establish a technically-based enterprise. Further education than a B.S. or M.S. degree may have been regarded as unnecessary (Roberts and Wainer, 1971, 107).

The prime motivation of the entrepreneurs for founding a firm in this study was that of money and being one's own boss. The motivation of challenge was found to be near the bottom of the list (Roberts and Wainer, 1971, 108). Roberts' and Wainer's explanation for this was that the entrepreneurs had worked in an

M.I.T. laboratory where responsibility was great, teamwork was emphasized and financial remuneration was poor.

3.5 CROSS: NEW FIRM FORMATION AND REGIONAL DEVELOPMENT

The primary aim of Cross's study is to contribute some understanding of the process involved in the formation of new firms. His main intention is to discover the role that new firm formation can play in regional development. Cross's study is concerned with new firm formation in the manufacturing industry in Scotland during the period 1968-77. It is within this period of time that Scotland received intensive regional assistance so a secondary aim of the study is to evaluate that particular programme of assistance. The results of Cross's survey of new firm founders is the part of the study that we are primarily concerned with.

Cross supports the supposition that spin-offs are one of the major components in the new firm formation process. They are new technical firms that have been established through technology transfer by individuals moving from a research laboratory or comparable institution (Cross, 1981, 195). Spin-offs are not restricted to movement from technical establishments such as research laboratories although that is the most common source, but can include transfer from any institution or company that has technical facilities. Cross, in his thesis on Scottish new firm formation concludes from his own and other studies that spin-offs

are not that different from the establishment of any other new firm. He adds, however, that perhaps the main feature that distinguishes ⁷¹ spin-offs from other new firms is the level of technology used and the significance of research ideas, rather than marketing and production knowledge in the formation of the firm (Cross, 1981, 195).

Cross briefly mentions the role of the incubator organization in recruiting workers in his discussion of 'seed-bed' growth. He suggests there is the consensus that large and successful companies attract highly trained personnel that have the potential to start their own firms. As the spin-off firms become successful they often become incubator organizations themselves and attract further personnel to the area (Cross, 1981, 208).

Cross acknowledges that there are three main approaches to the study of new firm formation: the personal (psychological/sociological) approach; the situational (geographical) approach; and the related factors approach (economic and work environment) (Cross, 1981, 179). Cross uses a structural approach, in which the actions of individuals are generally explicable in terms of their position and relations with the structure of which they form a part, in his examination of new firm formation. This structure follows a three part framework: the antecedent influences upon the entrepreneur; the incubator organization and the external or environmental factors.

The data used in this study was gathered during 1978 from

191 new manufacturing enterprises operating in Scotland during 1977, and which had been established between 1968 (January 1st) and 1977 (December 31st).

The average age of the new firm founders in this study was 32, with approximately 82 per cent of them falling within the twenty-six to forty-five age margin (Cross, 1981, 209). Unusual perhaps, when compared to other studies, roughly one third of all the entrepreneurs were forty or older when they established their firms (Cross, 1981, 211). When the age of the founder was collated with the reasons for founding new firms two main trends were discovered: 1) the desire for advancement is restricted to those founders forty years of age or less and 2) the founders setting up a new firm because they have been frustrated in their previous position are highly concentrated in the 36-40 age group (Cross, 1981, 210).

Seventy-six per cent of new firm founders held two or more jobs prior to establishing their own companies. Different positions held in the same firm were not included as separate jobs in this study (Cross, 1981, 202).

The main reason for leaving a previous employer and setting up a new firm could be summarized as follows: the desire to be independent and to be fully responsible for one's decisions and not dependent upon others. Auxiliary influences exist and these include the desire for a higher salary and the opportunity arising to establish a firm (Cross, 1981, 205). To tabulate the results, 53 per cent of the sample said a change for advancement

was their motivating factor, 17 per cent had experienced frustration in their previous employ, 14 per cent had their previous firm taken over or closed, and 5 per cent said that they wanted greater rewards. Cross looked at the factors leading to the change of position from the second last to the last job prior to founding a firm and found that the reasons given for this change in comparison to the reasons for founding a new firm did not differ in the slightest (Cross, 1981, 207).

Cross found that plant for plant, large plants produce more new firm founders than smaller ones, however this position is reversed if the number of new firm founders per incubator employment size category is standardized (Cross, 1981, 220). By calculating the number of new firm founders per 1,000 employees, he found that incubator organizations had approximately seven times the propensity for spin-offs than did firms with 250 employees or over.

The majority of new firms founded in this study (55 per cent) were started by more than one founder (Cross, 1981, 218). Very few of the founders had previously established a firm (approximately 12 per cent) (Cross, 1981, 221). There were three main sources of financing for the new firm: 44 per cent were started by personal savings; 18 per cent used local banks and 9 per cent acquired government loans.

3.6 JOHNSON AND CATHCART: INCUBATOR ORGANIZATION FERTILITY

The purpose of this article is to study the size of

incubator organizations and how they affect the rate of new firm formation (spin-offs). Johnson and Cathcart claim that the absolute size of plants has been increasing in the United Kingdom over a fairly long period and that it would be useful to know whether this trend has had any effect on the rate of new firm formation.

This study covers the incubator plants of the founders of 74 manufacturing firms founded in the Northern Region. The seventy-four firms that were involved were established by 115 principal founders. The principal founders of these firms could not be involved in any other business at the time of formation (Johnson and Cathcart, 1979, 220). The main source of information used to identify the relevant firms was a regional newspaper which regularly publishes details of all new incorporations. All incorporations occurring in 1971, 1972 and 1973 were scrutinized. Information on the size of the incubator plant (at the time the founder left) was sought through interviews and correspondence with each company.

The measure of fertility used in this study was the number of New Business Equivalents (NBE) per thousand employees. It appears from a chi-squared test and a summarization of the data that fertility declines with plant size (Johnson and Cathcart, 1979, 222). The number of principal founders per new business also appears to decline with increases in incubator plant size.

3.7 UTTERBACK AND REITBERGER: TECHNOLOGY AND INDUSTRIAL INNOVATION IN SWEDEN

Utterback and Reitberger are concerned with innovation in industry as a means of generating economic growth, employment, and competitive vitality in Sweden. Their emphasis is on the role that new technology-based firms play in the innovation process. It is realized that firms that start out with brilliant product ideas may fail because they do not shift to an emphasis on process innovation. A firm that does not change its strategy as technology evolves will usually fail (Utterback and Reitberger, 1982, 13).

To illuminate the role of new technology-based firms, Utterback and Reitberger interviewed the founders of 60 new firms that are producing products that they developed. The criteria set for selecting the sample was as follows: a) be formed between 1965 and 1980; b) be wholly and independently owned within Sweden; c) have at least 20 of its employees in Sweden in 1980; d) have sales of at least 5 million Swedish crowns in 1980; and e) have partly or wholly developed the major product, or products which today dominate its manufacturing business.

The firms surveyed were concentrated in machinery and electronics. The median age of the firms was ten years. The majority (38 cases = 63 per cent) were founded during the period 1968 - 1973 with thirteen firms formed before 1968 and nine firms after 1973. In 90 per cent of the cases, the main sources of equity capital reported were from personal savings and loans. Forty-nine of the sixty firms received either government money or

product development loans (Utterback and Reitberger, 1982, 47). Most of the firms had managed to move from a dominantly software to a dominantly hardware base in a few years. The introductory software oriented phase has, in many cases, even served as a necessary base for product development, giving a cash flow that provides the founders and their families with a minimal level of economic resources (Utterback and Reitberger, 1982, 49).

The median age of the founders in the sample was thirty-four years. The ages ranged from the youngest at twenty-three years to the oldest in the late forties. Twenty-one of the founders were younger than thirty-one years of age when they founded their firms, nineteen of the founders were between thirty-one and thirty-nine years of age, and nineteen of the founders were thirty-nine years of age or older at the time of establishment. 58 per cent of the entrepreneurs in their thirties have founded rapidly growing firms contrasted with 38 per cent and 42 per cent for the younger and older groups respectively (Utterback and Reitberger, 1982, 63).

The sample of new firm founders was reasonably well educated. 50 per cent of the sample were graduates of gymnasium (particularly technical gymnasium), 33 per cent were university graduates, and 20 per cent had a basic education. Utterback and Reitberger found that there is absolutely no relationship between the founder's level of education and the commercial success of firms in the sample (Utterback and Reitberger, 1982, 62).

Most of the founders had gained sound working experience by

the time they established their firms. Only 10 per cent of the company founders went directly from their university education to the start of their businesses. The median experience of the founders prior to founding their organizations was twelve years which was generally gained in three organizations (Utterback and Reitberger, 1982, 52). Two thirds of the sample had their prior working experience in a manufacturing enterprise. In thirty cases the manufacturing enterprise had more than fifty employees and in ten cases the enterprise had more than 500 employees. In more than 50 per cent of the cases studied, it was found that the new firms were essentially established on the ideas and information gained in prior employment (Utterback and Reitberger, 1982, 53). One to five individuals, in addition to the founders of the enterprise are recruited from the incubating organization. Larger firms in Sweden play a highly creative role in providing technology, people and especially early markets for companies in this sample. These larger firms are generally playing the role that venture capitalists and private sources of equity do in the United States (Utterback and Reitberger, 1982, 7).

Utterback and Reitberger have found that the reasons why entrepreneurs start companies are clearly related to performance. The companies that were established on the base of positive motivations ("To be my own boss.") performed better than did those started from negative motivations ("My job came to an end."). The founders mentioned one main motivating factor in starting their own firm; market opportunities which they perceived in their earlier work and which were not valued or

pursued by their previous employer (Utterback and Reitberger, 1982, 54).

Thirty-nine of the sixty companies in the sample were started by multiple founders. This founding group generally formed their friendships and decision to start a new enterprise while working together in their prior employment. Firms are more likely to be successful if, at the time of forming the firm, the founders represent a range of skills and expertise. This finding was very strongly supported by Utterback and Reitberger's data.

In conclusion, Utterback and Reitberger claim that product technology is a crucial factor in a firm's competitive performance. The fast growing firms in their sample compete on the quality and function capabilities of their products, rather than on price. Having a subsidiary in the United States or Japan characterizes the most rapidly growing and innovative firms in the sample.

3.8 LITVAK AND MAULE: A STUDY OF SUCCESSFUL TECHNICAL ENTREPRENEURS IN CANADA

This study provides empirical data about the characteristics of successful Canadian entrepreneurs, about the characteristics of their firms, and their perception of the environment for entrepreneurship in Canada. The study focuses on 39 entrepreneurs involved in the establishment of one or more technologically-based enterprises in the secondary manufacturing sector. Special emphasis is given to comparing Canadian born

with non-Canadian born entrepreneurs.

The characteristics of the entrepreneurs correspond roughly with those of other studies. At the time the questionnaire was completed in 1971 the average age of the respondent was forty-seven years of age. However, the majority of the entrepreneurs formed their first company from thirty-five to forty years of age. 59 per cent of the respondents held university degrees, all in the fields of science and engineering. The median level of education was the bachelor's degree, with 65 per cent of the respondents having a B.Sc. and 35 per cent achieving a M.A./M.Sc. or better. 39 per cent of the respondents had fathers who were self-employed. 22 per cent of the fathers had a professional and/or managerial background, 27 per cent were in clerical or sales positions, 32 per cent were skilled labourers, 11 per cent were unskilled labourers and 8 per cent were farmers (Litvak and Maule, 1972, 4-9).

The working experience of the entrepreneur has been linked closely to the success of the new firm. The majority of the founders in this study had two or more full-time jobs prior to establishing their firm (Litvak and Maule, 1972, 2-5). The majority of the respondents held professional and managerial positions in the job held prior to founding the firm, approximately 31 per cent of them held clerical and sales positions, 9 per cent were in skilled labour posts, and 6 per cent of them were farmers. Twenty-eight of the thirty-six respondents held their last job prior to founding in Canada, six

in the United States, one in Hungary and one in Sweden (Litvak and Maule, 1972, 4-15). Litvak and Maule identified three skills from the last job that the entrepreneurs found most valuable; managerial capacity, technical competence and financial ability.

Litvak and Maule make the distinction between the reasons given for the founders leaving the previous employer and the motivations for starting their own firm. They identify five reasons for resignation: learned of a market for new ideas; learned of possible financial backing; new breakthrough or new idea; someone decided to join in a venture, and personal conflict in the last job (Litvak and Maule, 1972, 4-32). 83 per cent of the respondents indicated that their former companies would not have allowed them to develop their product idea (Litvak and Maule, 1972, 2-10). There were three features indicated as being the most attractive in starting a first venture: challenge; the freedom to explore new ideas and being one's own boss (Litvak and Maule, 1972, 4-28).

The majority of the firms in the study were established by a group of founders. Only twenty per cent of the founders recruited employees from their previous job. The most frequently used sources of venture capital were personal savings and equity positions taken by small investors. Family/friends and the banks were used to a lesser extent (Litvak and Maule, 1972, 4-37).

One of the main features of previous studies of high technology industry development in Canada is the large role that foreign born entrepreneurs have played. Roughly one third of all

high technology firms included in Litvak and Maule's survey were founded or heavily influenced by foreign born entrepreneurs. The survey revealed that 38 per cent of the entrepreneurs were foreign born. All of the foreign born entrepreneurs came from either Europe or the United States. The non-Canadian born founder was found to be slightly better educated than the Canadian (Litvak and Maule, 1972, 2-2). 48 per cent of the Canadian born entrepreneurs had self-employed fathers as compared to 27 per cent for non-Canadian entrepreneurs. They suggest the reason for this distinction may be that the immigrants from Europe came from a lower socio-economic strata where the likelihood of a father being self-employed is lower, and came to Canada to make a better living (Litvak and Maule, 1972, 2-4). Litvak and Maule claim that having a father who owns his own business greatly influences the timing and motivation an entrepreneur has in establishing his firm. They argue that a founder with a self-employed father would have the entrepreneurial instinct (given the demonstration effect) as his founding motivation rather than being one's own boss or acquiring monetary rewards (Litvak and Maule, 1972, 2-4). However, they found there was no significant difference in founding motivations between Canadian and foreign born entrepreneurs. The differences occurred when analyzing the reasons for leaving the last job. 83 per cent of all respondents felt that their former employer would not have allowed them to develop their projects, while 100 per cent of foreign born respondents felt this way. 6 per cent of Canadian born entrepreneurs cited personal conflict as the reason for leaving their previous job, whereas 19 per cent of the

foreign born claimed the same reason.

Litvak and Maule also made a comparison of jobs held prior to the founding of the firm and the skills acquired through them. Whereas the foreign born entrepreneurs held an average of three jobs prior to founding, the Canadian born had a slightly better than two average. The most frequently cited skills acquired were managerial, technical competence and financial ability. Canadian born founders indicated their experience lay in the managerial and technical competence areas, while the experience of the non-Canadian born was more heavily on the personnel management side (Litvak and Maule, 1972, 2-9).

Canadian respondents tended to be less successful than those born outside of Canada. The term 'successful' in the context of this study was seen as the survival of the entrepreneurial operation during the initial years of its operation (Litvak and Maule, 1972, 1-1). There was a 24 per cent casualty rate for Canadian enterprises as opposed to 9 per cent for those founded by foreign born entrepreneurs. Litvak and Maule cited three reasons for this variance, the first two being the nature of the product being sold and an initial commitment to a specific idea or product. The third reason is related specifically to the initial financial sources of the firm. Both groups used personal savings as a major part of their investment capital, however the foreign born entrepreneurs made much greater use of institutional sources of capital. The third reason cited for the high Canadian casualty rate was the lack of a relationship with

the formal institutional sources of capital (Litvak and Maule, 1972, 2-12).

3.9 CONCLUSION

The literature provides a general consensus as to the nature of high technology entrepreneurship. The entrepreneur usually founds his firm during his mid-30's, a time when he desires a challenge and the chance to be his own boss. Most are well-educated, usually not exceeding a Master's level degree, and are technically oriented. The majority of entrepreneurs have had working experience prior to the founding of their firm, the usual number of jobs being two or three. Many new firms are established by multiple founders. Quite often these founders have met while being employed by a previous firm. In most cases the main source of new firm start-up funds has been personal savings. Little contact is made with government agencies and formal financial institutions.

Technology transfer is instrumental in the spin-off process, as are the incubator organizations from which the technology is acquired. Although the literature does not furnish a corresponding designation of the incubator organization, all agree that it provides the skills, impetus and technology with which to found a firm. The transfer of technology from the incubator organization can take direct, partial or vague forms. Direct and partial technology transfers are evident in the results of several studies, where many of the firms are in direct and indirect competition with their parent organizations. In

most cases entrepreneurs acknowledge that their skills and start-up technology have come from previous employers. The skills most often acquired are those in management and technical areas.

CHAPTER FOUR: OTTAWA'S HIGH TECHNOLOGY ENTREPRENEURS AND NEW FIRMS

4.1- INTRODUCTION

The objective of this chapter is to analyze, on the basis of the questionnaire, the nature of high technology entrepreneurship and new firm formation in Ottawa-Carleton, and to provide comparisons with other relevant studies where applicable. This chapter is divided into three sections: the antecedent influences upon the entrepreneur (founder characteristics); the incubator organization; and the new high technology firm.

4.2 THE ANTECEDENT INFLUENCES UPON THE NEW ENTREPRENEUR

The average age of Ottawa's high technology entrepreneur at the time he founded the firm was 36 years. Thirty-eight entrepreneurs were between the ages of twenty to thirty-four and forty four entrepreneurs were between the ages of thirty-five and sixty-four (Table 4.1). Most were new entrepreneurs, 82 per cent of the sample had not founded a firm previous to the one being examined (Table 4.2). 79 per cent of the twenty to thirty-four year age group were founding their first firm, while 84 per cent of the thirty-five to sixty-four age group were founding their first firm. This finding is comparable to the findings of similar studies conducted in the United States (Roberts, Roberts and Wainer), United Kingdom (Cross), Sweden (Utterback and Reitberger) and Canada (Litvak and Maule).

38 per cent of the respondents' fathers were self-employed (Table 4.3A). The father's occupations were fairly evenly spread

TABLE 4.1

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE FOUNDER'S AGE AT THE TIME OF ESTABLISHMENT

<u>AGE OF FOUNDER</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
20 - 24	2	2.4%
25 - 29	11	13.4%
30 - 34	25	30.5%
35 - 39	21	25.6%
40 - 44	15	18.3%
45 - 49	4	4.9%
50 - 54	2	2.4%
55 - 59	1	1.2%
60 - 64	1	1.2%
TOTAL	82	100.0%

THE MEAN = 35.84 YEARS

Source: author's questionnaire, 1982.

TABLE 4.2

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: FIRST FIRM ESTABLISHED BY
THE FOUNDER

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Yes	67	81.7%
No	15	18.3%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.3A

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-1982: FOUNDER'S FATHER WITH OWN BUSINESS

<u>RESPONSE</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>
YES	31	37.8%
NO	51	62.2%
TOTAL	82	100.0%

Sources: author's questionnaire, 1982.

TABLE 4.3B

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: OCCUPATION OF FOUNDER'S FATHER

<u>OCCUPATION</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>
Farmer	3	3.7%
Blue Collar Unskilled	13	15.9%
Blue Collar Skilled	13	15.9%
White Collar	19	23.2%
Professional	15	18.3%
Other	19	23.2%
TOTAL	82	100.0%

Sources: author's questionnaire, 1982.

over the various occupations with only the farmer category being poorly represented (Table 4.3B). This result is comparable to that of Cross, and Litvak and Maule however it falls short of the fifty per cent level for studies by Roberts, and Roberts and Wainer.

67 per cent of the entrepreneurs surveyed were born in Canada. Of the 33 per cent of foreign born entrepreneurs more than half were born in Great Britain, and a few in the United States (Table 4.4). The entrepreneurs lived in Ottawa an average of 11 years before establishing their firms. The time in Ottawa prior to establishing a firm ranged from as little as eight months to as long as fifty-nine years (Table 4.5).

An important characteristic of the technological entrepreneur is that he is well-educated. All of the entrepreneurs who responded were high school graduates. Approximately seventy-one per cent of the entrepreneurs received their high school training in Canada, three of the foreign born entrepreneurs being included in this figure. The American and British born entrepreneurs went to high school in the country of origin (Table 4.6). These figures roughly correspond to those of Litvak and Maule. 93 per cent of the entrepreneurs held post-secondary diplomas or university degrees. 65 per cent of the respondents held one degree, while 21.95 per cent held two degrees or diplomas (Table 4.7). Seven of the entrepreneurs held a Master's level degree, with only one holding a Ph.D. The area of engineering was by far the largest education group represented, accounting for 50 per cent of the founders surveyed,

TABLE 4.4

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82 FOUNDER'S LOCATION OF BIRTH

<u>COUNTRY</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Canada	55	67.1%
Total Other	27	32.9%
<u>OTHER</u>		
United States	4	4.9%
Great Britain	15	18.3%
Kenya	1	1.2%
Italy	1	1.2%
Romania	1	1.2%
Mexico	1	1.2%
Hungary	1	1.2%
Germany	1	1.2%
Australia	1	1.2%
New Zealand	1	1.2%

Sources: author's questionnaire, 1982.

TABLE 4.5

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE NUMBER OF YEARS THE
FOUNDER LIVED IN OTTAWA PRIOR TO THE ESTABLISHMENT OF HIS FIRM

<u>NUMBER OF YEARS</u>	<u>NUMBER OF RESPONDENTS</u>			<u>PERCENTAGE</u>
	<u>CANADIAN</u>	<u>FOREIGN</u>	<u>TOTAL</u>	
0 - 4	10	11	21	25.6%
5 - 9	11	7	18	22.0%
10 - 14	17	6	23	28.0%
15 - 19	6	2	8	9.8%
20 - 24	2	0	2	2.4%
25 - 29	2	1	3	3.7%
30 - 34	5	0	5	6.1%
35 - 39	2	0	2	2.4%
TOTAL	55	27	82	100.0%

THE MEAN = 11.3 YEARS

Source: author's questionnaire, 1982.

TABLE 4.6

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: WHERE THE FOUNDER RECEIVED HIS HIGH SCHOOL TRAINING

<u>COUNTRY</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Canada	58	70.7%
Total Other	24	29.3%
<u>OTHER</u>		
United States	4	4.9%
Great Britain	15	18.3%
Italy	1	1.2%
Mexico	1	1.2%
Hungary	1	1.2%
Australia	1	1.2%
New Zealand	1	1.2%
Total Respondents	82	

Sources: author's questionnaire, 1982.

TABLE 4.7

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE NUMBER OF DEGREES
AND/OR DIPLOMAS RECEIVED BY THE FOUNDER

<u># OF DEGREES/AREAS</u>	<u># OF ENTREPRENEURS</u>	<u>PERCENTAGE</u>
0	6	7.3%
1	53	64.6%
2	18	22.0%
3	4	4.9%
4	1	1.2%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

the 'other' and technical groups followed behind at 23 per cent and 22 per cent respectively. Six founders in the 'other' group had received no university degree or post-secondary diploma. The arts and business areas were poorly represented, comprising 27 per cent of the total survey. The most common 'other' categories were in the maths and sciences (Table 4.8). Unlike the studies of Roberts, Roberts and Wainer, and Litvak and Maule, (whose entrepreneurs by study design all came from a technical background) this study has entrepreneurs from other backgrounds, including the arts and management areas.

The number of jobs held previously by the entrepreneur sometimes indicates the amount of practical experience he has received, and the tools he has at his disposal at the time of the establishment of his firm. The average number of jobs held by the technical entrepreneurs surveyed was 4. Fifty per cent of the entrepreneurs held from three to four jobs (Table 4.9). For the purposes of this study a job comprises the positions held by the entrepreneur in different firms. This definition corresponds with that used by Cross and Litvak and Maule in their studies. This is slightly higher than the approximately two job average in the survey by Litvak and Maule, but corresponds generally to that of Cross's study of Scottish manufacturing industry.

Prior to the establishment of their first firm 85 per cent of the entrepreneurs held jobs outside of Ottawa (Table 4.10). 90 per cent of the entrepreneurs held their last job in Ottawa previous to establishing their company (Table 4.11). Two thirds of the founders had experience in the high technology sector as

TABLE 4.8

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE AREA IN WHICH THE
FOUNDER RECEIVED HIS UNIVERSITY OR COLLEGE TRAINING

<u>AREA OF DEGREE OR DIPLOMA</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
ENGINEERING	41	50.0%	40.2%
TECHNICAL	18	22.0%	17.7%
BA	7	8.5%	6.9%
COMMERCE	12	14.6%	11.8%
MBA	5	6.1%	4.9%
OTHER	19	23.2%	18.6%
TOTAL RESPONSES	102		100.0%
TOTAL RESPONDENTS	82		

Source: author's questionnaire, 1982.

TABLE 4.9

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE NUMBER OF FULL-TIME JOBS HELD BY THE FOUNDER PRIOR TO THE ESTABLISHMENT OF HIS FIRM

<u>NUMBER OF JOBS</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
0	1	1.2%
1 - 2	22	26.8%
3 - 4	41	50.0%
5 - 6	14	17.1%
7 - 8	3	3.7%
9 - 10	0	0.0%
11 - 12	1	1.2%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.10

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE FOUNDER WORKED OUTSIDE
OF THE OTTAWA AREA IN ANY OF HIS JOBS PRIOR TO THE ESTABLISHMENT OF
HIS FIRM

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Yes	70	85.4%
No	12	14.6%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.11

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE LOCATION OF THE
FOUNDER'S LAST JOB PRIOR TO THE ESTABLISHMENT OF HIS FIRM.

<u>LOCATION</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Ottawa	74	90.2%
Rest of Canada	4	4.9%
United States	3	3.7%
Other	1	1.2%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

the last job before embarking on the road to entrepreneurship (Table 4.12). Very few became entrepreneurs on leaving the federal government. Nearly 10 per cent of the 82 entrepreneurs became founders after a job with the federal government. This is lower than the 34 per cent of the combined founders and co-founders who had worked previously for the federal government.

Whereas most of the entrepreneurs had science or technical degrees, many had also obtained business/management knowledge during the later course of their working career. As can be seen in tables 4.13 and 4.14 the last job with previous employers for a high proportion of entrepreneurs is in management or sales/marketing. Financial and technical skills follow close behind. If one were to look at the educational background of the entrepreneur one would see many entrepreneurs with technical experience, but few with the technical and management experience needed to develop a successful firm (Table 4.15). Table 4.15 presents a uniting of questions 6, 14 and 15 from our study's questionnaire (see Appendix A). These questions comprise the entrepreneur's formal education, the knowledge gained by the entrepreneur during his working career, as well as the experience received during the entrepreneur's last employment. The table is divided into three sections: the entrepreneur's formal education; the entrepreneur's knowledge and experience gained during his working years; and a uniting of the formal and working knowledge of the entrepreneur. Technical and management skills and management skills alone are those most often acquired during the

TABLE 4.12

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE TYPE OF INDUSTRY IN WHICH THE FOUNDER WAS LAST EMPLOYED PRIOR TO THE ESTABLISHMENT OF HIS FIRM

<u>TYPE OF INDUSTRY</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
High Technology	53	64.6%
Federal Government	8	9.8%
Consulting	3	3.7%
Manufacturing (other than high tech)	4	4.9%
Other	14	1.2%
TOTAL	82	100.0%

Sources: author's questionnaire, 1982.

TABLE 4.13

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE SKILLS FROM THE
FOUNDER'S LAST JOB FOUND MOST VALUABLE IN MANAGING HIS FIRST
BUSINESS

<u>SKILL</u>	<u>NUMBER OF</u> <u>RESPONSES</u>	<u>PERCENTAGE</u>	<u>RELATIVE</u> <u>PERCENTAGE</u>
Programming	8	9.8%	5.5%
Sales/Marketing	22	26.8%	15.1%
Management	39	47.6%	26.7%
Production	5	6.1%	3.4%
Financial	16	19.5%	11.0%
Technical	26	31.7%	17.8%
Other	<u>30</u>	36.6%	<u>20.6%</u>
TOTAL RESPONSES	146		100.0%
TOTAL RESPONDENTS	82		

Source: author's questionnaire, 1982.

TABLE 4.14

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE AREAS IN WHICH THE
FOUNDER'S PREVIOUS EMPLOYERS PROVIDED THE MOST EXPERIENCE

<u>SKILL</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
Programming	22	26.8%	11.7%
Sales/Marketing	37	45.1%	19.7%
Management	53	64.6%	28.2%
Production	18	22.0%	9.6%
Financial	23	28.0%	12.2%
Technical	25	30.5%	13.3%
Other	10	12.2%	5.3%
TOTAL RESPONSES	188		100.0%
TOTAL RESPONDENTS	82		

Sources: author's questionnaire, 1982.

TABLE 4.15

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE COMPLEMENTARITY OF THE
ENTREPRENEUR'S WORK AND EDUCATIONAL BACKGROUND

<u>EDUCATIONAL</u> <u>BACKGROUND</u>	<u>NUMBER OF</u> <u>RESPONDENTS</u>	<u>PERCENTAGE</u>
Technical and Management	8	6.97.
Technical	77	66.87.
Management	14	12.17.
No education indicated	5	4.37.
Other	12	10.47.
TOTAL	116	100.007.

<u>WORK</u> <u>BACKGROUND</u>	<u>NUMBER OF</u> <u>RESPONDENTS</u>	<u>PERCENTAGE</u>
Technical and Management	44	37.97.
Technical	21	18.17.
Management	45	38.87.
No education indicated	1	0.97.
Other	5	4.37.
TOTAL	116	100.07.

TABLE 4.15 CONTINUED

<u>WORK AND EDUCATION BACKGROUND COMBINED</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Technical and Management	78	67.2%
Technical	17	14.7%
Management	15	12.9%
No education Indicated	1	0.9%
Other	5	4.3%
TOTAL	116	100.0%

Sources: author's questionnaire, 1982.

working experience segment of an entrepreneur's life. The value of the working experience can be seen by comparing the combined work and education background with that of the educational background. Clearly the management experience gained by the entrepreneur during those working years stands out (for further background see Appendix C).

The motivations for starting a new firm can be separated into two stages; the situation that induced the entrepreneur to leave his former employer and the reason for choosing entrepreneurship as opposed to working for another employer. Ottawa's entrepreneurs had four main reasons for leaving: learned of a market for new ideas; personal conflict in the last job; new breakthrough or new idea; and someone decided to join in venture (Table 4.16). Fifty per cent of the entrepreneurs gave additional reasons for leaving their previous employer, such as the previous employer closed his business, dissatisfaction with the previous employer, and the entrepreneur foresaw an opportunity for a successful business. These findings are similar to those of Cross, Litvak and Maule, and Utterback and Reitberger.

The founders had three main motivating factors to establish their own firms: being own boss - independence; freedom to explore new ideas; and a desire for increased job satisfaction (Table 4.17). Monetary reward inadequacy was a smaller factor in their estimation of motivation. These results are very similar to those obtained by Litvak and Maule, and Cross. Roberts' and Wainer's results remain quite different, probably because of their entrepreneurs' working and educational background.

TABLE 4.16

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE SPECIFIC SITUATION WHICH PRECIPITATED THE FOUNDER LEAVING HIS PREVIOUS EMPLOYER TO START HIS OWN COMPANY

<u>REASONS</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
1. Learned of market for new ideas	22	26.8%	17.7%
2. Learned of possible financial backing	6	7.3%	4.8%
3. Offered position in new enterprise	8	9.8%	6.5%
4. Personal conflict	11	13.4%	8.9%
5. New breakthrough or new idea	16	19.5%	12.9%
6. Someone decided to join in venture	16	19.5%	12.9%
7. Project completed, delayed or dropped	4	4.9%	3.2%
8. Other	41	50.0%	33.1%
TOTAL RESPONSES	124		100.0%
TOTAL RESPONDENTS	82		

Sources: author's questionnaire, 1982.

TABLE 4.17

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: REASONS CONSIDERED SIGNIFICANT BY THE FOUNDER IN HIS DECISION TO FOUND HIS OWN FIRM

<u>REASONS</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
1. Being own boss, independence	56	68.3%	28.4%
2. Monetary reward inadequacy	21	25.6%	10.6%
3. Freedom to explore new areas	52	63.4%	26.3%
4. Desire for increased job satisfaction	56	68.3%	28.4%
5. Other	12	14.6%	6.1%
TOTAL RESPONSES	197		100.0%
TOTAL RESPONDENTS	82		

Sources: author's questionnaire, 1982.

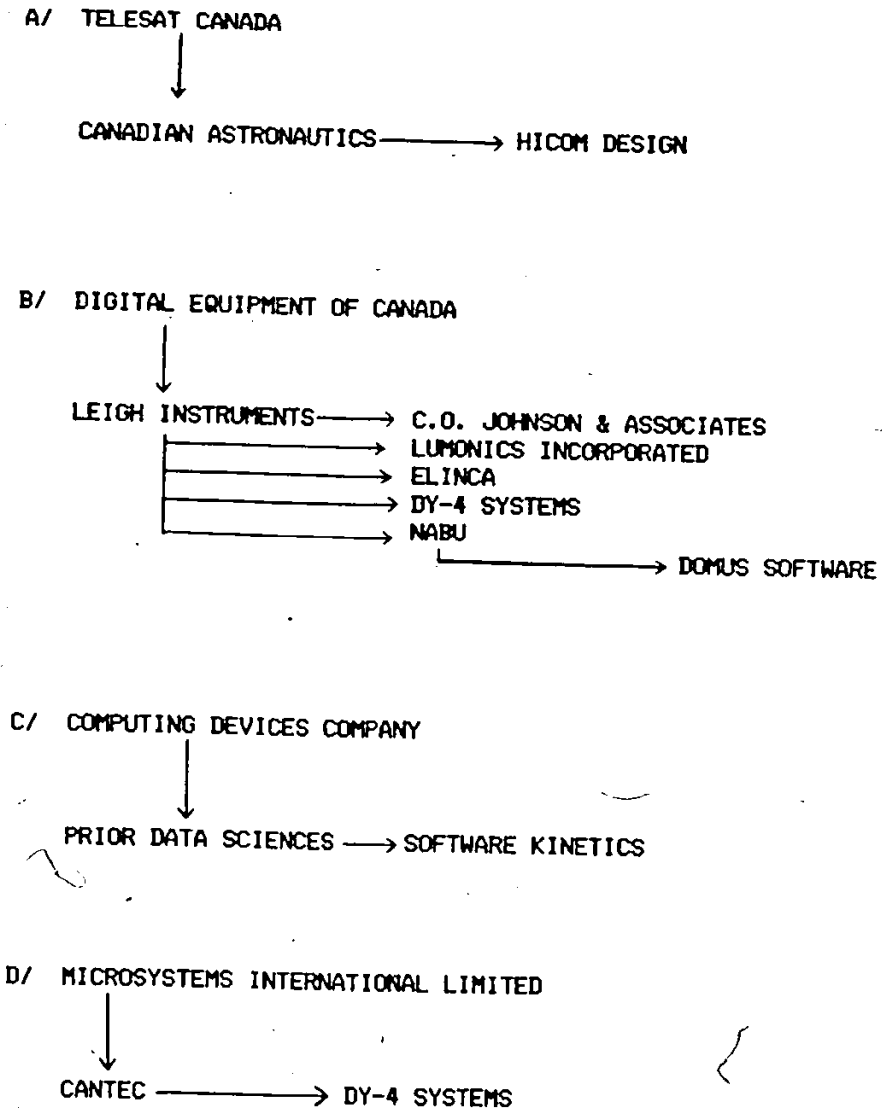
4.3 THE INCUBATOR ORGANIZATION

What is an incubator organization? Quite simply it should be the firm that has played the greatest role in establishing a new firm or spin-off. As seen from the literature review the incubator organization has three primary functions: to provide the entrepreneur with the necessary skills to found and manage a successful firm; to furnish the new firm with a suitable technology; and to provide the impetus to the worker to found a firm. American experience suggests that the spin-offs from an incubator organization may become capable incubator organizations in their own right (Cooper, 1971). Figure 4.1 reveals the success of several of our study's spin-off firms as incubator organizations. In effect, this figure shows the now growing hierarchy of third and fourth generation spin-offs and incubator organizations in the Ottawa area. Information contained in this figure was derived from question nine on the questionnaire (see Appendix A).

The concept of what constitutes an incubator organization is not clear. The incubator organization can be the educational institution the entrepreneur attended (Roberts, Roberts and Wainer), a subjective assessment by the entrepreneur as to the organization he feels contributed the most to the founding of his firm, and lastly, the organization worked for just prior to establishing the new firm (Cooper). For the initial purposes of our study the incubator organization was identified, as by Cooper, to be the last firm worked for previous to founding the high technology firm. We comment below on how satisfactory this

FIGURE 4.1

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: A SPIN-OFF TREE OF THIRD AND FOURTH GENERATION SPIN-OFF FIRMS



Source: author's questionnaire, 1982.

approach is to identifying the incubator organization.

What constitutes a successful incubator organization? The measure of success is usually the size or organizational capacity of the firm. Both Cooper and Johnson and Cathcart using the number of spin-offs per employee as their success measure, found that smaller incubator organizations (fewer than 500 employees) had a greater propensity for spin-offs than did larger firms. In this study of Ottawa-Carleton, 65 per cent of the incubator organizations were involved in the high technology domain (Table 4.18). Due to the omission of a question on the size of the last firm worked for, a spin-off rate could not be calculated for the firms included in the study, and hence the relative propensities of small or larger firms cannot be determined. It is notable that there were no spin-offs from the universities, unlike the example of Sweden, nor from one of Ottawa's largest science and technical organizations, the National Research Council. However, by comparison Cooper also noted the failure as incubators of the non-profit research organizations in Palo Alto.

An assessment of the answer given by the entrepreneurs as to which company provided the most formative experience in leading to the formation of their firm, combined with the information given on the last firm worked for prior to the establishment of the firm, provides some indication as to the success of the incubator organization in providing an impetus to the employee to found his own firm. In 43 per cent of the cases the last employer was identified as the one giving the greatest impetus to

TABLE 4.18

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: INCUBATOR ORGANIZATIONS
IDENTIFIED BY FOUNDERS AND CO-FOUNDERS

<u>NAME OF ORGANIZATION</u>	<u>NUMBER OF RESPONDENTS</u>
Bowmar Canada	2
Computing Devices of Canada	10
Leigh Instruments	7
Systems Approach	2
<u>NORTHERN TELECOM OWNED COMPANIES</u>	15
Northern Telecom	1
Bell Northern Research	4
Microsystems International Ltd.	10
<u>THE FEDERAL GOVERNMENT</u>	17
Federal Government (unspecified department)	1
Department of Public Works	2
Canada Mortgage and Housing Corporation	1
Statistics Canada	1
Department of Energy, Mines & Resources	2
Department of National Defence	1
Transport Canada	1
Agriculture Canada	1
Department of Communications	1
Canadian Radio-Television Commission (Crown Corporation)	2
Telesat Canada (Crown Corporation)	2
Royal Canadian Mounted Police (Government Agency)	2
Total Number of Respondents	53

Source: author's questionnaire, 1982.

entrepreneurship. However roughly 55 per cent of the sample indicated that it was the last employer and the last employer combined with other employers who had given the encouragement to firm formation (Table 4.19). In 7 per cent of the cases the entrepreneur indicated that none of his previous employers had given him the stimulus to found a company. Clearly this evidence raises questions about the supposition by other authors that the incubator organization is the last firm worked for.

In some cases, spin-off firms compete directly with their parent organization, from which they have obtained their technological ideas. The incubator organization is often the source of the technology used in the initial products of the new high technology firm. Sometimes the incubator organization has developed the technology but has chosen not to attempt to commercialize it, so the new firm is not competing with the incubator organization. In this study, 21 per cent of the firms surveyed had their initial product lines directly competitive with their parent organization. 10 per cent of the respondents suggested their firms were indirectly rather than directly competitive with their previous employer (Table 4.20A). The results did not vary significantly as the firms developed subsequent product lines (Table 4.20B).

4.4 NEW FIRM CHARACTERISTICS

Silicon Valley North spawned many new firms in the last five to six years. Roughly 50 per cent of the firms surveyed were founded in the period from 1978 to 1982 inclusively (Table 4.21).

TABLE 4.19

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE EMPLOYER(S) IDENTIFIED BY FOUNDERS AND CO-FOUNDERS AS PROVIDING THE IMPETUS FOR NEW FIRM ESTABLISHMENT

<u>ORGANIZATION</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Last employer	48	42.5%
Last employer and other employers	15	13.3%
Other employers	25	22.1%
No employer	8	7.1%
No response	17	15.0%
TOTAL	113	100.0%

Sources: author's questionnaire, 1982.

TABLE 4.20A

OTTAWA HIGH TECHNOLOGY FIRMS: THE DEGREE TO WHICH A FIRM'S
INITIAL PRODUCT LINE IS COMPETITIVE WITH ITS PARENT FIRM

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Not competitive	57	69.5%
Indirectly competitive	8	9.8%
Directly competitive	17	20.7%
TOTAL	82	100.0%

Sources: author's questionnaire, 1982.

TABLE 4.20B

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE DEGREE TO WHICH A
FIRM'S SUBSEQUENT PRODUCT LINE IS COMPETITIVE WITH ITS PARENT
FIRM

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Not competitive	58	70.7%
Indirectly competitive	8	9.8%
Directly competitive	16	19.5%
TOTAL	82	100.0%

Sources: author's questionnaire, 1982.

TABLE 4.21

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82 THE YEAR OF THE FIRM'S ESTABLISHMENT

<u>YEAR ESTABLISHED</u>	<u>NUMBER OF FIRMS</u>	<u>PERCENTAGE</u>
1966	1	1.2%
1967	0	0.0%
1968	1	1.2%
1969	4	4.9%
1970	1	1.2%
1971	2	2.4%
1972	4	4.9%
1973	2	2.4%
1974	6	7.3%
1975	8	9.8%
1976	6	7.3%
1977	7	8.5%
1978	15	18.3%
1979	8	9.8%
1980	7	8.5%
1981	7	8.5%
1982	3	3.7%
TOTAL	82	100.0%

THE MEAN = 1976.5

Source: author's questionnaire, 1982.

The average age of the firms at the time the survey took place was approximately 7 years.

The high technology industry in Ottawa is characterized by the number of small firms it embraces. Two thirds of the firms surveyed had a total employment level of twenty-five employees or fewer, with only seven firms having 100 employees or more (Tables 4.22A and 4.22B). The high technology community in Ottawa tends to be locally focussed in the sense that 80 per cent of the firms had no employees outside the Ottawa area. Of the fifteen firms that had employees elsewhere in Canada, only three of them had employment levels of twenty-six to one hundred workers (Table 4.22C). Only seven of these fifteen firms had employment outside of Canada.

The number of founders per new firm corresponds roughly to that of Utterback and Reitberger's study results. Approximately one third (38 per cent) of the firms started in the Ottawa area were started by sole founders, and 34 per cent had two founders (Table 4.23). The mean number of founders per new firm was 2. In addition very few of the entrepreneurs recruited people from their previous employment institution (Table 4.24). The average number of recruits was 1. Only one of the founders convinced a significant number of employees to join him in a new venture, and in this the employee response rate was very high as most faced unemployment as the alternative.

Few Ottawa high technology firms compete with firms in Japan, Europe, and 'other' countries. The primary sources of

TABLE 4.22A

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE FIRM'S TOTAL EMPLOYMENT LEVEL IN 1982

<u>SIZE OF FIRM</u>	<u>NUMBER OF FIRMS</u>	<u>PERCENTAGE</u>
1 - 5	23	28.0%
6 - 10	9	11.0%
11 - 25	23	28.0%
26 - 50	13	15.9%
51 - 100	7	8.5%
101 - 200	4	4.9%
201 - 400	2	2.4%
401 - 900	1	1.2%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.22B

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE FIRM'S OTTAWA EMPLOYMENT LEVEL IN 1982

<u>SIZE OF FIRM</u>	<u>NUMBER OF FIRMS</u>	<u>PERCENTAGE</u>
1 - 5	24	29.3%
6 - 10	10	12.2%
11 - 25	24	29.3%
26 - 50	10	12.2%
51 - 100	8	9.8%
101 - 200	4	4.9%
201 - 400	1	1.2%
401 - 900	1	1.2%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.22C

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE FIRM'S LEVEL OF EMPLOYMENT ELSEWHERE IN CANADA IN 1982

<u>SIZE OF FIRM</u>	<u>NUMBER OF FIRMS</u>	<u>PERCENTAGE</u>
0 - 5	75	91.5%
6 - 10	4	4.9%
11 - 25	0	0.0%
26 - 50	1	1.2%
51 - 100	2	2.4%
101 - 200	0	0.0%
201 - 400	0	0.0%
401 - 900	0	0.0%
TOTAL	82	100.00%

Sources: author's questionnaire, 1982.

TABLE 4.23

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE NUMBER OF FOUNDERS INVOLVED IN THE ESTABLISHMENT OF THE FIRM

<u>NUMBER OF FOUNDERS</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
1	31	37.87
2	28	34.17
3	14	17.17
4	7	8.57
5	0	0.07
6	2	2.47
TOTAL	82	100.07

Mean number of founders = 2.06

Source: author's questionnaire, 1982.

TABLE 4.24

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE NUMBER OF PEOPLE THE
FOUNDER RECRUITED TO LEAVE HIS PREVIOUS EMPLOYER AND JOIN HIS
COMPANY IN ITS FIRST YEAR OF EXISTENCE

<u>NUMBER OF RECRUITS</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
0	56	68.3%
1	6	7.3%
2	8	9.8%
3	6	7.3%
4	2	2.4%
5	3	3.7%
6 - 9	0	0.0%
10 - 19	0	0.0%
20 - 29	1	1.2%
TOTAL	82	100.0%

THE MEAN = 1.03 RECRUITS

Sources: author's questionnaire, 1982.

competition appear to be from firms in the United States, foreign subsidiaries based in Canada, and Canadian domestic firms (Table 4.25). However, the firms vary significantly in the number of key competitors they face. Three indicated they effectively have a monopoly, with no key competitors. Nearly half face only from one to five key competitors. The median number of key competitors was in the three to five firm range (Table 4.26). The average number of key competitors was 7.

The majority of the firms surveyed were initially financed by the personal savings of the founder, a result comparable to that of the studies of Utterback and Reitberger, Cross and, Litvak and Maule. The extent of government financial assistance for start-up is of interest. Very few of the founders had direct assistance from the federal or provincial governments, in fact most government involvement was in the form of contracts (Tables 4.27, 4.28A and 4.28B). No firm listed venture capital firms as a source of start-up investment funds and only five had any bank support.

New firms are often perceived to take several years to achieve profitability. Not so in the case of these Ottawa entrepreneurs. More than fifty per cent of the firms studied claimed they achieved profitability within the first year of existence; only nine firms indicated it took them three or more years (Table 4.29). 88 per cent of the firms reported their net earnings as positive for 1982, which was a dismal business year for most Canadian industries (Table 4.30). Approximately 50 per cent of the high technology companies stated that their

TABLE 4.25

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE FIRM'S KEY SOURCES OF
COMPETITION AS IDENTIFIED BY THE FOUNDER

<u>IMPORTS FROM</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
United States	39	47.6%	31.7%
Japan	9	11.0%	7.3%
Europe	2	2.4%	1.6%
Other	3	3.7%	2.4%
<u>DOMESTIC FROM</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
Foreign-owned firms	21	25.6%	17.1%
Canadian-owned firms	49	59.8%	39.8%

A TOTAL OF 123 RESPONSES FROM 82 FIRMS

Source: author's questionnaire, 1982.

TABLE 4.26

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE FIRM'S NUMBER OF KEY COMPETITORS AS IDENTIFIED BY THE FOUNDER

<u>NUMBER OF FIRMS</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
0	3	3.77.
1 - 2	10	12.27.
3 - 5	31	37.87.
6 - 9	14	17.17.
10 - 14	24	29.37.
TOTAL	82	100.07.

THE MEAN = 6.6 FIRMS

Sources: the author's questionnaire, 1982.

TABLE 4.27

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE SOURCE OF START-UP INVESTMENT FUNDS

<u>METHOD OF FINANCE</u>	<u>NUMBER OF RESPONSES</u>	<u>PERCENTAGE</u>	<u>RELATIVE PERCENTAGE</u>
Personal savings	68	82.9%	55.3%
Other private sources	21	25.6%	17.1%
Federal Government programs or assistance	8	9.8%	6.5%
Provincial Government programs or assistance	6	7.3%	4.9%
Assistance from previous employer	5	6.1%	4.1%
Other	15	18.3%	12.2%
TOTAL RESPONSES	123		100.0%
TOTAL RESPONDENTS	82		

Source: author's questionnaire, 1982.

TABLE 4.28A

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE ROLE OF THE FEDERAL GOVERNMENT IN THE ESTABLISHMENT OF THE FIRM

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
No role	63	76.8%
Played a role	19	23.2%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.28B

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE ROLE OF THE PROVINCIAL GOVERNMENT IN THE ESTABLISHMENT OF THE FIRM

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
No role	75	91.5%
Played a role	7	8.5%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

TABLE 4.29

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE NUMBER OF YEARS TO
ACHIEVE PROFITABILITY SINCE THE FOUNDING OF THE COMPANY

<u>NUMBER OF YEARS</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
0 - 1.0	50	61.0%
1.1 - 2.0	16	19.5%
2.1 - 3.0	7	8.5%
3.1 - 9.0	9	10.9%
TOTAL	82	100.0%

THE MEAN = 1.5 YEARS

Sources: author's questionnaire, 1982.

TABLE 4.30

OTTAWA HIGH TECHNOLOGY FIRMS 1965-82: THE FIRM'S 1982 NET EARNINGS

<u>RESPONSE</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Positive	72	87.8%
Zero or Negative	10	12.2%
TOTAL	82	100.0%

Sources: author's questionnaire, 1982.

profit performance for 1981/82 was average in relation to that of their main competitors. Very few thought their performance was below that of their competition (Table 4.31).

4.5 CONCLUSION

Ottawa's high technology entrepreneurs are well educated, the majority of them holding a bachelor level degree in engineering or a technical diploma. The entrepreneur generally founds his firm when he reaches his mid-thirties, after he has worked for three or four firms in a variety of locations. A founder is usually motivated to establish his own firm by the urge for increased independence and job satisfaction, as well as the freedom to explore new ideas. These antecedent characteristics of Ottawa's new firm founders correspond closely with those furnished by other studies. The prominence of those with technical educations and experience is evident.

The function of an incubator organization is three fold; to provide the entrepreneur with the skills, technology and impetus with which to found a firm. Ottawa's incubator organizations provided most entrepreneurs with technical and management skills, in some cases the only management skills a founder brought with him to his new firm. Direct technology transfer is evident in approximately thirty per cent of the new firms, as they tend to be directly or indirectly competitive with their parent organizations. Vague transfer is assumed in the remaining seventy per cent, given the entrepreneurial acknowledgement of skills provided by the incubator organization. Although the

TABLE 4.31

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82, THE FIRM'S PROFIT
PERFORMANCE IN 1981/82 IN RELATION TO ITS MAIN COMPETITORS

<u>RATING</u>	<u>NUMBER OF RESPONDENTS</u>	<u>PERCENTAGE</u>
Above	28	34.1%
Average	43	52.4%
Below	11	13.4%
TOTAL	82	100.0%

Source: author's questionnaire, 1982.

impetus to found a new firm is given by the incubator organization, the institution that constitutes the incubator organization is still in doubt. Fewer than fifty per cent of the entrepreneurs surveyed identified the last firm worked for as the one that provided the greatest impetus to found his firm. This raises questions about the supposition by other authors that the incubator organization is the last firm worked for.

Ottawa's high technology industry can be characterized by its many small and recently founded firms. Many firms have been founded by a group of founders. A third recruited employees from their most recent employer(s). There are many high technology firms in the R.M.O.C. that are local in nature, with few having employees outside the Ottawa area. They compete mainly with other North American firms. A small minority of firms compete with those from Japan and Europe. Most founders, as studies in other areas have reported, initially financed their firms with personal savings. Few had federal or provincial government assistance. An interesting, and perhaps surprising, measure of their success is that more than fifty per cent of the firms studied claimed they achieved profitability within the first year of existence.

CHAPTER FIVE? HYPOTHESES AND RELATIONSHIPS

5.1 INTRODUCTION

The purpose of this chapter is to discuss the hypotheses and relationships surrounding new firm formation and technical entrepreneurship. The elements considered are: the antecedent influences upon the entrepreneur; co-founding versus sole entrepreneurship; foreign born entrepreneurship; total employment and above competitor ratings by the entrepreneur as measures of success; and the development and differentiation of new firm formation and technical entrepreneurship between the years 1965 and 1982. This chapter will also attempt to compare the results of our study with those studies mentioned in Chapter Three.

5.2 THE ANTECEDENT INFLUENCES UPON THE ENTREPRENEUR

As has been seen in the preceding chapters, there are a number of major influences upon the entrepreneur that influence his founding a firm: his parental background; his educational background; and his work background. It is the founder's age at the time of founding, the motivations that led him to found a firm, and his parental background that we are primarily concerned with in this section. The influence of the founder's work and educational background will be discussed in later sections as they relate to different elements of new firm formation and technical entrepreneurship.

5.21 The Age of the Entrepreneur

The age of the entrepreneur has been said to affect the motivations behind the establishment of the firm. Cross in his study of Scottish entrepreneurs states that the average age of the entrepreneur should be expected to be an indicator of how the ranking of motivations could change. Likewise, Roberts, in his study of Route 128 firms in Boston, found that the age of the entrepreneur affects the level of technology transfer from the incubator organization to the new firm. Age could also affect the level of experience an entrepreneur brings to a new firm, as older entrepreneurs are more likely to have held more jobs and have had wider ranging experiences. The age of the entrepreneur may also affect the composition of the new firm; the initial start-up financing, the number of founders, as well as the number of recruits from the previous employer. The main question to be addressed however is whether the age of the entrepreneur has any bearing on the success of the new firm.

Our study indicates that the ages of the entrepreneurs are split in roughly equal proportions above and below the age of thirty-five. The educational backgrounds of these groups are broadly similar. 45 per cent of the below thirty-five age group and 55 per cent of the above thirty-five age group had engineering backgrounds, revealing a chi-squared statistic of 0.78 which allowed the rejection of the null hypothesis at the fifty per cent level. The results from the rest of the chi-squared tests concerning age and educational background were broadly similar, allowing for the rejection of the null hypothesis at the fifty and ninety per cent levels.

Do older entrepreneurs establish firms with a different composition than those of the under thirty-five category? The older age group showed a greater tendency toward sole entrepreneurship, with 46 per cent of the above thirty-five group founding firms by themselves. Only 29 per cent of the younger age group fell into this category. Likewise 71 per cent of the younger age group were involved in co-founding ventures with 55 per cent of the above thirty-five group falling into this classification. No direct relationship between these elements could be determined however as the null hypothesis of the chi-squared test had to be rejected at the fifty per cent level (one degree of freedom(d.f.), chi-squared statistic= 2.36). The number of recruits from the previous employer remained minimal in both cases, with 66 per cent of the below thirty-five group and 71 per cent of the above thirty-five group recruiting no one from their previous employer. The sources of initial investment funds was broadly similar between the two groups, with both relying heavily on their personal savings (1 d.f., chi-squared statistic=8.25E-02, level of rejection = ninety per cent).

Does the older entrepreneur bring more experience and knowledge to the new firm? Surprisingly no relationship could be found between the age of the entrepreneur and the number of full-time jobs he held previous to founding his firm. The null hypothesis had to be rejected at the fifty per cent level with the chi-squared statistic, with three degrees of freedom (3 d.f.) equal to 3.07. The older age group did show a much stronger tendency to have worked outside the Ottawa area on a full-time job previous to founding the firm. The null hypothesis was

accepted in this case as it could only be rejected at the five per cent level (1 d.f., $\chi^2=4.64$). The range of skills brought from the entrepreneur's previous jobs was much the same, although the younger group was slightly better represented in the programming area, while the older group had precedence in the management and financial areas. It should also be mentioned that the percentage of founders under thirty-five years of age founding their first firm was approximately the same as that for founders over thirty-five (1 d.f., $\chi^2=.36$, the level of rejection=90 per cent).

As mentioned in a preceding paragraph, the motivations of an entrepreneur could vary with age. Cross states in his study of Scottish entrepreneurs that the age of thirty-five indicates that the entrepreneur wants to start his own business before it becomes impossible to do so. No differentiation of motivations could be determined by analysis of the data of our study. No last minute plunge by entrepreneurs before "it is too late" was indicated by the data. The desire to increase job satisfaction (1 d.f., $\chi^2=1.97$, level of rejection=50 per cent) was approximately the same for the above and under thirty-five age groups, as were all of the other motivations and specific events precipitating the entrepreneur to leave his employer and start his own firm.

Roberts, in his study on technical entrepreneurship on Route 128, discovered a negative correlation between the older entrepreneur and the level of technology transferred from the

incubator organization to the new firm. He claims this is one of the elements of the technical obsolescence phenomenon. As an engineer or technician gets older his ability to keep abreast technically of what is going on in research and development declines. Although our study has no specific measure of technology transfer, a chi-squared test was performed to see if those firms that were founded by older entrepreneurs were more inclined to be directly competitive with their parent organization. A cross-tabulation revealed that a higher percentage of entrepreneurs belonging to the below thirty-five age group had their initial product line directly competitive with that of their parent organization. The chi-squared test results were with two degrees of freedom, 5.90, the level of rejection at the 10 per cent level. Subsequent product line competition with the parent company was approximately the same, with the level of rejection at the 50 per cent level.

Is the age of the entrepreneur a contributing factor to the success of the firm? Five variables of success were examined with respect to the age of the entrepreneurs: the level of total employment; the number of years to profit; the net earnings for 1982; the employment elsewhere in Canada; and rating the firm above its competitors. The level of total employment was similar for those in the above and below thirty-five age groups (2 d.f., $\chi^2=2.29$, level of rejection=50 per cent). This remains true for the other measures of success, all reaching the 50 per cent level of rejection, except the above competitors rating which had a χ^2 of $1.30E-04$ and landed in the 99.5 per

cent region of rejection. It can therefore be concluded that the age of the entrepreneurs (within the context of our study) had no influence on the success their firms.

5.22 The Self-Employed Father

The self-employed father is seen as an important element in the molding of an entrepreneur. Roberts and Wainer feel that the father having his own business would pass on important entrepreneurial traits and information, that those entrepreneurs coming from families without self-employment influence would lack. As the self-employed father advocates less formal education and greater working experience, it is thought that those founders with self-employed fathers would have had a greater number of full-time jobs previous to founding a firm, and perhaps be slightly younger at the time of founding than those without self-employed fathers. It would also be expected that founders with self-employed fathers would acquire some formal business training, in addition to the practical training they would experience during their working career. Likewise, those founders who have the help of a self-employed father's business contacts and information would be more likely to explore the other avenues of investment, the banking institutions, as well as the various government assistance programmes. The motivations of the founder with the self-employed father may be slightly different, as they might be more interested in the business aspects of owning a firm, rather than the freedom to explore new ideas or similar motivations that might be more important to the technician trying to develop his own ideas. One would think that

the entrepreneur with the self-employed father would be more successful, with useful business knowledge already to hand.

Our study data reveals that the work and education backgrounds of those entrepreneurs with self-employed fathers differs with those without self-employed fathers in two areas. Only 32 per cent of those entrepreneurs with self-employed fathers had an engineering degree, compared with 61 per cent of entrepreneurs without fathers with businesses. A chi-squared test revealed that a relationship between these two elements exists (1 d.f., $\chi^2=6.28$, level of rejection= 2.5 per cent). Of interest was the fact that none of the entrepreneurs with self-employed fathers had a Master's degree in Business Administration. The lack of an engineering degree by founders with self-employed fathers may be a result of the father steering his son into more business-connected areas, however there is no concrete evidence to substantiate this theory. The absence of Masters of Business Administration supports the theory that founders with self-employed fathers would be encouraged to acquire practical working business knowledge, rather than "waste" time in an academic institution. Despite the fact that self-employed fathers would advocate practical experience above formal education, entrepreneurs with self-employed fathers did not hold any more jobs than those without self-employed fathers (3 d.f., $\chi^2=4.53$, level of rejection= 50 per cent). Similarly those entrepreneurs with fathers who had their own business did not found their firms at an earlier age.

Are the motivations of an entrepreneur with a self-employed father any different from an entrepreneur without a self-employed father? The data reveals that having a self-employed father is not a contributing factor to the motivations involved in founding a firm. All of the chi-squared results fell into the fifty or ninety per cent level of rejection. The results were similar for those reasons indicated by the entrepreneur for leaving his previous employer, except for one: whereas 28 per cent of the entrepreneurs without self-employed fathers indicated 'someone decided to join in venture' as a reason for leaving their previous employer, only 7 per cent of entrepreneurs with self-employed fathers indicated this as a reason to leave the previous employer. The chi-squared test revealed that there was a relationship between these two elements (1 d.f., chi-squared=5.41, level of rejection 2.5 per cent). This result appears to indicate that an entrepreneur with a self-employed father reacts more to his own initiative, rather than to that of others. Surprisingly, with this fact in mind, a chi-squared test did not reveal a relationship with entrepreneurs with self-employed fathers to sole-founding.

The initial sources of investment for firms with founders who have self-employed fathers did not vary significantly with those of other firms. Personal savings dominated both categories as an initial source of investment, with entrepreneurs with self-employed fathers using personal savings slightly more. However no relationship could be determined by a chi-squared test (1 d.f., chi-squared =2.69, level of rejection= 50 per cent). As in other

cases the level of government support remained minimal.

Using the various measures of success, nothing could be found to indicate that entrepreneurs with self-employed fathers are more successful than those without. The number of years to profitability revealed no differences between the two groups, nor did the level of total employment, employment elsewhere in Canada, the net earnings for 1982, and the firm rated above its competitors.

5.23 The Influence of Founding Motivations

Utterback and Reitberger in their study of Swedish entrepreneurs have revealed a very strong relationship between the founding motivations of the firm and its ultimate success. The motivating factors of our study's entrepreneurs do not appear to bear a strong relationship to the success of the firm. Chi-squared tests were performed on the reasons given by the entrepreneurs for starting their own firms versus the measures of success already mentioned in this chapter. The founding motivations included were: being own boss-independence; monetary reward inadequacy; freedom to explore new areas; advancement; desire for increased job satisfaction; and other (the most prominent other reason was that of the alternative of unemployment versus self-employment). All of the chi-squared statistics derived from this test were rejected at either the fifty or ninety per cent level, hence the information derived from this study's data did not substantiate Utterback and Reitberger's findings.

5.3 CO-FOUNDING

New firms can be founded by single founders and by groups of founders. Previous studies have shown that more group founded firms than sole founded firms have been successful, as a group of individuals can better represent the range of skills and expertise that are needed to run a company (Utterback and Reitberger). It is the purpose of this section to contrast the success and structure of the sole and co-founding firm. If the complementarity of skills inherent in a co-founding firm exists, then does the co-founding firm achieve profitability at a faster rate, and measure higher on the other scales of success? Does the co-founding firm have a greater number of people working for it? Likewise is the method of initial investment more diverse with co-founding groups having more economic sources to tap? In short, it seems likely that the co-founding firm should be more successful as it starts with so much more than the sole-founding firm; more initial investment funds, a greater range of skills and a wider range of talent to choose from.

Cooper in his study of Silicon Valley entrepreneurs argues that more often than not new firms are founded by co-founders with a complementary background, insofar as one founder has a technical background and the other a management background. In this study a co-founding firm is defined as one in which two or more of the founders has responded to the questionnaire. Only six of the twenty-four firms with co-founders had entrepreneurs with a technical and management education background, 58 per cent

of the firms were founded by partners who both (or all where there were more than two) had technical backgrounds (Table 5.1). Only two of the co-founders involved with these firms both had a technical and management educational background, and thirty-eight (69 per cent) had only a technical education. Of the fifty-five co-founders involved in the study 36 indicated that they had a technical and management background after they combined their work and educational experience. This finding does not appear to be significantly different to the combined work and education background of the sole founders, among whom 65 per cent had a technical and management education/work background (Table 5.2). Clearly a third of both sole and co-founding firms seem to be lacking management or technical expertise among the founders, showing the co-founding firm to be immediately no better off in the range of founder's skills than the sole-founding firm.

Quite often a technical team will leave an organization in order to exploit their ideas, ideas that their present employer does not deem marketable (Litvak and Maule, 1973, 65). This study offers no strong evidence to support this point. Only eight of the entrepreneurs surveyed displayed dissatisfaction with their previous employer and four had their project completed, delayed or dropped. Of the twenty-four firms with a co-founding response, eleven firms had founders who did not work for the same company previous to founding. Only three firms that had a full co-founder response had founders that came from the same parent firm (Table 5.3).

As the level of complementarity of skills in co-founding

TABLE 5.1

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE ENTREPRENEURIAL WORK
AND EDUCATION BACKGROUND FOR CO-FOUNDING FIRMS AND THEIR CO-
FOUNDERS

A/ EDUCATION AND WORK BACKGROUND FOR FIRMS

<u>EDUCATION</u>	<u>NUMBER OF FIRMS</u>	<u>PERCENTAGE</u>
Technical and Management	6	25.0%
Management	0	0.0%
Technical	14	58.3%
Other	4	16.7%
TOTAL	24	100.0%

<u>WORK</u>	<u>NUMBER OF FIRMS</u>	<u>PERCENTAGE</u>
Technical and Management	15	62.5%
Management	5	20.8%
Technical	1	4.2%
Other	3	12.5%
TOTAL	24	100.0%

B/ EDUCATION AND WORK BACKGROUND FOR CO-FOUNDERS

<u>EDUCATION</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	2	3.6%
Management	7	12.7%
Technical	38	69.1%
Other	8	14.6%
TOTAL	55	100.0%

TABLE 5.1

EDUCATION AND WORK BACKGROUND FOR CO-FOUNDERS CONTINUED

<u>WORK</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	19	34.6%
Management	23	41.8%
Technical	10	18.8%
Other	3	5.8%
TOTAL	55	100.0%

<u>EDUCATION AND WORK BACKGROUND</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	36	65.5%
Management	7	12.7%
Technical	9	16.4%
Other	3	5.5%
TOTAL	55	100.0%

Sources: author's questionnaire, 1982.

TABLE 5.2

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: THE ENTREPRENEURIAL WORK
AND EDUCATION BACKGROUND FOR SOLE FOUNDERS

<u>EDUCATION</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	2	6.5%
Technical	17	54.9%
Management	5	16.1%
No education	4	12.9%
Other	3	9.7%
TOTAL	31	100.0%

<u>WORK BACKGROUND</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	14	45.2%
Technical	7	22.6%
Management	8	25.8%
None	1	3.2%
Other	1	3.2%
TOTAL	31	100.0%

<u>WORK AND EDUCATION BACKGROUND</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	20	64.5%
Technical	4	12.9%
Management	5	16.1%
Other	2	6.5%
TOTAL	31	100.0%

Sources: author's questionnaire, 1982.

TABLE 5.3

OTTAWA HIGH TECHNOLOGY FIRMS, 1965-82: CO-FOUNDERS FROM THE SAME INCUBATOR ORGANIZATION

FIRMS WITH FULL CO-FOUNDER RESPONSE

<u>NUMBER OF FOUNDERS</u>	<u>NUMBER OF FIRMS</u>
All founders	1
Three founders	1
Two founders	1
All from different incubator organizations	2
TOTAL	12

FIRMS WITHOUT FULL CO-FOUNDER RESPONSE

<u>NUMBER OF FOUNDERS</u>	<u>NUMBER OF FIRMS</u>
Four founders	1
Three founders	0
Two founders	7
All from different incubator organizations	4
TOTAL	12

Sources: author's questionnaire, 1982.

ventures remains roughly similar to that of a sole-founding firm, it is not surprising that they resemble each other in many other ways. Only three differences could be detected during the course of the analysis of sole versus co-founding firms. Co-founding firms are more heavily dominated by engineers, or founders with engineering degrees. 61 per cent of co-founding firms had founders who were engineers while 32 per cent of sole-founding firms were started by engineers (1 d.f., chi-squared= 6.28, level of rejection = 2.5 per cent). Co-founders had more experience in the 'other' skills category for the last job, 49 per cent of co-founders as opposed to 16 per cent of sole founders. The 'other' skill is basically comprised of personnel management skills. Lastly, co-founding firms used more provincial government programmes and assistance than did sole-founding firms, during their initial investment period. None of the sole founding firms used the provincial government programmes while 12 per cent of the co-founding firms made use of these programmes (1 d.f., chi-squared= 3.94, level of rejection 5.0 per cent).

The data and analysis surrounding co-founding firms seems to indicate that co-founding firms are no more successful than their sole founding counterparts, except perhaps in obtaining provincial government assistance. Approximately 90 per cent of both co-founding and sole-founding firms had positive net earnings for 1982. Co-founding firms achieved profitability slightly faster with 83 per cent of them achieving profitability within their first two years as opposed to 73 per cent for sole founding firms. Neither co-founding or sole founding firms appear to have many employees elsewhere in Canada. 94 per cent of sole-

founding firms have from zero to ten employees elsewhere in Canada, with 98 per cent as the corresponding proportion for co-founding firms. Similarly, about thirty-five per cent of co-founding and sole founding firms argued their profit performance was above their competitors. At first glance co-founding firms appear to be no better represented in the category of larger firms (2 d.f., $\chi^2 = .64$, level of rejection = 90 per cent). However when the co-founding category is broken down into individual categories, there is a positive relationship between the size of the firm and the number of co-founders (6 d.f., $\chi^2 = 12.65$, level of rejection = 5 per cent).

5.4 CANADIAN AND FOREIGN BORN ENTREPRENEURSHIP

One of the main features of Ottawa's high technology industry development is the large role that foreign born entrepreneurs have played. 33 per cent (27) of the entrepreneurs in this survey were foreign born. This percentage of foreign born entrepreneurs is quite high. Only twelve per cent of the entrepreneurs in Utterback and Reitberger's Swedish study were foreign born. Foreign entrepreneurship has not been significant enough in the United States to warrant its attention in new firm formation and technical entrepreneurship studies. What kind of influence has this foreign born element had on Ottawa's high technology development? As established by Litvak and Maule in their study of technological entrepreneurship in Canada, the foreign born entrepreneur has been as successful as the Canadian entrepreneur in the Canadian market. What have been the

contributing factors to this success? The aim of this section is to discuss the elements of foreign born entrepreneurship and to pinpoint any significant differences in its composition.

The parental background of the foreign entrepreneur does not vary greatly from that of the Canadian entrepreneur. 30 per cent of foreign born entrepreneurs had self-employed fathers in comparison to 42 per cent for Canadian entrepreneurs. All of the entrepreneurs who had listed their father's occupation as ~~farmer~~ were Canadian. Blue collar skilled and blue collar unskilled were evenly represented between the two groups. 29 per cent of Canadian entrepreneurs had fathers in white collar position. Only 11 per cent of foreign born entrepreneurs had fathers in this category (1 d.f., $\chi^2=3.29$, level of rejection = 10 per cent). Foreign born entrepreneurs were more likely to have fathers in the professional category than Canadian entrepreneurs, 30 per cent of foreign born entrepreneurs had professional fathers compared to 13 per cent for Canadian entrepreneurs (1 d.f., $\chi^2=3.46$, level of rejection 10 per cent). The high percentage of professional fathers may have contributed to the mobility of their sons.

The foreign born entrepreneurs, one third of all the entrepreneurs, have come from a number of places, the United States (5 per cent) and the United Kingdom (18 per cent) representing the majority (Table 4.4). There was no significant difference found between foreign-born and Canadian-born entrepreneurs in the levels of education achieved (number of degrees/diplomas). However it is interesting to note that the

only entrepreneur holding a Ph.D. is foreign born. 67 per cent of all foreign born entrepreneurs had an engineering degree as opposed to 42 per cent of all Canadian entrepreneurs (1 d.f., $\chi^2=4.48$, level of rejection = 5 per cent). The technical and 'other' categories were equally well represented, with approximately 20 per cent of both Canadian and foreign born entrepreneurs holding degrees or diplomas in these areas. The Commerce, B.A. and M.B.A. areas were poorly represented overall, and equally poorly by both foreign and Canadian born entrepreneurs.

Approximately 75 per cent of foreign entrepreneurs held from zero to four jobs prior to the founding of their firms. This did not differ significantly from Canadian born entrepreneurs (3 d.f., $\chi^2=.75$, level of rejection = 90 per cent). 96 per cent of foreign entrepreneurs worked outside the Ottawa area on one of their jobs prior to founding, compared to 80 per cent for Canadian born entrepreneurs (1 d.f., $\chi^2=3.85$, level of rejection 5 per cent). 82 per cent of foreign born entrepreneurs held their last job prior to founding in Ottawa, which is lower than the 95 per cent for Canadian entrepreneurs (1 d.f., $\chi^2=3.51$, level of rejection 10 per cent). Those who held their last job in the United States were all foreign born (1 d.f., $\chi^2=6.34$, 2.5 per cent level of rejection). Only five entrepreneurs held jobs in the rest of Canada or 'other'. The high technology industry was the most common last job category, 67 per cent of foreign born entrepreneurs and 64 per cent of Canadian entrepreneurs indicated this as the category to

which their last job belonged. Surprisingly 15 per cent of foreign born entrepreneurs held their last position in the federal government, whereas only 7 per cent of Canadian entrepreneurs fit into this category (1 d.f., chi-squared= 1.17, fifty per cent level of rejection). Consulting, manufacturing and 'other' categories were equally poorly represented by foreign and Canadian born entrepreneurs.

Respondents were also asked about skills acquired through any previous jobs and the last job prior to founding. 33 per cent of Canadian entrepreneurs acquired financial skills during the course of their pre-founding career, whereas only 19 per cent of foreign born entrepreneurs acquired these skills (1 d.f., chi-squared= 1.81, level of rejection = 50 per cent). Foreign born entrepreneurs acquired more programming (Canadian born 22 per cent, foreign born 37 per cent, 1 d.f., chi-squared= 2.14, level of rejection = 50 per cent) and technical skills (Canadian born 27 per cent, foreign born 37 per cent, 1 d.f., chi-squared= 0.82, level of rejection 50 per cent) from their working careers than did Canadian entrepreneurs. No differentiation could be made in any of the other skills acquired during all of the previous jobs. Canadian entrepreneurs (33 per cent) acquired more sales and marketing skills from their last job than did their foreign counterparts (15 per cent) (1 d.f., chi-squared= 2.96, level of rejection 10 per cent). Canadian born entrepreneurs were the only ones to acquire production skills (9 per cent). 41 per cent of foreign born entrepreneurs acquired technical expertise from their last job, whereas only 27 per cent of Canadian

founders acquired technical skills (1 d.f., chi-squared 1.52, level of rejection 50 per cent). It appears that foreign born entrepreneurs acquire more skills in the technical area during their careers prior to founding, while Canadian born entrepreneurs acquire business management skills.

What specific situation precipitates the foreign born entrepreneur to leave his previous employer and start a new firm? 64 per cent of the foreign entrepreneurs as opposed to 43 per cent of Canadian entrepreneurs left their previous employer due to 'other' reasons (1 d.f., chi-squared=2.71, level of rejection 10 per cent). These 'other' reasons were more often than not the closure of the previous owner's business. 26 per cent of Canadian entrepreneurs left their previous employer because they were asked to join in a venture. Only 7 per cent of foreign born entrepreneurs left for this reason (1 d.f., chi-squared= 3.76, level of rejection 5 per cent). Likewise 13 per cent of Canadian entrepreneurs left their previous employer because they were offered a position in a new enterprise, whereas only 4 per cent of foreign born entrepreneurs offered this reason. These two results seem to indicate that Canadian entrepreneurs are more likely to band together and start a firm, leaving foreign born entrepreneurs to found their own firm and find their own collaborators (often foreign born as well).

Do Canadian born entrepreneurs have different motivations than their foreign born counterparts to start their own firm? Being one's own boss, the freedom to explore new areas, and

increased job satisfaction are the three most popular motivations for starting a firm. No differentiation could be made between foreign born and Canadian born entrepreneurs with respect to these motivations. Inadequacy of monetary reward appeared to be a more prominent motivation amongst those entrepreneurs who are foreign born (37 per cent) as opposed to those who were born in Canada (20 per cent) (1 d.f., $\chi^2 = 2.76$, level of rejection 10 per cent). This motivation differentiation may be due to the foreign entrepreneur coming from a relatively lower income family background.

Canadian and foreign born entrepreneurs founded their firms in roughly the same pattern as for the sample as a whole. Very few founded their firms during the years 1966 to 1971 (13 per cent of Canadian entrepreneurs, 7 per cent of foreign born entrepreneurs). 36 per cent of Canadian founders and 48 per cent of foreign born founders established their firms during the period 1972-77. Approximately half of the firms established by Canadian entrepreneurs were founded from 1978 to 1982, with 44 per cent of foreign born firms in this category. No χ^2 relationship could be found between the entrepreneur's country of birth and the year he founded a firm (2 d.f., $\chi^2 = 1.25$, level of rejection = 90 per cent). At the time of founding 66 per cent of foreign born entrepreneurs had spent from zero to nine years in Ottawa. Approximately 68 per cent of Canadian born entrepreneurs had spent from zero to fourteen years in Ottawa prior to founding. In general Canadian born entrepreneurs spent longer in Ottawa prior to founding their firm than did their

foreign counterparts (7 d.f., chi-squared = 9.02, level of rejection 50 per cent). No difference could be found between the foreign and Canadian born age at the time of founding (1 d.f., chi-squared = 5.29, level of rejection = 95 per cent). Approximately 45 per cent of each group were between the ages of twenty and thirty-four when they founded their firm. Likewise the number of founders at the time of founding remained approximately the same for both foreign born and Canadian born firms (3 d.f., chi-squared = 3.47, level of rejection 50 per cent).

Canadian respondents in Litvak and Maule's 1972 study tended to be less successful than their foreign counterparts a factor they related to primarily to the initial source of investment. Litvak and Maule found that foreign born entrepreneurs tended to take greater advantage of formal banking institutions, as well as government programmes and assistance. Foreign entrepreneurs in our study did not take any greater advantage of formal lending institutions or federal or provincial programmes than their Canadian counterparts. Both parties relied heavily on their personal savings as a form of initial firm investment (78 per cent of foreign born and 86 per cent of Canadian born). Foreign entrepreneurs (11 per cent) used former employers as a source of funds more often than Canadian entrepreneurs (4 per cent), however this was not a major source of investment funds (1 d.f., chi-squared = 1.77, level of rejection 50 per cent). Both parties used other private sources to the same degree (1 d.f., chi-squared = 0.24, level of rejection 90 per cent). The role of the

federal and provincial governments remained minimal in both cases.

More than fifty per cent of both Canadian and foreign born entrepreneurs have between three and fourteen key competitors. Foreign born firms had slightly higher representation in the three to five competitor category with a response rate of 42 per cent, whereas 30 per cent of Canadian firms fell into this category. Canadian firms had a marginally higher representation in the six to nine competitor category, with a response rate of 22 per cent, foreign born firms had a 15 per cent response rate in this category. On the whole Canadian and foreign born entrepreneurs share the same proportion of key competitors (4 d.f., chi-squared = 2.92, level of rejection 90 per cent). Of the sources of competition mentioned in our study's questionnaire (see Appendix A), Canadian owned domestic firms seem to be the greatest source of competition for both the foreign born and Canadian born firms in the Ottawa area. 52 per cent of the firms of foreign born entrepreneurs compete with Canadian owned domestic firms, while 64 per cent of firms with Canadian born entrepreneurs experience this source of competition (1 d.f., chi-squared = 1.05, level of rejection 50 per cent). The firms of the foreign born entrepreneurs (33 per cent) compete at a slightly higher level with foreign owned domestic firms than do those of Canadian born entrepreneurs (22 per cent) (1 d.f., chi-squared = 1.26, level of rejection 50 per cent). The firms of Canadian and foreign born entrepreneurs competed on an equal basis with imports from American companies (approximately 45

percent). Competition with Japanese and European imports remained minimal in both cases. The firms of the foreign born entrepreneurs were the only ones to compete with imports from 'other' countries (1 d.f., chi-squared = 6.34, level of rejection 2.5 per cent). It is also interesting to note that the firms of foreign born and Canadian born entrepreneurs competed in the same fashion with their previous employers with respect to their initial product lines (2 d.f., chi-squared = 0.18, level of rejection = 95 per cent) and their subsequent product lines (2 d.f., chi-squared = 1.17, level of rejection = 90 per cent).

Are foreign born entrepreneurs more successful than their Canadian born counterparts? Approximately 90 per cent of both foreign born and Canadian born firms had their net earnings positive for 1982 (1 d.f., chi-squared = 4.42E-02, level of rejection = 90 per cent). 37 per cent of foreign born entrepreneurs rated their firm above those of their competitors, compared to 33 per cent of Canadian born firms (1 d.f., chi-squared = 0.15, level of rejection 90 per cent). 60 per cent of both foreign born and Canadian born entrepreneurs took one year or less after founding to achieve profitability. The only firm that took from 6 to ten years to achieve profitability was established by a foreign born entrepreneur (4 d.f., chi-squared = 3.96, level of rejection 50 per cent). Canadian born entrepreneurs have started more firms with a total employment of one to ten employees (47 per cent) than foreign born entrepreneurs (22 per cent), while foreign born entrepreneurs are much more strongly represented in the 11 to 50 employee category

(63 per cent foreign born, 35 per cent Canadian born). Foreign and Canadian born entrepreneurs had firms that were equally well represented in the 51 to 900 employee category. A relationship between where an entrepreneur is born and the size of his firm has been revealed by not only the cross-tabulation of data but the chi-squared test as well (2 d.f., chi-squared = 6.36, level of rejection = 5 per cent). Foreign born and Canadian born entrepreneurs have 95 to 100 per cent of their firms with zero to ten employees elsewhere in Canada.

5.5 TOTAL EMPLOYMENT: A MEASURE OF SUCCESS?

The aim of this section is first to reveal the characteristics of three levels of firms size measured by total employment for firms in the Ottawa area—those with one to ten employees, eleven to fifty employees, and fifty-one to nine hundred employees. Secondly, to determine whether larger firms are indeed more successful on the basis of other measures than their smaller counterparts.

Our study is comprised of thirty-two firms in the 1 - 10 employee category (herein referred to as category one), 36 in the 11 - 50 category (category 2) and 14 in the 51 to 900 category (category 3). 81 per cent of the firms in category one were founded by Canadian born entrepreneurs, 53 per cent in the second category and 71 per cent in the third category. It can be seen that the foreign born entrepreneurs are disproportionately represented in the second category (2 d.f., chi-squared = 6.36, level of rejection 5 per cent). This finding is quite similar to

that revealed in the preceding section. The age of the entrepreneur at founding is not significantly different between the three employment categories, although older entrepreneurs are slightly better represented in the one and three categories (2 d.f., chi-squared = 2.29, level of rejection = 50 per cent). Those entrepreneurs involved in the founding of larger firms have spent fewer years in Ottawa previous to their founding (14 d.f., chi-squared = 21.92, level of rejection = 10 per cent).

Analysis involving the education of the entrepreneur does not reveal any startling differences between the categories of total employment. Engineers tended to be involved in the founding of larger firms (71 per cent) and more poorly represented in the medium sized category (39 per cent), however no definitive relationship could be found between this type of education and a larger firm (2 d.f., chi-squared = 4.47, level of rejection 50 per cent). Entrepreneurs with both technical and B.A. qualifications had equal representation between the three employment categories. It is noteworthy that no entrepreneur holding a Master's in Business Administration or a degree in Commerce was involved in the founding of a category three firm. Those entrepreneurs with 'other' education were most strongly represented in the category two firms (33 per cent), however no relationship could be derived for this type of education and the size of the firm's total employment (2 d.f., chi-squared = 3.73, level of rejection 50 per cent).

The number of full-time jobs an entrepreneur holds prior to the founding of his firm seems to vary slightly with the size of

the firm. Approximately 75 per cent of those founders involved in category one firms held from zero to four jobs prior to founding, 72 per cent of those in category two held the same number of jobs, whereas 93 per cent of those entrepreneurs in category three held between zero and four jobs (6 d.f., chi-squared = 7.39, level of rejection 50 per cent). Approximately 85 per cent of all entrepreneurs held a job outside of Ottawa while holding one of his full-time jobs. Roughly 90 per cent of all entrepreneurs held their last job prior to founding in the Ottawa area. High technology firms, the federal government and 'other' category were equally represented as last job areas throughout the three employment categories. The very few entrepreneurs that worked as consultants before the founding of their firms are represented in the one and two categories of employment. Entrepreneurs with a manufacturing work background were only involved with those firms with a category two level of employment (2 d.f., chi-squared = 5.37, level of rejection 10 per cent).

The skills acquired by entrepreneurs during their last job and other jobs do not vary widely among the three employment categories. During the course of their careers, those entrepreneurs with a firm in the category three employment level had much greater technical experience than did those in the other two categories (2 d.f., chi-squared = 6.77, level of rejection 5 per cent). They also seem to have acquired more experience in the 'other' area as well (2 d.f., chi-squared = 4.25, level of rejection = 10 per cent). Those entrepreneurs that obtained programming experience in their last job were more

closely related to the founding of category one firms. In fact not one is represented in the category three employment level (2 d.f., chi-squared = 8.85, level of rejection 2.5 per cent). Category three firms tend to have more entrepreneurs with management experience in their last job (64 per cent as opposed to 41 per cent for category one firms, and 47 per cent for category two firms) (2 d.f., chi-squared = 2.19, level of rejection = 50 per cent).

Do the reasons for leaving⁴ the previous employer and starting a firm vary with the size of the firm the founder establishes and builds? Those firms in the first and third categories were started because their founders learned of possible financial backing, none of those entrepreneurs who started firms in the second category left their previous employer for this reason (2 d.f., chi-squared = 5.11, level of rejection 10 per cent). Those firms in the two larger categories had their founders leave their previous employers because of a new breakthrough or idea, in both cases thrice the percentage of those firms in category one (2 d.f., chi-squared = 3.52, level of rejection 50 per cent). The other reasons for leaving a previous employer remain for the most part equitably distributed throughout the three employment level groups. The same holds true for most of the reasons given for starting one's own firm, however the freedom to explore was much more prevalent in the category one and two firms (approximately 65 per cent for both, as compared to 43 per cent for category three firms). The desire for increased job satisfaction was more common among those

entrepreneurs involved in category one firms (81 per cent), with category two and three firms hovering around the sixty per cent mark (2 d.f., chi-squared = 4.14, level of rejection = 50 per cent). The motivations of advancement and monetary reward inadequacy remained minimal in all cases.

The majority of Ottawa's high technology firms have been founded within the last five to ten years. Category three firms were founded for the most part during the years 1966 to 1977, however category one and two firms appear to be founded much more recently (4 d.f., chi-squared = 13.16, level of rejection = 2.5 per cent). Larger firms (Category 3) have been founded predominantly by a group of founders rather than a sole founder (6 d.f., chi-squared = 12.65, level of rejection = 5 per cent). Firms with an employment level of from 51 to 900 employees also tend to employ more recruits from their founders' previous employers than do the lower employment groups (6 d.f., chi-squared = 12.51, level of rejection = 10 per cent).

Have the larger firms taken greater advantage of government programmes and assistance for their source of initial investment or have they relied as heavily on personal savings as the smaller firms? Federal and provincial programmes and assistance were not used very often for initial sources of investment by small companies, nor by larger companies. Provincial programmes and assistance have been slightly more popular than their federal counterparts, however they still remain minor sources of investment. A higher per cent of category three firms have used

the programmes operated by the provincial government than category one and two firms (2 d.f., chi-squared = 5.11, level of rejection = 10 per cent), whereas federal programmes and assistance are used on an equal basis in all three firm employment categories (2 d.f., chi-squared = 0.85, level of rejection = 90 per cent). Personal savings appeared to be used more often in the start-up of category one and two firms (84 and 89 per cent respectively), than in the start-up of category three firms (64 per cent) however the chi-squared result indicates that this relationship is not overly strong (2 d.f., chi-squared = 4.39, level of rejection = 50 per cent). The part that other forms of start-up funds played in the establishment of the firm remain minimal and equally so in all three firm employment categories.

The start-up role of the federal and provincial governments was at a minimum for the firms included in our study's sample. In most cases the government involvement has consisted of giving the firm a contract and/or providing a market. 36 per cent of the category three firms indicated the federal government played a role, whereas only 25 per cent of category two firms and 16 per cent of category one firms indicated so (2 d.f., chi-squared = 2.33, level of rejection = 50 per cent). The role of the provincial government was even smaller with only 14 per cent of category three firms indicating any involvement, 8 per cent of category two firms and 6 per cent of category one firms (2 d.f., chi-squared = 0.81, level of rejection = 90 per cent).

Does the number of key competitors and their source vary with the total employment of the firm? The number of key competitors does not seem to vary to any great extent between the three employment categories, although the only firms to indicate that they have no competition were in category one and two. Approximately 45 per cent of category one and two firms claim they compete with US imports, as opposed to 65 per cent of category three firms (2 d.f., chi-squared = 1.90, level of rejection 50 per cent). Category three firms compete more often with Japanese firms than do the other employment categories, however this is still in a small capacity (21 per cent of category three firms, as opposed to 8 and 9 per cent respectively for category one and two firms) (2 d.f., chi-squared = 1.91, level of rejection = 50 per cent). The level of competition with imports from Europe and 'other' places is quite low and no real distinction can be made between the three employment categories. 50 per cent of category three firms compete with foreign owned domestic firms, as opposed to 28 per cent of category two firms and 13 per cent of category one firms (2 d.f., chi-squared = 7.35, level of rejection = 5 per cent). It appears to be the smaller to medium size firms that compete with other Canadian owned domestic firms. Approximately 65 per cent of category one and two firms compete in this manner compared to 29 per cent of category three firms (2 d.f., chi-squared = 6.99, level of rejection = 5 per cent).

Are larger firms more likely to be competitive with their parent firms than their smaller counterparts are? The answer is no. 85 per cent of category three firms are not competitive with

their parent firms in terms of both their initial and subsequent product lines. This compares to 63 per cent for category one firms and approximately 70 per cent for category two firms. On the whole very few firms in the sample compete directly with their parent firms. However those that compete directly with their initial product lines, also compete with their subsequent product lines. The data indicate that the larger the firm the less likely it was in direct competition with its parent firm, but this relationship is not very strong statistically (initial product lines: 4 d.f., chi-squared = 7.76, level of rejection = 50 per cent) (subsequent product lines: 4 d.f., chi-squared = 3.97, level of rejection = 50 per cent).

Several of the measures of success seem to indicate that the larger firms have been more successful. Approximately 93 per cent of both category two and category three firms had their net earnings positive for 1982, compared to only 78 per cent of category one firms (2 d.f., chi-squared = 4.62, level of rejection 10 per cent). 90 per cent of category three firms had achieved profitability within their first two years of existence, compared to 84 per cent of category two firms and 68 per cent of category one firms (8 d.f., chi-squared = 9.68, level of rejection = 50 per cent). Only category three firms had more than ten employee elsewhere in Canada, while 100 per cent of category one and two firms had from zero to ten employees elsewhere (the majority of whom had zero) (4 d.f., chi-squared = 15.12, level of rejection 0.5 per cent). Lastly, larger firms more often rated themselves above their competitors in terms of

their profit performance (43 per cent, compared to 36 per cent for category two firms and 28 per cent for category three firms). However no strong relationship was revealed in the analysis (2 d.f., chi-squared = 2.21, level of rejection 50 per cent).

5.6 PORTRAIT OF THOSE FIRMS RATED 'ABOVE' THEIR COMPETITORS WITH RESPECT TO THEIR PROFIT PERFORMANCE

The outstanding features of those firms who rated themselves above their competitors with respect to their profit performance will be commented upon in this section. Omitted are those characteristics (variables) which did not help to differentiate the 'above' rated group from its below and average counterparts. In general, the discussion will concern the attributes of the entrepreneur, his motivations to leave his former employer and start his own firm, and the qualities of the firm which has rated its profit performance above that of its competitors.

Twenty eight of the eighty-two firms surveyed for this study rated themselves above their competitors in terms of their profit performance. 54 per cent of these firms were started from 1978 to 1982, with only ten per cent founded between 1966-71. Eleven of the firms were founded by sole founders, with an even distribution among the other rankings of co-founders. 46 per cent of the firms were founded by entrepreneurs between the ages of 20 and 34, with the remaining percentage represented by those 35 years of age or older. 64 per cent of the founders associated with this firm ranking were Canadian born.

What particular characteristics can we associate with the

entrepreneur who has established a firm in the above rated category? 36 per cent of those entrepreneurs with education in the 'other' (maths and sciences) category can be associated with 'above' firms compared to 17 per cent for those firms ranked average and below (1 d.f., chi-squared = 3.76, level of rejection = 10 per cent). Engineers on the other hand are much more poorly represented in this category with a 36 per cent share, as opposed to 64 per cent for below/average firms. The 'above' entrepreneur has held more jobs prior to the founding of the firm (3 off., chi-squared = 19.04, level of rejection 0.5 per cent). Within these jobs the 'above' entrepreneur has acquired more financial experience (39 per cent) than his below/average counterpart (22 per cent) but less technical knowledge (18 per cent for 'above' entrepreneurs and 37 per cent for below/average entrepreneurs).

The entrepreneurs who rated their firms as above their competitors had motivations that emphasize creativity and individuality. 36 per cent of the 'above' entrepreneurs left their previous employer because of a new breakthrough, or new idea, whereas only 11 per cent of those connected with below/average firms indicated this reason (1 d.f., chi-squared = 7.11, level of rejection = 1.0 per cent). Personal conflict was also a more common reason among those in the above category (21 per cent of 'above' entrepreneurs cited this reason as opposed to 9 per cent of the below/average entrepreneurs) (1 d.f., chi-squared = 2.35, level of rejection = 50 per cent). The freedom to explore was more often given as the motivation to start a new firm among the 'above' group (71 per cent) (1 d.f., chi-squared =

1.18, level of rejection = 50 per cent).

What characteristics can be linked with the firm that is rated by its founder as having profitability above its competitors? Analysis reveals that there is no significant difference between the sources of initial investment used by the 'above' firm and those used by below and average groups (all chi-squared tests could be rejected at the 90 per cent level). There also appears to be no significant difference between the groups with respect to total employment (2 d.f., chi-squared = 2.21, level of rejection = 50 per cent) and especially the level of employment elsewhere in Canada (2 d.f., chi-squared = 0.74, level of rejection 90 per cent). The 'above' rated group has fewer competitors; as 65 per cent of the 'above' firms had from zero to five competitors compared with 45 per cent of below/average firms (4 d.f., chi-squared = 24.55, level of rejection 0.5 per cent). 57 per cent of the 'above' firms compete with US imports, while only 43 per cent of average/below firms compete with them (1 d.f., chi-squared = 1.57, level of rejection = 50 per cent). 'Above' groups also compete more often with Japanese imports (18 per cent of 'above' group and 7 per cent of average/below group) (1 d.f., chi-squared = 2.06, level of rejection = 50 per cent). Canadian owned domestic firms are more competitive with those firms rated average/below (65 per cent) than with those in the 'above' rated category (50 per cent). The 'above' group is more often directly competitive with its parent firm than the average/below group, both in terms of their initial product line (2 d.f., chi-squared = 28.08, level of rejection 0.5 per cent).

and their subsequent product line (2 d.f., $\chi^2 = 27.93$, level of rejection 0.5 per cent).

5.7 THE HIGH TECHNOLOGY FIRM AND TECHNICAL ENTREPRENEURSHIP: A CHANGE THROUGH THE YEARS?

The aim of this section is to determine whether there are distinct differences in technical entrepreneurship and the new high technology firms formed at different times during the years encompassed by our study. The seventeen year period has been divided into three sections; 1966-71 (herein known as category one), 1972-77 (category two) and 1978 to 1982 (category three). Are there differences between these categories in terms of the level of government involvement; the source of start-up funds for the firm; the formal and working educations of the entrepreneur; and the level and source of competition? It is to these and other issues that this section will address itself.

The category representing the greatest number of firms is category three - forty firms (49 per cent) were founded during this period of time, approximately half of the study sample. Thirty-three firms were founded in category two (40 per cent) and only nine founded in category one (11 per cent). 78 per cent of the firms in category one were founded by Canadian entrepreneurs, 61 per cent in category two and 70 per cent in category three. The firms in category one tended to be established by older entrepreneurs, 78 per cent of the entrepreneurs who established firms in this time period were thirty-five years of age or older. Only 55 per cent of entrepreneurs in category two were in this age bracket and 48 per cent of category three entrepreneurs (2

d.f., chi-squared = 2.73, level of rejection 50 per cent). The number of years an entrepreneur lived in Ottawa prior to founding his firm does not seem to have changed through the years (14 d.f., chi-squared = 6.33, level of rejection 97.5 per cent). More entrepreneurs were founding their first firm in the first two categories, with approximately 88 per cent first time founders. 75 per cent of category three entrepreneurs were first time founders (2 d.f., chi-squared = 2.36, level of rejection = 50 per cent).

The type of formal education an entrepreneur acquires prior to founding does not appear to have changed significantly through the years. It was expected that more entrepreneurs would have a management or business background, as the popularity and availability of these courses have increased over the years. The only MBA graduates appear in the last two categories, with the majority of them in the third category (2 d.f., chi-squared = 2.19, level of rejection = 50 per cent). The percentage of Commerce graduates is evenly spread between the three categories. Fewer engineers were represented during the 1978-82 category (40 per cent) than in the first (56 per cent) and second categories (61 per cent) (2 d.f., chi-squared = 2.73, level of rejection = 50 per cent). The 'other' education category (maths and sciences) has become more highly represented in the last category.

No divergence can be detected between the categories of last employment prior to founding and the year in which the firm was

founded, however the skills acquired during the working career of the entrepreneur do appear to have changed. Programming in particular seems to be a skill acquired more frequently by those who have founded their firm during the period 1978-82. This is probably due to the increasing role that computers play in the high technology industry. 38 per cent of entrepreneurs in the third category had programming as a part of their working experience, compared to 18 per cent of category two entrepreneurs and 11 per cent of category one entrepreneurs (2 d.f., chi-squared = 4.71, level of rejection = 10 per cent). Financial experience was represented primarily by those in the first category. The degree of experience gained by the entrepreneur in the other areas offered (see Appendix A) was approximately the same throughout the three categories.

The entrepreneurs' motivations and reasons for leaving previous employment and starting a firm have largely remained stable. Possible financial backing and new breakthrough or idea was more common in category three than the other categories. 13 per cent of the entrepreneurs in category three indicated possible financial backing as their reason for leaving their previous employer compared with 0 per cent for category one (2 d.f., chi-squared = 3.19, level of rejection = 50 per cent). 28 per cent of category three entrepreneurs said a new breakthrough, or idea had caused them to leave their previous employer. This is compared to 11 per cent of category one founders and 12 per cent of category two founders (2 d.f., chi-squared = 3.18, level of rejection 50 per cent). Advancement was a very strong motivation

for establishing a firm for category one entrepreneurs, 33 per cent of them indicated this motivation, whereas only 6 per cent of category two and 8 per cent of category three founders mentioned this reason (2 d.f., chi-squared = 6.43, level of rejection = 5 per cent). 'Other' reasons to start a firm was also more common among those in category one, with 33 per cent of them indicating this as one of their motivations, compared to 21 per cent of category two and 5 per cent of category three founders (2 d.f., chi-squared = 6.63, level of rejection = 5 per cent).

The source of start-up funds does not differ much between the three categories but federal and provincial programmes and assistance have played a lesser role with more recent newcomers. 22 per cent of the firms founded in category one's time period used some form of federal programmes and/or assistance, only 9 per cent of category two firms and 8 per cent of category three firms used this source for initial investment (2 d.f., chi-squared = 1.84, level of rejection = 50 per cent). Similar results were obtained for provincial programmes and assistance. Personal savings have remained the primary source of start-up funds for all three categories as have private sources. 'Other' sources of investment (banks, venture capitalists) were used primarily by those firms in the 1966-71 category (2 d.f., chi-squared = 1.82, level of rejection = 50 per cent).

The proportion of firms indicating the federal government played a role in their establishment varied more substantially over the study's time framework, ranging from 44 per cent of category one firms to 27 per cent for category two firms and to

15 per cent for firms founded between 1978 and 1982 (2 d.f., chi-squared = 4.10, level of rejection = 50 per cent). By contrast the role of the provincial government did not differ between categories, as approximately 10 per cent of the firms in each category indicated that government had played some role in their formation.

Firms founded during the latter two time periods are slightly more competitive with their parent firms, than are their category one counterparts. Not one of category one's firms had its initial or subsequent product line directly competitive with its parent firm. Approximately twenty to twenty-five per cent of category two and three firms are directly competitive (initial product lines: 4 d.f., chi-squared = 4.13, level of rejection = 50 per cent)(subsequent product lines: 4 d.f., chi-squared = 4.42, level of rejection = 50 per cent).

Are those firms founded earlier more likely to be successful? The net earnings for 1982 reveal that approximately 90 per cent of firms in all three categories had achieved positive net earnings for 1982 (2 d.f., chi-squared = 0.60, level of rejection = 90 per cent). The data reveal that it has taken those firms founded between the years 1972 and 1982 longer to achieve profitability, particularly those founded between 1972 and 1977 (8 d.f., chi-squared = 8.35, level of rejection = 50 per cent). Roughly 30 to 35 per cent of the firms in each category rated themselves above their fellow competitors in terms of their profit performance (2 d.f., chi-squared = 0.42, level of

rejection = 90 per cent). Those firms founded between the years 1966 and 1971 have the largest total employment levels, as well as the greatest number of people working elsewhere in Canada (total employment: 4 d.f., chi-squared = 13.12, level of rejection = 1.0 per cent) (employment elsewhere in Canada: 4 d.f., chi-squared = 12.07, level of rejection = 2.5 per cent).

5.8 CONCLUSION

Technology transfer forms a critical component of spin-offs and new firm formation, and its existence is presumed irrespective of its form: direct, partial, vague or "non-transfer". Roberts' theory of technological obsolescence is to some degree substantiated by our study. Whereas younger entrepreneurs (under 35) are more often in direct competition initially with their parent organization and have acquired technical knowledge from previous employers, older entrepreneurs (over 35) acquire more management, financial and personnel skills. Roberts claims that older entrepreneurs are less able to keep abreast of technological developments, but our study indicates the reason for this may be due to increasing management responsibility as an employee advances in a firm. Technology transfer, therefore, should not be seen as inversely related to age. Our study suggests instead that its character evolves along with the maturity of the entrepreneur.

This thesis has found the size of the firm and the subjective rating of the firm's profit performance to be the most revealing indicators of new high technology firm success. An analysis of those firms that had their profit performance rated

above that of their competitors, emphasized the necessity for new high technology firm founders to have a solid educational and working background, as well as a creative faculty for managing and developing new technology. These entrepreneurial prerequisites did not appear in the examination of any of the other success measures. The success of the larger firm is indicative of the synergy created by the greater number of founders and recruits involved at the time of founding, its employment elsewhere in Canada and its sources of competition. Most of the larger firms were founded in the earlier years of our study's time frame, their ability to survive has been a critical factor leading to their growth and increasing importance. Our study and supporting high technology literature indicate that survival should not be regarded only as a necessary ingredient for success, but as a measure of success. Given this measure, most of our study's firms can to some extent be seen as successful.

The success of the firm does not appear to be affected significantly by the antecedent influences upon the entrepreneur. Although a few specific characteristics seem to be associated with larger firms and/or those whose entrepreneur had rated them 'above' their competitors in terms of their profit performance, there was not one outstanding characteristic that could be associated with an entrepreneur who has founded and created a successful firm. Likewise a composite picture of a successful entrepreneur could not be constructed on the basis of our data and analysis. Foreign entrepreneurship has been the main

discriminant of technical entrepreneurship in our study. Foreign entrepreneurs are: more technically oriented than their Canadian counterparts, both in their work and educational backgrounds; slightly more international in scope, as revealed by their working careers and their firm's sources of competition; and more closely associated with medium to large size firms.



CHAPTER SIX: CONCLUSION

Many regions have looked toward high technology development as a panacea for their development problems. Thus, the high technology industry development in the Ottawa area is of interest in part because of its scale and recent occurrence. There are some notable large firms such as Northern Telecom, Digital Equipment and Computing Devices, but most of Ottawa's high technology firms are small and have been founded within the last fifteen years. Many firms have been founded by a group of founders. The firms are local in nature with few having employees outside the Ottawa area. North American firm competition is prevalent, a minority of firms competing with those from Japan and Europe. Most founders initially financed their firms with personal savings. Few had federal or provincial government assistance. More than fifty per cent of the firms studied claimed they achieved profitability within their first year of existence.

What can we conclude about the nature of Ottawa's technical entrepreneurs and the form of the spin-off process? Ottawa's high technology entrepreneurs are well educated, the majority of them holding a bachelor level degree in engineering or a technical diploma. Unlike other studies (whose entrepreneurs by study design all come from a technical background) this study has entrepreneurs from other backgrounds, usually co-founders with an arts and management background. The entrepreneur generally founds his firm when he reaches his mid-thirties after he has worked for three or four firms in variety of locations. The

majority of the entrepreneurs had working experience in the high technology sector before embarking on the road to entrepreneurship. Ottawa's entrepreneurs had four main reasons for leaving their previous employer: learned of a market for new ideas; personal conflict in the last job; new breakthrough or new idea; and someone decided to join in venture. Fifty per cent of the entrepreneurs gave additional reasons for leaving their previous employer, and of these the closure of a previous employer's business was most often cited. Ottawa's new firm founder is usually motivated to establish his own firm by the urge for increased independence and job satisfaction, as well as the freedom to explore new ideas. These antecedent characteristics correspond closely with those furnished by other studies.

The role of a substantial number of foreign born entrepreneurs has been the main discriminant of technical entrepreneurship in this study. Although many of the foreign born and Canadian born entrepreneurial characteristics are similar, there are a few important areas where they differ. Foreign born entrepreneurs are more technically oriented than their Canadian counterparts with more of them having an engineering degree and acquiring technical expertise at work. Canadian born entrepreneurs are more managerial in nature, acquiring more sales and marketing skills in their last job than did foreign born entrepreneurs, and were the only ones to acquire production skills. Foreign born entrepreneurs are slightly more international in scope as revealed by their working careers and

their firm's sources of competition. A relationship between where an entrepreneur is born and the size of his firm was revealed, with foreign born entrepreneurs being more closely associated with medium to large size firms. The foreign born entrepreneur's technical and international orientation can be seen as an advantage in overseas competition and innovation become more critical in the high technology industry.

Unlike other studies, this thesis could not identify a clear characteristic profile of a successful entrepreneur. Statistical tests found no association between any of the entrepreneurial characteristics and measures of firm success. The provision of a composite picture of a successful entrepreneur by other studies may be due in part to their differing study environments, objectives and sampling procedures. Several of the studies were interested in identifying entrepreneurs and firms arising from a single or controlled set of incubator organizations. This constraint would to a certain extent homogenize the characteristics of an entrepreneur and enable the investigator to provide a more clearly defined entrepreneurial portrait. Different study environments may also provide varying cultural, financial and infra-structural constraints. These constraints could result in differing entrepreneurial attitudes, opportunities, and chances for the spin-off firm to succeed.

This thesis does not provide conclusive evidence as to which institutions may be considered the incubator organizations. Our study results confirmed the important role of the last employer in many high technology firm start-ups; however a number of

founders either excluded it or named it in conjunction with other employers as being the most influential in the founding of their firm. Although there are varying opinions on the subject, probably the best definition of an incubator remains as the institution that contributes the most to an entrepreneur and his spin-off firm. In order to determine this institution, a more exhaustive study than the one conducted here is needed, with a more thorough examination of the entrepreneur's work history, the technology his new firm markets and his subjective assessment of incubator contributions. A further study would also help to ascertain the degree to which an area's growth can be considered indigenous.

This thesis has identified a pattern of spin-offs, with three initial major incubator organizations, Computing Devices, Northern Telecom and its related firms, and the federal government. A hierarchy of incubator organizations has emerged from this initial pattern of spin-offs, which now reaches into the third and fourth generation. This incubator hierarchy supports the supposition that it is the growing high technology enterprises that are the most efficient incubators. It is not surprising to see the participation of Computing Devices and Northern Telecom and its related companies as incubator organizations, for both have been based in Ottawa for a considerable period of time and have significant research facilities.

The participation of the federal government as an incubator organization is of interest, as several studies have found that

the role of a government is usually secondary in nature, supporting and encouraging research in an area, rather than providing the generic technology that is usually associated with commercial marketability. There was not one main government department from which the new firms spun-off, making the nature of the technology transferred difficult to assess, in many cases the founder had been in a computer-related position. Although the universities and National Research Council don't act as incubator organizations they are still important to the surrounding high technology companies, as they can provide both skilled personnel and selective applied and generic technology.

In view of the emphasis on indigenous growth and high technology industry in modern regional development theory and practice, an interesting question arises: how indigenous is indigenous growth? One third of the entrepreneurs who started the high technology companies in Ottawa's TOC were born outside of Canada, and went to high school in their country of birth. Moreover, some of the technology that is being utilized by the new firms has come from outside of Ottawa. The majority of the entrepreneurs have worked outside the Ottawa area, and many of the firms are strongly export-oriented. These factors point to many external influences in new firm formation. Can one still feel comfortable in calling much of the high technology development in Ottawa-Carleton indigenous? I believe so, and for the following reasons: the entrepreneurs have lived here an average of eleven years before founding their firms, approximately fifty per cent attribute their founding motivations

and skills to incubator firms in the Ottawa area, and they have stayed here rather than establish their firm in another region.

Spin-offs and New Firm Formation: Ottawa's High Technology Industry

This questionnaire should be completed by the founder of this company.

CONFIDENTIAL

1. What was your role in the establishment of this company? Please indicate the name of your co-founders (if any).

Are your co-founders still with the company? If not, where may I contact them?

2. In what year was this company established in the local area? _____

3. What was your age at the time of establishment? _____

4. How many years had you lived in the Ottawa area prior to the establishment of this firm? _____

5. Where were you born? Canada () Other (Please specify) _____

Where did you receive your high school training? Canada ()
Other _____

6. Please identify the area in which you received your University or College training. (Check all which apply).

Engineering ()

Technical ()

BA ()

Commerce ()

MBA ()

Other _____

7. Please indicate your father's occupation. _____

Did he have his own business? Yes () No ()

8. Is this the first firm you have established? If no, please give the year your first firm was established and its characteristics.

9. What was your last job before establishing this company?

Location of Job _____

Year of Appointment _____

Type of Industry _____

Name of Company _____

Year of Resignation _____

10. Approximately how many full-time jobs did you have before establishing this company? _____

Did you work outside the Ottawa area (Including outside of Canada) on any of these jobs? Yes () No ()

11. What specific situation precipitated your leaving to start your own company? (Check all which apply).

Learned of market for new ideas ()

Learned of possible financial backing ()

Offered position in new enterprise ()

Personal conflict ()

New breakthrough, or new idea ()

Someone decided to join in venture ()

Project completed, delayed or dropped ()

Other (Please specify) _____

12. Which of the following would you consider to be significant in your personal decision to establish your own firm? (Check all which apply):

1) Being own boss - independence ()

2) Monetary reward inadequacy ()

3) Freedom to explore new areas ()

4) Advancement ()

5) Desire for increased job satisfaction ()

Other (Please specify) _____

18. What role (if any) did the Federal Government or crown corporations play in the establishment of this firm?

What role (if any) did the Provincial Government play in the establishment of this firm?

19. What is this firm's 1982 level of employment?

Total _____

In the Ottawa Area _____

Elsewhere in Canada _____

Elsewhere in World _____

20. Are your net earnings for 1982 positive? Yes () No ()

How many years since the founding of the company did it take before you achieved profitability? _____

21. How would you rate your profit performance in 1981/82 in relation to your main competitors?

Above ()

Average ()

Below ()

22. How many firms constitute your key competition?

1 - 2 ()

3 - 5 ()

6 - 10 ()

10 or more ()

23. What are your key sources of competition?

Imports from US () Japan () Europe () Other ()

Domestic from Foreign owned firms () Canadian owned firms ()

13. How many people did you recruit to leave your previous employer to join your company in its first year of existence? _____

14. What skills from your last job did you find most valuable in managing your first business? Please describe.

15. Which previous employer(s) (if any) provided the most formative experience in leading to your founding this firm?

In which areas did it(they) provide the most experience?
(Check all which apply).

Programming ()

Sales/Marketing ()

Management ()

Production ()

Financial ()

Technical (Please specify) _____

Other (Please specify) _____

16. Were this firm's initial product lines/technology competitive with those of your previous employer? Yes () No ()

If yes, Directly () Indirectly ()

4 Were this firm's subsequent product lines/technology competitive with those of your previous employer? Yes () No ()

If yes, Directly () Indirectly ()

17. How did you initially finance this firm? (Check all which apply).

1) Personal savings ()

2) Other private sources ()

3) Federal Government programs or assistance ()

4) Provincial Government programs or assistance ()

5) Assistance from previous employer ()

Other (Please specify) _____

APPENDIX A

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NAME OF RESPONDENT _____

POSITION _____

COMPANY _____

TELEPHONE NO. _____

Thank you for your co-operation.

Linda Nichol
Geography Department
Ottawa University
165 Waller St.
Ottawa, Ontario
K1N 6N5
231-2395

Dr. Guy Steed (Science Council) 992-3986

Mr. Shawn Markey (CIDC) 236-3500

APPENDIX B

RESPONSE RATE FOR QUESTIONNAIREFOUNDING RESPONSE RATE

<u>QUESTIONNAIRE DESIGNATION</u>	<u>NUMBER OF QUESTIONNAIRES</u>
Questionnaires sent	247
Questionnaires returned that could not be used	62
Questionnaires returned that could be used	82
Questionnaires used as a special mention	3
<u>TOTAL</u>	147

RESPONSE RATE = 59.51%

CO-FOUNDING RESPONSE RATE

<u>QUESTIONNAIRE DESIGNATION</u>	<u>NUMBER OF QUESTIONNAIRES</u>
Questionnaires sent	72
Questionnaires returned (all could be used)	31

RESPONSE RATE = 43.05%

APPENDIX C1

WORK AND EDUCATIONAL BACKGROUND FOR CO-FOUNDERS D

F= Founder

Company A: F1 educ) Engineering, technical
work) Production, marketing
F2 educ) No university or college training
work) Management, financial, sales, technical

Company B: F1 educ) Science
work) Technical
F2 educ) Engineering, music
work) Other

Company C: F1 educ) Engineering, technical, Commerce
work) Production, technical
F2 educ) Commerce
work) Management, production, financial

Company D: F1 educ) Technical
work) Shop organization
F2 educ) Commerce
work) Sales

Company E: F1 educ) Engineering, technical, BA
work) Programming, technical, management
F2 educ) Engineering
work) Marketing, management, sales, programming
F3 educ) MBA
work) Sales, financial, technical, management

Company F: F1 educ) Engineering
work) Planning
F2 educ) Engineering, Science
work) Programming, management

Company G: F1 educ) Engineering
work) Technical, management, sales
F2 educ) BA
work) Sales, marketing, management, technical
F3 educ) Engineering
work) Programming, management, production
F4 educ) Engineering
work) Financial, management, programming

Company H: F1 educ) Engineering, Commerce
work) Sales, marketing, financial, technical
F2 educ) Engineering
work) Management, production, technical

APPENDIX C1

WORK AND EDUCATIONAL BACKGROUND FOR CO-FOUNDERS CONTINUED

Company I: F1 educ) BA
work) Technical, sales, marketing
F2 educ) Commerce
work) Technical

Company J: F1 educ) Engineering
work) No acknowledged work experience
F2 educ) Engineering
work) No acknowledged work experience

Company K: F1 educ) Engineering
work) Sales, marketing, management
F2 educ) Engineering
work) Programming, sales, marketing, management

Company L: F1 educ) Engineering
work) Engineering skills, technical
F2 educ) Engineering
work) Technical, management

Company M: F1 educ) Engineering
work) Financial, management
F2 educ) Physics
work) Financial, management, programming, sales, marketing

Company N: F1 educ) Engineering
work) Technical
F2 educ) Engineering
work) Technical, marketing

Company O: F1 educ) Commerce
work) Financial, management
F2 educ) Engineering
work) Technical

Company P: F1 educ) Engineering
work) Marketing, management, technical
F2 educ) Engineering, technical, BA
work) Financial, management

Company Q: F1 educ) Math, Physics, Engineering
work) Programming, technical
F2 educ) Engineering, technical
work) Marketing, management
F3 educ) Science
work) Technical, programming
F4 educ) Science
work) Technical, management, marketing, sales, programming

APPENDIX C1

WORK AND EDUCATIONAL BACKGROUND FOR CO-FOUNDERS CONTINUED

Company R: F1 educ) Engineering
work) Management, financial
F2 educ) Theoretical Physics
work) Management

Company S: F1 educ) Engineering
work) Sales, marketing
F2 educ) Engineering
work) Technical, sales, marketing, management

Company T: F1 educ) No university or college training
work) Programming, sales, marketing, management,
production
F2 educ) BA
work) Sales, marketing, management, production,
financial

Company U: F1 educ) Commerce, Common Law
work) Sales, marketing, management, financial
F2 educ) Engineering
work) Management, technical
F3 educ) Commerce
work) Sales, marketing
F4 educ) Engineering
work) Sales, marketing, management, financial

Company V: F1 educ) Engineering, technical
work) No work skills admitted
F2 educ) Engineering
work) Management, programming, technical

Company W: F1 educ) Engineering
work) Programming
F2 educ) No university or college training
work) Sales, marketing, management, financial,
production

Company X: F1 educ) Engineering
work) Technical
F2 educ) Engineering
work) Sales, marketing, management

Sources: author's questionnaire, 1982.

APPENDIX C2

WORK AND EDUCATIONAL BACKGROUND FOR SOLE FOUNDERS

Company 1:	educ)	BA
	work)	Management, sales, technical, financial, programming
Company 2:	educ)	Engineering
	work)	Management, financial, technical, other
Company 3:	educ)	No university or college training
	work)	Sales, marketing, programming
Company 4:	educ)	Mathematics/Physics
	work)	Engineering, management, systems analysis
Company 5:	educ)	Commerce
	work)	Sales, marketing, management, financial
Company 6:	educ)	Engineering, technical
	work)	Management, financial, technical
Company 7:	educ)	Technical
	work)	Technical
Company 8:	educ)	Technical, mathematics
	work)	Financial, programming, management, production
Company 9:	educ)	No university or college training
	work)	Product knowledge, management
Company 10:	educ)	BA, Commerce
	work)	Programming
Company 11:	educ)	Engineering
	work)	Sales, marketing, production, equipment design
Company 12:	educ)	Commerce
	work)	Management, technical, financial
Company 13:	educ)	Commerce
	work)	Production, technical
Company 14:	educ)	No university or college training
	work)	Management, consulting skills
Company 15:	educ)	Engineering
	work)	Programming, sales, marketing, management, production, financial, technical

APPENDIX C2

WORK AND EDUCATIONAL BACKGROUND FOR SOLE FOUNDERS CONTINUED

Company 16: educ) Mathematics
work) Programming, sales, marketing, management, production

Company 17: educ) B.Education, Philosophy
work) Management, sales, marketing

Company 18: educ) Engineering
work) management

Company 19: educ) MBA, Science
work) Technical, programming, management, marketing

Company 20: educ) Engineering
work) Sales, marketing, technical, management

Company 21: educ) Engineering, technical
work) Programming, management, technical

Company 22: educ) Physics, MBA
work) Programming

Company 23: educ) Engineering
work) Financial, management, technical

Company 24: educ) Engineering
work) Programming, sales, marketing, management, technical

Company 25: educ) Commerce
work) Financial, management, programming

Company 26: educ) Engineering, technical
work) Sales, marketing, financial, management, technical

Company 27: educ) PhD Mathematics
work) No admitted skills

Company 28: educ) Technical
work) Management, common sense

Company 29: educ) Technical
work) Marketing

Company 30: educ) No university or College training
work) Marketing

Company 31: educ) BA
work) Technical, production

Source: author's questionnaire, 1982.

APPENDIX C3

SUMMARY
EDUCATIONAL AND WORK BACKGROUND FOR THOSE CO-FOUNDERS WHO HAVE NO
CO-FOUNDING RESPONSE

<u>EDUCATION</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	4	13.31%
Technical	22	73.33%
Management	2	6.67%
No education	1	3.33%
Other	1	3.33%
TOTAL	30	100.00%

<u>WORK</u>	<u>NUMBER OF FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	11	36.67%
Technical	4	13.30%
Management	14	46.67%
None	1	3.33%
Other	0	0.00%
TOTAL	30	100.00%

<u>WORK AND EDUCATION</u> <u>BACKGROUND</u>	<u>NUMBER OF</u> <u>FOUNDERS</u>	<u>PERCENTAGE</u>
Technical and Management	22	73.33%
Technical	4	13.30%
Management	3	10.00%
None	1	3.33%
TOTAL	30	100.00%

Sources: author's questionnaire, 1982.

APPENDIX C4

EDUCATIONAL AND WORK BACKGROUND FOR THOSE CO-FOUNDERS WHO HAVE NO
CO-FOUNDING RESPONSE

- Company 1 : educ) Engineering
work) Management, sales, marketing
- Company 2 : educ) Engineering
work) Technical, management
- Company 3 : educ) Engineering (M.Sc.)
work) Programming
- Company 4 : educ) Engineering
work) Engineering, management, technical
- Company 5 : educ) Technical
work) Management, technical, production, marketing
- Company 6 : educ) Technical
work) Technical
- Company 7 : educ) Engineering
work) Sales, marketing, management, technical
- Company 8 : educ) Commerce
work) Management, financial
- Company 9 : educ) Engineering, technical
work) Management, production
- Company 10: educ) Engineering, technical
work) Technical, sales, marketing, management,
production, financial
- Company 11: educ) Engineering
work) Technical, marketing, financial
- Company 12: educ) Engineering
work) Financial, management
- Company 13: educ) Engineering
work) Management, production
- Company 14: educ) Technical
work) Management, production, technical
- Company 15: educ) Engineering
work) Management, programming

APPENDIX C4

EDUCATIONAL AND WORK BACKGROUND FOR THOSE CO-FOUNDERS WHO HAVE NO
CO-FOUNDING RESPONSE CONTINUED

- Company 16: educ) BA
work) Marketing, management
- Company 17: educ) Engineering, MBA
work) Management, production
- Company 18: educ) Engineering
work) Programming
- Company 19: educ) No degree (Military)
work) None admitted
- Company 20: educ) B.Sc. (Chemistry)
work) Programming
- Company 21: educ) Technical, B.Sc.
work) Management, programming
- Company 22: educ) Physics
work) Programming, sales, marketing, management
- Company 23: educ) Engineering, technical
work) Management
- Company 24: educ) Commerce
work) Marketing, management
- Company 25: educ) Engineering, technical, BA
work) Management, financial
- Company 26: educ) Engineering
work) Management, production, financial
- Company 27: educ) Technical
work) Sales, marketing, financial
- Company 28: educ) Engineering, Technical, Commerce
work) Sales, marketing, management
- Company 29: educ) Engineering, Commerce
work) Technical, management
- Company 30: educ) Engineering, MBA
work) Sales, marketing, financial

Sources: author's questionnaire, 1982.

APPENDIX D1

LIST OF INCUBATOR ORGANIZATIONS FOR CO-FOUNDING FIRMSCOMPANIES WITH FULL CO-FOUNDER RESPONSE

- Company A: Founder 1) R.O.R. Associates
Founder 2) Datagraphics
- Company B: Founder 1) Subtech
Founder 2) John Swift & Associates
- Company C: Founder 1) Anchor Tool & Die (Montreal)
Founder 2) Fleetway Manufacturing Company Limited
- Company D: Founder 1) Data Logic
Founder 2) Data Logic
Founder 3) Cord King of Canada
- Company E: Founder 1) no name given (a communications company)
Founder 2) Bell Canada
- Company F: Founder 1) Systemhouse
Founder 2) Systemhouse
Founder 3) Systemhouse
Founder 4) Alpha Microsystems (Toronto)
- Company G: Founder 1) Farinon (Montreal)
Founder 2) Quasar Systems
- Company H: Founder 1) Microsystems International Limited
Founder 2) Microsystems International Limited
- Company I: Founder 1) Systems Approach Limited
Founder 2) Systems Approach Limited
- Company J: Founder 1) Microsystems International Limited
Founder 2) Microsystems International Limited
- Company K: Founder 1) Carleton Board of Education
Founder 2) Adga Limited
- Company L: Founder 1) Computer Science Canada
Founder 2) ADP Autonet (Nashville, Tennessee)

APPENDIX D1

LIST OF INCUBATOR ORGANIZATIONS FOR CO-FOUNDING FIRMS CONTINUEDFIRMS WITHOUT FULL CO-FOUNDER RESPONSE

- Company A: Founder 1) I.P. Sharp Associates
Founder 2) Microsystems International Limited
- Company B: Founder 1) Spectra Research Limited
Founder 2) Leigh Instruments
- Company C: Founder 1) Federal Government (C.R.T.C.)
Founder 2) Federal Government (C.R.T.C.)
- Company D: Founder 1) Student
Founder 2) Student
- Company E: Founder 1) Computing Devices Company
Founder 2) Computing Devices Company
Founder 3) Computing Devices Company
Founder 4) Computing Devices Company
- Company F: Founder 1) Bell Northern Research
Founder 2) Bell Northern Research
- Company G: Founder 1) Cantec Representatives
Founder 2) Leigh Instruments
- Company H: Founder 1) Dahlstrom Eastern Limited
Founder 2) Dahlstrom Eastern Limited
- Company I: Founder 1) Leigh Instruments
Founder 2) Systems Dimensions Limited
Founder 3) The Software Factory (Valleyforge, PA)
Founder 4) Computer Systems Limited
- Company J: Founder 1) Federal Government (E.M.R.)
Founder 2) Federal Government (E.M.R.)
- Company K: Founder 1) Royal Canadian Mounted Police
Founder 2) Royal Canadian Mounted Police
- Company L: Founder 1) Federal Government (Public Works)
Founder 2) Systems Dimensions Limited

Sources: author's questionnaire, 1982.

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