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University Grant Program Research Report

FOREIGN OWNERSHIP AND TECHNOLOGICAL
INNOVATION IN CANADA: A STUDY OF THE
INDUSTRIAL MACHINERY SECTOR OF INDUSTRY

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October, 1975
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The views and opinions expressed in this report are those of
 the author and are not necessarily endorsed by the Department
 of Industry, Trade and Commerce.

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INTRODUCTION

The topic of foreign investment in Canada has been a controversial one for many years. Although interest was first initiated by the Royal Commission on Canada's Economic Prospects (Gordon Report, 1958), the issue since then has been the focus of many research studies. From these studies, many aspects of the foreign ownership of Canadian industries by multinational firms are now known. This spectrum of knowledge ranges from the behavior and organization of multinational firms to the role of research and development of foreign subsidiaries in Canada. Most of these studies also analyzed in depth the impact of foreign investment on the host country. However, these earlier studies were fragmented in nature as they were pioneers in the field and due to varying circumstances had different interests and concerns such as the impact of foreign investment on Canada's political sovereignty, industry structure, economic independence, market competition and a variety of other related issues. (Safarian, 1966, 1969); (Watkin's Report, 1968); (Wahn Report, 1970)

All these studies were not unfruitful, as the passage of time has allowed for the detection of areas left unexplored and a growing realization of the true impact of foreign investment on Canada. A recent study (Gray Report, 1972) provides a comprehensive and integrative view of the whole problem of foreign direct investment in Canada. Some researchers in the area have called this study and

report a major turning point in Canadian thinking towards the problem. In fact, many are now in the process of attempting to formulate a National Policy with regards to foreign investment or what is now popularly known as an 'Industrial Strategy' for Canada. (Rotstein, 1972); (Daly, 1972)

Unfortunately, the problems are still far from being clear as the whole issue is still very complex. To begin with, before an industrial strategy can be formulated, there must be agreement as to what Canada's national goals are or should be. Some prominent writers (Fayerweather, 1974); (Gordon, 1974) have suggested that there are two major subgoals Canada should pursue in order to achieve broader national objectives such as economic growth, price stability, balance of international payments and national sovereignty. These two subgoals are as follows:

- (1) Employment - More jobs to match growth of the labour force. Better quality and challenging jobs to absorb university graduates.
- (2) Sophistication of Industry - Studies have shown that the industrial development of a nation is highly dependent on the growth and sophistication of some key industry sectors.

Canada's record in the achievement of these two important subgoals has been very disappointing. There is evidence that Canadian industries, universities and government departments have for years been unable to absorb the output of science trained graduates from

Canadian universities. A recent study also shows that in comparison with other developed nations Canada's performance in high to medium technology industries and her record of technological innovation is very poor indeed (Bourgault, 1972). Failure to achieve these subgoals can hamper the achievement of an even better standard of living, can fail to provide higher quality employment opportunities and can encourage a 'brain-drain' of highly trained graduates out of Canada.

Such problems are cause for national concern. Obviously there are some possible directions the government can take to reduce the magnitude of these important problems, but the question remains, is there sufficient knowledge about the impact of foreign ownership on these two national subgoals to enable the formulation of necessary guidelines for an 'Industrial Strategy'. The question posed must be considered in the light of recent research studies.

Multinational Firm Policies on R&D

The two important national subgoals previously discussed are highly interdependent. If one concern is the provision of more and better quality jobs for Canadians, then it is contingent on the development of a sophisticated manufacturing industry. One key issue revolves around increasing the development of R&D activity in Canada, especially in the industrial sector.

A recent survey of the literature (Ondrack, 1974) in which the issue of opportunities for R&D employment is the main focus, contends that the facts and figures point clearly to the problem of a comparatively

poor record in innovation and development. Comparatively less is spent on R&D in the industrial sector in Canada than in most developed countries. The trend moves in the other direction for most developed countries, that is, more R&D effort is increasingly being carried out by industry. This had led to some speculation that Canadian firms maybe just do not see innovation as part of their role.

Why is this so? In attempting to answer this question the nature of R&D among industry in Canada must be examined more closely. Firstly, one obvious factor to consider is that Canadian industries to a high degree are foreign owned and controlled. Godfrey & Watkins, (1970) especially point out the fact that this high ownership and control is prevalent in some key industrial sectors such as manufacturing, petroleum and natural gas and mining and smelting. The R&D problem is exacerbated in that industries which are heavily foreign owned are the same ones which would ordinarily be active in R&D for the development of products. In the Canadian case, however, these industrial sectors are not active in R&D expenditures compared to other industrial nations nor active in the export of manufactured products.

To further understand this phenomenon, a recent study for the Science Council of Canada explores the research and development roles of foreign subsidiaries. (Cordell, 1971) The following is a summary of Dr. Cordell's findings.

First, a multinational firm will seek to centralize control of the R&D program to develop an international research capability with laboratories operating around the world which respond to, and feed information to centralized laboratories. Host country research operations may be under-

taken for a wide variety of reasons; to take advantage of local skills, to obtain access to lower costs, to establish listening posts, and to transfer technology to local operations. Two general types of R&D operations seemed to be predominant in Canada, the interdependent laboratory and the local support laboratory.

An interdependent laboratory may be one of many scattered around the world which mainly conducts research and has little to do with development. It is closely connected to the international research program, may be directly supervised by international head office, and may have little interaction with local manufacturing operations. A local support laboratory mainly acts as a technical service centre to examine why a product may fail to operate in the Canadian market, to help adapt a product to the Canadian market, to translate foreign technology to local specifications, and to scale down production technology and engineering to shorter runs for the Canadian market.

The critical aspect of the international interdependent laboratory is that while it is physically in Canada and may even be located adjacent to the plant site, there may be little interaction between R&D personnel and plant management. The research performed may have little to do with new product innovation in Canada and often is very specialized, confined to a specific stage of the R&D process. Innovation capability may be increased for the firm as a whole, but not directly for the Canadian economy, as any innovations which may occur are the property of the international head office.

Local support research operations are the most common type found in subsidiaries in Canada and are typically associated with a "miniature

replica" or semi-autonomous branch plant. This type of research program has little or no work allocated from world headquarters and the chief functions are adaptation and modifications of product/process to Canadian conditions and transfer of production technology from head office to branch plant. Innovations here are generally confined to the successful introduction of a product into Canada which has been designed and successfully marketed elsewhere. While the difficulties and complexities involved in this type of innovation are not to be underrated, it is not the same type of innovation as that required for new product development. Should any of this latter type of innovation occur in a local support laboratory, these innovations too become the property of the international firm, subject to the decision of the international head office as to whether, and where the innovation would be produced.

Thus neither type of laboratory offers many opportunities for innovation in Canada (unless this is designated by head office as part of their role) and even if some innovations should occur, they do not necessarily result in any improvement in Canadian industrial production or exports. The situation can be summed up in another quote from Dr. Cordell's (1971) Science Council report. "In no case did we find a Canadian subsidiary that felt it had the freedom to enter foreign markets at will with a product which it thought could be produced in Canada and competitively exported".

The greatest potential for R&D jobs and for innovation in Canada then, probably lies with indigenous, domestically controlled industry or with foreign owned subsidiaries with considerable autonomy in R&D operations.

However, R&D performance of indigenous firms in Canada has not been particularly impressive so far and this poor performance has been attributed by the Science Council to the generally smaller size of such firms and the fragmented Canadian market. Subsidiaries with highly autonomous research and development capabilities already offer considerable opportunities for R&D employment and for innovation but future growth of such opportunities is tied to the willingness of foreign head offices to allow greater autonomy in host country subsidiaries.

Another recent study by the National Industrial Conference Board (Duerr, 1970) on the R&D activities of American Multinational Firms, confirms most of the findings of Dr. Cordell. That is, the tendency for these firms to centralize control of R&D, frequently in the U.S. and to delegate lesser R&D roles to their foreign subsidiaries such as in the transfer of technology and the modification of products to suit local needs.

The general conclusion that can be drawn then is that the high degree of foreign ownership and control of the key industrial sectors of the economy and Canada's poor R&D performance must be seen as related.

The Problem in Perspective

Since the main issue is now fairly clear, what then are the policy options open to deal with it? Two main options that seem to be most frequently discussed (Fayerweather; 1974) (Ondrack, 1974) are:

- (a) To change the basic pattern of distribution of government financial support for R&D programs. In place of the quite broad program of contributions to all sorts of R&D development in many industries, some current proposals run in the direction of deliberately aimed support for stronger specific efforts

The idea would be to identify particularly promising areas of industrial development and invest a greater part of government aid for R&D in major efforts to push these product areas. (Fayerweather, pg.95)

- (b) Secondly, not only must support be more selective in terms of industry sector but it should also be aimed at Canadian owned and controlled firms in order to stimulate the development of domestic R&D operations. Support should also be given to foreign subsidiaries but only to those with unusual R&D autonomy.

These policy options raise further questions to be answered. What industrial sectors should be allowed stronger support? Is it really valid to support more extensively only Canadian owned and controlled firms in R&D? Unfortunately, there are few definite answers yet to the above questions.

This analysis suggests new avenues for research in the need to carry out research on industry sector studies to determine their relative strengths and weaknesses in R&D. Also it is imperative to have some comparative knowledge on Canadian versus Foreign owned firms on some key variables in each of these key industry sectors. This research project and the approach to be discussed next serves to partially bridge this gap in present knowledge.

II THE STUDY

The relationship between the independent variable: foreign ownership, and the dependent variable: technological innovation in a host country, can be extremely complex due to a large number of intervening variables. Such variables as environmental uncertainty and technological complexity (Laurence and Lorsch, 1970) organization size (Hecht and Siegel, 1973, Ondrack, 1973) and maturity of the firm (Hymer) can all affect the autonomy relationship between headquarters and subsidiary operations. This study has attempted to be an extension of the work of Cordell by studying the foreign ownership effect on R & D while controlling for certain of the intervening variables. Of course in organizational field studies, it is not possible to locate sites which satisfy all sample criteria, nor are all the variables dichotomous or trichotomous in nature. Therefore, the study design can be a good deal more sophisticated than the actual study and measurements of the variables are sometimes judgemental. With these caveats in mind, the study design is described as follows:

Subjects

In order to control somewhat for the variable, technological complexity, it was decided to restrict the study to firms in the industrial machinery sector of industry in Canada. The industrial machinery sector is suitable for study because a number of such firms exist in Canada, both domestically and foreign owned, and a high export potential exists in this sector.

While industrial machinery firms may face varying degrees of environmental complexity and technological complexity, the problem of comparing R & D activities between widely disparate types of technology and environment is avoided.

Secondly, firms are classified into size categories by the number of persons employed. With technology held more or less constant, the number of persons employed is a fairly accurate indicator of the size of the firm and the firms are classified into 3 sizes (<500, 500-1000, 1000+). Other such variables as profitability and maturity cannot be easily identified externally and can best be assessed during interviews with representatives of the firms.

Within R & D, three types of operations are expected: miniature replica, internationally integrated, and autonomous. It is expected that foreign owned firms will be dominated by the first two types of operations and Canadian R & D operations would be autonomous, encompassing research - development - industrial engineering and production.

<u>Independent Variables</u>	<u>Intervening</u>		<u>Dependent</u>	
<u>Ownership</u> (2)	<u>Size</u> (3)	<u>Technology</u> (1)	<u>R & D</u> (3)	1. Number of jobs
Foreign	Large	Industrial	Integrated	2. Levels of jobs
Canadian	Medium	Machinery	Replica	3. Innovation record
	Small		Autonomous	4. Expert record

(2 x 3 x 1) = 6 cells for independent and intervening variables)

Method

A survey outline for interviewing purposes was developed to be used in interviews with representatives of the sample firms. In each firm, the study attempted to interview the director of R & D, or of product engineering, or of product development. In smaller firms, such a person would report directly to the chief executive officer, in larger firms, the respondent might report to a vice-president. In either case, the respondents had to be at a sufficiently high level in the organization to understand the workings of the whole (local) firm and could comment on such matters as sales, earnings, autonomy, market strategy and finance as well as R & D.

The questionnaire was divided into two parts, the first dealing with general organizational information and the second with the specific role of the R & D operation. The second part of the questionnaire had two versions, one for R & D in Canadian owned firms and one for R & D in foreign owned firms. The foreign version covered relationships between R & D at headquarters and other parts of the firm and the R & D located in Canada. Early versions of the interview form were pilot tested and the third version was used for the study.

In selecting firms for the study, a deliberate attempt was made to select firms with a reputation for innovation and new product development. Ordinarily, a study should try to use a random selection of firms and study non-innovative as well as innovative firms. However, it was felt that within the limits of this study, more useful information could be gained by concentrating on the behaviour of innovators. A comparison of innovative and non-innovative firms in the same industry could easily be a separate study in itself.

The search for innovative firms was conducted by a review of industrial trade journals and business publications to see which firms were frequently written up for their product innovations. Membership lists of various industry trade and research associations were also consulted. Finally, an attempt was made to get some geographical distribution among the firms so that the study did not concentrate in any one area of Canada. The reason for this is that R & D behaviour might be quite

would have less generalizable findings than a geographically balanced study.

Results

Surveys of the trade literature revealed a number of innovative firms but not across all size or ownership classifications. Most firms tended to be in the small and medium size categories and most tended to be in the Ontario - Quebec region. In order to obtain geographical representation, some firms in other areas of the country were selected to fit size and ownership criteria and did not necessarily have a reputation for innovation. No firms satisfying the sample criteria were found in the Maritimes. Tables 1 and 2 below show the distributions of the firms on the sample criteria.

Table 1

Distribution of Firms by Ownership and Size (No. of employees)

	<u>Small < 500</u>	<u>Medium 500 - 1000</u>	<u>Large 1000 +</u>	<u>Totals</u>
Foreign owned	7	1	2	10
Canadian owned	6	4	1	11
				<u>21</u>

Table 2

Distribution of Firms by Region and Size.

	<u>Small</u>	<u>Medium</u>	<u>Large</u>
B.C.	2	2	
Prairies	5	2	
Ontario	3	1	
Quebec	3		3

On the matter of foreign ownership, three of the firms changed ownership status during or just prior to the study. In all cases, they were classified according to their former status since their R & D record had been developed under their prior status. However, the change in ownership also had significant implications for future R & D activities in these firms and these will be discussed later in the report.

The balance of the results will be described under four sections as follows:

1. Autonomy of firm
2. Operations of firm

Autonomy of the Firm

While all the foreign-owned firms were subsidiaries, not all of the Canadian firms were autonomous operations. Instead, some were branches of other Canadian firms and subject to many of the same controls as foreign-owned subsidiaries. Table 3 below shows the distribution of firms according to subsidiary status.

Table 3

Subsidiary Status of Firms in the Study

	<u>Subsidiary</u>	<u>Headquarters</u>			
Canadian-owned	SSMM (4)	SSSS	11	S	Small
		MML (7)		10	M
Foreign-owned	SSSSSS MMLL (10)		21	L	Large

Subsidiaries can either be founded or purchased depending upon whether the headquarters firm wants to develop an operation as a miniature replica of some aspect of its larger operations, or whether it wishes to acquire some stream of earnings, market share or technology. Table 4 shows the historical origin of the firms in the sample.

Table 4

Origin of Firms in Sample

	<u>Founded by Headquarters</u>	<u>Purchased</u>
Canadian-owned	SSSSS MMML (9)	SM (2)
Foreign-owned	SSSSLL (7)	SSM 3

In addition, some firms follow a control strategy of using a manager from headquarters as the chief executive officer (C.E.O.) in a subsidiary while others employ foreign nationals in such posts. Table 5 below shows the distribution of nationality of chief executive officers of the firms in the sample. Former foreigners with Canadian citizenship are classified as Canadians.

Table 5

Nationality of Chief Executive Officer of Firms in Sample

	<u>Canadian National</u>	<u>Foreign National</u>
Canadian-owned	SSSMM SSSMM L (11)	
Foreign-owned	SSS SSM L (7)	<u>SS L</u> (3)

In terms of the structure of control relationships between headquarters and subsidiaries, a variety of forms can exist. For this study, four general classifications were used:

- a) Autonomy - where the firm has its own board and reports to no one else.
- b) Holding company - where the firm operates in a highly autonomous manner but reports to a headquarters board or headquarters executive. Usually such subsidiaries report only financial plans and results on an annual basis.
- c) Profit Centre - where the firm submits detailed annual budgets and operations forecasts and is free to operate within designated limits of approved plans and budgets.
- d) Integrated subsidiary - where the firm carries out directions from headquarters and is responsible for local administration.

Table 6 below shows the distribution of the firms in the sample on the four types of control:

Table 6

Control Relationships of Firms in the Sample

	<u>Autonomous</u>	<u>Holding Co.</u>	<u>Profit Centre</u>	<u>Integrated</u>
Canadian-owned	SS SS MM L (7)	S	SMM (3)	
Foreign-owned		LL SS (4)	SM (2)	SSSS (4)

It should be noted that control relationships can evolve over time, so that a formerly integrated subsidiary may now operate as a profit centre or a former holding company subsidiary may eventually operate as an integrated subsidiary. Reasons for such changes in control policy and the history of such changes in some of the firms will be discussed later in the report. It should also be noted that subsidiaries with the least autonomy such as the integrated subsidiaries, offer the fewest job opportunities at managerial and professional levels and that in general

a positive correlation exists between subsidiary autonomy and professional/managerial job opportunities. There is also a positive relationship between subsidiary size and autonomy so that a co-variant relationship tends to exist between size and professional/managerial job opportunities.

Operations of the Firm

In terms of the three basic functions R & D, production, and marketing, a firm can choose to operate in any one of the functions, hire the services of outsiders for any function, or operate all three functions internally. An autonomous firm can make these decisions for itself and a more controlled subsidiary must operate according to its role as designated by headquarters. In general, the more functions existing within a firm, the wider the range of job opportunities in the firm.

The following is a list of categories of operations of a firm ranging from single functions to multi functions.

a) Sales and Distribution - this type of firm may be a highly integrated subsidiary or a purchaser of technology and production. In either case, it operates as a sales and distribution outlet for an array of goods and is intended to serve some designated market. The principal job opportunities in such a firm are in sales and customer service and the firm is generally wholly dependent on external sources for new products or innovations. Some sales/distribution firms may add some local modifications to products to adapt the products to local markets.

b) Local Assembly - this type of firm purchases or receives components from other sources but assembles them locally as the final stage in the production process. Such a firm is wholly dependent on external sources for technology, but again may add some modifications for local markets. Job opportunities are slightly expanded with the addition of personnel for assembly supervision. Local modifications at this stage are usually developed by machinists and technicians in conjunction with sales.

c) Local Manufacturing (few lines) - this type of firm may assemble a number of products from purchased components and may also fabricate some original components. The technology for the original components may be either purchased, or locally developed. Some unique products may also be developed out of the local modifications to existing products.

d) Miniature Replica - this type of firm carries an extensive line of products generally from purchased technology, but with almost complete local fabrication and production. Such a firm usually requires an extensive local market to justify the capital cost of extensive local production facilities. Original design and

development may still be external to the firm but the firm may have sizable R & D function to modify and adapt purchased technology to local markets. Subsidiaries of this type may be designated as producers for certain lines for export markets.

e) Local Design and Specialized Production - this type of firm may either have developed some unique local innovation or have been designated as the designer and producer of certain lines by the parent company. A local design firm is often a more advanced miniature replica, but may also have been purchased in a takeover. A Canadian owned local design firm may have some products arising from local innovations as the backbone of its operations and then supplement its product lines with several lines of purchased technology, either fabricated locally or imported. Subsidiaries of this type may be designated as producers of the specialized line for export markets and may also be free to pursue export markets as their specialized line probably does not compete with lines from other parts of the firm.

f) Local Design and General Production - this type of firm relies almost completely on local R & D for all its product lines although it may still purchase some specialized components, it is also free to enter into any line of business or pursue any markets, although a subsidiary of this type may be responsible for a general group of products and will only be able to pursue new markets within its designated group. Subsidiaries of this type may also be responsible for supplying the world market of the firm for the subsidiaries group of products. Such types of firms, whether subsidiaries or Canadian owned firms, offer the widest range and greatest depth of job opportunities and offer the greatest potential for new product innovation and development.

Table 7 below shows the distribution of firms in the sample across the continuum of operations.

Table 7

Distribution of Sample Firms on a Continuum of Operations

	<u>Sales & Distribution</u>	<u>Local Assembly</u>	<u>Local Mfg. (few lines)</u>	<u>Local Replica</u>	<u>Local Design (Specialized)</u>	<u>Local Design (General)</u>
Canadian-owned			SMM (3)			SSSMM L (8) SS
Foreign-owned	SSSS (4)				SS L (3)	S M L (3)

It is apparent from Table 2 that most of the Canadian-owned firms fall into the local design-general production category and thus have the potential for a wide range

of jobs, innovation, and export sales. Some of the Canadian owned firms are subsidiaries operating within Canada and are subject to the same restrictions as a foreign-owned subsidiary. The foreign-owned firms have a more varied distribution across the types of operations. Some are merely sales and distribution firms, some are local design-specialized production, and some are local design-general production. The actual job, innovation, and export potential of these firms will be discussed later in the report.

Research and Development

A firm's activity in the role of R & D was measured in three ways: the numbers of persons employed in R & D, the types of persons employed, and the role of the R & D department in the firm. Table 8 below shows the distribution of the numbers of persons employed in R & D in the sample firms:

Table 8

Number of Persons Employed in R & D

	<u>0 - 2</u>	<u>2 - 3</u>	<u>3 - 5</u>	<u>6 - 10</u>	<u>10 +</u>	<u>Total</u>
Canadian-owned	S	SSS SS M	M	M	M L	11
Foreign-owned	SS		SS		L L	10
			S M			<u>21</u>

Table 8 only accounts for persons at the level of draftsman and higher and does not include stenographic and clerical staff. In Table 9 which follows, a distribution of the types of persons employed in R & D is shown. Being employed in R & D was defined as being employed where the primary responsibility is the development of new products and processes or modified products or processes and does not include responsibility for marketing, production or customer service. However, in smaller firms, the R & D person frequently interacts with marketing, production and service, either to obtain ideas for innovation or to see an innovation from concept to production. This coordinating role was particularly true of engineers in small and medium size firms. In Table 9 technical machinists and draftsmen were classified as technicians, engineers and those with scientific bachelor's degrees were classified as engineers, and those with advanced degrees were classified as scientists.

Table 9

Types of Employees in R & D in the Sample Firms

	<u>None</u>	<u>Technicians Only</u>	<u>Technicians & Engineers</u>	<u>Technicians, Engineers & Scientists</u>
Canadian-owned		SSS	SSSMMM	M L
Foreign-owned	SSSS	S	SS	M L L

The type of R & D performed in a firm can vary greatly, from none to original product development to contributions to the state of knowledge. However, most R & D in the industrial machinery sector consists of modifying existing technology and creating variations of some existing product. A lot of industrial machinery firms work as job shops constructing equipment according to customer specifications. In these cases, a great deal of the technological information comes from the customer, or from consultants hired by the customer. The job shop supplies productive capacity and production knowledge. For Table 10 below, a continuum of R & D roles in a firm was developed as follows:

- a) No R & D - this type of firm relies completely on external technology and concentrates on marketing or assembly and marketing.
- b) Modify existing technology - this type of firm adopts existing technology to local conditions or smaller production runs, or builds according to customer specifications. Usually such a firm employs only technicians in the R & D capacity but may have one engineer who also supervises production.
- c) Develop Existing Technology - this type of firm relies mainly on external technology but develops products complementary to the existing technology. The complementary products may be solely for the local market, but the firm may also be designated as the producer of certain specialized lines. In such cases, the firm is able to develop some amount of specialized expertise, while the main concern is still production and marketing.
- d) Develop and License - this type of firm develops a good deal of internal technology but complements its line with products developed under license from external sources. Usually licenses are used where the R & D investment is too great to try to duplicate or where the perceived market is too small for the R & D investment. License agreements usually prohibit the firm from exporting products manufactured under license, but the firm is free to export products from any locally developed technology.
- e) Local Design and Local Production - this type of firm is usually self reliant in R & D but may borrow from any possible external source. Often such firms

do not have an extensive R & D department, but have a technical and engineering staff with many years of accumulated experience. Many of these firms are also conservative in their approach to marketing and concentrate on the local markets or their role may be designated to serve the local market.

f) Local Design and Marketing Orientation - this type of firm is self reliant in R & D, but pursues an aggressive marketing strategy by either investigating new products as ventures, or by pursuing new markets. This type of firm doesn't necessarily employ the most people in R & D, but it is probably the most innovative and the most challenging place to work.

Table 10 below shows the distribution of the sample firms across the various roles for R & D:

Table 10

R & D Roles of the Firms in the Sample

	<u>Nil</u>	<u>Modify</u>	<u>Develop</u>	<u>Develop & License</u>	<u>Design, Local</u>	<u>Design, Export</u>
Canadian-owned		S		M M	S S S	SS MM L
Foreign-owned	SS SS			S M		SS LL

It is apparent that the Canadian owned firms lean toward the self reliant end of the continuum, but not all are active in seeking new products or markets. However, it is also apparent that at least some of the foreign-owned subsidiaries have the freedom to be self reliant in technology and pursue new markets. The nature of these subsidiaries and how their structure differs from others will be discussed later in this report.

Future Plans

All of the firms were surveyed on their future plans with respect to the nature of the product line, the nature of their R & D activities and their attitude toward export markets. Since all firms indicated that they expected to grow in the future (some less rapidly than others), this response is not listed in Table 13 which follows. The other types of responses were categorized in the following manner.

a) Momentum - this type of firm neither expects nor plans any major changes and expects to continue in the same markets with the same products. Any growth expected will be from either greater market share, or maintenance of market share in an expanding market.

b) Development - this type of firm expects to operate with a broader product line, either from its own modifications or from external technology. This would mean an expansion of market share by wider coverage of the same basic market.

c) Diversify - this type of firm expects to get into different product lines, either from internal or external innovations. Thus it not only intends to expand its market share, but also intends to penetrate into other markets.

d) Expand - this type of firm expects to grow by getting into a different type of business either by purchasing a subsidiary or developing a new division. None of the firms indicated this choice which suggests that all of them have a fairly stable definition of their current business and intend to stay with it for the foreseeable future. Some of the firms had expanded by purchasing subsidiaries before, but none are apparently contemplating such a move now.

Table 11 below shows the distribution of the future plans of the firm in the sample.

Table 11

Future Plans of Firms in the Sample

	<u>Momentum</u>	<u>Development</u>	<u>Diversify</u>	<u>Expand</u>
Canadian-owned	S M M	SSS MM	SS L	
Foreign-owned	SSSS	SSS M LL		

Some of the firms also indicated an intention to begin or increase their export marketing activity while others expected to remain solely in the Canadian market. The range of responses for export market plans is as follows:

a) No export plans.

b) Export markets (development) - this type of firm expects to follow the product development strategy, but also intends to enter or expand in foreign markets. Such a strategy can be designated for a subsidiary if the subsidiary has a considerable degree of autonomy and has a sizeable R & D operation.

c) Export Markets (Diversify) - this is the most aggressive strategy and can only be realistically attempted by a firm with considerable autonomy and R & D strength. In general, such a firm has to operate from a sizeable domestic market to provide a base for this type of expansion.

Table 12 below shows the distribution of the firms across the various categories of export plans.

Table 12

Export Plans of Firms in the Sample

	<u>Export Development</u>	<u>Export Diversify</u>	<u>No Export Plans</u>
Canadian-owned	SSS M	L	SSS M MM
Foreign-owned	SS M LL		SSS SS

In terms of export plans, the sample is split almost in half with 11 firms having no plans for pursuing export markets. Only one firm is planning to pursue the most aggressive strategy, but several others, both Canadian and foreign owned, intend to pursue some form of export markets.

Discussion

The discussion will be organized into two parts, one for each section of the results and the conclusions section will discuss results for the study as a whole.

Autonomy

All of the foreign owned firms and four of the eleven Canadian owned firms were subsidiaries of some headquarters. In both cases, a majority of the subsidiaries were founded rather than purchased. When a firm establishes a subsidiary, the firm usually has a specific role in mind for the subsidiary of either a marketing or a production function. The marketing function is generally intended to serve one regional or section of a market while the production function is intended to produce a specific type of product. A founded subsidiary then operates within the constraints of a designated role right from inception. The designated role may evolve over time, but the guiding principle is that the subsidiary is to operate in an integrated manner, as an instrument of headquarters policy.

A purchased subsidiary is generally a firm that had operated with independent autonomy and theoretically was able to engage in independent research, independent production, and pursue any markets. Not all firms could or would act to utilize such freedom; of course, but in being taken over, they would then have to operate within the objectives of their new owners. Therefore, a purchased subsidiary may operate under several constraints just as does founded subsidiary, but the degree of constraint depends upon the degree of subsidiary integration desired by headquarters.

In terms of the nature of control in the firms in this study, four of the foreign owned subsidiaries operated as integrated subsidiaries while six operated in a holding company relationship. A holding company relationship may allow a great deal of freedom to a subsidiary, particularly if it was a purchased subsidiary as was the case in three out of the six holding company subsidiaries. However, a holding company subsidiary is still constrained to the extent that it is expected to stay within its basic product grouping and must still negotiate its range of freedom in the ability to pursue world markets. In this case each of the purchased subsidiaries had the freedom to do independent research and pursue world markets within their product grouping while only one of the founded holding company subsidiaries had this freedom. The other two founded holding company subsidiaries were much more restricted.

The ownership status of some of the firms in the sample was also changing during the time of the study: Two firms were formerly foreign owned and were becoming Canadian owned, while one Canadian owned firm was recently purchased by a

European firm. Each of these firms had developed independent technology prior to the change of ownership status, but one of the subsidiaries had been founded rather than purchased.

The founded subsidiary at the outset, had been designated by its U.S. headquarters, as a local production facility for replication of some of the headquarters products. Over time, the headquarters became interested in other lines of business and gradually transferred more and more of the original technological capacity to the Canadian subsidiary. Finally, the subsidiary became the sole producer of its group of products and headquarters sold control of the subsidiary to a Canadian firm. Thus the subsidiary was quite capable of operating as an independent firm in technology and innovations for some time prior to the change in ownership status. However, the firm's officers are strongly of the opinion that being a Canadian owned firm will now give them far more scope for expansion and diversity in the future. They felt that their previous owners had lost interest in the Canadian subsidiary and consequently, the subsidiary was not allowed capital for expansion.

One of the other firms had been an independent firm which was purchased by a U.S. holding company. The subsidiary was controlled in a holding company relationship and was free to operate in any direction upon approval of annual plans by headquarters. However, subsidiary officers felt that headquarters were mostly interested in short term earnings (as is typical of many new conglomerates) and was reluctant to approve expenditures for certain types of expansion. For example, the subsidiary was active in pursuing export markets and wanted to increase its marketing staff. Headquarters also wanted export sales but was unwilling to allow the increased overhead cost of additional marketing staff. The change of ownership status came about when officers of the holding company made several changes in order to be classified as a Canadian rather than a U.S. firm. This was done because all of the holding companies subsidiaries were Canadian firms and it was felt to be both operationally and politically advantageous for the holding company to be classified as a Canadian firm. The change in ownership status was of no significance to the officers of the subsidiary as they felt the same superiors and company policies would still be in force.

The third company was a Canadian owned firm put up for sale by its founders who wished to retire and had no obvious successors. The firm had a history of independent research and had recently developed some significant innovations in its field. The ultimate purchaser was a European based manufacturer of allied lines of products. Rather than operating as a holding company, the European headquarters

wanted to absorb the Canadian firm as an integrated subsidiary. The intention was to take the Canadian innovation and assign it to production at some European plants and designate the Canadian firm as a producer of some of the headquarters lines of products. Unfortunately, for the takeover firm, the Canadian innovation was developed under a P.A.I.T. grant and the technology could not be so easily transferred out of the country, under the terms of this program. Consequently, the Canadian firm had to be treated as a holding company subsidiary and now remains the sole manufacturer of the innovation. In order to be able to produce the expected export volume generated by the world-wide sales net work of the parent firm, the production capacity of the Canadian firm is being expanded.

In terms of generating Canadian jobs, capital investment and export sales, the P.A.I.T. program was a success in this case. On the other hand, foreign-owned subsidiaries were often reluctant to get involved in such government assisted research programs for exactly the same reasons. Their parent firms wanted to decide where goods should be produced, regardless of where the technology had been produced. This feeling was especially strong where firms felt the cost of Canadian production was too high.

Operations, Research and Future Plans

These three sections of the study results are grouped for discussion because there is a close relationship between the nature of a subsidiary's operations, its R & D activity and its future plans. In turn, these activities are largely affected by the autonomy enjoyed by a subsidiary. A domestically owned firm, however, is theoretically free to pursue any type of operation, R & D, and future plans and these are probably affected by the size of the firm more than anything else. Yet, the results show that a pattern of behaviour also emerges for the Canadian owned firms as well. This pattern is illustrated in Table 13 by looking at the behaviour of the Canadian owned firms across the various measures of activity used in the study.

Table 13

Behaviour of Canadian Owned Firms

Control		Profit Centre	Holding Co.	Integrated Subsidiary	Autonomy
Firms		SMM	S	---	SS SS MM L
Operations		Local Mfg. Few Lines	Local Replica	Local Design, Specialize	Local Design, Free Production
		SMM			SSS SS MM L
R & D Role		Modify exist- ing Tech.	License and develop	Design for Local Market	Design for Local and other markets
		S	MM	SSS	SS MM L
R & D Size	0	1 - 3	3 - 5	6 - 10	10 +
	S	SSS SS M	M	M	M L
R & D Employees		None	Technicians	Engineers- and Tech.	Engineers, Tech. and Scientists
		S	SS	MMM SS S	M L
Future Plans		Momentum	Develop	Diversify	Expand
		S MM	SSS MM	SS L	--
Foreign Markets		None	Foreign	Diverse Foreign	
		SS MMM S	SSS M	L	

Eight of the Canadian firms are autonomous and the same eight operate with local design and are free to produce in any area. These characteristics appear to be unrelated to size of the firm. Five of the eight autonomous firms design for both local and other markets but three of the smaller firms concentrate on local markets. Size of firm appears to be the prime variable in affecting the number and type of persons employed in R & D as only the medium and large size firms employ more than 3 - 5 persons in R & D. Some of the small firms employ engineers and technicians in R & D but only the larger firms employ any scientists. In terms of future plans, the eight autonomous firms are split between a development strategy and the more aggressive diversity strategy, but none of the eight foresee pursuing the cautious momentum strategy. Only five firms intend pursuing foreign markets however, while the rest intend to pursue growth in the domestic market.

We see from these results, that as the strategy and activities become more aggressive (or risk taking) the number of firms becomes smaller and smaller. This is a common occurrence in any study of strategy. What should be noted is that the large Canadian firm remained at the most aggressive end of the continuum through every test of activity and that three small and one medium size firms were almost as consistently aggressive. At the same time, three of the four Canadian owned branch plants followed the most conservative pattern through all the tests, despite the fact that two of them were medium size firms. Thus Canadian-owned branch plants can be as conservative as foreign-owned branch plants and small Canadian-owned firms can be as aggressive as large firms. The differences are not a function of size, but apparently a function of strategy of the firm or aggressiveness of its management.

Table 14 below shows the behaviour of the foreign-owned firms across the various measures of activities.

Table 14

Behaviour of Foreign-Owned Firms

Control	Integrated Subsidiary	Profit Centre	Holding Company	Autonomy
	SSSS		SSS M LL	--
Operations	Sales & Dist.	Local Mfg.	Local Design, Specialize	Local Design, Free Markets
	SSSS	--	SS L	S M L
R & D Role	Nil	License & Develop	Design, Local Market	Design Local & other Markets
	SSSS	S M	--	SS LL
R & D Size	Nil	1 - 3	3 - 6	6 - 10 10 +
	SSSS	--	SSS M	-- LL
R & D Employees	Nil	Technicians	Engineers & Technicians	Engineers, Technicians & Scientists
	SSSS	S	SS	M LL
Future Plans	Momentum	Develop	Diversify	Expand
	SSSS	SSS M LL	--	--
Foreign Markets	None	Foreign	Diverse Foreign	
	SSSSS	SS M LL	--	

It is quickly apparent that the four small integrated subsidiaries are very conservative in their operations. They are totally dependent on headquarters technology and pursue a very limited range of activities. They offer no prospects for job opportunities in R & D or experience in export markets, nor is any change in their role apparently designated for them. Yet these same four firms can be quite active competitors within the domestic market and have the resources available from headquarters to match any competitive threats in pricing or innovation. The next stage in development for such subsidiaries is either some local assembly or modifications to the existing product line if headquarters authorizes such activity. At this stage, the parent firm can easily shut down a subsidiary without suffering much of a capital loss, but if some local manufacturing is allowed, the capital commitment becomes a consideration.

The six remaining firms in the foreign-owned sample were organized as holding company subsidiaries, despite the fact that only three were purchased subsidiaries. The benefits of this type of control relationship are apparent in that four of the six used local R & D and were free to pursue other markets and five of the six intended to pursue foreign markets. However, all of the six intended to follow a strategy of developing their present product line and none expected to grow by diversifying. The larger foreign-owned subsidiaries had the largest R & D operations and more sophisticated personnel and the smaller firms had correspondingly smaller R & D operations. Despite the autonomy and resources of the holding company subsidiaries, their overall strategy, even when they expected to grow in foreign markets, was generally more conservative than some Canadian-owned firms with smaller resources. The size of a subsidiary firm seems to be more related to the aggressiveness of its behaviour than in Canadian-owned firms, but even the largest holding company subsidiary was not as aggressive as the large Canadian firm. Thus the holding company subsidiary is still apparently inhibited somewhat in its behaviour, or does not feel the need to be as aggressive as an autonomous firm.

However, the holding company subsidiary still offers considerably more job opportunities in R & D, in strategic decision making and in export opportunities, than either the integrated or local replica type of subsidiary. The exact nature of the autonomy enjoyed by a holding company subsidiary will always be a matter of negotiation between the parent firm and the subsidiary officers. A subsidiary which manufactures a product closely allied to the rest of the firm's product line is in more danger of being converted to an integrated subsidiary than one which specializes in some highly differentiated products. Finally, a founded subsidiary is probably more prone to having its control status changed than a purchased subsidiary, because a founded subsidiary operates within a designated role from inception.

Conclusion

On the surface, employment in R & D in firms in Canada seems to be just a matter of size of the firm. Large firms employ more R & D personnel than small firms and similarly large firms do more export business than smaller firms. However, there are exceptions to this pattern and the nature of the exceptions seems to be closely related to ownership of the firm. In brief, the following conclusions have been summarized from this study.

1. Integrated subsidiaries, whether Canadian-owned or foreign-owned, offer little in the way of R & D job opportunities and operate within the constraints of their role as designated by their headquarters or parent firm. This role is usually to serve the local market, although sometimes the role can be to specialize in a particular type of production to serve the needs of other parts of the firm. The management orientation in such firms is toward assembly, inventories, sales, shipping and customer service. They gain little or no experience in innovation, design, production, marketing, finance or exports. This distinction in types of managerial experience and orientation is essentially the same as Chandler's (1962) distinction between administrative and strategic decision making.

2. Holding company subsidiaries have nearly the same autonomy, R & D job opportunities, etc.. as Canadian-owned firms and the smaller subsidiaries have access to more resources via the parent firm than do Canadian firms of similar size. Thus holding company subsidiaries (or commonwealth affiliates in Smith's, 1972, terminology) offer considerable potential for R & D employment opportunities, product innovation and export sales. Depending upon its designated role, a holding company subsidiary may have an R & D operation which is neither a miniature replica support lab or an integrated lab (in Cordell's, 1971, terms) but instead may operate as an autonomous development lab.

3. Despite their potential, holding company subsidiaries tend to be more conservative in outlook than non-subsidiary firms on a size for size basis. Such subsidiaries may be very aggressive within their terms of reference, but there is little tendency (or perhaps little freedom) to consider modifying the terms of reference.

4. Among subsidiaries, the degree of involvement in R & D, local design, and freedom to pursue export markets is closely associated with size of the subsidiary. Among Canadian-owned firms, these activities are mostly determined by management policy and are not directly related to size of the firm. There are some very aggressive and innovative small Canadian firms which operate that way because their management has chosen that strategy.

5. Government programs to assist the R & D process have been of most benefit to Canadian-owned firms, and some holding company subsidiaries. The headquarters of many subsidiaries did not want to accept the restrictions of government aid programs and of course, only those subsidiaries with R & D as a designated activity would be interested in such programs. Some Canadian firms also felt the programs were too restrictive in that the proposals had to be slanted in terms of scientific research while their greatest need was for assistance with product development .

It is on this last point that some recommendations for policy might be put forward. Small firms are generally unable and unwilling to undertake scientific research, and in the area of industrial machinery, most product innovation and development arises out of modifying or borrowing from existing technology. Quite often the type of activity defined as R & D by an industrial machinery firm is actually product development activity. This may consist of building proto-types, test models, test labs, or trial and error attempts at development. These activities can represent considerable expense for smaller firms, yet little form of assistance is available to them because product development work is not sufficiently "scientific" to qualify for support.

Secondly, the small firm which does succeed in developing some new product frequently does not have a large enough market in Canada to justify setting up a production line. Consequently, they stick to building one-off models and rarely achieve economies of scale. Many firms would like to pursue foreign markets to generate sufficient demand for efficient production, but the expense of getting into such market development is too inhibiting for them.

Finally, broad brush programs of government assistance to industry in Canada in the area of R & D do not seem to be an effective means of encouraging the development of improved R & D performance. Most of the high technology and manufacturing sectors of the Canadian economy are dominated by foreign ownership, but only certain types of subsidiaries have any real potential for innovation leading to greater exports and domestic employment. It would be far more effective for government support programs to offer selective assistance to foreign subsidiaries and better assistance to Canadian-owned firms. The selection process could be accomplished by a series of guidelines on the autonomy of the subsidiary and the same type of support need not be available to all types of firms in Canada.

In summary, the recommendations from this study are:

a) R & D assistance programs should be more selective in terms of the ownership of the firm and the autonomy of the subsidiary. First priority should go to Canadian-owned firms and the next priority should be to relatively autonomous subsidiaries.

b) Special assistance should be available to smaller Canadian-owned firms for product development expenses in addition to research costs.

c) Special assistance should be available to smaller Canadian-owned firms for market development expenses once new products have been developed.

The reason foreign-owned firms tend to be more successful and profitable on a size for size basis (Hecht & Siegel 1973) is that they enjoy the resources of the parent firm. The independent Canadian-owned firm, especially of medium and small size, has no such access to superior resources and must always operate as a threshold firm, struggling to stay alive as much as improve. The thrust of these recommendations is to try to redress the competitive imbalance somewhat and give the Canadian-owned firm some "friends in court". If some special support programs for product and market development could be operated without too much restrictive paperwork (anathema to small business), considerable improvements in Canada's unfortunate industrial export record might be achieved.

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Appendix I

The Relationship between Ownership, R + D Activity and
Innovation Among Firms in the Industrial Machinery Sector.

The question of whether or not a firm is innovative can often be difficult to answer. It can be especially difficult if an attempt is made to use objective criteria as indices of the amount of innovation in a firm. Historical data such as number of patents and size of R + D budget, are not entirely suitable for a number of reasons. For example, there can be quite a time lag between the development of an invention and the issuance of a patent to an innovative firm while another firm may have had a number of patents at some earlier time but is no longer innovative at the time of a survey. Using number of patents as a criterion, the innovative firm would look poor while the firm which is coasting would look good. Similarly a branch plant of a foreign owned firm may have a sizeable R + D budget for the modification of existing technology while an autonomous firm may have a smaller R + D budget devoted to the development of new technology.

This study attempted to use objective criteria for assessing innovation, such as historical record of patents, size of R + D budget, number of persons and education level of persons employed in R + D. However, it was concluded that these criteria were too often influenced by size of the organization and simply did not accurately reflect the actual state of innovation in a firm. More important as a criterion was the behavior of firm personnel toward innovation and their attitudes toward innovation. In order to assess these attitudes and behaviors, interviews were done with firm personnel on such variables as autonomy of the local firm, competitive strategy of the local firm, the specific nature of local R + D activity, and the sources used for technological data.

Accordingly, four categories of behavior were developed of a continuum of innovation activity. Each of the four categories is explained below and the firms in the sample were classified for innovative behavior according to these categories.

1. Innovative

In this type of firm, there is an attitude of commitment toward the development of new products or processes which are significant departures from previous products or processes. The competitive strategy of the firm emphasizes technological superiority over such strategies as customer service or competitive prices. While it is difficult to quantify, there is a feeling of excitement or satisfaction in the air at the R + D section of the firm. Quite often, the R + D is directed by a well-experienced person in the field of the firm's products, who leads a team of support personnel such as engineering drafts men, laboratory technologists and engineering machinists. There is also evidence of considerable pride of achievement and an attitude of self-reliance in the firm which is derived from seeing the development of an innovation from concept to finished product. Persons interviewed in such firms exhibit implicit awareness of the concept of product life cycle and their firms carry a number of lines of products in various stages of product life cycle.

2. Evolutionary/internal

In this type of firm, there is an attitude of commitment to the development of modifications to existing technology, either in products or processes. There is still a strong reliance on internal generation of ideas and concepts, but this creativity is directed toward applications and modifications of someone else's basic concept or technology. Their emphasis in R + D then tends to be toward evolutionary improvements on existing technology. For example, one firm imported diesel engines but developed an extensive line of stationary power generating units built around the core of the diesel engine. Another firm imported a series of hydraulic pumps, but built a series of oil-field pumping stations around the imported components. In both cases, a considerable body of local expertise developed over time on an evolutionary basis, which could not easily be duplicated by the original source of the basic technology.

Frequently an important objective in these firms is to try to develop a standardized line of products to achieve some economies of scale in production. Many of these firms have a history of complicated, single-unit production such as pumping station turn-key installations where the firm acts as the assembler of purchased components to satisfy the specifications of a customer. Over time, sufficient experience is gained within the firm to start selling specifications to customers and the firm may start to produce some of its own components.

3. Evolutionary/external

In this type of firm, modifications and improvements to existing technology are produced by the firm, but the stimulus (requests) for new products/processes is primarily external to the firm. The external sources are usually customers, consultants, or competitors. These sorts of firms use engineering and production capacity as their primary competitive strategy and are quite proud of their ability to be able to produce anything to customer specifications. These firms have a pool of very experienced production engineers or technicians who can solve the problems of converting blueprints to finished products. Innovations in these firms would then be confined to production efficiencies or effectiveness and the firm tries to act as a contract fabricator in industrial machinery projects. This type of firm quite often also acts as an agent or importer of components or complementary product lines which may or may not be utilized in the type of projects on which the firm bids.

4. Non-innovative

This type of firm relies almost solely on external sources of technology, for both conception and modifications to products and processes. While such a firm may have some production facilities, the principal concern of the firm is marketing and distribution of finished products. Quite often the production activities are limited to local assembly of imported components. Despite the total dependency on external technology, a non-innovative firm may still have quite modern products to offer to its market as the firm acts as a distributor for innovations conceived elsewhere.

All four types of firms reported that customer suggestions or requests were an important source of new ideas and R + D personnel were often in frequent contact with important customers. However the non-innovative firm would merely pass along suggestions to headquarters while the other types of firms would try to solve the problem locally.

Since many of the firms in this sample are subsidiaries of other firms, the general competitive strategy of the parent firm must also be considered in assessing the behavior of a subsidiary firm. Depending on whether a subsidiary is structured as an integrated, profit centre or holding company subsidiary, the general strategy of the parent may have a considerable effect on the behavior and attitudes toward R + D in the subsidiary. Theoretically, the more autonomous the subsidiary, the more freedom there would be in the subsidiary to choose some degree of an innovative strategy. However, an integrated subsidiary in a firm with a strategy of technological innovation would not necessarily be an innovative subsidiary. Instead, the subsidiary role would likely be to market and distribute the innovation generated from headquarters.

Table 1 below shows the distribution of the firms in the sample over the continuum of innovative behavior. The table also shows the nature of the structure of the subsidiaries where applicable.

It can easily be seen in Table 1 that Canadian-owned, independent firms tend to be concentrated toward the innovative end of the spectrum while foreign owned subsidiaries tend to be spread towards the more conservative end of the continuum. In terms of the structure of foreign-owned subsidiaries, it is clear that integrated subsidiaries are the most conservative and in general, the results on innovative behavior are consistent with previously discussed findings in this study on the structure of subsidiaries. The more integrated the

Table 1
Innovative Behavior and Structure of Firms

	Innovative	Evolution- Internal	Evolution- External	Non- Innov.	Total
Canadian owned	L(IND)* M(IND) M(IND) S(IND) ⁺⁺ S(P.C.) (5)	S(IND) S(IND) S(IND) (3)	S(H.C.) ⁺ M(P.C.) M(P.C.) (3)	-	11
Foreign owned	M(P.C.) (1)	S(H.C.) L(H.C.) (2)	S(H.C.) S(P.C.) L(H.C.) (3)	S(ITG), S(ITG) S(ITG), S(ITG) (4)	10
					21

*IND = independent firm

P.C. = Profit centre subsidiary

H.C. = Holding company subsidiary

ITG = Integrated subsidiary

+ formerly an independent firm

++ recently purchased by a foreign manufacturer and will operate as a profit centre after attempted integration failed.

subsidiary, the more one finds less activity in R + D, a more constrained nature of operations, and less innovative behavior in the subsidiary firm. The more autonomous the firm, the more one finds greater R + D activity, a greater variety of organization functions and activities and more innovative behavior and attitudes conducive toward innovation.

However, it must be remembered that these results were obtained from firms within one industry, industrial machinery. All firms surveyed felt that the keys to success or even survival were quality of product, reasonable price and good customer service first, and then innovative products. In the industrial machinery market, a firm which could not deliver on the first three factors would not survive regardless of the innovations it could offer to the market.

Once a firm can satisfy the three primary factors of quality, price and service, then it can operate within a continuum of strategy toward innovation. For example, two firms of the same size may employ the same number of persons in R + D, but the role of the R + D department and hence the climate for innovation may be entirely different. In an independent firm which chooses a strategy of self-reliance, the R + D department must be innovative in order for the firm to survive. The R + D process and resources would be focussed on the problem of new product ideas, test designs/models, the transfer of innovations to production, and eventually the market. Of necessity then, R + D perspective must be wholistic in thinking of products and processes and must also be in terms of product life cycles.

In either a subsidiary firm or an independent firm with strategies of dependence on external technological sources, the R + D focus can be more limited. Here the perspective can be limited to design modifications, packaging of components or designing accessories for existing products. Products are generally in the mature phase in such firms which means that the R + D people get little exposure to the birth stage and don't have to think in wholistic terms.

In summary, the following pattern of variables seems to be associated with innovative behavior. First, there must be opportunity to choose a competitive strategy of innovation, second, there must be a commitment of resources to innovation-oriented R + D, and third, there must be motivated personnel in the R + D activity. Without the first two conditions being satisfied, motivation for innovation will be unlikely to be aroused and there would be little to attract innovation-minded people to such firms. Subsidiary firms can only satisfy the first two conditions if such a role is designated for them or if subsidiary management are able to negotiate such a role with their headquarters. Figure 1 below illustrates some of the differences between autonomous firms and subsidiary firms on structure variables associated with innovative behavior.

Figure 1

Structure of Firms and Innovation Potential

Structure Variable	Autonomous Firm	Holding Company Subsidiary	Profit Centre Subsidiary	Integrated Subsidiary
Strategy	Free to Decide	Usually Negotiated	Some Negotiation, Mostly Directed	Directed
Scope of Operations	Wholistic, All Functions	Quasi-Independent, Most functions local, key functions at H.Q.	Strategic Functions at H.Q., necessary operating functions are local	Mostly directed by H.Q., a few local functions for specialized role.
R & D Resources	Free to allocate	Allocate within annual budget	Sometimes directed, sometimes in annual budget	Directed for designated R&D role (if any)
R & D Activity	Subject to strategy decision	Subject to strategy role	Constrained by defined role of subsidiary	Directed tasks if R&D at all
Motivation	High potential	Good potential	Moderate potential	Low potential

In general, most firms tend to centralize strategic decision-making (Chandler, 1966) and many centralize strategic functions, such as R & D, (Hymer, 1972). Decentralized R & D most often is not the strategic R & D of the firm, but instead is specialized as either miniature replica labs or integrated support labs (Cordell, 1971). Decentralized, independent R & D labs are only likely to be found in relatively autonomous holding company subsidiaries. Therefore, the structure of a firm can be a significant variable in affecting the potential for innovation within a firm in that various structures can encourage or discourage innovation. This conclusion also suggests a linkage between organization structure and motivation for innovation.

Such a linkage had previously been suggested (Ondrack, 1973) in terms of the path-goal theory of motivation and the results of this study support the path-goal hypothesis. In brief, the theory suggests that motivation is most likely to be aroused when a person is able to perceive or expect a reasonable relationship between his effort and behavior (path) and the achievement of a goal. If the person foresees no opportunity for the achievement of a goal or no relationship between effort and achievement, then motivation will not be aroused toward that particular goal, or alternatively, a person might channel energies toward different achievements. For example, two agricultural machinery manufacturing firms of similar size were sampled where both were direct competitors in the prairies market, but one was an integrated subsidiary and the other was an independent firm.

The president of the independent firm favored a strategy of technological innovation and had authorized the creation of an R & D group with a test lab. The firm was constantly striving to improve their products and develop technological uniqueness from competitors. Moreover, the president actively sought export sales and frequently exhibited the firm's products at foreign trade fairs. The atmosphere of the firm was characterized by aggressive and energetic behavior along with a great deal of pride in their technological self-reliance.

The president of the integrated subsidiary was also personally interested in innovation but could not get authorization for an R & D group from his headquarters. The headquarters firm located all of its R & D at headquarters and the designated role of the Canadian subsidiary was to act as a marketing, distribution, and service centre for the prairies market. The subsidiary president conceded that it would be a waste of time to think about innovation because their designated objectives were in the areas of sales and servicing. Consequently, the energies of the firm were directed in these areas. They were not allowed to pursue export markets and the firm was completely dependent upon external

technology.

However, independence alone is not sufficient for innovation. A third firm in the same area was also studied which was Canadian-owned and independent. Rather than pursuing a strategy of innovation and self-reliance in technology, the executives of this firm chose a strategy of risk-avoidance. Most of their products were either direct imports or manufactured under license because these arrangements were cheaper and less risky than original R & D. The firm was also not allowed to pursue export sales under the various licensing agreements, but the firm was content with servicing the local prairie markets. Obviously such a firm would not attract innovative people nor motivate innovative behavior within the firm. However, this firm was recently purchased by a Canadian holding company and the possibility existed that a new role would be designated for the firm by the new H.Q..

Figure 2 below illustrates the relationship between autonomy, strategy, and innovation potential.

Figure 2

Relationship between Autonomy, Strategy and Innovation

	<u>STRATEGY</u>	
	<u>Take Risk</u>	<u>Avoid Risk</u>
Freedom to Choose Strategy	High Innovation Potential	Low Innovation Potential
Designated Strategy	Good Innovation Potential	No Innovation Potential

From this representation, it can be seen that only one combination provides a situation of high potential for innovation while the others provide lesser degrees of potential.

Given a favorable situation in a firm, there is still the question of whether people will actually be innovative in terms of individual energies, activities and aspirations. However, this leads to questions of individual motivations which are beyond the scope of this study and have been studied extensively elsewhere. While such matters were not directly studied in this project, it was possible to make some non-systematic observations of individuals in creative and innovative organizations. These observations are only tentative at present and may only be valid within the context of the industry studied or similar industries.

The most innovative people seemed to have a great interest in their particular market and a good understanding of the needs of their customers. Rather than hiding away in an R & D lab all the time, they frequently interacted with customers or the marketing personnel of the firm. Secondly, they seemed to have the ability to conceptualize a product or a solution to a market problem and then translate the concept into a producible, physical product. In other words, they tended to be very practically oriented with a good mechanical sense and could easily relate their concepts in understandable terms to machinists or production engineers. When asked what sort of persons they would like to hire for their operations, these persons said they were very frustrated in trying to hire engineers or technical staff. The problem seemed to be that too many engineers and technicians were too theoretically oriented or trained to work on highly specialized pieces of problems. Few seemed to be able to think wholistically about products and instead could only think in terms of components or a narrow aspect of the innovation → production process. The innovative people wanted to hire people who liked to build things and weren't afraid to get their hands dirty tinkering with real machinery.

Finally, the innovative people had an implicit sense of product life cycles and recognized the differences between start-up of a product, maturity of a product, and decline of a product. Quite understandably, their greatest interest was in working in the start-up phase and they were not much interested in the maturity or decline phases except as challenges for new ideas.

These relationships are illustrated in the following figures.

Figure 3

Motivation Potential for Individuals Given Appropriate Structure

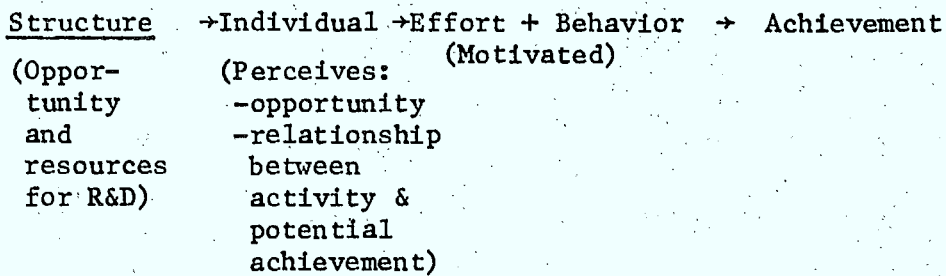


Figure 4

Processes Among Innovative Persons

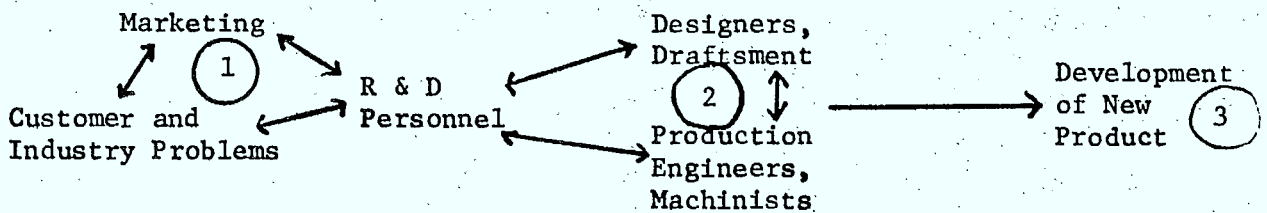
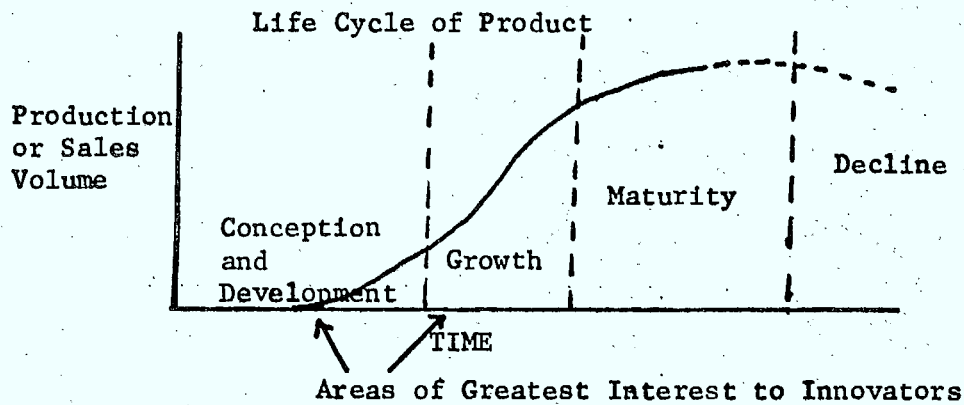


Figure 5



As previously stated, the relationships illustrated in these figures were not specifically studied in this project, but are impressions about attitudes and abilities gathered while conducting interviews on structural aspects of the firms. While it is concluded from this study that a strong relationship can exist between autonomy, strategy, R & D resources and innovation in a firm, two further areas of study are apparent. One area of study would be to further examine the entrepreneurial/mechanically creative mentality which appears to be characteristic of innovators, and the second, would be to see if this type of innovative mentality is active among innovators in other types of industry. If such a mentality was found to be systematically confirmed among innovative persons (at least in certain industries), then the innovation process could be greatly aided by combining a favorable organization situation with more selective recruiting of R & D personnel.

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