

DRAFT:  
HANDICAPS TO CANADIAN INNOVATORS  
APPENDICES  
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HANDICAPS TO INNOVATION  
SURVEY FINDINGS AND ANALYSIS

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**HANDICAPS TO INNOVATION:  
SURVEY FINDINGS AND ANALYSIS**

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EXHIBIT A-1

HANDICAPS STUDY TERMS OF REFERENCE

Reference Study 1: The Handicaps of Canadian Innovators

- Identify the specific handicaps experienced by different segments of Canadian industry in executing and exploiting technological innovations, and wherever possible quantify these effects.
- Factors to be considered would include:  

Access to technology; access to capital; access to markets; scale effects; industrial structure; availability of suppliers and services; availability of manpower; environmental factors such as taxes, tariffs, government policies.
- Provide a pragmatic overview of the specific handicaps facing industrial innovators in Canada as compared to their competitors, in particular with regard to problems of undertaking original innovation in Canada.
- The following are specific issues to be addressed in the study:
  1. To provide a definitive statement of the handicaps faced by Canadian firms in undertaking technological innovation including, where possible, quantitative data on their impact.
  2. To examine the real or perceived impediments, as viewed by the firm, which affect their decision concerning whether to initiate innovation.
  3. To determine whether the significance of the handicaps is affected by factors such as ownership, size, type of industry, type of innovation and geographical locations within Canada.
  4. To estimate the implications for the Canadian economy of failure to redress any handicaps which are found to exist.
  5. To suggest means by which public policy could reduce the severity of handicaps in order to improve the incentive to innovate and the possibility of success.
  6. To suggest further studies which might clarify some of the issues which are raised in a quantitative or qualitative sense.

## I - INTRODUCTION AND APPROACH

In partial fulfillment of the terms of reference (see Exhibit A-1, opposite) for the study of the handicaps to innovation in Canada, Peat, Marwick and Partners conducted interviews with selected company representatives, government officials, and others. This appendix discusses the results of these interviews and reports handicaps to innovation as perceived by innovating organizations themselves.

In this section, we elaborate on the innovation process and outline the approach to the interviews of innovators.

### THE INNOVATION PROCESS

A clear understanding of the innovation process is important both for the actual study as well as a point of reference to readers of the study results. Charts are used to do this selected from an article by Erik A. Haeffner\*.

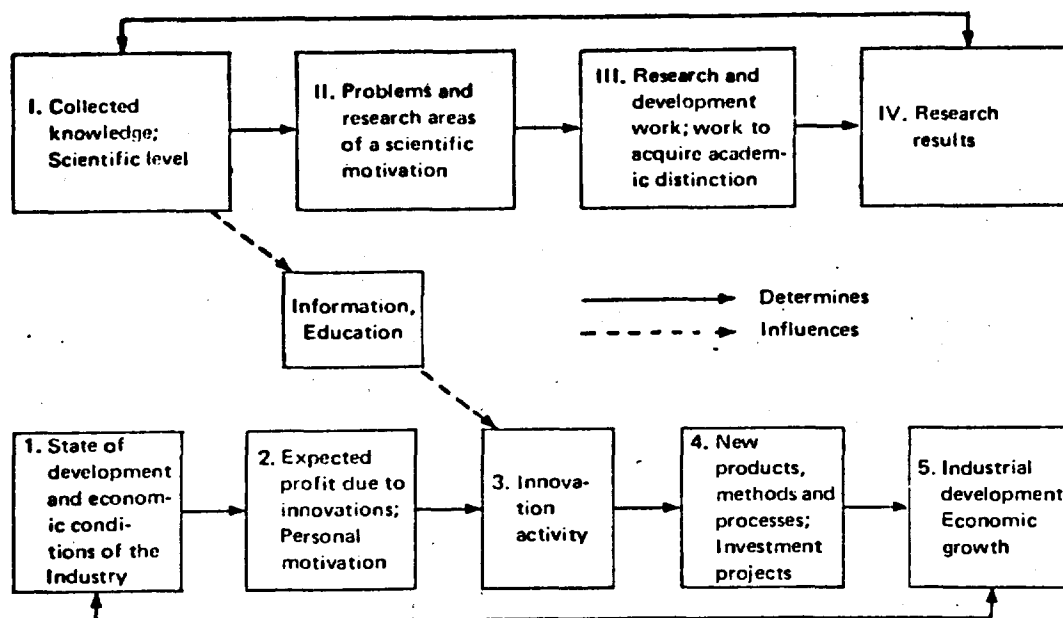
The formerly fashionable "Innovation Chain" concept of the innovation process regards basic research as the direct cause of new industrial products, processes and methods resulting in economic growth. Recent research has indicated that the "Innovation Chain" concept is not accurate. A study by Myers and Marquis in which 567 commercially successful innovations were reviewed, found that only three per cent could be identified as being initiated by the research.

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\* "The Innovation Process" from Technology Review, March/April 1973. (The Report of the Senate Special Committee on Science Policy included in Volume 3, pages 685 to 686 direct quotes of Haeffner's article.)

Marquis states that, "Successful innovations begins with a new idea which involves the recognition of both technical feasibility and demand. Recognition of demand is a more frequent factor in successful innovation than recognition of technical potential\*\*.

Based upon this and other research, Haeffner decided that a new and more accurate model of the innovation process was needed. The following chart presents that new model for the innovation process:

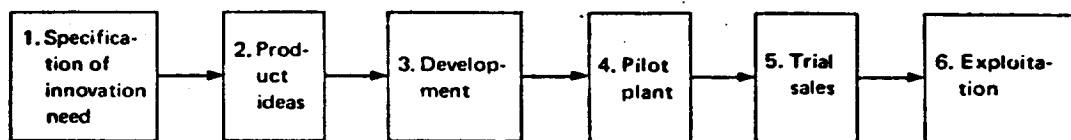


In summary, the above chart represents the model for technical progress and economic growth. As Haeffner describes, "Research has one primary effect; it increases the body of available knowledge, and this knowledge affects innovation. The impetus to innovation, however, is the state of the industry, and the industry's expectation of profit arising from the effect".\*\*

\* Innovation Magazine, Number Seven, 1969.

\*\* Op. cit.

In the following chart, "innovation activity" (box 3) in the above chart) is further illustrated:



SOURCE: Erik A. Haeffner, "The Innovation Process", *Technology Review*, March/April, 1973, pp. 20-21.

Hence the innovation process is based directly on the specification of innovation need, and only indirectly on the state of scientific research. Certainly there are, at least the "three per cent of exceptions", but the vast majority of innovation can be understood as a direct result of market need.

Erik Haeffner concludes his article with the following comment:

"We think that the Science Council of Canada has made a very good point, when it observes that there has been an over-emphasis on producing generator of information, and not enough stress on putting existing information to work."

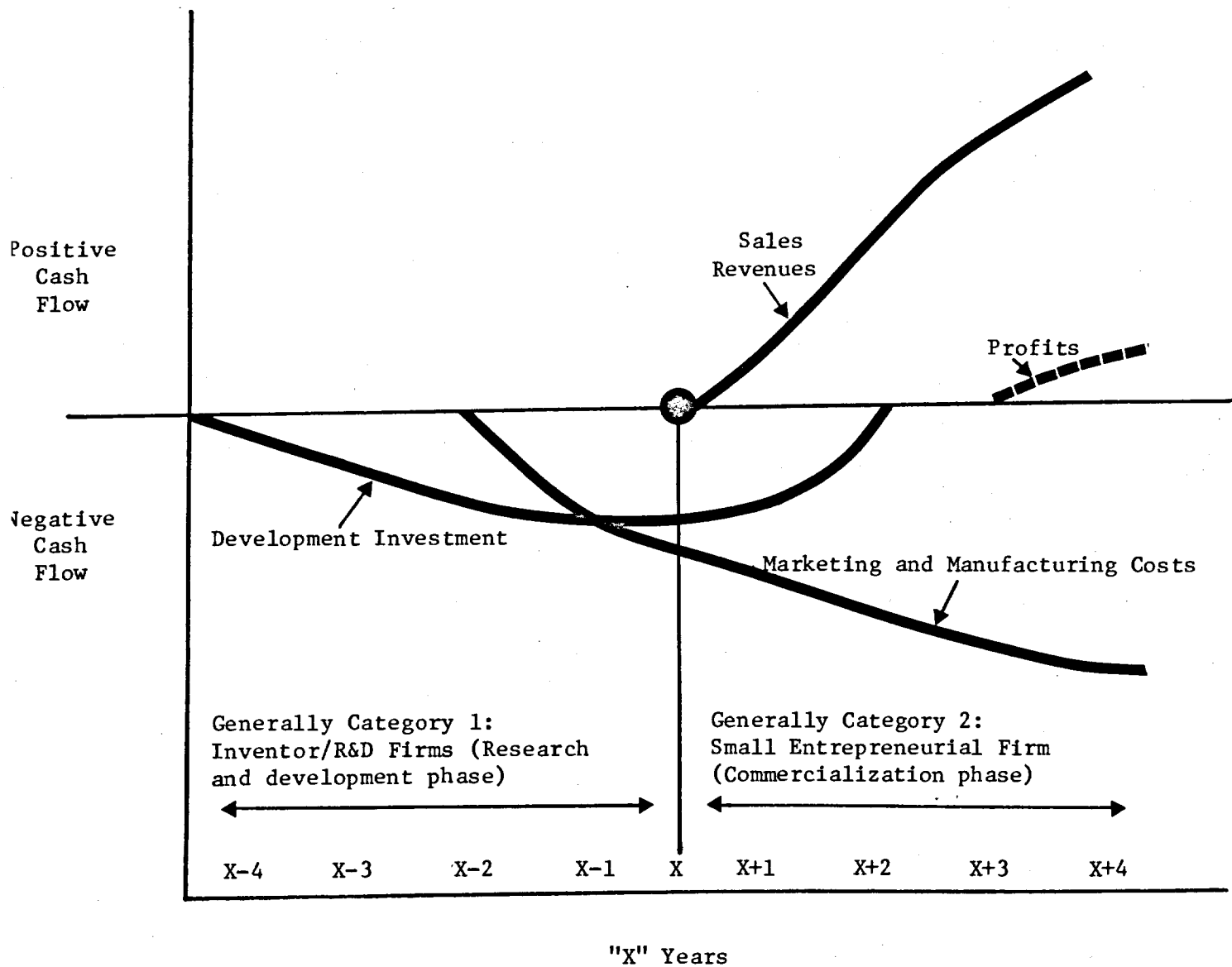
It is with this perspective of the innovation process that the study team approached the survey of innovators.

#### SURVEY APPROACH

The basic approach to the survey of innovators was to contact a cross-section of companies or individuals not yet formalized into companies. We divided the firms contacted according to an appropriate degree of maturity and experience with the innovation process,

EXHIBIT A-2

ILLUSTRATIVE CASE OF RELATIVE CASH FLOW  
FOR INVENTORS (CATEGORY 1) AND ENTREPRENEURS (CATEGORY 2)





which in turn is related to size and ownership. It is recognized that there are some overlapping categories. The categories are:

1. Innovator and small R & D firms, regarded as potential innovators. Of this category, we interviewed 11 individual inventors and officials of small R & D firms.
2. Small entrepreneurial companies, namely the companies that have begun or completed in some productions the commercialization phase of innovation. In this category we contacted 12 firms.
3. Medium to large Canadian-owned companies - these are well established large companies or at least those with professional management. We contacted 17 firms in this category.
4. Foreign-owned companies, generally large-size companies. We contacted 11 companies in this category.

Our conception of the innovation process encompasses three basic types of innovators. Category 1 innovators, which includes inventors and small R & D firms, are regarded as potential innovators. They have expended money of research, possibly with some governmental assistance, but have not yet begun the commercialization phase. Our Category 2 firms - small entrepreneurial companies - have begun the commercialization process which includes manufacturing, marketing, and other operational processes of a new business. Exhibit A-2, opposite, shows the relative positions of both Category 1 and Category 2 firms in the innovation process.

The final type of innovator includes our Category 3 - medium to large Canadian companies - and Category 4 - foreign-owned companies.

They are the more established firms who have had successful innovations in the past, and are now typically also trying to replace dying product lines with new innovative products or to add new products to increase their size by internal growth.

To better appreciate the context of individual companies' innovation efforts and to examine the impact of the handicaps due to type of industry, we concentrated on three basic industries, namely:

- electronics, particularly communications (where we interviewed 13 firms)
- machinery for the mining and pulp and paper industries (in this area we contacted 17 firms)
- small and large household appliances - "white goods" (where we contacted 11 firms).

In addition, we have contacted ten firms which do not fall into any of these industries and are regarded as "others". The "other" category includes primarily inventors who are not in a particular industry while the four companies in the "other" category are in fields related to the three major industries. This selection of industries was agreed upon during the course of our panel meetings. It was chosen because it provides a good range of probable innovative activity from "high" in the electronics industry to relatively "low" in the white goods area and "moderate" in the machinery area.

The 51 firms can be categorized as follows:

Company	Electronics	Machinery	White Goods	Other	Total
Inventor/Small R & D	3	0	2	6	11
Entrepreneur	4	4	1	3	12
Medium/Large Canadian	2	9	5	1	17
Foreign-Owned	4	4	3	0	11

Prior to the interviews, we developed as many hypotheses as we could about the handicaps to each category of innovator and listed the traditional ways of overcoming these handicaps. This exercise prepared our interviewing team (the authors of this report) for discussions with company officials.

Our approach in conducting this survey of companies was to use a basic checklist of questions to conduct unstructured interviews to allow those contacted to express what they regarded as "handicaps to the innovation process". Basic information compiled for each company (which is confidential) includes:

- financial data
- product lines
- innovation process relevant to the company
- R & D capability and employees

- handicaps to innovation
- suggestions as to solutions to overcoming handicaps.

In addition, we solicited any general comments on the topic of innovation which those interviewed cared to make.

In general, in the small- and medium-sized firms, we met with the chief executive officer and sometimes with his R & D director. In the larger firms, we generally met with the general manager of a major division in one of the industrial areas or the director of R & D. These individuals were best able to discuss the innovation process as it evolved in their company and the particular handicaps encountered. While the majority of our industry contacts were in the Ontario and Quebec heartland, one-quarter of the companies contacted were in the West and in the Maritimes.

#### Others Interviewed

To complement the company interviews, we also interviewed others whom we believed to have some insight into the handicaps to innovation. In this regard, various government officials at both the provincial and federal level (42 in all) were contacted. Their views were sought regarding existing governmental programs and policies and industry backgrounds. We also solicited any general comments which those contacted felt appropriate.

To supplement our survey, we also have contacted eight university professors, five industry association officials and eight others, primarily venture capital company representatives. These contacts provided information from another perspective. In particular, the industry association officials provided industry background, the venture capital representatives were able to provide a composite view of the innovation process, and several of the university professors were doing research in the area of innovation in Canada. Much of our findings from this group has been useful and incorporated in our analysis of findings.

#### Complementary Efforts

Throughout the basic survey of company representatives and others, the handicaps study as a whole was reviewed at three "panel of innovators" meetings. These meetings included the study team, Ministry of State for Science and Technology officials and selected industry spokesmen, generally in the top management levels.

In addition, while the interviews were in progress, we were undertaking a more general review of current literature and available documentation regarding handicaps to innovation in Canada. The interviews and literature review enabled the study team to draw conclusions on handicaps from a broader economic perspective as well as from the point of view of the individual firm.

EXHIBIT A-3

FREQUENCY OF HANDICAPS MENTIONED BY TYPE OF INNOVATOR

Type of Handicaps \ Companies by Category	Inventor, Small R & D Category 1	Entrepreneur Category 2	Medium/Large Canadian Category 3	Foreign-Owned Category 4	Overall Totals	Frequency Ranking
Financial	50%	26%	14%	10%	21%	2
Managerial	0%	6%	7%	17%	8%	5
Technical/Manufacturing	11%	21%	23%	20%	20%	3
Marketing	6%	29%	38%	50%	34%	1
Governmental	33%	18%	18%	3%	17%	4
<b>TOTALS:</b>	100%	100%	100%	100%	100%	

NOTE: This chart expresses percentages of number of mentions, and not percentages of companies interviewed.

## II - FINDINGS BY TYPE OF HANDICAP AND TYPE OF INNOVATOR

This section describes the results of the interviews with 51 companies. First, we report what the company officials perceive as the barriers to innovation. Second, interpretations are made of the perceived handicaps, based on our own assessment.

The findings are organized into the four innovator categories of inventor/small R & D firms, entrepreneur, medium/large Canadian company, and foreign-owned company. The types of handicaps covered in each case are: financial, managerial, technical/manufacturing, marketing, and governmental. Findings are also presented from the perspective of the handicaps to the firm which has not yet initiated the innovation process.

To summarize the findings, two charts have been prepared showing the handicaps mentioned by companies interviewed. The first shows frequency of mention by type of handicap (Exhibit A-3, opposite) and the second a listing of specific handicaps and the number of times each was mentioned (Exhibit A-4, overleaf). The principal findings depicted on these charts are:

1. Financial. The financial handicaps identified include a lack of capital, low profit margins and export financing problems.

EXHIBIT A-4

SUMMARY OF HANDICAPS AS PERCEIVED BY INNOVATORS

Companies By Category  Handicaps Identified	C O M P A N I E S			
	CATEGORY 1	CATEGORY 2	CATEGORY 3	CATEGORY 4
	Inventor and Small R & D Firms	Small Entrepreneurial	Medium to Large Canadian	Foreign-Owned
<u>FINANCIAL:</u>				
- lack of capital	X X X X X X X X X	X X X X X X X X X	X X X X X	
- low profit margins			X	X X
- export financing				X
<u>MANAGERIAL:</u>				
- own management too technical		X X	X	
- need long-range planning			X	
- restrictions of parent				X X
- own management too conservative			X	
- firm too large				XXX
<u>TECHNICAL/MANUFACTURING:</u>				
- high R & D costs	X	XX	X	
- technological risks		X X		
- development problems		X	X	
- skilled labour shortage	X	X	X X X X	X X X X X
- Canadian Standards Association			X	
- foreign R & D competition		X	X X X	X



<u>MARKETING:</u>				
- small Canadian market	X	X X X	X X X X X X	X X X X X X X X
- large marketing costs		X X		
- too many competitors (fragmented market)		X X	X X X X X	X X
- poor marketing strategy		X X	X X	
- long sales cycle			X	
- conservatism of private and corporate consumer		X	X X X	X X X X
- short product cycle			X	
<u>GOVERNMENT:</u>				
- lack of financial assistance	X X X X	X		X
- limited patent protection	X X			
- limited government "buy-Canadian" policy		X X	X X X	
- resource policy uncertainty		X	X X	
- transfer prices taxation		X		
- government red tape		X	X X X	
Number of firms <sup>①</sup>	11	12	17	11

Peat, Marwick and Partners

① Firms often made more than one mention of a handicap.

In general, the "lack of capital" was explained as a result of the conservative nature of the Canadian financial institutions. For Category 1 firms, lack of capital is generally money needed to get the innovation process started. For Category 2 firms, it is generally lack of expansion money required for growth. Categories 3 and 4 firms mention "low profit margins" as a rationale for not having sufficient funds to invest in innovation.

Overall financial handicaps were identified by 21% of all respondents.

It is also interesting to note that as a company moves from Category 1 to Category 3 and 4, the percentage who mentioned financial handicaps (as compared with other handicaps) significantly declines.

The shift of responses from Category 1 through to 4 is a logical one. In 1 and 2 there is a combination of the inexperience of the principals of the innovating firm and reticence of lending institutions. In 3 and 4 the statements made during interviews relate to the overall environment.

2. Managerial. Only eight per cent of all companies identified managerial handicaps.

As depicted by Exhibit A-3, there was no mention of managerial handicaps by Category 1 companies. Whereas the Categories 2, 3 and 4 companies had a level percentage mention of between 6% and 17%.

The relatively infrequent mention of this problem by Category 1 firms can perhaps be explained by the reluctance of the interviewees to admit even to themselves their own managerial weaknesses.

3. Technical/Manufacturing. Overall, technical/manufacturing handicaps (as a percentage compared with other handicaps) were identified by 20% of the respondents.

Again, as shown in Exhibit A-3, the Category 1 companies deviate significantly from the norm in that only 11% of that category identified this area.

The distribution of occurrence is logical, Category 1 companies are composed of a small group of highly skilled technical personnel. Whereas, companies in Category 3 and 4 mention the problem of a shortage of skilled labour most frequently.

4. Marketing. The marketing handicap was identified by 34% of the interviewed companies, and ranks as the No. 1 concern expressed.

It is interesting to note that the percentage increases dramatically from Category 1 to Category 4 companies, namely from 6% to 50%. This may reflect a growing understanding of marketing as a problem other than an increasing difficulty encountered in marketing itself.

The concern of foreign-owned large companies regarding the small Canadian market can be interpreted as an expression of their larger international markets outlook. It is also possibly a reflection of their lack of authority to export from a Canadian base.

5. Government. "Government" has been shown as a distinct handicap area because (a) it has been specifically identified by companies, and (b) because government policy and posture is important to the innovation process. Many companies interviewed expressed the concern that government is not doing enough to foster innovation, while others expressed a feeling of a developing "anti-business" posture by government in general.

Casting government as a handicap may indicate that official grant programs subsidizing laboratories and individual innovators are inefficient or burdened with excess paper work.

Our overall total percentages rank government as fourth with 17% of the 51 firms identifying government as a handicap.

Certainly, there is a level of overlap in this set of handicap types and one could discuss (and analyze) cause and effects of the various handicaps, as well as interrelationships among them. However, we feel

that these charts depict the concerns of companies in Canada regarding handicaps to innovation and in the functional way which they view the problems.

Two general observations can be made at this point. First, firms appear to look outward as they mature, and attribute handicaps to other than their own funding needs. Second, smaller sized innovators often perceive that lack of innovation is somehow the "fault of others" rather than the result of managerial deficiencies. We now examine the findings for each of the four categories.

INVENTOR/SMALL R & D FIRMS  
(CATEGORY 1) FINDINGS

Category 1 interviews were concentrated on individual inventors or small firms in the development process.

As depicted in Exhibit A-3, the major concern expressed by this category of innovator is financial with "governmental" handicaps having the second highest number of mentions. The following is a brief review of handicaps perceived by innovators in each functional area:

1. Financial

Most interviews indicated that raising venture capital is their major problem. They expressed concern regarding "risk aversion" of the Canadian financial institutions. In addition, several felt that government programs do not address themselves to this type of potential innovator. However, three firms were able to get limited government financial help, particularly in R & D areas. Not being able to carry forward development losses more than five years for tax purposes is also a financial handicap for this group.

2. Managerial/Marketing

Managerial and marketing handicaps for this group centre on the inability to obtain appropriate financial assistance from Canadian governmental or venture capital groups. A majority of those interviewed expressed their frustrations in seeking assistance. The solution for four people interviewed was to seek and obtain financial assistance in the U.S. or the U.K. One company expressed its difficulty in finding skilled personnel, as well as the small Canadian market and need to export to survive.

3. Technical/Manufacturing

All persons interviewed had developed at least a prototype model of their potential innovation. The majority were unable to develop a production model because of the lack of financial assistance or an advantageous joint venture.

Interpretation of  
Perceived Handicaps

The innovator was technically-oriented, and either working from a university R & D base or from the industrial equivalent. He generally perceives the financial handicaps as his major obstacle.

There are two reasons for this:

1. The limitations of the innovator himself:
  - lack of financial expertise or even an interest in financial matters
  - lack of an objective evaluation of the value of the innovation on the market
  - lack of marketing strategy.
2. The alleged conservatism of Canadian lending institutions.

Case Study of a  
Small R & D Firm

The following case study is provided to further illustrate the perceived handicaps of innovators and our interpretation of them. Individual and company identities have been disguised because of the confidential nature of the study, as is true with the other case studies presented.

Company Alpha is a small Canadian company which was started by several university professors to provide a commercial outlet for some of the interesting research that was being carried out at the University. The company was incorporated four years ago and has been completely concerned with its internal R & D effort.

To date, Company Alpha has been successful in development of a high technology prototype.

Company Alpha has had limited capital. Basically, each professor and several friends provided the initial capital. This was supplemented by a small federal grant for its R & D effort. The company is now seeking additional capitalization (based upon its successful R & D efforts) to initiate the innovative process. Company Alpha indicates that financial assistance was available from a U.S. company, but the conditions would have required relocating to the U.S. and the end of trying to develop a Canadian firm.

The innovative process now requires a major change in thrust from a basic R & D lab (a Category 1) to a commercial firm (a Category 2). To achieve this, in addition to further capital requirements, Company Alpha is trying to develop a business plan.

Although Company Alpha has developed a highly successful prototype, the problem remains of making this a commercial success. Company Alpha is attempting to proceed through the innovative process. Although it believes its major problem is lack of capital (and indeed it needs additional capital) we interpret the real problem to be how it would (and can) effectively utilize additional financial resources.

#### Solution

The solution to both a credible solicitation for capital and effective utilization of capital is the development of a business plan. This should include financial analysis for capital budgeting with risk analysis, a market analysis, including probable market share, competition, and sales strategy, and a manufacturing plan to provide the strategy for the transition from an internal R & D lab environment to a manufacturing environment.

#### ENTREPRENEUR (CATEGORY 2) FINDINGS

The small Canadian entrepreneurial firm (Category 2) includes primarily those companies who have just begun the product commercialization phase of the innovation process. Two firms interviewed are in

the small category because of size, but are well established service companies in the engineering consulting area. These two companies are basically oriented to "innovate by contract" and for this section are atypical. Our primary concern is with the small company who has moved recently from the development phase (Category 1) to the commercial (sales) phase (Category 2). Findings are as follows:

1. Financial

Nine of the companies identified the financial area as a major problem. Although most of these companies have been able to acquire some governmental assistance in the R & D area, the start-up costs in the marketing and manufacturing areas have required substantial expenditures. This category company is typically operating at a loss or only marginally profitable, and most probably has a negative cash flow position (relating to return on investment). The tax problem mentioned for Category 1 is even more important for Category 2.

2. Marketing

Nine of the companies mentioned handicaps in the marketing area. The handicaps mentioned include the small Canadian market (requiring exports to survive); large expenditures for promotion and distribution; strong competition from established firms who tend to be well known; and difficulties in developing and implementing effective marketing strategy.

3. Managerial

Two companies specifically mentioned the problem of having a technically-oriented management, and indicated that experienced business management was necessary.

4. Technical/Manufacturing

Seven companies expressed handicaps in the technical area. These included the high cost of R & D expenses; foreign research competition; the rapid technological changes and inherent risk involved in high technology



development; actual problems encountered in the development process, skilled labour shortage and competition from foreign companies with large R & D capabilities. It was suggested that skilled manpower goes south where the pay is better and there are more jobs.

#### 5. Governmental

Several companies expressed concern regarding government policies. One company wanted a better defined "buy-Canadian" policy; another company complained that the U.S. companies have an advantage as a result of intercorporate transfer prices which understate actual Canadian costs. The "red tape" of government incentive programs and the conservatism of Canadians was also mentioned.

It was also indicated that governmental policy does not encourage small businesses, and in particular the limited tax write-offs and limited tariff protection were mentioned.

#### Interpretation of Perceived Handicaps

In general, these small Canadian firms have encountered a wider range of problems (vs. the inventor/R & D firms Category 1) since they have actually entered the marketplace.

The Category 1 firm is concerned almost exclusively with invention. The small Canadian firm of Category 2 is now concerned with sales, profits and a probable negative cash flow. The Category 2 firm must successfully perform in all aspects of business management (marketing, finance, manufacturing, development, and general management) probably with limited human resources. In addition to internal performance, the Category 2 firm is also encountering external problems of changing technology and competition. At the same time, the Category 2

firm is probably trying to begin diversification through the development of a new, related product line.

The Category 2 firm identified handicaps that are fairly evenly distributed between financial, technical/manufacturing, marketing, and governments. Only "managerial" remains low in terms of identified handicaps. In general, companies interviewed recognized this need for better management, but none had developed a financial analysis or business plan to outline requirements to successfully achieve commercialization. They lacked the effective entrepreneurial type of management required to move from the research stage to a truly innovative stage.

These handicaps to innovation are essentially similar to the problems faced in other countries. However, Canada seems to have a more limited history of entrepreneurial activity than most industrially developed countries, and hence Canadians have less experience in this area. Part of this could be due to limited business educational opportunities and to the general "branch plant" operational manager orientation in Canada. Managerial handicaps, combined with the limited venture capital and second level financing institutions limitations, the relatively small and fragmented Canadian market and the limited skilled technical/manufacturing personnel, would seem to place the Canadian potential entrepreneur at a disadvantage vis a vis his American counterparts.

Entrepreneurial  
Case Study

Company Beta was started four years ago in Western Canada by a university professor to design and manufacture a high-technological product for the Canadian market. A year after formulation, the firm introduced its first commercial product. The following year a more advanced product was introduced. Sales have grown rapidly, however, while the firm is showing a profit, it has a negative cash flow position because of large start-up expenses in marketing and manufacturing.

The firm was initially capitalized by a NRC grant and some venture capital money. The firm has tried to support its R&D staff from various government grants which relate to Beta's intended product areas.

Beta has grown to nearly 70 people. This growth has increased its expenses and most significantly its management complexity.

Two years after formation a marketing executive was hired. His efforts have largely been responsible for the sales growth. Currently, the firm has begun exporting to Europe and has set up a marketing representative there - primarily because of the limited Canadian market.

The firm made a decision early to establish its own manufacturing facilities, and was successful in the introduction of its

first product line. However, rapid technological changes restrict the potential life cycle of its first product. For survival, company Beta is developing a more sophisticated product line but requires a high R&D expense. Company Beta has committed itself to the high risk of this new development to maintain its survival.

Company Beta has been successful in overcoming various handicaps and initiating the innovation process. Because of the limited product life cycle of its first product line and high development cost for its proposed product line, its future is still questionable.

Company Beta is perhaps typical for this category. Its major concerns are marketing, technical and financial. Problems in all these areas are relatively severe due to the constraints of Canadian environment for innovation as discussed above.

MEDIUM/LARGE CANADIAN COMPANIES  
(CATEGORY 3) FINDINGS

This category includes a wide range of firm sizes, from the \$5 to \$10 million public company to the \$100 million plus in sales size companies. We are mainly concerned with the growing professionally managed firm or a division of a larger Canadian firm in this category.

These Category 3 companies indicated that marketing was the major handicap to innovation (38% of handicaps identified) - both the small Canadian market and its fragmentation were the items most mentioned. To a lesser extent (23%) the handicaps identified were

technical and manufacturing, primarily skilled labour shortage and foreign R & D competition. The following are the stated handicaps from the 17 companies interviewed:

1. Financial

Of the 17 companies interviewed, five identified limited financial resources as a major handicap. In one case, there was sufficient capital available, but only on the condition that the company would give too much equity to finance the development of a major new product. In a second, a Canadian holding company acted as a cash drain on the company. A third company sold ownership to a U.S. multi-national, repatriated it again and is now undercapitalized. A fourth has been continually undercapitalized to finance expansion.

2. Managerial

Three companies indicated particular managerial handicaps. One indicated that its technically-oriented management was a handicap that had been overcome. The second felt that a lack of long-range planning and marketing research was a handicap to further corporate growth. The third company indicated that its senior management was too conservative.

3. Technical/Manufacturing

In the technical area, one company expressed the concern that its R & D orientation was too limited and should be better utilized to develop potential product lines. The high costs of R & D personnel was also mentioned as a serious problem. In the manufacturing area and to a lesser extent in the R & D area, three firms specifically indicated the shortage of skilled personnel. Another company mentioned materials shortages and a current manufacturing problem in the production of new innovative product lines. One company indicated problems obtaining certification from the Canadian Standards Association.

4. Marketing

Marketing handicaps, the No.1 problem of this category, was mentioned 17 times. The limited size of the Canadian

market was indicated by six firms. Domination of the market by very large, foreign-controlled firms was mentioned by five companies. Three firms commented on customer reluctance to accept innovative products until the products had proved themselves through long operating experience in other firms within the industry. Another firm in the consumer products area mentioned the difficulty in achieving innovation as a result of the short product life cycle of products in their industry. Yet another company in the machinery products area commented on the long sales cycle as a handicap, since it creates a significant cash flow problem.

5. Governmental

Three companies expressed problems with governmental red tape and delays regarding grant programs. The current uncertainty caused by resource taxation policies was mentioned as inhibiting major capital expenditures by one company. Three companies complained that governmental assistance actually was given to a non-Canadian competitor as part of a regional development program.

Interpretation of  
Perceived Handicaps

Of the firms interviewed in this category, nine were in the machinery area, five in the white goods area, and two in electronics and one in the "other" category. In general, it is impossible to draw any conclusions regarding the firm's survival and its ability to innovate. In the machinery area, several of the firms are highly innovative, while others rely on foreign licenses. The same statement can be made for the remainder of the firms of this category.

The smaller-sized innovating companies have overcome their technical, financial, and marketing problems. It appears that

2

governmental financial or technical assistance has not been essential to stimulating the innovations that have occurred.

Financing remains a problem to many of the medium-sized Canadian companies, although in some instances it appears that financial problems could be solved if the companies sold out control to other firms, (and in many cases have to sell to foreign firms). Internally-generated funds are just not sufficient to sustain innovation and growth.

Lack of qualified technical staff to support R & D, and production engineering was mentioned, yet little use seemed to be made of contract research or other technical assistance from federal and provincial research organizations.

Six companies mentioned the limited Canadian market size; however, many of these Canadian companies have been able to find export markets, and thus innovate successfully. In fact, exporting was specifically mentioned as a requirement for survival by many individuals. The problem of too many competitors, mentioned by five firms and trade officials, compounds the problem of a small market. A fragmentation of the market means that for individual firms the potential return to any innovation investment is limited.

Government was mentioned largely as problem of entanglement, whereby there was too much "red tape" in obtaining grants, or that

government was hampering innovation through some other regulatory or intervention activity. Government was believed to be a "handicap" itself, and not an instrument to remove some of the handicaps.

Medium-Sized Canadian-  
Controlled Company -  
Case Study

Company Theta was founded in the mid-60's to provide special equipment to the Canadian oil and mining industries. Company sales are now in the \$10 million area. The company was able to develop a successful product and received government assistance from PAIT, IRDIA, and other agencies. It was also able to successfully gain assistance from both venture capital firms and local banks in the early 70's after a successful sales and product capability was proven. However, Company Theta is still under-capitalized for growth.

The Theta Company management recognized the need to move from a technically-oriented management to a business-oriented management. Its Chief Executive Officer was technically-oriented and upgraded his management capability through a correspondence business administration study program.

In the late 60's, the Theta Company found that its sales in Canada were dropping off drastically. The solution was an extensive export effort. Currently, about 75% of the company sales are exports.

Company Theta is also typical in Canada regarding financial assistance. Once a company has established a successful track-record,



both venture capital and government grant assistance is more readily available. Company Theta's management is probably atypical, since it has retained an entrepreneurial thrust.

FOREIGN-CONTROLLED FIRMS  
(CATEGORY 4) FINDINGS

Foreign-owned firms were treated as a separate category and on the average were larger than the medium to large Canadian-owned firms. Ownership was primarily American although some were controlled by European parents.

Category 4 firms (foreign-owned) indicated that marketing is their major handicap. Fifty-six per cent of the handicaps were in the marketing area - this is the largest percentage for any functional area for all categories of this survey. In the marketing area, the small Canadian market was the most identified handicap, followed by the conservatism of the consumers. The small market was enough to support a viable operation, but insufficient to support extensive innovation activities.

Interestingly, the foreign ownership question vis-a-vis the rise of Canadian nationalism seemed to have different effects on different companies. Although several expressed their concern and efforts to be "good corporate citizens" (particularly in electronics), others wondered why they should retain their operations in Canada because of their heavy exports to the U.S. Even though several of the firms had

been successfully innovating and had high exports, there were some concerns that corporate headquarters might restrict the operations of the Canadian subsidiaries.

1. Financial

Two of the 11 firms (both in appliances) indicated that low profit margins inhibited innovation. Another company discussed a major Canadian innovation in which parental financial backing assisted the innovation to succeed.

Five other firms in the electronics industry had sufficient size and cash flow to sustain R & D programs (on a reduced basis) through the recent lean years of the industry. The large R & D costs and the many years payback period for sophisticated products was mentioned by several firms as inhibiting innovation.

Government financial assistance has been helpful in at least two major innovation cases, though it could not be determined whether such assistance was critical.

2. Managerial

Five companies have an established screening process for new products. However, three companies mentioned that their own large size inhibited innovation. In two cases, spin-off examples were cited of employees leaving the company to set up small companies to market a particular product development.

The two foreign-owned firms in the appliance industry indicated that the parent restricted their innovation to adaptation to the Canadian market of the parent's products. The others tended to have product responsibility and world market access, although there were various degrees of world corporate headquarters influence on their overall product planning. In all but two cases world corporate headquarters had active influence on corporate strategy.

### 3. Technical/Manufacturing

Lack of skilled personnel was mentioned by five of the firms interviewed.

One firm particularly emphasized the problem of being the only large electronics firm in his region, and that the lack of interaction with other firms tended to inhibit innovation.

Access to parent technology differed from firm to firm. One company's technical resources merely performed installation and maintenance services for the head office's sophisticated product lines. Two used the products as is. Four others tended to use the parents' R & D establishment of basic research, while each had its own Canadian product development capability. Three firms had very little access to parent R & D, since their product lines tended to be entirely dissimilar to their parent firms' interests. Lack of access to parent R & D did not necessarily inhibit innovation, and access to parent R & D assisted in some cases the efforts of the technological development capability in Canada.

### 4. Marketing

Nine of the 11 firms mentioned the small size of the Canadian market as a handicap to innovation, although not necessarily to the viability of the companies' operations in Canada. Small Canadian markets seem important to the foreign-controlled firms, even when such firms are able to export their product lines. This is perhaps because their establishment as a subsidiary in Canada was originally based on a Canadian market need (e.g. a Defense requirement), and the small Canadian market tested the *raison d'etre* of being in Canada.

The lack of a Canadian market was a handicap that could be overcome by export sales. International marketing organizations were used by most firms, and parental control over access to international markets, as mentioned above, ranged in degree. Non-tariff barriers by the U.S. Government were mentioned by two companies as handicaps to sales to the U.S. Government.

Four of the firms specifically mentioned the general conservatism of the Canadians as individuals and corporate consumers. Another firm believed Canadian companies did not understand the marketing problems in the industry (electronics), and that Canadian managers of subsidiaries were "operators" not "managers".

#### 5. Government

Only one firm mentioned government as a source of handicap to innovation, and that was a comment about too little government financial assistance to support innovation.

#### Interpretation of Perceived Handicaps

The firms that were surveyed represent a restricted sample of foreign-owned companies. The restriction of the sample to electronics, machinery and white goods companies tends to lead to specific conclusions, where behaviour seems to differ considerably between industries. For example, all the electronics firms interviewed had some innovations in Canada to their credit, while the white goods companies had none. The handicaps to innovation for foreign-controlled firms appear to depend on the nature of their business.

Based on our interviews, the following were the innovation behaviour patterns of foreign-controlled firms:

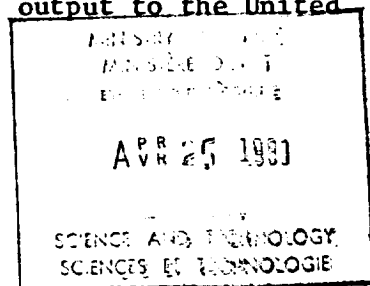
- little innovation will occur if the subsidiary is set up as a manufacturing, distribution and service operation; most non-electronic companies in our sample were in this category
- virtually independent foreign-controlled companies will encounter innovation problems similar to Canadian-controlled firms; two to three foreign-owned companies exhibited this behaviour

- access to corporate headquarters' R & D does not appear to enhance or inhibit innovation in Canada; there were no cases of a fruitful interplay between the Canadian sub and parent R & D facilities
- weak Canadian management will inhibit innovation directly through poor performance, thereby not developing innovation capacity and indirectly by not obtaining more product authority from headquarters; it was difficult to isolate this phenomenon, although the reverse effect of strong management was important in at least two firms
- in periods of industry recessions, corporate headquarters can insist on a costs and staff reduction of the subsidiary. Following such periods the innovative capacity may be developed outside the country rather than rebuild in Canada.

It appears, from the survey of firms, that many foreign-controlled firms can specialize in products in Canada, and develop sufficient engineering capability to innovate in "niche" product line in Canada. Relying initially on foreign financial and product resources, some firms have developed innovative capability. However, relying continuously on parent product or design capability seems to hinder innovation in Canada.

Foreign-Controlled  
Company Case Study

Company Delta, an electronics company, initially entered the Canadian market to perform a defense contract for the Canadian Government. Based upon the R & D efforts from that contract, a product line was developed. Delta Company was able to further develop this product line and related product lines and sell some of its output to the United States.



Delta Company currently operates autonomously on a day-to-day basis with an annual review of capital and business plans with the head office. It has been able to justify six product lines and has done both the R & D development and manufacturing for the world market.

Company Delta indicates a need to export its highly technical products because of the limited (small) Canadian market. It currently exports over 80% of total sales.

Company Delta has indicated a shortage of qualified engineering talent. It has worked out a program with a local university on a "co-op" basis to help solve this handicap.

Company Delta experienced one major product line failure when it tried to enter a new market. The new product line decision was made in Canada based primarily on market research done by the Canadian affiliate. The decision to enter the market and also later to abandon the area was made by the Canadian affiliate and presented to the headquarters' officials. Company Delta's Canadian affiliate devised its corporate strategy to stay only in its familiar markets after this experience. However, those markets provide substantial opportunity for innovation.

Company Delta is typical of the foreign-owned firms with innovative capability in Canada particularly in the electronics area. Company Delta presents an annual business plan to the headquarters with monthly reviews, but has been able to conduct its business without parental restrictions. Company Delta has innovated in Canada and hence

its competitive advantage in certain product lines and 80% export statistics.

Company Delta also provides an example of how the Canadian Government encourages and supports foreign-owned companies. Delta originally came to Canada to fulfill a defense contract from the Canadian Government. It has also received Federal assistance in R & D efforts.

#### HANDICAPS PRIOR TO INNOVATION

Most of the firms interviewed had at least attempted to innovate, if they were not also engaged in an active innovation process. Some firms, however, had yet to initiate the innovation process.

A few case histories cover the range of companies interviewed in this category:

1. Small Entrepreneurial Firm

The first case is a small entrepreneurial firm with Canadian ownership and a successful initial product line. Almost by definition, Category 2 firms, such as this, have started to innovate. However, the company has yet to go through a process of attempting innovation in other product lines.

This company has successfully developed and marketed an electronics product. Having begun without a formal analysis of the market and other factors, it has an informal policy of "crossing bridges as they come to them".

Being in the fast-paced electronics area with a very limited product life cycle, the firm realizes that it must initiate new innovations

just to survive. However, no decision has yet been made, nor conceivably will be until it becomes absolutely essential. Again the firm will probably attempt to "cross the bridge when it occurs".

2. Large Canadian-Owned Firm

The second case history is of a large, diversified Canadian-owned company. The divisional president of a major division expressed the desire to innovate, but said that he could not justify the allocation of funds to his division for any innovations as compared with other divisions of the firm. Basically, his rate of return analysis was lower than other divisions for potential innovations. This was primarily due to marketing considerations. Because of the large number of competitors and limited Canadian market, he was not able to financially justify the development of any potential innovations in Canada by his division.

3. Large Canadian Firm

The third case is of a large Canadian-controlled firm in the consumer durables industry. It has recently embarked on a major innovation effort in specific product lines, after a history of licensing foreign-designed product lines.

Prior to the current innovation effort, the firm perceived its industry as fiercely competitive, dominated by multi-nationals which depended largely on product development outside Canada. The firm judged that it had achieved sufficient size to mount a significant attempt to develop new products on its own. The decision was a strategic one which in effect substantially altered the firm's course.

4. Foreign-Controlled Firm

A foreign-controlled firm in a consumer durable industry was undertaking no significant innovation activity, primarily because of lack of need. Technological change in the industry was comparably slow, and most new product development occurred in the U.S. parent.



When pressed for the reason for lack of innovation, the company talked of low profit margin and small Canadian market. The company maintained that since it was handling a wide range of products, any R & D work would have to be splintered among several product lines. This argument was not convincing, since the company could have considered concentrating innovation effort in a small number of product lines. The company was basically an assembly and marketing operation in Canada and not set up to initiate innovation activities in Canada.

### Analysis

To the extent that these cases typify why many firms do not attempt to innovate there are two basic reasons:

1. Whether to or not to attempt to innovate can be likened to any other type of project evaluation; does the potential return justify the investment? Due to the many handicaps to innovation the answer in Canada is usually, "no".
2. A firm will attempt innovation when it is essential, either to survive competitively or to achieve significant growth; otherwise, it tries to maintain its market position with existing or imported product lines.

In these two respects, Canadian firms are probably similar to firms in other countries. Most firms in Canada are in no technical, managerial or financial position to attempt innovation. Those more at a point when innovation can be considered assess the handicaps to innovation similarly to firms that have attempted to innovate, although with less actual experience to help make their decisions.

The one uniquely Canadian reason for firms with some technological base not attempting innovation is the small Canadian market.

Companies simply do not innovate, since Canadian sales alone do not justify the investment, and they do not consider sales outside the country. Such a non-export orientation is due both to the lack of export experience and the lack of competitiveness of product lines beyond the protected Canadian market.

### III - SUMMARY OF CONCLUSIONS

From the interviews of 51 innovators and would be innovators, we have canvassed what companies in Canada perceive as handicaps to innovation. For each type of innovator an assessment was made of the real handicaps. These perceptions of the handicaps and our conclusions about each type of innovator are summarized below:

#### INVENTORS/SMALL R & D FIRMS

##### Perceived Handicaps

Inventors or small R & D firms are regarded as potential innovators. They perceive their main handicap as difficulty in obtaining capital, whether from financial institutions, venture capital firms, or government agencies.

##### Assessment of Actual Handicaps

Access to capital is important and difficult for inventors and small R & D firms, but the lack of managerial capability to commercially exploit their patent or idea is the fundamental handicap. There has been an inability to develop or acquire the financial and marketing business skills required to solicit financing or exploit inventions.

SMALL ENTREPRE-  
NEURIAL FIRMS

Perceived Handicaps

Small entrepreneurial firms that are attempting to innovate - they may have one product line launched but still show a negative cash flow - perceive a variety of technical, marketing, financial, and sometimes managerial handicaps to innovation.

Assessment of  
Actual Handicaps

The core of the problem for entrepreneurial firms is (a) lack of adequate equity and/or debt financing, in part as a result of the high cost and perceived riskiness of innovation, and (b) insufficient attention to or capability by the firms' principals in marketing and general business planning and management.

MEDIUM TO LARGE  
CANADIAN-CONTROLLED FIRMS

Perceived Handicaps

Medium to large Canadian-controlled firms include primarily the growing, professionally-managed firms; their perceived handicaps were mainly financial for those companies which were undercapitalized, and market access due to the limited size of the Canadian market or foreign-controlled company domination of it.

Assessment of  
Actual Handicaps

Firms rapidly growing through innovation face continuing cash needs, while firms with other, more stable product lines have fewer cash flow problems. In Canada, there is insufficient response from equity and debt capital sources, although investing institutions would maintain that there is insufficient potential return from these innovation investments.

The small Canadian market comments show that Canadian-controller producers have too insufficient a market share in Canada to base the manufacture of an internationally competitive product, or that they generally lack an export orientation. The foreign-owned company domination comments further attest to the dominant market position of entrenched multi-nationals operating in Canada.

FOREIGN-CONTROLLED FIRMS

Perceived Handicaps

Foreign-controlled firms attributed their lack of innovation primarily to the small Canadian market. Other supporting reasons frequently mentioned were the lack of skilled manpower and conservatism of Canadians as customers or consumers in general.

Assessment of  
Actual Handicaps

When foreign-controlled firms are established in Canada to manufacture and market product lines of the parent company, innovation

in Canada is severely inhibited. It is more profitable for these firms to manufacture similar product lines and depend on head office product development.

If the Canadian subsidiary produces different product lines from its parent or is awarded product authority, the company will normally attempt to innovate to the extent that innovation is required to remain competitive. Product responsibility is a function of the historical development of the company - whether its management has sought an independent path, sometimes depending on whether the company is a recently acquired subsidiary. Product responsibility will also be more likely in industries where government is an important customer.

Parent R & D facilities only assist innovation in Canada for Canadian subsidiaries with product line responsibility. In other cases new product technology enters Canada in a mature stage for manufacture only here.

#### FIRMS PRIOR TO INNOVATION

Companies that have not yet innovated perceive similar handicaps to those encountered by firms that have attempted to innovate. They also seem to be deterred by formidable entry barriers in the market structure of the industry. In many cases, these barriers are the product of the dominant position of foreign-controlled firms in introducing innovation into the Canadian market.

APPENDIX B

SUGGESTIONS BY INNOVATORS TO  
OVERCOME HANDICAPS

SUGGESTIONS BY TYPE OF INNOVATOR AND

Handicaps	Inventor/R & D Lab.	Entrepreneur
Financial	<ul style="list-style-type: none"> <li>- make assistance programs simpler for inventor/entrepreneur to qualify</li> <li>- use panel of experts to judge value of proposals</li> <li>- remove sales taxes from parts in prototype testing</li> <li>- increase eligibility of expenditures for assistance grants and speed up assistance payments</li> <li>- financial assistance at an earlier stage required</li> <li>- seek money for capital equipment as well as for staffing</li> </ul>	<ul style="list-style-type: none"> <li>- more assistance to cover R &amp; D expenditures</li> <li>- better government information system re possible financing sources</li> <li>- tie R &amp; D grants to Canadian ownership</li> <li>- low interest loans to companies not necessarily in high profit industry</li> <li>- need more venture capital</li> <li>- tax write-off policy</li> </ul>
Managerial	<ul style="list-style-type: none"> <li>- government should assist in preparation of business plans and market research</li> </ul>	
Technical/ Manufacturing	<ul style="list-style-type: none"> <li>- government should purchase machine tools from Canada to help modernize machine tool industry</li> <li>- more access to university and government laboratories</li> <li>- government should establish system to assist innovators communicate with each other</li> <li>- univ. co-ops. program</li> </ul>	<ul style="list-style-type: none"> <li>- federal government should set technical specifications to encourage Canadian design</li> <li>- government R &amp; D should be more related to industry problems</li> </ul>
Market/ Marketing	<ul style="list-style-type: none"> <li>- reduce time of tariff rebates</li> </ul>	<ul style="list-style-type: none"> <li>- stronger "buy Canadian content" policies</li> <li>- government help find niches in Canadian market</li> <li>- allow selling out to U.S. firm to take advantage of distribution system</li> <li>- rely on larger company's distribution system</li> <li>- don't subsidize non-innovating competitors just to establish in under-developed regions</li> <li>- tariff protection</li> </ul>



BY TYPE OF HANDICAP

<p>Medium to Large Canadian-Controlled Companies</p>	<p>Foreign-Controlled Companies</p>
<ul style="list-style-type: none"> <li>- reduce time lag of government financial assistance grants</li> <li>- assistance programs should be results oriented, not grants</li> <li>- reduce paperwork for grants</li> <li>- don't restrict financing to Canadian-owned firms, thus excluding capitalized opportunities with foreign subsidiaries</li> <li>- need tax incentives or grants to innovate</li> <li>- "grant Canadian-owned" not just "grant Canadian" policy</li> </ul>	<ul style="list-style-type: none"> <li>- government sharing of financial risks in innovation</li> <li>- government assistance programs allowing all expenditures related to innovation</li> <li>- clear up political uncertainties in industry</li> <li>- more government assistance in R &amp; D</li> </ul>
	<ul style="list-style-type: none"> <li>- develop good managers, marketing skills and better understanding of innovation process</li> </ul>
<ul style="list-style-type: none"> <li>- emphasize technology transfer rather than home-grown technical development</li> <li>- make university engineering training more practical</li> <li>- make grants for tooling and applied research</li> </ul>	<ul style="list-style-type: none"> <li>- make government res. labs and engineers available to industry</li> </ul>
<ul style="list-style-type: none"> <li>- stronger "buy Canadian" policies</li> <li>- don't set up subsidized competitors through DREE, PAIT grants</li> <li>- government should support or provide market research assistance</li> <li>- should have industry associations representing Canadian-owned manufacturers</li> </ul>	<ul style="list-style-type: none"> <li>- promote product line responsibility for N. America for Canadian subsidiary</li> <li>- more government assistance in market research</li> <li>- tariffs to develop domestic market</li> </ul>

SUGGESTIONS BY INNOVATORS TO  
OVERCOME HANDICAPS

During interviews with firms (See Appendix A) we not only received information regarding the handicaps facing innovations but also specific suggestions regarding steps to overcome the identified handicaps. As might be expected, most suggestions dealt with simply removing the handicap identified without much practical regard to an overall approach or policy. However, other suggestions were more carefully thought out and provide a worthwhile comment for policy considerations.

Exhibit B-1, opposite, lists the types of suggestions by category of innovators. In this appendix, we will briefly discuss some of these suggestions and also offer an interpretation based upon the analysis of the four categories of innovators.

SUGGESTIONS BY TYPE  
OF INNOVATOR

The inventor/small R & D firms (Category 1) primarily suggests a greater availability of capital -- either government or private. Because of the limitation of private capital from venture capital firms, merchant banks or other financial institutions, this group looks to simplified procedures and expanded public capital grants. This suggestion can be followed up by encouragement of private capital sources by incentive program, or an expanded public direct assistance program.

This group requires practical management assistance in the form of market analysis and business planning but generally do not recognize it. Such assistance is a necessary condition to solving the financial problem whether private and/or public capital support is chosen so that competing requests for capital can be rationally evaluated. This requires that the inventor/innovator undertakes both a market analysis and a business plan. From this plan, the source of capital can perform a realistic evaluation of competing proposals.

The inventor/small R & D individual making the capital request will need assistance in preparing both a market analysis and a viable business plan. The question is then who is best able to offer this assistance -- the capital source or some independent individual or agency. Again to insure an objective evaluation of competing capital requests, some independent individual or agency should be utilized to provide assistance in the business plan preparation. The inventor also suggests technical/manufacturing assistance from the Government. Four areas are identified on Exhibit B-1 in this regard.

Another area mentioned related to Government assistance is regarding tariff rebate time delays. When components are imported to be assembled in Canada, and then subsequently exported, a time delay regarding a rebate of import tariffs is encountered. For the inventor or small firm, this time delay can cause a cash flow problem.

The entrepreneurs (Category 2) as in the case of those interviewed in Category 1 stressed the need for capital. Again because of the limitations of private capital, this group suggests more public financial assistance be offered to innovators. In addition, this group raises the suggestion that public assistance should be offered exclusively to Canadian-owned firms. They also suggest a "more positive government policy towards small firms", by which they mean allowing capitalized research expenditures to be depreciated against future earnings over longer time periods than are currently provided for in tax policies.

The question of financial assistance again raises the issue of whether the source of capital for innovation should be mainly public or private. Should the government move towards a policy which would encourage more private capital?

Regarding "managerial" suggestions, none are listed. Yet as previously mentioned the effective entrepreneurial function of management is required for the survival of Category 2 firms. Indeed, they similarly to Category 1 firms need much more effective business planning and again this reinforces the notion that the funding source should require and assist the firms to undertake proper business planning - both for a means to evaluate competing capital requests, as well as, to increase the ability of recipients to survive.

In the technical/manufacturing area the suggestion is made that government R & D should be more related to industry problems.

This type of suggestion was repeatedly made during our survey by all types of firms. It suggests that the allocation of Canada's limited R & D resources, particularly governmental, should be re-evaluated and new policies developed in order to make a direct contribution to the development and manufacturing capability of the private sector in Canada.

In the marketing area, the entrepreneur has suggested a stronger "Canadian content" purchasing policy to require increased sourcing and technological development in Canada. One firm suggested that the government should not subsidize a "non-innovating" competitor just to establish operations in under-developed regions. Although most firms indicated the "need to export to survive" there were no direct suggestions in this area. These Category 2 firms, as well as Category 3 and 4 companies, indicated the relatively small and fragmented Canadian market as a major handicap, and raised the issue of whether the government should intervene in the market structure of specific industries.

The medium to large Canadian-controlled companies (Category 3) have comments centred primarily on a reduction of red-tape and paperwork required for various incentive program grants. It was also suggested that grants go to Canadian companies and be "based upon results" (i.e. benefits to society from R & D grant expenditures). These comments, along with those of the previous two categories, would suggest that the entire R & D grant programs, procedures and evaluation criteria be reviewed to make it more effective in the innovation process in Canada.

The suggestions in the technical/manufacturing area by this group include making university engineering training more practical. They also recommend a program to foster diffusion of technology. This is based upon the assumption that Canada might utilize internationally available technology in its innovation process through a technology transfer program, in addition to that currently available via multi-national corporations.

As well as importing technology Canada may wish on some occasion to sell or license its research to foreign-based companies for development, rather than conduct the innovation process in Canada. To assess this possibility requires the establishment of innovation strategies on a sector basis, and an evaluation of how much R & D commitment Canada should make in specific product areas.

The suggestions in the marketing area included a stronger "buy Canadian" policy and not subsidizing competitors, both previously discussed. Two other suggestions are: (1) the government should support or provide market research assistance (which is actually now provided in some provincial and federal programs) and (2) there should be industry associations representing Canadian-owned manufacturers. The implementation of these suggestions might include the restructuring of industry associations, and providing them with the capability of undertaking market research and other industry-wide support work.

The foreign-controlled companies (Category 4) generally suggested in the financial area that there should be more government R & D assistance to all firms, rather than only Canadian-owned ones.

Foreign-controlled companies as well as many Canadian firms expressed their reluctance to make major R & D expenditure in Canada because of the rise of nationalistic sentiment and an "anti-business attitude", as well as governmental policy uncertainties. Developing a working rapport between foreign-controlled companies and government is critical to the establishment and implementation of innovation strategies.

The remainder of suggestions in this category have previously been discussed with one exception, namely promote North American or world-wide product line responsibility for Canadian subsidiaries. In our sample two-thirds of the foreign-owned companies have such responsibility in some product lines, particularly among electronics firms.

APPENDIX C

SUGGESTIONS BY GOVERNMENT  
OFFICIALS TO OVERCOME HANDICAPS



## ACTUAL AND POTENTIAL GOVERNMENT INITIATIVES

Area of Handicaps	ACTUAL GOVERNMENT INITIATIVES		POTENTIAL INITIATIVES	
	Programs with Innovation Objectives	Programs with Other Objectives	Programs with Innovation Objectives	Programs with Other Objectives
1. Patent Applications Problems with: i.e. lack of knowledge, costs, other handicaps in obtaining patents	<ul style="list-style-type: none"> <li>- Some increased staffing of regional offices by Patent Office</li> <li>- Ontario government now offers inventors advisory services</li> </ul>		<ul style="list-style-type: none"> <li>- improving patent information system</li> <li>- establish advisory services on (a) how to check whether idea is patentable, (b) how to take out a patent</li> <li>- grant or other award program to provide (a) financial assistance (b) recognition</li> </ul>	
2. Problems of obtaining benefits from patent:  - benefits accruing to employee as well as employer when firm obtains a patent  - licensing patents, i.e. finding participating company to exploit patent	<ul style="list-style-type: none"> <li>- Ontario government has started communications program</li> <li>- CPDL markets patents which belong to federal government; CPDL has moved in some cases into federally-sponsored res. programs (including universities), dovetailing DSS contracting and programs, ensuring patent exploitation stays in Canada, and in protecting patent primarily in the U.S.</li> </ul>		<ul style="list-style-type: none"> <li>- establish model employer/employee contract</li> <li>- could be CPDL type agency marketing, protecting privately-held patents</li> </ul>	

Abbreviations: CPDL - Canadian Patents Development Ltd.  
DSS - Department of Supply and Services

## ENTREPRENEURS/SMALL CANADIAN COMPANIES

## ACTUAL AND POTENTIAL GOVERNMENT INITIATIVES

Area of Handicaps	ACTUAL GOVERNMENT INITIATIVES		POTENTIAL INITIATIVES	
	Programs with Innovation Objectives	Programs with Other Objectives	Programs with Innovation Objectives	Programs with Other Objectives
1. Start-up of New Venture		<ul style="list-style-type: none"> <li>- various advisory, financial services to help entrepreneurs, but not particularly start-up operations</li> </ul>		<ul style="list-style-type: none"> <li>- could be government-sponsored or government service to (a) educate potential entrepreneurs, (b) find managerial help and (c) help obtain financial assistance.</li> </ul>
2. Managerial (financial, marketing, production, problems).	<ul style="list-style-type: none"> <li>- business school research programs (IT&amp;C)</li> </ul>	<ul style="list-style-type: none"> <li>- CASE (Counselling Assistance to Small Enterprises) program</li> <li>- TIS of NRC providing on-going technical advisory services</li> <li>- DREE experimental program of assistance to entrepreneurs in Maritimes.</li> </ul>		<ul style="list-style-type: none"> <li>- expansion of support to education by universities for new product development and entrepreneurs</li> <li>- expansion of support to assist entrepreneurs.</li> </ul>
3. Technical, manufacturing problems.	<ul style="list-style-type: none"> <li>- Science Council studying tech. transfer of govt. research to business</li> </ul>	<ul style="list-style-type: none"> <li>- TIS of NRC</li> <li>- CRIQ, ORF, BC Research Inst., NRC undertakes development work for companies</li> <li>- productivity and design centres and centres of excellence supported by government.</li> </ul>		<ul style="list-style-type: none"> <li>- better business/government R &amp; D and university interface to have more institutional support for private companies</li> </ul>
4. Access to risk capital	<ul style="list-style-type: none"> <li>- Technology-incentive programs, primarily sponsored by IT&amp;C but also by other federal departments and agencies</li> </ul>	<ul style="list-style-type: none"> <li>- impending creation of FBDB</li> <li>- Ontario govt. and possible federal tax incentives to venture capital creation</li> <li>- technologically oriented procurement programs help obtain private risk capital for small firms</li> </ul>	<ul style="list-style-type: none"> <li>- expand focus of technology-incentive programs for (a) small business, and (b) all innovation-related expenses</li> <li>- simplify procedures for obtaining funds from federal sources and programs</li> </ul>	<ul style="list-style-type: none"> <li>- ensuring that FBDB takes equity positions, provides risk capital</li> <li>- incentives or regulations for financial institutions to set up venture capital organizations.</li> </ul>

Abbreviations:

FBDB - Federal Business Development Bank

CRIQ - Centre de Recherche Industrielle du Quebec

TIS/NRC - Technical Information Service of National Research Council

ORF - Ontario Research Foundation

## MEDIUM- TO LARGE-SIZED CANADIAN-CONTROLLED COMPANIES

## POTENTIAL AND ACTUAL GOVERNMENT INITIATIVES

Areas of Handicaps	ACTUAL GOVERNMENT INITIATIVES		POTENTIAL GOVERNMENT INITIATIVES	
	Programs with Innovation Objectives	Programs with Other Objectives	Programs with Innovation Objectives	Programs with Other Objectives
1. Managerial	<ul style="list-style-type: none"> <li>- design, productivity improvement and university centres of excellence</li> </ul>	<ul style="list-style-type: none"> <li>- TIS (NRC) advisory services</li> <li>- consulting services in selected sectors (e.g. footwear)</li> <li>- merger advice and implementation assistance (e.g. footwear industry)</li> <li>- ad hoc and planned government equity participation (e.g. CDC, deHavilland/Canadaair, OTDC).</li> </ul>	<ul style="list-style-type: none"> <li>- could stimulate research, teaching, consulting in R &amp; D/new product organizational design for circumstances particular to Canada (large use of research centres, government laboratories, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>- could establish service emphasizing marketing</li> <li>- better delivery of university and consulting services</li> <li>- increased use of government equity participation to force reorganization</li> <li>- faster feedback from industry to engineering facilities, manpower programs, possibly through the development of research institutes</li> </ul>
2. Technical, access to technology	<ul style="list-style-type: none"> <li>- CPDL promotion of government-owned patents</li> <li>- various provincial, federal research centres, to advise, work jointly, or arrange joint ventures</li> </ul>		<ul style="list-style-type: none"> <li>- incentives to Canadian companies to visit other countries' technical facilities</li> <li>- change patent laws so that MNE is no longer protected by patent</li> </ul>	
3. Access to markets:	<ul style="list-style-type: none"> <li>- some increase in contracting out of science-based R &amp; D by government</li> </ul>	<ul style="list-style-type: none"> <li>- continuing government negotiations for lowering tariff barriers, reducing non-tariff barriers</li> <li>- export assistance programs (EDC, trade missions, incentives to make bids)</li> <li>- government procurement that favours Canadian content</li> <li>- competition legislation increasing specialization agreements</li> </ul>	<ul style="list-style-type: none"> <li>- higher tariff and non-tariff barriers for high technology products</li> <li>- examine effect of standards and regulations on inhibition to innovation (e.g. food, pharmaceuticals)</li> </ul>	<ul style="list-style-type: none"> <li>- export tax incentives (like DISC)</li> <li>- natural resources bartering for increased access to foreign markets</li> <li>- regulation of markets to make accessible to selected firms (e.g. communications)</li> <li>- aggregation of provincial, local markets.</li> </ul>
4. Access to capital:	<ul style="list-style-type: none"> <li>- PAIT, IRDIA, other tech. assistance grants</li> </ul>	<ul style="list-style-type: none"> <li>- financial assistance to specific projects or purchases (e.g. Microsystems)</li> <li>- regional incentive programs (DREE)</li> </ul>	<ul style="list-style-type: none"> <li>- open up grants to all innovation expenditures</li> <li>- allow foreign take-overs only when innovative capacity would be improved</li> </ul>	<ul style="list-style-type: none"> <li>- regulation or provide incentives to encourage merchant banking</li> <li>- use EDC type of instrument domestically</li> </ul>

Abbreviations: OTDC - Ontario Transportation Development Corporation

EDC - Export Development Corporation

CDC - Canada Development Corporation

MNE - Multinational Enterprise

Exhibit C-4

FOREIGN-CONTROLLED COMPANIES

ACTUAL AND POTENTIAL GOVERNMENT INITIATIVES

Area of Handicaps	ACTUAL GOVERNMENT INITIATIVES		POTENTIAL GOVERNMENT INITIATIVES	
	Programs with Innovation Objectives	Programs with Other Objectives	Programs with Innovation Objectives	Programs with Other Objectives
1. Dependence on parents for new product development.	- PAIT, other technological development incentive grants	- financial incentives to develop Canadian product lines  - use of leverage of large scale procurement to get product line responsibility for Canadian sub	- FIRA used to promote Canadian innovation activities	- use tariff trade-offs to increase Canadian specialization
2. Restricted access to markets; restricted rights to Canadian developed technology; restricted access to other technology sources.	- IT&C/CPDL preventing loss of new technology to foreign parent (e.g. CIL Research, pharmaceutical industry)		- incentives to make licensing agreements with Canadian patent holders  - incentives to sub-contract technological sub-systems or components to Canadian suppliers	- FIRA used to increase independence of Canadian operation
3. Lack of product responsibility; lack of corporate financial assistance to develop new products; lack of power in corporate planning decisions.		- government equity investment in parent corporation (e.g. Texasgulf, West Coast Transmission)  - government procurement, industrial sector policies, financial assistance, regulation, and competition policies as leverage to induce Canadian product responsibility.		- FIRA used to obtain more product responsibility for Canada  - federal initiative in setting industrial sector policies  - federal initiative in coordinating with provinces industrial sector strategies.  - government procurement, industrial sector policies, financial assistance, regulation, and competition policies as leverage to induce Canadian product responsibility.

Abbreviations: FIRA - Foreign Investment Review Agency

SUGGESTIONS BY GOVERNMENT  
OFFICIALS TO OVERCOME HANDICAPS

Interviews with government officials were conducted in parallel with the interviews of the four categories of innovators (see Appendix A). In this appendix we summarize the actual and potential government initiatives, as suggested by government officials, to overcome the handicaps to Canadian innovators.

ORGANIZATION  
OF FINDINGS

Exhibits C-1 to C-4 organize the findings from the government interviews by category of innovator (i.e. inventor, entrepreneur, medium to large, and foreign-controlled companies). The actual government initiatives are set alongside the potential government initiatives as identified during the interviews.

In addition, government activities directed toward stimulating innovation are set apart from those directed toward some other objectives. The distinction is made since there are many government activities which affect innovation but are not specifically established to foster innovation. Similarly many activities could be established which should not be directed solely toward innovation but take into account other objectives as well.

## INITIAL OBSERVATIONS

The extent and scope of government activities that relate to innovation is indeed complex and enormous. An initial observation about actual and potential government activities concludes that:

1. The federal government and various provincial governments seem to be attempting to reduce the handicaps to innovation in Canada through a number of programs (e.g. provincial advisory services and research institutes, federal industrial sector strategies, contracting out of R & D, procurement policies, patent marketing, and foreign ownership regulations).
2. From discussions with government officials there appear to be a number of gaps yet to be filled by the government.

Further government initiatives to reduce handicaps to innovation would include: new programs, adjustments to existing programs, changes in application of regulatory powers, and altering the intervention of government in the overall economic environment. Further detailed analysis of actual and potential government programs is part of the main report on handicaps to innovation.

APPENDIX D

INDUSTRY - SPECIFIC HANDICAPS  
TO INNOVATION

INDUSTRY - SPECIFIC HANDICAPS  
TO INNOVATION

The company survey (see Appendix A) was concentrated in three industries, namely communications electronics; machinery for the mining and pulp and paper industries; and large and small appliances or "white goods". This appendix reviews the handicaps findings specific to these three industries and discusses the more general question of industry specific handicaps.

As mentioned in Appendix A, we discussed this selective industry approach with MOSST officials and others at the "Panel of Innovators" meetings. Our choice was based upon an intuitive range of probable level of innovation activities from high in electronics, medium in the machinery area, to relatively small in the white goods area. For the most part, our study has borne out this selection.

The following is a review of the three industries based primarily on interviews with industry and government officials.

ELECTRONICS INDUSTRY

During our study we contacted 13 firms in the electronics industry, primarily in the communications and other non-consumer product areas. In addition, we contacted appropriate governmental officials, trade association representative, and trade publishers.



Innovation and  
Industry Trends

Northern Electric is a Canadian-owned giant with over \$600 million in sales, with next firm in size being RCA with over \$160 million in sales, not all in electronics products. Many small firms are Canadian-owned, but most medium to large firms (\$10 to \$100 million) are foreign subsidiaries.

A substantial part of the electronics industry, besides the consumer and communications sectors, was very defense-oriented, and has undergone severe consolidation since the 1969-1971 slowdown. Larger firms have rationalized their product lines and are trying to achieve a better balance of defense and commercial sales.

Canada has innovated in particular products and in some systems, such as the domestic satellite system, communications switching systems and a new computer system. However, the Canadian innovations in electronic tend to be application orientated vs. new components orientated. This means that Canada continues to rely on foreign technology (particularly in the high technology areas of integrated circuits and other advanced components). Canada does not have an equivalent to Santa Clara County (near San Francisco in California, which is a world centre of innovative technology in electronics). New advances in the component technology can obsolete application oriented innovations virtually overnight. Hence Canada's electronics industry has a major vulnerability to the fast paced high-technological advances in the component areas.

EXHIBIT D-1

CANADIAN ELECTRONICS INDUSTRY - PRODUCTION, IMPORTS AND EXPORTS  
(\$ Millions)

YEAR	HOME ENTERTAINMENT PRODUCTS			TELEPHONE AND TELEGRAPH PRODUCTS			ALL OTHER ELECTRONICS PRODUCTS			ALL ELECTRONICS PRODUCTS		
	Production	Imports	Exports	Production	Imports	Exports	Production	Imports	Exports	Production	Imports	Exports
1962	114	14	3	108	28	6	268	101	48	490	143	57
1963	117	15	6	124	24	9	304	102	43	544	140	58
1964	134	23	8	133	25	11	297	143	41	564	191	59
1965	140	35	8	144	25	14	299	176	54	583	237	77
1966	171	50	20	174	29	11	367	278	75	712	357	106
1967	175	67	25	234	35	19	419	312	91	828	414	135
1968	190	89	30	230	32	49	480	310	132	900	431	211
1969	230	124	34	238	37	55	567	391	98	1035	552	187
1970	196	124	29	249	43	68	500	401	136	945	568	233
1971*	231	150	30	264	41	56	535	453	152	1030	645	239

\* Preliminary Figures

Sources: Statistics Canada - 65-004, 65-007, 43-205, 43-206,  
Canadian Electronics Engineering

Although the electronics industry has had substantial growth over the past decade, a review of the import/export and production figures in Exhibit D-1, opposite, indicate that while the export position has improved, Canada's overall ability to innovate and remain competitive on a world market has been diminishing. Utilizing the domestic production, imports and exports figures from Exhibit A-10 for all electronic products, we have the following comparison:

	<u>1963</u>	<u>1971</u>	<u>% Increase</u>
Production for Domestic Consumption	490	1,030	210
Exports	57	239	419
Imports	143	645	451

In 1972, imports jumped to over a billion dollars to exceed domestic production, and industry spokesmen are worried that this trend could continue.

#### Reasons for Existing State of Innovation

Beyond this more general disruption of the macro industry environment, there are certain factors which seem to encourage and others which seem to discourage innovation in Canadian electronics, as follows:

##### 1. Behaviour of Foreign-owned Firms:

The important position of large foreign owned companies has two diverging impacts on the innovative activities in the industry:

- foreign-owned firms carry out research, development and innovation in their Canadian operation for specialized product lines usually with some "head office" research
- the number of foreign-owned companies that seek business as suppliers of electronic equipment fragments the Canadian market so that any one company cannot generate sufficient sales to sustain innovative activity.

## 2. Government Procurement

Market pull is an important element in the electronics industry and the government can provide most of the domestic market for high technology products. This influence can be exercised either through direct purchases (defense, avionics, etc.), crown corporations (Post Office, CNR, Air Canada, CBC, etc.) and regulated utilities (telephone companies, CN/CP, etc.). The industry claims that the Canadian Government uses this tool with much less vigor than most other governments. The federal government has not until recently communicated well in advance to the electronics industry, the need for new products or systems requirements. Nor has it been able to evaluate the consequences of awarding contracts to the development of Canadian-based expertise upon which further technological advances can be made for domestic and export sales.

## 3. Scale of Technology

Innovation in the electronics industry can occur at the entrepreneurial level (as described above), but scale of manufacturing and markets are critical to more complex systems and products innovation:

- Canada has a major company in Northern but even with its size its experience with micro-systems to date seems to indicate that its scale is not large enough to compete with world leaders in microsystems
- in Canada, there are many medium-sized companies, particularly foreign-owned, which fragment the market; through the emergence of consortia and coordinated government purchasing, organizational entities may reach sufficient size to handle the large systems requirements which lead to innovation and create a demand for small innovating sub-contractors, sometimes spin-offs from larger firms.

### Handicaps for Small Electronics Companies

In recent years some small Canadian firms (three or four in our sample) with new electronics products have been able to emerge, although most have had financial problems. Their initial sales are to the federal government, or are assisted by government grants and venture capital investments. These initiatives are also made easier by the fact that relatively little tooling is required and that start-up production costs are low in this part of the electronics industry.

These small firms frequently have difficulties when they go into full production or second product lines. This, and the need to sustain technological leadership, often bring technical and managerial problems. In addition, establishing the first Canadian sale is sometimes made more difficult by lack of acceptance of Canadian products by purchasers. These problems have been reduced in some cases by venture capital firms lending financial and management aid.

### PULP AND PAPER AND MINING MACHINERY INDUSTRIES

Our survey covered 17 machinery manufacturers for the mining, and pulp and paper industries, and also included trade representatives and end users (i.e. pulp and paper and mining companies).

The current status of the Canadian machinery industry has remained rather constant over the past 20 years. In general, the machinery area is an old well-established market with a relatively

EXHIBIT D-2

MINING MACHINERY  
EXPORT AND IMPORT TRENDS  
(\$000)

YEAR	DOMESTIC PRODUCTION	EXPORTS	IMPORTS	TOTAL DOMESTIC MARKET	IMPORTS % OF TOTAL DOMESTIC MARKET
1954*	25,618	2,793	57,896	80,721	71.7
1967					
1968	100,179	25,116	214,679	289,742	74.1
1969	121,380	40,117	290,080	371,343	78.1
1970	117,101	43,334	256,374	330,141	77.6
1971	141,940	50,805	293,897	385,029	76.3
1972	N/A	N/A	365,898	N/A	N/A

\* Royal Commission on Canadian Economic Prospects, 1956

SOURCES: Statistics Canada Publications

42-214    65-004  
65-005    65-007  
65-203    65-212

using the following categories:

- drilling, excavating, mining and related machinery and parts
- rock drilling, earth boring and related machinery and parts
- excavating, dredging and loading equipment and parts
- mining and ore processing machinery and parts

EXHIBIT D-3

PULP AND PAPER MACHINERY  
EXPORT AND IMPORT TRENDS  
(\$000)

YEAR	DOMESTIC PRODUCTION	EXPORTS	IMPORTS	TOTAL DOMESTIC MARKET	IMPORT % OF TOTAL DOMESTIC MARKET
1954*	16,068	2,747	7,457	20,778	35.9
1967	70,334	14,784	20,072	75,622	26.5
1968	56,747	9,733	14,401	61,415	23.4
1969	59,385	15,645	21,131	64,871	32.6
1970	78,785	14,250	41,866	106,401	39.4
1971	65,993	12,304	34,928	88,617	39.4
1972	N/A	17,175	24,101	N/A	N/A

\* Royal Commission on Canadian Economic Prospects, 1956

SOURCES: Statistics Canada Publications

42-214      65-004  
65-005      65-007  
65-203      65-212

slow innovation cycle, requiring major capital investment for potential innovators. Exhibits D-2 and D-3, opposite, show the import, export, domestic production and imports as a percentage of the total Canadian market. Historically in the mining machinery area, imports as a percentage of the total market have been about 70% to 80%; in contrast, the pulp and paper machinery industry imports as a per cent of total market in 1954 have been about 35% to 40%.

#### Mining Machinery

In reference to Exhibit D-2, it should be pointed out that the percentage of imports of total market, does not imply the remainder of mining machinery is of Canadian technological content. In fact, the domestic production of machinery is composed heavily of foreign-owned firms using foreign technology and the remaining Canadian firms also rely heavily on foreign technology in the form of licensing arrangements. Regarding licensing arrangements, the cost to the firm is substantial - between 5-10% of the sales figure - and, hence, either reduces the profitability or increases the price by the same percentage. This, in turn, may reduce the amount the firm can afford to reinvest in R & D and an innovation process. It is therefore difficult for a firm using licensing arrangements to develop its own product lines.

A Department of Energy Mines and Resources report on the mining industry confirmed the lack of innovation by mining machinery companies.\* Innovation in the mining industry in Canada is primarily process innovation, with large integrated mining companies spending about 65% of

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\* Richardson, P.R. et al, The Role of Innovation in the Mining and Mining Supply Industries, EMR, July 1974.



EXHIBIT D-4

VOLUME OF CANADIAN MINING COMPARED TO SWEDEN

	Copper <sup>A</sup>	Lead <sup>A</sup>	Zinc <sup>A</sup>	Nickel <sup>A</sup>	Asbestos <sup>A</sup>	Coal <sup>A</sup>	Iron <sup>C</sup> Ore
Sweden	30,300	88,000	105,600	-	-	-	36,749
Canada	721,430	433,465	1,397,246	294,341	1,661,644	15,132	47,352

SOURCE: The Canadian Mining Journal, A National Business Publication, February, 1973, p.43.

A = Short tons

B = Excluding lignite (000) short tons

C = (000) short tons

the R & D dollars. The mining equipment suppliers undertook only about \$6 million of R & D in 1974, about 15% of the total R & D in the industry. Moreover, this R & D appeared to commercialize a minimal amount of its R & D.

A recurring question of our study team during particularly the survey of the mining machinery industry (with 76.3% imports) is why Canada cannot, with an apparently large demand, develop its own machinery industry? Why is there not more Canadian innovation?

The low market share of domestic producers is not justified by the size of the market. A comparison of Canadian and Swedish mining production shows that a relatively high demand does exist in Canada. (See Exhibit D-4, opposite). Industry officials have commented on the strength of the Swedish mining equipment industry despite the apparent lack of substantial domestic demand in Sweden.

There have been some very successful Canadian innovations, but they tend to be in specialized areas such as off-road vehicles, portable drills, mobile work-stations, and geological testing (which is really a hybrid innovation - high-technology physics applied in the mining exploration area), not in the main-stream machinery areas.

The answer seems to be a large number of machinery manufacturers (mostly foreign-owned) who established themselves in the market throughout the development of the industry. Partly due to historic reasons of emphasis on developing resources cheaply, Canada has encouraged the use

of mining machinery from already established companies, which were foreign-based. Entry into this market has a high capital cost which Canadian companies have been unable to justify or achieve. Hence, Canadian companies that have successfully innovated are in lower costs and specialized areas.

Another explanation, starting from the demand side, is that established foreign owned companies (particularly mining companies) relied on their traditional "domestic" (e.g. U.S.) suppliers when they moved into Canada. Once this pattern was established it was not possible for Canadian manufacturers to gain a significant share of the market.

#### Pulp and Paper Machinery

From the company and industry interviews, we found that the main handicaps in the pulp and paper machinery industry are:

1. Concessional Financing

DREE and other grants have attracted foreign-controlled firms to Canada and these firms have also received cheap financing through foreign government credits on the condition that the machinery was purchased from the home country. Pulp and paper companies already established here have, in the past, been less interested in setting up new production facilities because they viewed them as being competition with their existing plants.

2. Integrated Foreign Companies

In large scale turnkey contracts the more vertically integrated foreign owned machinery manufacturers have a competitive edge over Canadian owned firms. It is unclear why Canadian-controlled firms have not reached the required scale of operations, since the domestic demand is relatively high.

### 3. Conservatism of Canadian Buyers

Canadian pulp and paper manufacturers, are somewhat conservative in trying new equipment, since they are reluctant to commit increasingly large investments to untested equipment.

More innovation occurs in the pulp and paper making machinery industry than in the mining machinery industry. One of the probable reasons appears to be the strong inter-relationship of engineering consulting, joint research institute (Pulp and Paper Research Institute of Canada), pulp and paper companies, and machinery manufacturers. A second reason seems to be that some major foreign-controlled subsidiaries are relatively independent from parents, or have product lines in pulp and paper machinery area that the parent does not have.

Thus, it would appear that a nucleus of purchasers, suppliers, pooled R & D, and engineering consulting firms have led to critical mass of factors favouring innovation in the pulp and paper machinery industry, while in the mining machinery industry the lack of such inter-related interests has led only to isolated innovations.

### APPLIANCES INDUSTRY

Our survey of the appliances industry ("white goods") includes small electrical appliances (SIC 331) and major appliances (SIC 332). In all we have contacted 11 companies, interviewed governmental officials and reviewed Canadian studies on the white goods area, particularly the Institute of Quantitative Analysis study\*. White goods is a "mature"

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\* Institute for the Quantitative Analysis of Social and Economic Policy, The Canadian Appliance Industry, University of Toronto for the Department of Industry, Trade and Commerce.

industry with major innovation being relatively infrequent, generally spawned outside the industry (e.g. micro-wave ovens), and more emphasis placed on design changes than on their product innovation.

The large appliances industry has mature product lines dominated by several vertically integrated firms. Industry rationalization has occurred in Canada and in the rest of the world in the last several years, but according to one government official at a slower rate in Canada than elsewhere.

The pattern of new product development is for innovation to occur in the United States, be imported into Canada, then manufactured here, and finally copied by Canadian companies. Thus, Canadian-controlled companies are at the most mature product part of the business.

In small appliances, there is room for small firms although larger firms tend to dominate. There is a high degree of importation of specialized small appliances. Small appliances are also characterized by fad or undifferentiated products which depend on extensive distribution and marketing systems. This is style, not design change.

The table below reviews import, production and export statistics for 1972:

	<u>DOMESTIC PRODUCTION</u>	<u>EXPORTS</u>	<u>IMPORTS</u>	<u>IMPORTS AS A % OF DOMESTIC MARKET</u>
	(\$ millions)			
Small Appliances	150	10	90	39%
Major Appliances	400	30	100	22%

The relatively low per cent of imports in the white goods area tends to be misleading in terms of innovation. The major Canadian producers in large appliances are foreign-owned companies, whose product development in Canada approaches nil. Based on estimates obtained in our survey, Canadian companies have only 20% to 25% of the domestic market of large appliances.

A summary of our findings regarding handicaps in the white goods industry is presented below.

### Large Appliances

#### 1. Foreign-Owned Company Behaviour

Interviews with large appliances Canadian-controlled companies tended to confirm that their foreseeable market shares in Canada are too small to support or compete with the larger R & D establishments in the U.S. Canadian companies tend to operate on the basis of licence agreements with U.S. manufacturers, either with one particular one or through arrangement with several.

#### 2. Scale Effects

It is also confirmed that large scale operations are essential to business success in the industry. One firm recognized that in order to extend its distribution system across Canada it will have to merge with another firm. The largest Canadian-controlled firm is just large enough to have some R & D facilities, but depends mainly on licensing for new product development.

### Small Appliances

#### 1. Scale of Production

All small appliances manufacturers interviewed emphasized the large tooling and manufacturing expenses inhibiting new products in the context of the small Canadian market.

Tooling costs for the U.S. were mentioned by one firm as double that of Canada (due to more exacting competitive requirements in the U.S.), thus making export to the U.S. an inhibiting prospect to increase sales. Europe has an entirely different set of technical specifications.

2. Scale of Marketing

Another major inhibitor to innovation is the high brand allegiance to well-known manufacturers, reinforced by spill-over advertising from the U.S. Two innovating Canadian-controlled firms had overcome this handicap by arranging for distribution through, in one case a large merchandising company, and in the other a large foreign-controlled manufacturer.

3. Lack of Skilled Manpower

Lack of skilled manpower for design and tooling was mentioned by three firms as being a problem. Another complained that federal assistance grants could not be awarded because his skilled personnel were not university graduates.

4. Foreign-Owned Company Behaviour

The two foreign-controlled firms interviewed stated that their innovation efforts were restricted by their parent to converting American products to meet CSA standards. One of them said that any new technology produced by the company automatically reverted to the parent.

CONCLUSIONS RE  
INDUSTRY-SPECIFIC HANDICAPS

The three industries studied show that the handicaps to innovation vary considerably from one industry to another.

Each of the three industries studied represents an industry in Simmonds classification of manufacturing by mode of competition:\*

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\* As explained in Chapter II of the main report, cost-minimizing refers to industries in which cost reduction is the key competitive factor, sales-maximizing where marketing is most important, and performance-maximizing where the quality of the product provides the competitive edge.

performance maximizing (electronics), sales maximizing (appliances), and cost minimizing (mining and pulp and paper machinery). To a limited extent, innovation potential and handicaps in these types of industry can be generalized:

1. In performance maximizing industries foreign-owned firms can more easily develop product line responsibility and thus undertake some innovation in Canada. Nevertheless, firms in Canada are usually too small to develop in the high cost of innovation areas, and have to rely on specializing in small scale technology, or applications of major innovations.
2. In sales maximizing industries foreign-owned firms develop market power in Canada, which makes entry difficult for new firms. Foreign-controlled firms find it more efficient to centralize new product development in parent facilities outside Canada. The innovation cycle is slow and large firms are resistant to new technology. Small to medium-sized firms in Canada are again relegated to innovating in small "niches" in the market.
3. In cost-minimizing industries, the innovation cycle is slow and diffusion of process innovations kept to a minimum by the major firms. Suppliers to these industries are heavily foreign-controlled, and their high cost equipment product development takes place mainly, though not exclusively, outside Canada.

Industry classification by itself, however, is too general a variable to identify a specific set of handicaps. Each industry must be analysed as to its structure, as follows:

- market structure; whether the suppliers and customers are in Canada, whether they are government controlled or regulated, the number and size of firms in the industry, major produce line categories



- technological content; scale of technological investment required, innovation cycle, tendency for cross-functional (or inter-industry) innovation
- Canadian content; R & D and engineering design and production expertise in Canada vis-a-vis international technological development capabilities.

A few examples in the performance maximizing category of industries helps to explain the importance of industry structure.

In terms of the market structure of aircraft and parts, computers, and telecommunications, different innovation barriers exist for major product lines within the industry. For example, the avionics product category can be developed in sub-systems, while airframes cannot - which means the latter have an enormous cost barrier to innovation in Canada.

In chemicals (including pharmaceuticals) government purchasing leverage is much less than in scientific instruments, and aircraft; in telecommunication and computers its leverage in the market is in part purchasing and in part regulatory. The firm size industry consolidation differs for all these industries mentioned. Foreign ownership is high in all, although its ramifications vary.

In terms of technological content, the scale of investment is high for airframes, computer mainframes, and chemical processes, but relatively low for scientific instruments, and computer software and peripherals. Computers (and electronics generally) have the most cross-industry application of all.

Each of these industries has significant Canadian content, although more in research than in development capability in pharmaceuticals for example. Canadian development capability has been strong in the past in airframes, computer mainframes, and terminal equipment (in telecommunications), but has or is slipping, so that further innovation will possibly be restricted to the less costly innovation investment areas. Also, Canadian demand for communications has helped to precipitate innovations in telecommunications. These examples are simply a few generalized illustrations of why it is essential to examine the structure of individual industries to determine the handicaps to innovation. Overcoming the handicaps requires an understanding that handicaps cannot be differentiated by industry classification alone, except possibly through groupings by "mode of competition" or some other broad classification. To plan how to overcome handicaps requires an understanding of the industry structure in the level of detail of Canadian content, technological content, and market structure.

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