THE EXTRINSIC BENEFITS OF INDUSTRIAL TECHNOLOGICAL INNOVATION IN CANADA

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I - INTRODUCTION

PURPOSE

The purpose of this report is to present the findings of an investigation into the extrinsic benefits to be gained for Canada from an increase in the level of domestic technological innovation, where extrinsic benefits were defined for this study to be those which do not flow to the innovator himself. The report has two main parts. The first examines in a general and discursive manner the types of benefits that might accrue in terms of the economic and sociological well-being of the country. The second part focusses on certain quantifiable aspects of these benefits. It assesses the way in which the direct economic benefits of innovation vary under different assumptions with regard to the nature of the innovation, the innovating organization, and conditions external to the firm.

BACKGROUND

To put the discussion in proper context, it is necessary first to define the meaning and scope of the terminology and concepts which are being dealt with.

Innovation

For purposes of this study, "innovation" is defined as the first successful introduction on a commercial scale of a new or improved product, process, system or service.

Technological Innovation in Canada

Since the study terms of reference relate to the benefits of technological innovation in Canada, it is necessary to make a distinction between Canadian innovation and innovative technological change in Canada. Canada, being a part of the world industrial community, is competing with other members of that community for both domestic and foreign markets. It is therefore necessary and desirable for Canada to maintain a level of technological competence comparable to that of its competitors. Canadian industry will thus adopt technological change in both products and processes irrespective of whether the change is originally developed in Canada or elsewhere. In the context of this study, the new technology qualifies as a Canadian innovation, however, only when it is originally developed and commercially introduced by Canadian industry.

This study is therefore concerned not with the benefits of technological change in Canada but rather with the incremental benefits of Canada's being the developer of the technology.

In order to asses this increment, it is assumed that Canada will acquire the new technology, but that the route by which this acquisition takes place could fall into one of a number of categories including, for example:

- develop the new technology in Canada in a Canadain owned company
- develop the new technology in Canada in a foreign owned company
- import the product from a foreign manufacturer through a Canadian wholesaler

- produce the product in a Canadian firm under license from the foreign developer
- produce the product in a Canadian subsidiary of the foreign developer

For this study, we define the "benefits" of Canadian innovation as those advantageous circumstances which occur only, or to a greater extent, when the new technology is developed and introduced in Canada by a Canadian owned company rather than acquired through some alternative route. While development of the new technology in Canada by a foreign owned company could be considered a Canadian innovation, for purposes of clarity we have categorized it separately.

Impacts vs. Benefits

One further clarification which is necessary is the distinction between the impact or gross result of Canadian innovation and the benefit or net result. In the matter of quantifiable economic aspects, the difference between the gross and net impacts has a clear definition and is termed "opportunity cost". The opportunity cost concept reflects the idea that if the various resources or factors of production were not applied to the activity being studied, they would be engaged in some other endeavours and would thereby contribute to a greater or lesser extent to the economy. Thus, the "benefit" of applying these resources to a particular activity is the gross impact of that activity minus the impact these resources would have had if engaged in an alternative activity.

Apart from this technical distinction, differentiation between

impacts and benefits is commonly used as a reminder that there are both positive and negative effects of many innovations. An innovation which contributes a net benefit to one sector of the country may create a net disbenefit in other sectors. A simplistic example of this might be the snowmobile which is reputed to be a source of benefit to those who use one and a source of annoyance to some who do not.

II - THE GENERAL CASE FOR CANADIAN INNOVATION

CANADA'S POSITION AS A TRADING NATION

Canada generally suffers from a comparative disadvantage relative to other countries in the foreign trade of manufactured products. The reasons for this are inherent in the characteristics of secondary manufacturing and of the Canadian economy.

High labour content and/or sophisticated processing methods or equipment characterize the products of secondary manufacturing. In addition, the costs of producing and marketing these manufactured products generally tend to be non-linear; that is, unit costs tend to decrease with volume.

To have a comparative advantage in any sector of secondary manufacturing, a country requires an advantage in that sector relative to other countries in unit labour costs, level of technological expertise and/or domestic market scale. The characteristics of the Canadian situation argue against our acquiring an advantage in either labour costs or domestic market scale in virtually all sectors. Our potential for strengthening our relative world position in a particular secondary manufacturing sector thus lies in developing a competitive advantage through technological innovation of a superior or cheaper product.

Canada's existing secondary manufacturing sector currently yields a number of benefits:

- it is generally more labour intensive than primary manufacturing or resource based industries and hence contributes more per unit of output to employment

- it demands a broad range of skills and hence adds to the diversity of employment opportunities
- it is comparatively flexible with regard to location and can thus be situated where people want to live
- because of comparative labour intensity and the ability to make small incremental additions to capital, it is flexible in terms of expansion.

However, since Canada's secondary manufacturing sector is generally not competitive with that of other countries, we do little exporting, and we preserve our domestic market for the products of this sector through protective tariffs. This situation has disadvantages in that Canadian consumers must pay higher prices for both domestically produced and imported products.

If these products could be imported without tariffs from the countries which produce them most cheaply, Canadian consumers could reap considerable benefits, but open competition could lead to a decline in the size of our secondary manufacturing industry with consequent reduction in the benefits it generates.

In order to increase purchases of manufactured goods from abroad, Canada would have to obtain additional foreign exchange. This in turn implies that we would have to increase our exports to other countries.

This could be done by further exploiting our existing comparative advantage in certain resource based industries. Unfortunately, this route has its drawbacks. Firstly, it exposes the economy to a higher degree of risk. World demand for, and prices of, resource products are subject to wider fluctuations than are found in most manufacturing sectors. As a result, our economy would likely be subjected to wider fluctuations than at present. Secondly, since commodity prices are particularly sensitive to the

interaction of supply and demand, an increase in Canadian commodity exports would automatically have a depressing effect on prices and hence on income. Thirdly, an increase in resource exports might also be a short term proposition since the resources are in many cases depletable. Finally, resource industries provide little or no flexibility in the location of associated jobs.

It may be possible, however, to obtain the consumer benefits of an unprotected secondary manufacturing industry without an associated decline in the size of the sector or an increase in reliance on exports of natural resources. This could be accomplished if we could shift the emphasis of secondary manufacturing toward products which could be sold abroad. To do this, however, it would be necessary to develop a comparative advantage in world trade in these products. Technological innovation offers Canada the most promising route to achieve such a position. While it is not certain that increased technological innovation can produce a significant increase in comparative advantage for Canada, other countries have successfully used and are still using this route to achieve strong and even dominant world trade positions in particular sectors.

An increase in domestic technological innovation could lead to a shift in secondary manufacturing toward industries which could function in a less protective environment and to increased manufacturing exports. Such an increase in exports could be accompanied by reduced raw material exports, reduced manufacture of certain products for domestic consumption, reduced unemployment or a combination of these.

The resultant benefits to Canada could include:

- a decrease in prices paid by Canadian consumers for many products, or an increase in returns to Canadian factors of production, through:
  - (a) economies of scale on products produced in Canada
  - (b) a reduction in tariffs on products currently imported and
  - (c) the availability of lower priced imports in lieu of protected domestic production
- maintenance of a significant secondary manufacturing industry with its associated benefits in terms of labour intensity, job diversity, locational flexibility and flexibility of expansion
- acquisition of the above consumer benefits without the disadvantanges of increased reliance on the resource sector.

TIMING OF TECHNOLOGICAL CHANGE

Another source of benefit from domestic innovation is the fact that the advantageous impacts of the technological change are enjoyed over a longer period of time. If the new technology is developed outside Canada, a time lag will usually occur before it is available to Canadians. Canada will reap none of the advantages associated with the new technology until such time as the technology can be imported from abroad. Once the time lag has expired, the benefits of technological change per se will be equal irrespective of how the technology was acquired.

A similar type of time benefit would accrue in a case where a technological innovation is developed in Canada which would not have been

developed at all in other countries due to lack of local demand. Products designed to meet unique needs of Canada's geographic or climatic characteristics might fall into this category. In such a case, the technology lag would be indefinite and the benefits of a Canadian innovation would be synonymous with the benefits of technological change. Such a situation is unlikely to occur frequently, but the potential for these benefits merits consideration in the evaluation of certain innovation possibilities.

It was stated earlier that the concern of this study was the benefits of Canadian innovation as opposed to the benefits of technological change in Canada, but in the instance of timing benefits the two are equal for the duration of the technology lag. We have not tried to deal in detail with the advantages of technological change per se since these are generally highly specific to the nature of the change and can vary widely among different innovations. For example, an improved type of yo-yo could have virtually no impact on the majority of the population and only minimal impact on a small segment. A new type of automobile engine which improved mileage and eliminated harmful emissions could have a substantial impact both on economics (in terms of operating costs, reduction in demand for petroleum products) and on personal well being (in terms of savings of human health and life). And an innovation like the computer can have impacts which touch on almost every aspect of life, broadening man's ability to learn, teach, accomplish tasks and expand his contact with the past, the present and the future.

Thus, to deal with all the benefits of technological change would require detailed knowledge of both the innovation and the

circumstances into which it was introduced. However, there are two benefits of technological change which may generally be expected to occur (although to varying degrees) in most instances of innovation. These benefits would be particular to Canadian innovation again only for the duration of the technology lag:

- the impact of new technology on the growth and development of the economy as a whole is felt that much sooner. The experience of the developed nations since the Industrial Revolution has generaly confirmed that technological innovation (whether generated domestically or imported from other countries) is an essential contributor to economic growth, although measurement of the extent of technology's impact is difficult

- increased consumer surplus arising from lower production costs or a better product. These consumer surplus benefits would accrue to persons who previously purchased the product and to persons who previously used some other product and have now substituted the new product. However, the increased consumer surplus associated with the innovated product may be partially offset by changes in the consumer surplus associated with other products whose consumption level is affected.

OTHER

In the literature one finds a range of other potential benefits of domestic innovation which derive from or are in addition to those discussed above. These include:

- increased returns to the innovating firm, its employees and its suppliers

- increase in the variety of employment opportunities, particularly for scientific, engineering, and other technical personnel

- increased national pride
- enhanced ability to maintian national independence
- "avalanche effects" which encourage others to risk undertaking further innovation
- "learning by doing" which increases the ability to accomplish further innovation.

Clearly, there are a number of potential areas of benefit which could accrue from an increase in technological innovation in Canada. We suggest that the most significant benefits, however, would derive from the potential effects on Canada's position as a trading nation.

III - MEASUREMENT OF BENEFITS

As stated at the beginning of this report, the investigation of benefits of Canadian innovation includes not only an identification and discussion of the types of benefits which might be expected to occur but also an examination of the magnitude of those benefits which can be quantified under various assumptions regarding the nature of the innovation.

The previous discussion has outlined a number of potential benefits of Canadian innovation. However, in many cases, attempting to assign a numerical value to these benefits would be extremely difficult for a variety of reasons:

- in some cases the benefit has little or no tangible manifestation and as such is impervious to expression in quantitative terms. An example of this might be national pride

- in some cases the benefit has or could have quantitative implications but the extent of these implications would be exceedingly difficult to predict. Economic implications of an improvement in the climate for further innovation is an example.

- in other cases the benefit which arises is so far removed from the innovation or so far down the "multiplier" pyramid that it is impossible to assess with any certainty the extent to which other outside influences might augment or decrease the benefit generated by the innovation. Third and fourth tier supplier impacts and multiplier effects of increased labour income are example.

It was, therefore, concluded that the innovation benefits which could realistically be quantified and which offered the greatest potential

for useful analysis were the direct economic benefits accruing from an increase in domestic innovation.

These economic benefits have not been discussed previously as a separate category. However, they have formed an implicit part of the types of benefits already discussed since they may accrue both as a result of the operating characteristics of the innovating firm and as a result of an improvement in the firm's comparative advantages in international trade.

ROUTES TO NEW TECHNOLOGY

Since, as mentioned earlier, Canada is likely to acquire the new technology by some other route if domestic innovation does not take place, the direct economic benefits of innovation must be measured relative to the benefits accruing if another route were followed. Thus, it was decided to define five alternative routes to new technology and the benefits of Canadian innovation would be measured relative to each of the other alternatives.

The five routes were:

- develop the new technology in Canada in a Canadian owned company (Canadian innovation)
- develop the new technology in Canada in a foreign owned company
- import the product from a foreign manufacturer through a Canadian wholesaler
- produce the product in a Canadian firm under license from the foreign developer
- produce the product in a Canadian subsidiary of the foreign developer

While these are not the only routes by which Canada can acquire new technologies (for example, ownership of wholesalers, licensees and subsidiaries could be split between foreign and Canadian), it was felt that these covered a sufficient range of alternatives to permit useful comparison.

ECONOMIC BENEFITS DEFINED

An "economic benefit" as used in this segment of the study is the net change in Canadian gross national product arising from application of resources to the development, production or importation of the new technology. This benefit is measured in terms of returns to Canadian labour, Canadian capital and the Canadian public sector and can either arise directly as a result of the firm's value added activity or indirectly as a result of the firm's purchases of Canadian supplies and equipment and the consequent increase in factor payments at that level.

The advantages of using changes in gross national product as a measure of benefits are twofold:

- GNP is generally regarded as the fundamental index of economic activity and changes in GNP are regarded as the fundamental index of economic health

- by using GNP as a measure and categorizing benefits by the sectors to which they flow one can cover benefits arising from a number of sources without double counting.

Specifically the economic benefits were considered to fall into five categories:

- after-tax returns to Canadian equity capital
- after-tax returns to Canadian debt capital
- net returns to Canadian labour
- net returns to Canadian governments (taxation, duty, etc.)
- net returns to Canadian welfare funds.

These benefits can be further subdivided into those accruing as a direct result of the activity of the firm dealing in the new technology and those accruing indirectly from activity generated in other Canadian firms as a result of the original firm's purchases of materials, supplies, services and equipment.

Some consideration was given to the question of whether returns to Canadian equity capital constitute an extrinsic benefit of innovation since they in essence accrue to the innovating firm. However, it was decided that they should be included. In the first place, any measure of an increase in economic activity which fails to include this return makes a prejudgement of how the total activity increase will be allocated in the future among the factors of production and government. One is faced with a situation whereby a company which is owned by the innovator technically generates no extrinsic benefits with regard to return on capital, but, if the same company's tax rate were increased to 75%, a part of those same returns would become an extrinsic benefit. In addition, multiplier effects(not considered here because they would essentially be proportionate to direct benefits) would flow from all returns and would clearly be extrinsic.

Thus, it was decided that all "economic benefits" would be included in the analysis irrespective of whether, under certain assumed conditions, they would flow to the innovator or to parties outside the innovating firm. Each category of benefit, however, would be calculated separately in order that the distinction could be made between those defined as "intrinsic" and "extrinsic".

PROCEDURE FOR MEASUREMENT

Measurement of the economic benefits of Canadian innovation could take a number of forms. The word "measurement" in itself suggests a single number which represents the dollars to be gained by an increase in domestic innovative activity. However, a number of questions arise. How much of an increase will there be? What types of products or processes will be developed? How many failures must be paid for out of the national gains from each success? What are the costs of these failures? Where will the resources come from to produce the new technology?

Obviously it is impossible to come up with a single answer to the question of national economic benefits without making assumptions with regard to all these factors.

It was therefore felt that evaluation of the direct economic benfits of innovation might be facilitated by focussing on individual instances of successful innovation. This would yield the relative, if not the absolute, flow of benefits to various sectors of the economy. It would also indicate the relationship between the economic importance of the innovated product or process and the magnitude of the economic benefits.

The quantitative measurement aspect of the benefits analysis therefore focusses on the types and relative values of economic benefits obtained through individual cases of domestic innovation versus acquisition of the new technology by some other route. In order to conduct this analysis, it was decided to structure a conceptual model which would be used to measure and explore differences in impact on gross national product among the various routes of acquiring new technology.

ECONOMIC BENEFITS MODEL

The economic benefits model is basically a mathematical procedure for measuring economic impact in terms of returns to capital, labour, government and welfare funds under the various assumptions regarding the route to new technology. The incremental impact of one route to technology over and above another can then be calculated and the opportunity cost of incremental resources deducted to determine the net benefit arising from the one alternative relative to the other.

The economic model itself consists of a series of equations which describe the relationships between the desired outputs (i.e. economic impacts) and the variables on which these outputs are dependent. A very general equation, for example, would be:

Returns to Labour = sales x (employment/sales) x (average salaries - average personal income taxes - average welfare contribution).

In actual fact, the equation relating to returns to labour was sub-divided into several equations each relating to a different category of employment (e.g. production, management, administration, sales, R&D).

Analysis of these equations indicated that in order to perform impact calculations, it is necessary to determine the values of a number of variables under the different assumptions as to the route through which the new technology is acquired. Many of these variables are relatively independent of the means of technology acquisition and can thus be determined by analysing general published statistics. Examples of these variables include personal and corporate income tax rates, rates of duty on imports, wages and salaries by type of worker, rates of contribution to Canada Pension and Unemployment Insurance funds, etc.

It was judged, however, that there were a number of other variables which might conceivably be affected by the method of acquiring the new technology. These variables are:

- market size, domestic and foreign
- return on capital before R&D and taxes
- expenditures for R&D (or equivalent, such as royalties)
- capital per sales dollar including - source
  - debt to equity ratio
- employment by type per sales dollar including structure of the management group and associated salaries
- total purchases of materials and supplies including the per cent obtained from Canadian sources.

Establishing the Values of Input Variables

In order to apply the model, it was therefore necessary to determine how the values of these input variables would be likely to vary under the different assumptions as to how the technology is obtained. It was felt that there were three alternative methods of establishing these relationships:

1. Perform a detailed audit of two or three innovating Canadian companies to determine actual "Canadian innovator" values and use these data together with the estimates of experienced persons to assess how these would vary under alternative acquisition methods such as licensing, direct foreign investment, and importation.

2. Conduct a number of interviews with companies using new technology under the alternative sets of conditions in an attempt to obtain sufficient empirical data to establish the input values.

3. Establish the relative values of the input variables under the alternative routes to acquiring new technology through a process of logical deduction combined with the use of published statistics to determine absolute values.

It was felt at the outset that the preferred method of establishing input values would be the first of the three possible procedures; that is, a detailed audit of two or three innovating Canadian companies. This method would provide an empirical basis for the analysis of the benefits of innovation and the depth of investigation contemplated would make it possible to ensure separation between impacts directly attributable to innovation and impacts arising from other factors.

Unfortunately, though this method was pursued at some length with three different companies, it eventually became apparent that the depth of information required would not be forthcoming for a variety of reasons. The chief handicaps were firstly the extensive demands which would be placed on already very busy executives in helping us to analyze and interpret the data, and secondly the extremely confidential nature of some of the data required. Consequently, it was decided to abandon this method of obtaining input data at least for purposes of this study.

The second method of obtaining input data, that is, a generalized empirical case, was given definite consideration. It too, however, had significant drawbacks in terms of the time which would be involved in data collection, the possible failure to obtain cooperation in terms of executive time and release of confidential information, and difficulties in segregating innovation impacts from other impacts without a detailed audit.

It was therefore decided that for the present study the third method of establishing input values would be used. The development of an empirically-based model under either of the first two methods was not discarded but rather deferred as a possible follow-up to confirm and/or refine the input assumptions developed for a theoretically-based analysis.

Since this approach for establishing input values involves making assumptions about these values, albeit through logical deduction, the approach does not provide absolute benefit measures for particular situations.

However, the assumptions with regard to the nature of the innovation and the degree of its impact on such areas of potential benefit as market advantages, economies of scale, labour content, sources of supply etc. can be varied. In this way, it is possible to infer relative differences in benefits due to variations in the assumptions and hence to identify the types of conditions under which significant benefits from domestic innovation could be derived.

Time Scope
of the Analysis

Because the economic analysis relates to impacts generated by an on-going corporate entity, the impacts largely occur on a continuing basis over a period of years. Under a "dynamic" approach, economic impacts and opportunity costs can be viewed as two streams occurring over the Canadian life span of the new technology. These two streams can be discounted at an appropriate rate and the present value of net benefits calculated for each alternative method of acquiring the new technology.

An alternative way of viewing benefits would be a so-called "snapshot" approach which anlyses the alternative company types for a single representative year and calculates relative benefits over that one-year period. Such an approach presumes two main conditions:

- that the company format and policy with regard to R&D remains constant over time. That is, the innovators continue to innovate, introduce new technology, and engage in R&D effort comparable to the effort associated with such continuing innovation while the licensee, subsidiary, and importer continue to acquire the new technology through licenses, parents, and foreign manufacturers respectively

- that the companies' progress since the first innovative introduction has been sufficient that any differences in impacts in the early stages have been amortized to the extent that they are now insignificant to the benefits analysis.

For purposes of this study, it was decided that the latter or "snapshot" approach would provide a more manageable way of dealing with benefits without significantly compromising the validity of the findings.

IV - APPLICATION OF THE MODEL

The economic benefits model was used to compare the benefits to Canada from five alternative methods of acquiring new technology, specifically:

- develop the new technology in Canada in a Canadian-owned company
- develop the new technology in Canada in a foreign-owned company
- import the product from a foreign manufacturer through a Canadian wholesaler
- produce the product in a Canadian firm under license from the foreign developer
- produce the product in a Canadian subsidiary of the foreign developer.

HYPOTHETICAL SCENARIOS

Under the method chosen for establishing input values, it was necessary to hypothesize a number of scenarios relating to conditions under which these alternative company types operated with respect to the variable inputs to the model, viz:

- market size, domestic and foreign
- return on capital before R&D and taxes
- expenditures for R&D (or equivalent, such as royalties
- capital per sales dollar including:
  - source
  - debt to equity ratio
- employment by type per sales dollar including structure of the management group and associated salaries

EXHIBIT 1

PROBABLE RELATIONSHIP BETWEEN CANADIAN INNOVATION AND ALTERNATIVES RE MODEL INPUT VARIABLES

	Innovating Subsidiary	Subsidiary	Licensee	Importer
Domestic Market	> =	> =	> =	> =
Foreign Market	< =	< =	< =	< =
Returns on Capital Before R&D	= *	> =	> =	<
R&D Expenditure	= *	<	<	<
Capital Per Sales Dollar	= *	> < =	> < =	<
Production Employment/Sales	= *	> < =	> < =	<
R&D Employment/Sales	= *	<	<	<
Management Employment/Sales	= *	< =	< =	<
Purchases of Canadian Supplies	= *	< =	< =	<

>	Greater than innovator
<	Less than innovator
=	Equal to innovator
*	May be slightly less than innovator due to parent connections

- total purchases of materials and supplies including the percent obtained from Canadian sources.

The ways in which these inputs might be expected to vary among the alternative company types were derived through a process of logical deduction rather than empirical evidence. The resultant conclusions with regard to possible variations and the reasoning behind these conclusions are outlined in depth in Appendix A and are summarized in Exhibit 1, opposite.

On the basis of these conclusions, a number of scenarios were hypothesized for comparative analysis. Although they do not represent the complete spectrum of possible alternatives, it was felt they provided a reasonable range to permit comparisons. A total of 18 separate scenarios were developed. These, together with the specific input assumptions, are described in the following sections.

INPUT ASSUMPTIONS

The first overall assumption was that the product in question will sell at the same price regardless of the route to acquisition of the new technology. Any differences in costs of production (importation) were assumed to flow to factors of production rather than to consumers.

Basic Cases

Five basic case scenarios were prepared, one for each alternative company type. The four manufacturing alternatives were assumed to operate under identical conditions with respect to the variable inputs

EXHIBIT 2

BASIC CASE ASSUMPTIONS

	Innovator	Innovating Subsidiary	Subsidiary	Licensee	Importer
SALES	----------$50 Million----------				
CAPITAL					
Equity per sales dollar	.36	.36	.36	.36	.17
Source of Equity	Canada	Foreign	Foreign	Foreign	Canada
Long term debt per sales dollar	.15	.15	.15	.15	.04
Source of debt	Canada	Canada	Canada	Canada	Canada
Interest on long term debt	9%	9%	9%	9%	9%
Return on capital before taxes and R&D	35%	35%	35%	35%	18.5%
R&D expense or equivalent per sales dollar	.075	.075	.03	.03	-
Depreciation per dollar capital	.10	.10	.10	.10	.05
LABOUR					
Employment per million sales dollars:					
Production, warehousing, etc.	25	25	25	25	4
Management	1	1	1	1	.5
Administration (includes sales except in case of imports	9	9	9	9	4
Sales	-	-	-	-	2
R&D	3	3	-	-	-
Average salaries per employee:					
Production, warehousing, etc.	8,000	8,000	8,000	8,000	6,000
Management *	20,000	20,000	20,000	20,000	20,000
Administration	8,000	8,000	8,000	8,000	8,000
Sales	-	-	-	-	13,500
R&D	13,000	13,000	-	-	-
GOVERNMENT					
Corporate tax rate	50%	50%	50%	50%	50%
Average personal income tax rates					
Production	14.5%	14.5%	14.5%	14.5%	12.5%
Management	21.5%	21.5%	21.5%	21.5%	21.5%
Administration	14.5%	14.5%	14.5%	14.5%	14.5%
Sales	-	-	-	-	17.5%
R&D	17.5%	17.5%	-	-	-
Federal sales tax - per domestic sales dollar	.12	.12	.12	.12	.12
Duty - per dollar imports	.15	.15	.15	.15	.15
Business and property tax per dollar of total capital	.008	.008	.008	.008	.011
WELFARE					
Contributions to CPP per employee:					
Employee	88.20	88.20	88.20	88.20	88.20
Company	88.20	88.20	88.20	88.20	88.20
Contributions to UIC per employee					
Employee	70.20	70.20	70.20	70.20	(54.00 prodn. (70.20 others
Company	98.28	98.28	98.28	98.28	(75.60 prodn. (98.28 others
Contributions to W.C.B. per dollar production wages	.011	.011	.011	.011	.011
SUPPLIERS					
Materials & supplies per sales dollar	.45	.45	.45	.45	.85
Canadian proportion	75%	75%	75%	75%	13.2%
Canadian supplier parameters	2/3 average co., 1/3 innovator				average co.

* Management was differentiated by level and salary for the purpose of assessing the impact of different scenatios.

with the following exceptions:

1. Basic Case - Innovator - spends a higher proportion of sales on R&D than the non-innovating subsidiary or licensee.

2. Basic Case - Innovating Subsidiary - identical to basic case innovator but profits accrue to foreign capital.

3. Basic Case - Subsidiary - identical to basic case innovator but pays royalties to parent which are less than innovator's R&D expenses, and profits accrue to foreign capital.

4. Basic Case - Licensee - identical to basic case subsidiary but royalties are transmitted to a foreign licensor. Profits flow to Canadian capital.

The fifth case, that of the importer, was quite significantly different from the other four.

5. Basic Case - Importer - serves the same sales volume as the three manufacturing alternatives but, since he operates as a wholesaler, he has different value added, capitalization, labour structure, rate of return, etc. Also has no expenditure on R&D.

Input Assumptions
to the Basic Cases

The input assumptions to the basic cases are shown in Exhibit 2, opposite. The relative differences among the basic cases are explained in Appendix A. The absolute values of the input assumptions were derived from the following sources:

- equity per sales dollar - manufacturing derived from average for Canadian manufacturing industries, 1973; wholesaling from average for Canadian wholesalers, 1973

- long term debt per sales dollar - same sources as equity per sales dollar

- interest on long term debt - 10 year average yield on 40 industrial bonds (8.0%) plus one percent premium. Premium based on opinion of bank investment analysts that medium to high risk bonds would yield a premium of 0.5 to 2.0%.

- return on capital before taxes and R&D - estimates for manufacturers based generally on the experience of successful innovative producers of high technology such as Xerox and IBM; wholesaler based on 1973 Canadian wholesaling average

- R&D expense per sales dollar - innovator and innovating subsidiary estimated on the basis of practice of other research oriented companies (usually five to ten percent of sales); licensee and subsidiary based on information that technology transfer agreements generally command a two to five percent royalty fee

- employment per million sales dollars - production employees in manufacturing from 1971 manufacturing industry average; combined management and administration employees from same source; split between management and administration based on judgment and inferences from average salaries of this group. R&D workers derived from 1971 data regarding industrial R&D expenditure in Canada. For wholesaling, the best available data on employment was the 1966 Census which provided only total employees per sales dollar. The total was allocated to the classifications based on judgment

- average salaries per employee - with the exception of R&D workers, these were generally based on 1971 industry data. R&D salaries were derived from 1971 statistics on industrial R&D expenditure in Canada

- corporate tax rate - the official corporate tax rate was used

- personal income tax rates - based on effective 1971 income tax rates associated with the assumed salary levels

- federal sales tax rate - actual rate

- duty per dollar imports - estimate of a reasonable average rate

- business and property tax - based on rates paid by average manufacturing and wholesaling companies as given in 1973 industry financial statistics

- contributions to CPP and UIC - based on actual contribution rates associated with assumed salary levels

- contributions to WCB - average rate of contribution in 1968 confirmed as reasonable for the present by WCB officials

- materials and supplies per sales dollar - calculated by totalling all value added components per sales dollar as derived above including an estimate for capital depreciation - difference between sales and value added represented purchases. Reasonableness of estimate confirmed by 1971 industry data.

Variations to
the Basic Cases

The remaining thirteen scenarios which were developed were all modifications of the five basic cases. The scenarios and their corresponding assumptions were:

6. Innovator - Export Market without Economies of Scale - since the innovator owns the technology outright, he is not likely to be bound by any legal or agreed restrictions as to the market he may serve. Perhaps more important is his potential market advantage in offering a superior or cheaper product. This gives him a head start in the world market. It is therefore possible that he could expand his sales volume through serving export markets. Under certain circumstances, his unit costs may be constant over the sales range of domestic market to domestic plus foreign market and he would achieve no economies of scale. This scenario, therefore, assumes the innovator has foreign sales of $100 million in addition to domestic sales of $50 million. All other parameters are the same as the basic case except that duty is charged on only 1/3 of his total imports since the remaining 2/3 are re-exported and subject to duty rebate.

7. Innovator - Export Market with Economies of Scale - as above but for every doubling of sales, capital increases only 70% and production labour increases 90%. All labour savings are passed on to production employees. All capital, tax and welfare savings are returned to equity holders.

8. Innovating Subsidiary - Export Market with Economies of Scale - the innovating subsidiary might well enjoy the same market advantages as the innovator. This scenario is therefore identical to number 7 but profits flow to offshore capital.

9. Innovator - Domestic Market Disadvantage without Diseconomies of Scale - because of poor marketing, lack of capital, etc., the innovator cannot obtain the share of domestic market hypothesized in the basic case. Over the range of sales decline, however, he does not suffer any increase in unit costs. This scenario assumes he gets only 60% of domestic market or $30 million sales. All other inputs relate to sales as in basic case.

10. Innovator - Domestic Market Disadvantage with Diseconomies of Scale - as above but when sales are reduced to 1/2, capital is reduced to 1/1.7 and production labour is reduced to 1/1.9. All additional costs come out of profits before tax.

11. Innovator - Foreign Market Served Through Independently Operating Subsidiaries - in order for the innovator to gain acceptance in certain foreign markets, it may be necessary to establish operating subsidiaries there. This scenario assumes that the subsidiaries are wholly owned but provide the same degree of value added as does the parent and purchase all supplies independently. The parent serves the Canadian market only - $50 million in sales. The foreign market of $100 million is served by the foreign subsidiaries. The subsidiaries are identical foreign counterparts of the parent with the following exceptions:

    - the subsidiaries' equity capital is obtained from a foreign parent (i.e. Canada)
    - while the total organization spends 7.5% of sales on R&D, 2/3 of this is performed by the parent
    - 10% of subsidiaries' management personnel requirements (representing the top management levels) are located in the parent organization and the subsidiaries remit to the parent a management fee equivalent to their savings on management salaries.

Although the subsidiaries like the parent import 25% of their materials and supplies, it is assumed that none of these imports come from Canada.

12. Innovator - Foreign Market Served Through Semi-Dependent Subsidiaries - domestic and foreign markets are as above. However, instead of performing 55% value added, the subsidiaries perform only 40%. The remaining value added and associated materials and supplies are obtained from the parent organization. Since the ratio of value added to supplies is 55:45, the parent supplies the subsidiaries with goods valued at $15 million value added plus $12.3 million materials (15:12.3 = 55:45). The subsidiary production is therefore only $72.7 million and the parent's is $77.3 million. All economic impact calculations are adjusted to reflect this change. In addition:

    - the subsidiaries' equity capital is obtained from Canada
    - the subsidiaries do only 1/4 of the organization's R&D (reduced from case 11 above due to the decreased production activities)
    - 10% of subsidiaries management personnel are located in the parent with the subsidiaries' remitting a management fee equivalent to their savings on salaries.

13. Subsidiary - More Efficient than in Basic Case - as a result of parent experience, guidance and/or assistance, the subsidiary is able to serve the Canadian market using less capital and production labour than in the basic case. The subsidiary is assumed to serve the Canadian market with debt and equity capital and production labour equivalent to 90% of the base case requirements. One-half of the labour savings revert to production employees. All other savings are returned to equity holders.

14. Subsidiary - Semi-Dependent on Foreign Parent - this case is the Canadian inverse of case 12 such that the Canadian subsidiary has only 40% value added in Canada and purchases components from the parent equal to 27.3% of sales ($13.65 million in this instance). All economic impacts are adjusted to the revised level of Canadian activity and imports. In addition, 10% of the management personnel requirements are located in the foreign parent and the subsidiary remits a management fee equivalent to its savings on executive salaries.

15. Subsidiary - Truncated Management, Foreign Nationals - because of centralization of certain functions by the parent, the subsidiary has fewer management personnel per sales dollar than in the basic case. In addition, some managers from the parent organization are brought in on a short-term basis to provide part of the remaining

management team. It is assumed that 10% of the subsidiary's management personnel requirements are located in the parent organization. A management fee equivalent to the resultant salary saving is remitted to the parent. In addition, 6% of the management positions are filled by foreign nationals who are in Canada on short-term assignment.

16. Subsidiary - Buys Fewer Supplies in Canada - as hypothesized in Appendix A, foreign suppliers may have a distinct competitive advantage over Canadian suppliers from the viewpoint of subsidiaries and licensees. It was therefore assumed for this scenario that the subsidiary would purchase all high technology supplies abroad. The original split between Canadian supplies and imports and the weighing assigned to create an average Canadian supplier was based on the assumption that total material inputs were split evenly into four categories:

    - Canadian General Supplies
    - Canadian Raw and Fabricated Materials
    - Canadian High Technology Supplies
    - Imports

    The Canadian high technology supplier was assumed to be identical to the innovator in terms of output parameters while the other Canadian supplier categories were assumed to be similar to an average manufacturing company. For this scenario it was assumed that the base case purchases of Canadian high technology supplies were transferred to foreign suppliers. Thus, purchases of Canadian supplies were reduced to 50% of total purchases, and supplier impact was based on the economic parameters of the non-high technology suppliers.

17. Licensee - Buys Fewer Supplies in Canada - as Scenario 16 above.

18. Licensee - More Efficient than in Basic Case - the same reasoning as in Scenario 13 can be applied to the licensee who has the benefit of the licensor's experience and assistance - although he presumably pays a higher license fee for this service. The licensee is therefore assumed to serve the Canadian market with 90% of the basic case requirements for capital and labour. His license fee, however, is increased from 3% to 4½% of sales. All savings after the additional license fee has been paid are retained as before tax profits.

Two Canadian supplier scenarios were also formulated for application in evaluating the supplier impacts of the above scenarios:

1. Supplier - Average Company - the supplier operates in all respects like an average Canadian manufacturing company.

2. Supplier - Innovative Type - the supplier operates in all respects like the basic case innovator.

The second or innovating supplier scenario is identical in all respects to the basic case innovator. The "average company" supplier case is identical to the innovator case with the following exceptions:

- interest on long-term debt	- 8% vs 9%
- return on capital before tax and R&D	- 16% vs 35%
- R&D per sales dollar	- nil vs .075
- R&D employment per million sales $	- nil vs 3
- materials and supplies per sales $	- $.55 vs $.45

These assumptions more closely resemble the characteristics of an "average" Canadian manufacturing company.

OPPORTUNITY COST ASSUMPTIONS

In order to determine the net economic benefit arising from the gross economic impacts of the various scenarios, assumptions were also developed regarding the opportunity cost of the various inputs. These assumptions are listed below.

Equity and Debt Capital

The opportunity cost of capital obtained from Canadian sources was assumed to be the interest rate on long term U.S. bonds. Since there

is considerable Canadian investment in the U.S., the implication is that all available Canadian capital cannot earn a competitive rate of return in Canada. It is therefore reasonable to assume that U.S. bonds are an appropriate alternative investment. Since the capital is presumably invested over a period of years, the average rate over the 1964-1974 period was used - i.e. 8.2% before tax. It was assumed that the return on these U.S. investments would be taxed at the corporate rate of 50%.

The opportunity cost on capital obtained from foreign sources was assumed to be zero. It was hypothesized that if this capital were not invested in a Canadian subsidiary, it would be invested outside of Canada.

A justifiable alternative opportunity cost of capital sourced in Canada would be the average return on investment in Canadian secondary industry. However, in view of the complexity of this assumption's impact on the opportunity cost of all other parameters, it was decided not to test it at this time.

Returns to Labour

Two assumptions were tested with regard to the opportunity cost of labour and the findings with respect to each assumption are included in the results. The first assumption was zero opportunity cost. This presumes either a labour market with unemployment at all levels or a situation whereby the promotion of one person to a higher salary level

results in the promotion and comparable salary upgrading at all levels below. In both cases the total salaries paid for additional jobs represent a full benefit.

The second assumption presumes that there is virtually full employment of all but unskilled workers who could, were there a position available, only command the minimum wage. Thus, positions above minimum wage level created as a result of the innovation are presumed to be filled by persons who were previously employed in other organizations at the same income level. Their opportunity cost is therefore equal to their income. The loss of output from their previous employment is assumed to be partially compensated by the creation of an equivalent number of positions at the minimum wage level which are filled by persons previously unemployed. These positions are filled to bring the complement to the previous level in anticipation that, through staff development over time, the total capability will reach or exceed the original level. The opportunity cost of this latter group is zero.

Corporate Income Tax

The opportunity cost of income tax paid on returns to Canadian debt and equity capital was assumed to be the tax which would be paid in Canada if the capital were invested in U.S. bonds. The opportunity cost was therefore equivalent to the amount of Canadian capital times 8.2% times 35%. The 35% represents a tax rate of 50% less U.S. withholding tax of 15%.

The opportunity cost of taxes paid on returns to foreign capital was assumed to be zero because of the assumption that the foreign capital would otherwise have been invested outside Canada.

Personal Income Tax

Under the assumption of zero opportunity cost of labour, the opportunity cost of personal income tax was also assumed to be zero.

Under the assumption of zero labour opportunity cost at minimum wage levels only, personal income tax opportunity cost was assumed to be zero on taxes associated with minimum wages and 100% on taxes associated with higher levels of income.

Federal Sales Tax

Given that capital would otherwise be invested in U.S. bonds and would generate no production, it was assumed that the opportunity cost of Federal Sales Tax payments is zero. This assumption is questionable under the situation where labour has an opportunity cost at salaries above minimum wage since it assumes that these workers generated no taxable output. However, for the sake of simplicity it was assumed that this was in fact the case.

Duty

The opportunity cost of duty was also assumed to be zero since investment in U.S. bonds does not directly generate imports of goods. Again for simplicity it was assumed that in the non-zero opportunity cost of labour situation, the previous employment of these workers generated no imports or duty.

Business and Property Tax

The opportunity cost of business and property tax was also assumed to be zero based on the above stated assumptions and simplifications.

Welfare Contributions

Under the assumption of zero opportunity cost of labour, the opportunity cost of contributions to CPP, UIC and WCB was assumed to be zero.

Under the assumption of zero labour opportunity cost only at minimum wage levels, the opportunity cost of these contributions was also assumed to be 100% of contributions associated with salary levels above the minimum wage and zero at minimum wage levels.

Depreciation

The concept of depreciation was originally included in the analysis to evaluate the total value added and hence the purchases of materials and supplies. Evaluating the opportunity cost of real depreciation would involve an analysis of the sources of capital assets, markets for capital equipment, construction contracts, etc. and assessments of the factors of production devoted to creating the depreciable assets. Consequently, it was decided for this analysis to assume that the opportunity cost of real depreciation was 100%; i.e. that all resources involved in the creation of depreciable assets would receive the same return if they were employed elsewhere.

EXHIBIT 3

SUMMARY OF NET BENEFITS RELATIVE
TO "INNOVATOR BASIC" SCENARIO

SCENARIO/ COMPARISON NUMBER	INNOVATOR BASIC COMPARED WITH:	TOTAL NET BENEFITS ($ Millions) With OCL*	Without OCL*
2.	Innovating Subsidiary Basic	(1.3)	(1.3)
3.	Subsidiary Basic	(.9)	(2.2)
4.	Licensee Basic	1.6	0.3
5.	Importer Basic	(7.6)	(15.6)
6.	Innovator Export Market Without Economies of Scale	32.5	55.4
7.	Innovator Export Market With Economies of Scale	34.3	58.4
8.	Innovating Subsidiary - Export Market With Economies of Scale	28.2	52.3
9.	Innovator - Domestic Disadvantage Without Diseconomies of Scale	(9.3)	(13.9)
10.	Innovator - Domestic Disadvantage With Diseconomies of Scale	(9.8)	(14.3)
11.	Innovator with Independent Foreign Subsidiaries	1.5	3.1
12.	Innovator with Semi-Dependent Foreign Subsidiaries	10.0	17.4
13.	Subsidiary - More Efficient	(1.0)	(2.3)
14.	Subsidiary - Semi-Dependent on Parent	(3.6)	(7.7)
15.	Subsidiary - Truncated Management	(.9)	(2.4)
16.	Subsidiary - Buys Fewer Supplies in Canada	(1.5)	(3.8)
17.	Licensee - Buys Fewer Supplies in Canada	1.0	(1.4)
18.	Licensee - More Efficient	1.8	(.1)

Brackets denote negative

* OCL - opportunity cost of labour

R&D Expenditures
Other than Labour

The expenditures which the innovator makes on in-house research and development are divided almost equally between labour costs and current and capital purchases. The opportunity cost of the labour component was treated like the returns to other labour categories. The opportunity cost of the resources involved in producing the goods accounting for the remaining current and capital expenditures was assumed to be 100%. It was felt that to refine this assumption would necessitate disproportionate effort in developing analyses and assumptions with regard to the portion purchased from Canadian suppliers, the split between current and capitalized expenses, and levels of resource inputs.

NET BENEFIT
CALCULATIONS

The net benefit calculations were performed by comparing pairs of scenarios with respect to gross impact and deducting the opportunity cost associated with any incremental resources used in one scenario over the other. Since the 18 scenarios give rise to 153 possible pairs, it was decided to compare each scenario with the "Innovator Basic" case. Once these comparisons had been made it would be a simple arithmetic procedure to make any other comparison which might be of interest.

The results of these comparisons are shown in Exhibit 3, opposite. The numbers represent the net benefits dervied from the alternative scenario

over and above the innovator basic case. A negative figure therefore means that the innovator basic case generates more net benefits than the alternative while a positive number means that the alternative generates more benefit.

To determine the relative benefits between any other two scenarios, it is necessary only to calculate the difference between their benefits relative to the "Innovator Basic" case. Thus, if it is desired to know the benefits of an innovator with an export market with economies of scale versus one without economies of scale, one deducts the benefits of scenario 6 from scenario 7 and determines that the benefits are (34.3 - 32.5) = $1.8 million with opportunity cost of labour and (58.4 - 55.4) = $3.0 million without.

ANALYSIS OF FINDINGS

Total Benefits

An examination of the total net benefits in Exhibit 3 brings to light a number of points of interest. Looking first at the comparisons will small relative differences, it is significant that the comparisons with the basic case innovating subsidiary, subsidiary and licensee indicate little or no economic advantages from Canadian innovation provided the alternative involves some form of Canadian manufacturing. A number of compensating factors give rise to this result and will be discussed in the following section on flow of benefits.

Comparisons 13 and 18, which deal with the more efficient subsidiary and licensee, indicate that the impact of greater efficiency in a company purchasing technology also has little impact on the derived innovator benefits or disbenefits under the assumptions made. In the case of the subsidiary, its benefits relative to the innovator actually decrease since part of the savings accrue to offshore capital. In the licensee example, the innovator's disbenefits increase where labour is assumed to have an opportunity cost but decrease with no opportunity cost of labour due to impact of reduced labour force requirements.

Similarly, comparisons 16 and 17 where subsidiary and licensee purchase fewer Canadian supplies indicate that the impact of this reduction is not extensive, at least at the first supplier level. This is due mainly to the offsetting effect of additional duty which is assumed to flow to the Canadian government as a result of increased supply imports.

The comparison with the subidiary with truncated management indicates that, to the extent management was assumed to decline in the scenario, there is little net impact from this source on the relative disbenefits of the subsidiary alternative. Another scenario which differs only slightly from the innovator basic is scenario 11 in which the innovator serves export markets through independent foregin subsidiaries. However, this comparison does indicate one point of interest - that even with all export sales being furnished through foreign subsidiaries, the home country still derives some benefits that would not arise if the foreign sales did not exist.

The above analysis presents largely negative information with regard to innovation benefits; that is, the factors which have little or no impact on benefits to be derived. The remaining comparisons, however, yield much more positive results. An examination of comparisons 5 through 10 and comparison 12 yields two points of interest:

- in all cases, there is a significant difference in terms of benefits (either positive or negative) from the innovator basic case.
- in all cases, the market served by Canadian production activity is significantly different from the innovator basic case.

While the correlation between these two points is not unexpected, it is significant to note both the magnitude of increased benefits and the fact that a Canadian production difference between cases is the one source tested from which significant benefits flow. A difference of $100 million in the market served by Canadian production yields almost one-third of that amount in benefits with an assumed opportunity cost of labour and over half that amount without opportunity cost. These same relationships hold true when the innovator's sales are varied downward from $50 to $30 million (scenarios 9 and 10). Furthermore, when wholesaling activity is substituted for production (scenario 5), the loss in benefits ranges between 15 percent and 31 percent of the value of production activity lost.

Other points of interest with regard to these comparisons are first the impact of economies of scale. Assuming that these economies of scale are not passed on in terms of price, it can be observed through

comparing scenarios 6 and 7 and scenarios 9 and 10 that they have little significant impact on the benefits which accrue. Also, a comparison of scenarios 8 and 2 yields the information that when export sales accrue to an innovating subsidiary, the benefits to Canada range between $29.5 and $53.6 million; when they accrue to a Canadian innovator the benefits, as per scenario 7, are $34.3 to $58.4 million. This indicates the impact of ownership of the innovating firm.

A final point regarding the total net benefits is the significance of the assumption regarding opportunity cost of labour. The difference in derived benefits with and without opportunity cost or, termed somewhat differently, without and with unemployment at all skill levels, points out the importance of this assumption and hence the influence which the state of the economy, particularly the unemployment level, might have on the benefits to be derived from an increase in innovative activity.

Flow of Benefits

While the total relative benefits among the various alternatives are of interest, it is also important to observe the sectors to which these benefits accrue. Such analysis is useful because the value of a unit of benefit to one sector may be judged to differ from the value of the same unit of benefit to another sector.

The sectors to which benefits flow, both directly and through suppliers, are presented for each scenario comparison in Exhibit 4 through 20 at the end of this section. As with total benefits, comparisons between other pairs of scenarios can be made by calculating the differences in their benefits relative to the innovator basic case.

The basic case comparisons of the innovator with the other manufacturing alternatives (innovating subsidiary, subsidiary and licensee in exhibits 4, 5 and 6) point out that the Canadian innovator has an advantage over both types of subsidiary in terms of returns to equity. This is only partially offset by the subsidiaries' higher returns to government arising from the absence of opportunity cost on corporate income taxes. However, in comparison with the licensee, the innovator is at a disadvantage since the licensee's profits also revert to Canadian capital but his profits are higher due to his lower R&D expenses. This profit advantage is also reflected in returns to government via corporate income taxes. The innovator enjoys an advantage in returns to labour over the non-innovating due to R&D employment but is equal in this respect to the innovating subsidiary.

The innovator's net disadvantage relative to the licensee arises from the assumption that he earns the same return on capital as the licensee beofre R&D and taxes are taken into account. If this assumtion were modified such that the innovator covered his R&D expenses through a higher return to capital, he would show a net benefit over all the basic alternatives. A mere increase in R&D employment would not have this effect since it would simply result in a transfer of flows away from equity and corporate taxes towards labour and personal taxes. However, his return would have to be substantially higher for a significant benefit to occur and this would have to be reflected in higher prices to consumers which in turn would have other impacts.

In cases where the subsidiary and licensee are more efficient (Exhibits 15 and 20), the above comments with regard to the innovator's advantages and disadvantages generally hold true. Here the innovator's advantage in returns to labour increases but is again offset to some extent by higher taxes paid by the subsidiary and by higher profits and taxes for the licensee. Exhibit 17, the subsidiary with truncated management, is only fractionally different from the basic case subsidiary (Exhibit 5). A drop in subsidiary management personnel of 16 per cent brought about a maximum increase in the innovator's benefits of $200,000 or 0.4 per cent of sales. Management salaries would have to represent a much higher proportion of sales or management personnel would have to be cut much more sharply for this factor to make a significant difference.

The two cases where the innovator's supplier impact is greater than the subsidiary's or licensee's (Exhibits 18 and 19) indicate that, under the assumptions made with regard to supplier value-added, the innovator benefits in this area are fairly substantial at the first level. The difference in purchases of Canadian supplies was about $5.6 million and the resultant benefit through suppliers was $1.5 to $2.5 million. However, as noted earlier, this benefit was largely offset by the increased duty paid by licensee and subsidiary on imported supplies (almost $850,000). It should also be noted that the Canadian suppliers who were eliminated had an above average value added (55 per cent of sales) and thus the supplier benefits to the various factors of production might be somewhat inflated.

Innovator benefits through suppliers accrue on approximately the same scale when the subsidiary alternative is assumed to

have only 40 per cent Canadian value added (Exhibit 16). Additional direct benefits also accrue to debt, labour and welfare funds but these are partially offset by the subsidiary's increased duty payments.

One factor of note in the above cases is that an innovation benefit to one sector is frequently offset at least to some extent by an innovation disbenefit elsewhere. Thus it is possible that a significant change in one of the input assumptions could reverse the innovator's position relative to another scenario. For example, an increase in corporate tax rate to 75 per cent would make the subsidiary preferable to the Canadian innovator in all cases where Canadian production is equal among the alternatives. Similarly, an increase in duty rates from 15 to 45 per cent would reduce the innovator's Canadian supplier advantage (Exhibits 18 and 19) by about $1.7 million and would thus give the overall advantage to the licensee under both opportunity cost of labour assumptions and to the subsidiary where an opportunity cost of labour was assumed.

Turning to the cases where significant variations in the market served by Canadian production are incorporated into the scenarios, one finds first that in the cases where the innovator has a domestic market disadvantage (Exhibits 11 and 12) the greatest loss in benefits, assuming an opportunity cost of labour, is borne by government. Over half of this loss, however, is through the decrease in sales tax revenues ($2.4 million). Apart from government, the major loss in benefit is to the labour sector. This relative position could change if a greater portion of sales value flowed to equity rather than labour but in this case, as in all the cases which were examined, the

change in flow would have to be substantial. In these cases it is also of note that the direct loss in benefits is much greater than the loss of benefits through suppliers.

In the cases where the innovator serves a foreign market either wholly or partially through Canadian production (Exhibits 8, 9 and 14), the direct benefits again are substantially greater than the benefits through suppliers. The chief loss when production for foreign markets is moved offshore (Exhibit 14) accrues to the labour sector with lesser losses accruing to government and through suppliers.

The effect of economies of scale on the flow of benefits can be observed by comparing scenario 6 with scenario 7 (Exhibits 8 and 9). When economies of scale are assumed to occur, the labour sector suffers a slight loss, but this is more than compensated by additional returns to equity. Also, no account has been taken in this scenario of the potential for reducing prices as a result of economies of scale and hence increasing market penetration. While this would reduce the returns to equity per sales dollar, total returns to labour would increase and total returns to equity may also increase due to higher sales. It would appear to be in this area of increased sales that the chief benefits of economies of scale could arise.

One point which is common to all the comparisons where the market served by Canadian production differs is the fact that, while reasonable changes in the input assumptions may alter the magnitude of the benefit or disbenefit, they would not alter the overall conclusion with regard to the relative positions of the alternatives. There would appear to be an incontrovertible relationship between benefits and differences in the market served by Canadian production.

The remaining comparisons give rise to a few other points of interest. First, the innovating subsidiary with a foreign market (Exhibit 10) enjoys a slight advantage over the comparable Canadian innovator (Exhibit 9) in terms of returns to government, but a substantial disadvantage in returns to Canadian equity and is thus not as desirable an alternative from the total benefit point of view. Secondly, when the innovator sets up independent, but wholly owned, subsidiaries to serve foreign markets (Exhibit 13), the government stands to lose corporate tax revenues but the economy as a whole gains due to the higher after-tax returns to equity and higher management requirements. Finally, in the case of product importation, all sectors stand to lose benefits except the government which compensates for tax losses through increased duty receipts.

EXHIBIT 4

INNOVATING SUBSIDIARY BASIC Vs. INNOVATOR BASIC CASE

(Comparison 2)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)			(1.85)	(1.85)
Returns to Canadian Debt	-	-			-	-
Returns to Canadian Labour	-	-			-	-
Returns to Canadian Government	.52	.52			.52	.52
Returns to Canadian Welfare Funds	-	-			-	-
TOTAL	(1.33)	(1.33)			(1.33)	(1.33)

1. OCL - Opportunity cost of labour

EXHIBIT 5

SUBSIDIARY BASIC Vs. INNOVATOR BASIC CASE

(Comparison 3)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)			(1.85)	(1.85)
Returns to Canadian Debt	-	-			-	-
Returns to Canadian Labour	(.55)	(1.59)			(.55)	(1.59)
Returns to Canadian Government	1.59	1.30			1.59	1.30
Returns to Canadian Welfare Funds	(.04)	(.05)			(.04)	(.05)
TOTAL	(.85)	(2.19)			(.85)	(2.19)

1. OCL - Opportunity cost of labour

EXHIBIT 6

LICENSEE BASIC Vs. INNOVATOR BASIC CASE

(Comparison 4)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	1.12	1.12			1.12	1.12
Returns to Canadian Debt	-	-			-	-
Returns to Canadian Labour	(.55)	(1.59)			(.55)	(1.59)
Returns to Canadian Government	1.06	.78			1.06	.78
Returns to Canadian Welfare Funds	(.04)	(.05)			(.04)	(.05)
TOTAL	1.59	.26			1.59	.26

1. OCL - Opportunity cost of labour

EXHIBIT 7

IMPORTER BASIC Vs. INNOVATOR BASIC CASE

(Comparison 5)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.23)	(1.23)	(.31)	(.31)	(1.54)	(1.54)
Returns to Canadian Debt	(.02)	(.02)	(.04)	(.04)	(.06)	(.06)
Returns to Canadian Labour	(5.02)	(9.78)	(1.54)	(2.91)	(6.56)	(12.69)
Returns to Canadian Government	1.87	.61	(.81)	(1.17)	1.06	(.56)
Returns to Canadian Welfare Funds	(.39)	(.55)	(.12)	(.17)	(.51)	(.72)
TOTAL	(4.79)	(10.97)	(2.82)	(4.60)	(7.61)	(15.57)

1. OCL - Opportunity cost of labour

EXHIBIT 8

INNOVATOR - FOREIGN MARKET WITHOUT ECONOMIES OF SCALE Vs. INNOVATOR BASIC CASE

(Comparison 6)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	3.70	3.70	.88	.88	4.58	4.58
Returns to Canadian Debt	.06	.06	.12	.12	.18	.18
Returns to Canadian Labour	13.88	27.43	4.44	8.55	18.32	35.98
Returns to Canadian Government	6.30	9.86	1.70	2.77	8.00	12.63
Returns to Canadian Welfare Funds	1.08	1.53	.35	.49	1.43	2.02
TOTAL	25.02	42.58	7.49	12.81	32.51	55.39

1. OCL - Opportunity cost of labour

EXHIBIT 9

INNOVATOR - FOREIGN MARKET WITH ECONOMIES OF SCALE Vs. INNOVATOR BASIC CASE

(Comparison 7)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	5.45	5.45	.88	.88	6.33	6.33
Returns to Canadian Debt	.04	.04	.12	.12	.16	.16
Returns to Canadian Labour	12.75	27.34	4.44	8.55	17.19	35.89
Returns to Canadian Government	7.54	11.36	1.70	2.77	9.24	14.13
Returns to Canadian Welfare Funds	1.00	1.43	.35	.49	1.35	1.92
TOTAL	26.78	45.62	7.49	12.81	34.27	58.43

1. OCL - Opportunity cost of labour

EXHIBIT 10

INNOVATING SUBSIDIARY - EXPORT MARKET WITH ECONOMIES OF SCALE Vs. INNOVATOR BASIC CASE

(Comparison 8)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)	.88	.88	(.97)	(.97)
Returns to Canadian Debt	.04	.04	.12	.12	.16	.16
Returns to Canadian Labour	12.75	27.34	4.44	8.55	17.19	35.89
Returns to Canadian Government	8.73	12.56	1.70	2.77	10.43	15.33
Returns to Canadian Welfare Funds	1.00	1.43	.35	.49	1.35	1.92
TOTAL	20.67	39.52	7.49	12.81	28.16	52.33

1. OCL - Opportunity cost of labour

EXHIBIT 11

INNOVATOR - DOMESTIC MARKET DISADVANTAGE WITHOUT DISECONOMIES OF SCALE Vs. INNOVATOR BASIC CASE

(Comparison 9)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(.74)	(.74)	(.18)	(.18)	(.92)	(.92)
Returns to Canadian Debt	(.01)	(.01)	(.03)	(.03)	(.04)	(.04)
Returns to Canadian Labour	(2.78)	(5.49)	(.89)	(1.71)	(3.67)	(7.20)
Returns to Canadian Government	(3.91)	(4.62)	(.47)	(.69)	(4.38)	(5.31)
Returns to Canadian Welfare Funds	(.22)	(.31)	(.07)	(.10)	(.29)	(.41)
TOTAL	(7.66)	(11.17)	(1.64)	(2.71)	(9.30)	(13.88)

1. OCL - Opportunity cost of labour

EXHIBIT 12

INNOVATOR - DOMESTIC DISADVANTAGE WITH DISECONOMIES OF SCALE Vs. INNOVATOR BASIC CASE

(Comparison 10)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.07)	(1.07)	(.18)	(.18)	(1.25)	(1.25)
Returns to Canadian Debt	(.01)	(.01)	(.03)	(.03)	(.04)	(.04)
Returns to Canadian Labour	(2.63)	(5.23)	(.89)	(1.71)	(3.52)	(6.94)
Returns to Canadian Government	(4.28)	(4.96)	(.47)	(.69)	(4.75)	(5.65)
Returns to Canadian Welfare Funds	(.21)	(.29)	(.07)	(.10)	(.28)	(.39)
TOTAL	(8.20)	(11.56)	(1.64)	(2.71)	(9.84)	(14.27)

1. OCL - Opportunity cost of labour

EXHIBIT 13

INNOVATOR WITH INDEPENDENT FOREIGN SUBSIDIARIES Vs. INNOVATOR BASIC CASE

(Comparison 11)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	3.70	3.70			3.70	3.70
Returns to Canadian Debt	-	-			-	-
Returns to Canadian Labour	.58	1.78			.58	1.78
Returns to Canadian Government	(2.85)	(2.49)			(2.85)	(2.49)
Returns to Canadian Welfare Funds	.05	.06			.05	.06
TOTAL	1.48	3.05			1.48	3.05

1. OCL - Opportunity cost of labour

EXHIBIT 14

INNOVATOR WITH SEMI-DEPENDENT FOREIGN SUBSIDIARIES Vs. INNOVATOR BASIC CASE

(Comparison 12)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	3.70	3.70	.24	.24	3.94	3.94
Returns to Canadian Debt	.02	.02	.03	.03	.05	.05
Returns to Canadian Labour	4.22	8.83	1.21	2.33	5.43	11.16
Returns to Canadian Government	(.31)	.93	.46	.76	.15	1.69
Returns to Canadian Welfare Funds	.33	.46	.10	.13	.43	.59
TOTAL	7.96	13.94	2.04	3.49	10.00	17.43

1. OCL - Opportunity cost of labour

EXHIBIT 15

SUBSIDIARY MORE EFFICIENT Vs. INNOVATOR BASIC CASE

(Comparison 13)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)			(1.85)	(1.85)
Returns to Canadian Debt	*	*			*	*
Returns to Canadian Labour	(1.01)	(2.04)			(1.01)	(2.04)
Returns to Canadian Government	1.93	1.68			1.93	1.68
Returns to Canadian Welfare Funds	(.08)	(.10)			(.08)	(.10)
TOTAL	(1.01)	(2.31)			(1.01)	(2.31)

1. OCL - Opportunity cost of labour

* Less than $0.01 Million

EXHIBIT 16

SUBSIDIARY SEMI-DEPENDENT ON PARENT Vs. INNOVATOR BASIC CASE

(Comparison 14)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)	(.12)	(.12)	(1.97)	(1.97)
Returns to Canadian Debt	(.01)	(.01)	(.02)	(.02)	(.03)	(.03)
Returns to Canadian Labour	(2.29)	(4.90)	(.61)	(1.17)	(2.90)	(6.07)
Returns to Canadian Government	1.90	1.21	(.32)	(.47)	1.58	.74
Returns to Canadian Welfare Funds	(.18)	(.25)	(.05)	(.07)	(.23)	(.32)
TOTAL	(2.43)	(5.80)	(1.12)	(1.85)	(3.55)	(7.65)

1. OCL - Opportunity cost of labour

EXHIBIT 17

SUBSIDIARY - TRUNCATED MANAGEMENT Vs. INNOVATOR BASIC CASE

(Comparison 15)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)			(1.85)	(1.85)
Returns to Canadian Debt	-	-			-	-
Returns to Canadian Labour	(.58)	(1.75)			(.58)	(1.75)
Returns to Canadian Government	1.58	1.26			1.58	1.26
Returns to Canadian Welfare Funds	(.05)	(.06)			(.05)	(.06)
TOTAL	(.90)	(2.40)			(.90)	(2.40)

1. OCL - Opportunity cost of labour

EXHIBIT 18

SUBSIDIARY BUYS FEWER CANADIAN SUPPLIES Vs. INNOVATOR BASIC CASE

(Comparison 16)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	(1.85)	(1.85)	(.19)	(.19)	(2.04)	(2.04)
Returns to Canadian Debt	-	-	(.02)	(.02)	(.02)	(.02)
Returns to Canadian Labour	(.55)	(1.59)	(.78)	(1.54)	(1.33)	(3.13)
Returns to Canadian Government	2.43	2.14	(.43)	(.63)	2.00	1.51
Returns to Canadian Welfare Funds	(.04)	(.05)	(.06)	(.09)	(.10)	(.14)
TOTAL	(.01)	(1.35)	(1.48)	(2.47)	(1.49)	(3.82)

1. OCL - Opportunity cost of labour

EXHIBIT 19

LICENSEE BUYS FEWER CANADIAN SUPPLIES Vs. INNOVATOR BASIC CASE

(Comparison 17)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	1.12	1.12	(.19)	(.19)	.93	.93
Returns to Canadian Debt	-	-	(.02)	(.02)	(.02)	(.02)
Returns to Canadian Labour	(.55)	(1.59)	(.78)	(1.54)	(1.33)	(3.13)
Returns to Canadian Government	1.91	1.63	(.43)	(.63)	1.48	1.00
Returns to Canadian Welfare Funds	(.04)	(.05)	(.06)	(.09)	(.10)	(.14)
TOTAL	2.44	1.11	(1.48)	(2.47)	.96	(1.36)

1. OCL - Opportunity cost of labour

EXHIBIT 20

LICENSEE MORE EFFICIENT Vs. INNOVATOR BASIC CASE

(Comparison 18)

	Direct Benefits ($ Millions)		Benefits Thru Suppliers ($ Millions)		Total Net Benefits ($ Millions)	
	With OCL[1]	Without OCL	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Equity	1.51	1.51			1.51	1.51
Returns to Canadian Debt	*	*			*	*
Returns to Canadian Labour	(1.01)	(2.42)			(1.01)	(2.42)
Returns to Canadian Government	1.35	.97			1.35	.97
Returns to Canadian Welfare Funds	(.08)	(.11)			(.08)	(.11)
TOTAL	1.77	(.05)			1.77	(.05)

1. OCL - Opportunity cost of labour

* Less than $0.01 Million

V - CONCLUSIONS

Perhaps the most significant point arising from the economic benefits analysis is the overwhelming importance of the level of sales served by Canadian production. Canadian innovation by a Canadian owned company yields basic case benefits (disbenefits) over the licensing and non-innovating subsidiary alternatives ranging between (3%) and 4.5% of sales. The benefits associated with the innovator obtaining an export market equal to twice its domestic sales (as exemplified by comparison of the innovator basic with scenarios 6 and 7) range between 20 and 40 percent of total sales.

In cases where Canadian production to serve only the domestic market replaces product importation (which has no Canadian production component), the benefits are substantial, irrespective of whether this production takes place through a Canadian innovator, licensee or subsidiary.

Thus, from the economic point of view, Candian innovation without corresponding market advantages does not lead to significant relative benefits; but it can, through its potential to create a competitive advantage and therefore generate export sales, generate significant benefits over the other methods of acquiring new technology.

The relationship between benefits and the market served by Candian production is further confirmed by the case of the innovating subsidiary. Foreign ownership alone reduces benefits only to a small extent, provided that foreign ownership does not affect either the

probability of successful innovations taking place or the ability of the company to exploit potential markets.

It is possible that the other potential advantages of Canadian innovation which have not been quantified (timing effects, national pride, learning by doing, etc.) would be equally important if values could be assigned to them. However, is not unreasonable to assume that these potential benefits could also be larger where the innovating company can capture a significant export market.

The general case for innovation discussed the advantages of innovation's potential impact on Canada's world trading position. These were:

- a decrease in prices paid by Canadian consumers for many products or an increase in returns to Canadian factors of production through:
  - (a) economies of scale on products produced in Canada
  - (b) a reduction in tariffs on products currently imported and
  - (c) the availability of lower priced imports in lieu of protected domestic production
- maintenance of a significant secondary manufacturing industry with its associated benefits in terms of labour intensity, job diversity, locational flexibility and flexibility of expansion
- acquisition of the above consumer benefits without the disadvantages of increased reliance on the resource sector.

The quantitative analysis of benefits demonstrates that if innovation provides a competitive advantage, the direct economic benefits would be very large, and these are only a part of the totality of potential benefits.

This finding has several implications in terms of the thrust of a Canadian innovation policy. If we are to maximize the potential rewards, such a policy should try to focus our innovative efforts on products, processes and/or service where:

- there is a substantial potential world market;
- the technological innovation may have a significant effect on the marketability of the product through better quality, cost, or suitability for designed purposes;
- the technological innovation has a reasonable probability of providing Canada with good trading position despite her natural disadvantages of high labour cost, distance from markets and fragmented domestic market;
- the value added in Canada tends to be high; and,
- Canada has a reasonable probability of being the first to develop and market the innovation

While the above comments suggest that Canada could reap considerable benefits through appropriately focussed and successful domestic innovation, they omit one important factor. A full valuation of net benefits must also take into account the costs associated with innovation attempts which did not lead to successfully marketable products. Some of these failures have been taken into account in the R&D expenditures incurred by the successful innovator since these expenses are based on the actual experience of innovating companies whose R&D efforts are presumably not totally successful. However, the many instances of innovation attempts by companies and individuals which do not attain success are not included.

Thus, if it is determined that a program to stimulate domestic innovation should be undertaken, the program design should bear in mind:

- the five criteria for an innovative effort focussed on maximizing benefits to Canada
- the fact (not considered in this study) that the benefits thus derived will be offset to some extent by the cost of unsuccessful efforts and the cost of the program itself
- the need for further study to determine the products and processes most likely to satisfy the five criteria.

APPENDIX A

RELATIVE VALUES OF INPUT FACTORS

RELATIVE VALUES OF INPUT FACTORS

A number of inputs to the economic benefits model were felt to be potentially affected by the way in which the new technology is acquired. These inputs are:

- market size, domestic and foreign
- return on capital before R&D and taxes
- expenditure for R&D (or equivalent such as royalties)
- capital per sales dollar including
  - source
  - debt to equity ratio
- employment by type per sales dollar including structure of the management group and associated salaries
- total purchases of materials and supplies including the per cent obtained from Canadian sources.

The way in which these inputs might be expected to vary among the five methods of acquiring the technology is discussed in this Appendix.

Market Size

The question of market size is key to all aspects of potential benefits from an innovation. By simply varying this one parameter among the alternative methods of obtaining new technology, one can influence total returns to capital, employment, purchases of Canadian supplies, and returns to government.

The market for a new technology must be measured in terms of products sold. A process innovation has a market only in terms of the

products which it creates (unless the process innovation is in itself a saleable product, such as a machine, which the innovator sells to other manufacturers. This case, however, is considered to be a product innovation for purposes of this study).

Thus, market measures must refer to sales of products, either innovative themselves or produced by an innovative process.

It should be noted that, in the case of a process innovation, the importing (wholesaling) alternative is not relevant since it refers to the importation of a physical commodity. The importer of a process is a licensee of process technology.

Generally speaking, the potential market for a new technology is the same irrespective of the means by which the innovation is obtained.

The share of market actually captured under each alternative, however, is a function of the assumptions with regard to the company's operating consitions. The relevant operating conditions will vary depending on whether one is concerned with the domestic market or the foreign market for the product.

1) Domestic Market

There are two main conditions affecting the share of domestic market captured under each alternative: the price of the product (influenced by production efficiency) and the effectiveness of the distribution and marketing system. Assuming that these are equal among

the alternatives, the share of domestic market captured by each is likely to be the same.

In terms of price, however, (and hence position on the demand curve), the Canadian innovator may be at a disadvantage relative to the other alternatives. Relative to the licensee, his disadvantage may arise from the heavier R&D costs he carries (assuming he passes these on in terms of higher prices) and from the fact that the licensee may have the benefit of the production experience gained by the company which developed the technology. The innovator has these same disadvantages relative to the foreign subsidiary. In addition, the subsidiary and the innovating subsidiary may be able to obtain cost advantages through parental economies of scale in terms of buying power, administrative functions, R&D, etc. Parental linkages could also work against the subsidiaries, however, if the parent company is "fat" in terms of personnel or if much time and money must be spent in communications with the parent.

Relative to the importer, the innovator may or may not have a price disadvantage depending on the level of tariffs and on the extent of the mark-up imposed by the manufacturer. The cost of originally producing the product will undoubtedly be lower in the importing case since the manufacturer is supplying markets other than Canada. The cost to the importer, however, will depend on both tariffs and manufacturer's mark-up.

Thus, the innovator may as a result of price be at a disadvantage in terms of the domestic market share captured. This price

disadvantage may be partially offset by non-price influences such as perceived advantages of "buying Canadian" (e.g. good service, accessibility of parts, etc.). In addition, the innovator may be able to amortize some of his costs by moving into foreign markets. This is discussed under foreign market shares.

In terms of the effectiveness of the domestic distribution and marketing system, the Canadian innovator may also be at a disadvantage, at least relative to the importing and foreign subsidy alternatives.

The importer, by nature, may be distributing other products and hence may have the advantage of a ready-made distribution system. By the same token, the subsidiary and innovating subsidiary could have distribution and marketing advantages relative to the other alternatives as a result of spill-over advertising by the foreign parent, market recognition of the parent's brand name, assistance by the parent in establishing the distribution system, etc. These advantages on the part of the importer and the subsidiaries are, however, likely to lessen in importance as the innovation reaches a mature stage in the life cycle at which time the innovator has acquired the experience and capital to effectively distribute and market the products of the new technology.

The licensee is unlikely to have either advantages or disadvantages in distribution relative to the Canadian innovator. Circumstances could arise, however, where the licensee produces products other than the innovation in question and thus has some market advantages in terms of distribution.

In summary, it is reasonable to assume that the domestic sales may be equal under each of the five alternative methods of acquiring the technology given equal effectiveness in pricing and distribution. However, under certain circumstances, it is possible that the importing, subsidiary, innovating subsidiary and licensing alternatives could capture a higher share of the domestic market than the innovator alternative. Thus it would also be acceptable to vary the Canadian innovator's domestic market share downwards relative to the other alternatives.

To assume such a disadvantage on the part of the innovator however, implies one or more of the following conditions; that all alternatives capture the same foreign market share; that the innovator is still at a fairly early stage in development; that the product has a fairly elastic demand curve; and that marketing, distribution and brand recognition are important to commercial success.

2) Foreign Market

The relative share of the foreign market for the innovation captured under the five alternatives is influenced more by legal or suasive restrictions than by pricing or the effectiveness of the distribution system. If there were no restraints on access to foreign markets, the relevant conditions and effects would be similar to those discussed under domestic markets. In actual fact, however, it is more likely that the share of foreign market will be governed by conditions beyond the control of the company providing the new technology.

The importer, for example, is unlikely to serve markets outside Canada. The manufacturer who produces the product will have his own channels of distribution into other markets either in the form of subsidiaries or other importers and might react negatively to the Canadian distributor's re-exporting the products. Furthermore, the importer, after paying the freight into Canada is unlikely to be price competitive with distributors in other countries.

The subsidiary is likely to be in a similar position in terms of serving markets outside Canada but in this case the parent may explicitly limit him to serving the Canadian market. Again, the parent is likely to have its own channels of distribution to foreign markets and, if the subsidiary is not restrained by parent directives, it may still find itself unable to compete with the parent in these markets.

The innovating subsidiary may possibly suffer the same restrictions. However, in this case it is more likely that the subsidiary would be allowed to serve foreign markets through Canadian production since the experience in dealing with the technology is located here.

The licensee is also likely to be restricted to domestic markets by the terms of the licensing agreement. Generally these agreements allow the licensee to use the technology or produce the product for sale in specified markets. The licensor himself can serve the markets outside Canada either through exporting, subsidiaries or other licensees and thus earn for himself the revenues available from these markets.

The Canadian innovator, however, is not subject to the above restrictions. He may fail to capture a share of the foreign market because of either pricing or distribution problems, but he is more likely to be able to export the new technology than are the other alternative types of companies with the possible exception of the innovating subsidiary. This is partly due to the absence of legal and suasive restrictions, but it could also well result from the potential advantage of being the first to offer a superior or cheaper product in the world market.

Thus, it would be reasonable to assume either that none of the alternatives capture a share of the foreign market or that the innovator and innovating subsidiary capture some variable share while the other three alternatives capture none.

Return on Capital
Before R&D and Taxes

The rate of return on invested capital (i.e. equity plus long term debt) before taking into account taxes and discretionary expenditures on R&D can be affected by the selling price of the product and/or by the costs associated with providing it (including amount of capital, labour, etc.).

Assuming that the selling price of the product is the same among the four manufacturing alternatives (innovator, innovating subsidiary, licensee, and subsidiary), that their capitalization structures are similar, and that none benefit from economies of scale associated with higher market volumes, it would be reasonable to expect each of the

four to achieve the same rate of return on invested capital before R&D expense.

On the other hand, it is conceivable that the subsidiary or licensee or both could benefit from the knowledge and experience of the original developer of the technology (parent or licensor) to produce the product more efficiently than the innovator or innovating subsidiary. Such savings may come from the more effective use of labour and capital, from savings on purchases of supplies, etc. Thus, given equal markets, it could also be reasonable to assume that the subsidiary or licensee can achieve higher returns before R&D expense than the two innovator alternatives.

If the assumption regarding equal markets is removed, economies of scale may affect the relative rates of return. Assuming the innovator or innovating subsidiary achieve higher sales volumes (through exports) than the licensee or subsidiary, they may through savings in unit costs be able to improve their rate of return on capital. Conversely, if they are not able to obtain as great a share of the market as the other two alternatives, their return on capital may suffer as a result of higher unit costs. Thus, such economies or diseconomies must be taken into account in determining rates of return under various market conditions.

The importer is in a somewhat different situation from the manufacturing alternatives and cannot effectively be related to them in terms of return on capital. As discussed in the following section, his capital requirements may be lower than the other companies. At the same time, since he must absorb the cost of the manufacturer's mark-up, his profit

per unit may be much lower. Perhaps most important, however, is the fact that he is unlikely to have to invest in specialized equipment in order to provide the new technology. Hence it might be argued that he bears less risk than the manufacturing alternatives and is therefore satisfied with a lower rate of return on invested capital.

Expenditure for
Research and Development

The expenditure for research and development as a proportion of sales will depend primarily on the means by which the new technology is acquired.

The importer, for example, is virtually certain not to undertake any R&D activity in Canada. The cost of developing new technology will be included in the price which he pays to the manufacturer for the product. Thus, his return on capital will not be reduced by any expenditure on R&D.

The subsidiary which manufactures products developed by its parent may carry out some research and development work in Canada, but is likely to rely most heavily on the parent's research facilities and the associated effectiveness advantages of a single centralized research department. The licensee, whose policy has been to purchase technology from outside, is also likely to have limited R&D facilities. He may be in a position whereby any new technology that he develops as a result of the license reverts in part to the licensor.

In addition, in carrying out further development work on the licensed technology, he is perhaps two or three years behind the licensor and his research may therefore yield little in terms of profitable developments. Consequently, the R&D costs of these two alternatives are likely to consist only of a royalty or licence fee based on sales volume.

The Canadian innovator, and innovating subsidiary, however, assuming they have a policy of continuing innovation, are likely to spend a substantial portion of their revenue on research and development. Consequently, it would be acceptable to assume that the Canadian innovator and innovating subsidiary have the greatest expenditure on R&D.

Capitalization

The capitalization of the company through which the new technology is being acquired has three facets: the total amount of capital required, the debt to equity ratio or leverage, and the nationality of those providing the capital (which determines where the returns on capital will flow).

1) Capital Requirements

The volume of capital required by a firm (i.e. equity and long term debt) is related to the amount of fixed plant which it must maintain and to its cash flow or liquidity requirements. Among firms in the same line of business, differences can generally be attributed to the amount of activity which takes place. Thus, the total capital requirements under each of the five alternatives will vary in part in relation to the sales volume.

Aspects other than sales volumes, however, also play a part in determining the capital requirements of the firm. The importer, for example, because he is not engaged in production activities, requires considerably less in the way of machinery and plant than do the other three alternatives. He is likely, however, to need more extensive warehousing facilities and to finance very heavy inventories. This will to some degree offset his savings in terms of plant and equipment, but the importing alternative is still likely to require considerably less capital than the subsidiary, licensing, innovating subsidiary and innovating alternatives.

The remaining four alternatives could be approximately equal in terms of capital requirements. However, differences might occur as a result of different levels of R&D activity or different levels of efficiency in the use of capital. If the innovators have extensive laboratory facilities in addition to their production facilities, they may require a greater amount of capital to finance them. They are unlikely, however, to require less capital than either the subsidiary or licensee. Thus, it would be acceptable to vary the innovators' capital above but not below the requirements of the subsidiary and licensee for the same sales and efficiency levels.

Two possible sources of greater efficiency in the use of capital are economies of scale which might arise from market size advantages, and more rapid advancement along the learning curve which might arise from having access to others' experience. Either of these could influence the capital requirements per sales dollar of the manufacturing alternatives.

The economies of scale may play a part when the innovators have a sales advantage or disadvantage over the other alternatives. The underlying circumstances were discussed in an earlier section. Such advantages or disadvantages could give the innovators a corresponding advantage or disadvantage in capital needs per sales dollar.

Efficiency improvements based on knowledge levels at a given point in time rather than sales are most likely to accrue to the subsidiary or licensee. These two are in a position to benefit from the experience of an associate who has already produced the new technology over a period of time. The knowledge and experience obtained from these sources may give the subsidiary or licensee an advantage over the innovators in terms of capital requirements.

2) Debt: Equity Ratio

The debt equity ratio of a company is determined, in the long run, by the relative costs of financing in the debt and equity markets as well as by corporate and institutional policies. Assuming that all five alternatives bear the same degree of risk discounted potential return in the eys of investors (private and institutional) it could be assumed that all atlernatives would have similar debt to equity ratios.

It is possible that any one of the alternatives might be perceived differently by debt investors as opposed to equity investors. In this case, the debt to equity ratio would swing in favour of the type of investor with the more favourable perception of the firm's prospects. The most likely situation in which this would occur would

be in the case of the foreign owned subsidiary, either innovating or non-innovating, where the parent (i.e. equity holder) perceives a fairly high degree of risk in the venture relative to investment alternatives, but the financial institutions (i.e. debt investors) perceive a lower degree of risk in view of the parent's financial resources. In this case, one would expect that the ratio of debt to equity would be higher in the subsidiary alternatives.

3) Source of Capital

It is most likely that all five alternatives will obtain their debt capital from local (i.e. Canadian) financing sources. The possible exceptions again, are the foreign subsidiaries which may obtain some of their debt capital through institutions associated with the parent.

Equity financing is similarly likely to come from Canada in the case of the importer, licensee and innovator. Equity capital for the subsidiaries, however, by definition comes from foreign sources since the subsidiaries for purposes of this study are assumed to be wholly owned by the parent.

Employment

The impact on employment of acquiring new technology under each of the five alternatives can be looked at from three different levels: production employees, research scientists and technicians, and management and administrative employees.

Employment of Canadian production workers will, by definition be zero in the importing case, and in the other four cases will vary

with sales volume, the extent of value-added within the firm and the efficiency in use of production labour. Given equal efficiencies, production employment may be calculated directly under each manufacturing alternative based on the scenario assumptions as to market and value-added. The absence of "production" workers in the importing case will be offset to some degree by employment of handling and shipping personnel, but their skills and associated salaries are likely to be lower than the production employees.

As in the case of capital, production employees per sales dollar may be affected by efficiencies arising from economies of scale or position on the learning curve. The arguments with respect to the relative levels of this parameter among the various manufacturing alternatives were advanced in the "capital requirements" section.

Employment of research scientists and technicians is determined by the extent of R&D activity carried out in the Canadian firm, which in turn depends on the method by which the technology is acquired. The importer will employ no R&D workers. The subsidiary and licensee will similarly employ none if it is assumed that all their R&D expenditure is in the form of royalties. The Canadian innovator and innovating subsidiary alternatives will undoubtedly employ some scientists and technicians, the number varying with the expenditure on R&D.

As with production employment, the requirements for Canadian management and administrative personnel will vary among alternatives

to some degree depending on the extent of Canadian value-added and the sales volume. In addition, however, other factors may influence the level of employment in this category. These conditions include the amount of effort required to administer the firm's functions and the degree of independence which the firm has in establishing its management and administrative group.

The importer is likely to employ the fewest management and administrative personnel since it does not need to administer either production or research functions. The additional effort involved in handling the importing function is unlikely to be comparable with that associated with the other functions.

The innovator and licensee are likely to differ only in terms of the amount of effort required to manage the research function. In the first case this will involve overseeing the research department, while in the second it will involve negotiating and administratering licenses. Thus, there is likely to be little difference between the two alternatives.

Assuming the subsidiary is administratively independent from its parent, it too will differ from the innovator only in terms of the effort involved in administering the research and development function. If, however, it must maintain extensive communications and interaction with the parent, the subsidiary may require additional personnel at the

management level. On the other hand, many of the subsidiary's functions may be actually carried out by the parent, resulting in a lower level of management per sales dollar. In addition, the managers of Canadian subsidiaries often come from the parent organization, thus reducing the employment of Canadian management people. The innovating subsidiary is likely to have the same management complement as the Canadian innovator.

The average level of management salaries will also vary depending on the extent of management functions carried out in the Canadian firm. In the case of the subsidiary, for example, which obtains management services from the foreign parent, the management personnel employed in Canada are likely to be at the lower levels of the management hierarchy. They are therefore likely to earn a lower average salary than would be the case were the full spectrum of management activities carried out within the Canadian operation.

The reverse situation is also likely to arise in the case where the Canadian operation itself has foreign subsidiaries to which it provides management assistance. Here the management level per Canadian sales dollar will be weighted more heavily towards the higher salaried personnel with a resultant increase in average management salaries.

Purchases of
Canadian Supplies

The purchases of materials and supplies from Canadian companies as a portion of total sales under four of the alternatives is a function

of two main conditions: the availability of competitive Canadian suppliers and the degree of value-added by the company. The importer is not included in this analysis since he does not produce any products and thus uses Canadian supplies only in terms of such overhead items as utilities, office supplies, etc.

If the Canadian suppliers have a strong advantage relative to foreign suppliers (as in the case, perhaps, of some raw materials) then it might be expected that all alternatives would use these suppliers to the same degree. Conversely, if the Canadian suppliers are non-existent or very weak relative to foreign suppliers (as perhaps in the case of computer semi-conductors), presumably all alternatives would turn to foreign sources of supply.

In the median case, however, where the Canadian suppliers have neither a strong advantage or disadvantage over foreign suppliers, the purchasing patterns are more likely to vary among the four alternatives. The foreign subsidiary may find it more advantageous, or even mandatory, to make use of the same sources of supply as its parent. The cost advantages to be gained from associating with possible quantity discount arrangements between the parent and the supplier, the fact that the parent's supplier has experience in meeting the company's requirements, and the possibility of centralized purchasing by the parent organization would influence the Canadian subsidiary toward using the parent company supplier. Since this supplier is presumably also foreign, the subsidiary's purchases of Canadian materials and supplies will be reduced.

The licensee may also be inclined to use the foreign supplier. The licensor, who develops the technology, has presumably developed sources of supply in his own country and the licensee might find it more profitable to make use of this supplier's experience and economies of scale.

The Canadian innovator and foreign subsidiary innovator do not necessarily have the advantage of a supplier already experienced in producing their materials and components. They are therefore more likely than the subsidiary or licensee to turn to Canadian sources of supply. They can aid them in developing the products necessary to meet their requirements and at the same time avoid the freight and tariff charges associated with importing materials and supplies.

Thus, under conditions of equal value-added, it is reasonable to assume either that the subsidiary, licensee, innovating subsidiary and innovator use Canadian suppliers to the same degree, or that the innovator and innovating subsidiary use Canadian suppliers to a greater degree than either of the other alternatives. It is highly unlikely, however, that the innovator or innovating subsidiary would fall below the licensee or subsidiary in terms of use of Canadian supplies.

Assuming that the degree of value-added does in fact vary among the four alternatives, a situation arises whereby the type of supplies being purchased may differ in each instance. For example, if one company's value-added is low relative to the other two alternatives, that company is presumably purchasing more in the way of sub-assemblies rather

than components and raw materials. If these sub-assemblies are not available in Canada, he will purchase them from foreign suppliers. The other alternatives, however, with a higher value-added, are likely purchasing materials and components and these may be more economically available from a Canadian supplier. Under these circumstances, purchases of Canadian supplies relative to sales may be lower in the alternative with lower value added.

APPENDIX B

SAMPLE CALCULATION OF NET ECONOMIC BENEFITS OF INNOVATION

APPENDIX B

SAMPLE CALCULATION OF NET ECONOMIC BENEFITS OF INNOVATION

Case - Subsidiary buys fewer Canadian supplies vs. Innovation Basic Case (scenario 16 vs. scenario 1).

Input Assumptions - Innovation Basic Case - as shown in Exhibit 2 of the report.

Subsidiary Case - Subsidiary Basic Case with modifications described for scenario 16, p. IV-8 of the report.

Procedure

The calculation of the net benefits of a particular scenario of Canadian innovation (in this instance the so-called "basic" case) relative to the scenario of some other means of acquiring the new technology (in this instance through a wholly owned subsidiary which buys 50% of its supplies including all high technology supplies from abroad) consists of three steps:

1. Calculating the gross economic impact (i.e. impact on GNP) of each scenario under the conditions postulated for that scenario.

2. Calculating the differences between the gross impacts of the two scenarios including both those that arise directly from operations and those that are inferred by the differences in pruchases of Canadian supplies.

3. Calculating the opportunity costs associated with any additional factors of production which are utilized under one scenario but not the other and calculating the economic impact net of these opportunity costs.

The application of this procedure is illustrated in the attached exhibits.

Exhibits B-1 and B-2

These exhibits are largely self-explanatory and show the way in which the input assumptions for each scenario are used to calculate gross economic impact.

Exhibit B-3

This exhibit, which shows the difference in gross economic impact, is derived chiefly by deducting the values shown in Exhibit B-1 from those shown in Exibit B-2.

Two points may require clarification:

1. Although the subsidiary (B-2) had the same equity and higher after-tax returns to equity than the innovator (B-1), the Canadian portion of the subsidiary's equity is zero and hence the profits do not represent a return to Canadian capital.

2. Since the subsidiary was assumed to purchase from abroad those high-technology supplies which in the basic case were assumed to come from Canadian suppliers, the incremental supplier impact of the innovator was assumed to be in proportion to the impact that an innovating Canadian supplier would have on the economy (G.N.P.). The supplier's impacts per sales dollar are, in this case, identical to the basic case innovator's impact per sales dollar, with the exception of Federal Sales Tax. Since this was applied to the innovator's sales, it was not applied to the suppliers.

Exhibit B-4

This exhibit shows the calculation of net benefit by deducting opportunity costs associated with the additional resources used in one case over the other. Opportunity cost assumptions are explained on pp. IV-9 through IV-14 of the report.

EXHIBIT B-1
GROSS IMPACT

Scenario Description - Basic Case - Innovator (Scenario 1)

Type of Company		Innovator		
Sale:	domestic	$ 50 million		
	foreign	$		$ 50.0 M
Capitalization:	equity	(.36 x sales)	$ 18.0 M	
	debt	(.15 x sales)	$ 7.5 M	25.5 M
R & D Expenditures		(.075 x sales)		$ 3.75 M
Before tax profits		(.35 x total capital)	$ 8.925 M	
		minus R & D expenditures	$ 3.75 M	$ 5.175 M
Employees:	production	25 x sales / 1,000,000	1250	
	management	1 x sales / 1,000,000	50	
	administration	9 x sales / 1,000,000	450	
	R & D	R&D expenditure / 25,000	150	1900

continued .....

Exhibit B-1

Return to Capital

Equity	before tax profits	$ 5.175 M
	less taxes @ 50%	$ 2.587 M
	after tax profit	$ 2.588 M
Debt	9% x debt capital	.675 M

Returns to labour

Production employees x $8,000	$ 10.0 M	
Management employees x $20,000	$ 1.0 M	
Administrative employees x $8,000	$ 3.6 M	
R & D employees x $13,000	$ 1.95 M	
Total		$ 16.55 M

Purchases of Supplies

Total Purchases	.45 x sales	$ 22.5 M
Canadian Purchases	75% x purchases	$ 16.875 M
Foreign Purchases	25% x purchases	$ 5.625 M

continued .....

Exhibit B-1

Returns to Government

Personal Income Tax:	Production Salaries x 14.5%	1.45 M	
	Management Salaries x 21.5%	.215 M	
	Administrative Salaries x 14.5%	.522 M	
	R & D Salaries x 17.5%	.341 M	
			$ 2.528 M
Corporate Income Tax (from page 2)			$ 2.587 M
Federal Sales Tax - 12% x domestic sales			$ 6.0 M
Duty	15% x foreign purchases		$ .844 M
Business & Property Taxes 8% x capital			$ .204 M
Total Returns to Government			$ 12.163 M

Returns to Welfare Funds

CPP	production employees	x	$88.20 - Employee	
	management employees	x	$88.20 - Company	
	administrative employees	x		
	R & D employees	x		.168 M - Employee
				$ .168 M - Company
UIC	production employees	x	$70.20 - Employee	
	management employees	x	$98.28 - Company	
	administrative employees	x		
	R & D employees	x		.133 M - Employee
				$ .187 M - Company
WCB	production salaries	x 1.1%		$ .110 M - Company

EXHIBIT B-2
GROSS IMPACT

Scenario Description - Subsidiary buys fewer suppliers in Canada (Senario 16)

Type of Company		Subsidiary		
Sale:	domestic	$ 50.0 M		
	foreign	$		$ 50.0 M
Capitalization:	equity	(.36 x sales)	$ 18.0 M	
	debt	(.15 x sales)	$ 7.5 M	25.5 M
R & D Expenditures (Royalties)		(.03 x sales)		$ 1.5 M
Before tax Profits		(35% x total capital)	$ 8.925 M	
		minus R & D expenditures	$ 1.5 M	$ 7.425 M
Employees:	production	$\frac{25 \text{ x sales}}{1{,}000{,}000}$	1250	
	management	$\frac{1 \text{ x sales}}{1{,}000{,}000}$	50	
	administration	$\frac{9 \text{ x sales}}{1{,}000{,}000}$	450	
	R & D	$\frac{\text{R\&D expenditure}}{25{,}000}$	0*	1750

* R&D employment is generated by expenditure on in-house R&D activity but not by expenditure on royalties.

Continued .....

Exhibit B-2

Return to Capital

Equity	before tax profits	$ 7.425 M
	less taxes @ 50%	$ 3.712 M
	after tax profit	$ 3.713 M
Debt	9 % x debt capital	.675

Returns to Labour

Production employees x $8,000	$ 10.0 M	
Management employees x $20,000	$ 1.0 M	
Administrative employees x $8,000	$ 3.6 M	
R & D employees x $13,000	$ 0	
Total		$ 14.6 M

Purchases of Supplies

Total Purchases	45%	x sales	$ 22.5 M
Canadian Purchases	50%	x purchases	$ 11.25 M
Foreign Purchases	50%	x purchases	$ 11.25 M

continued .....

Exhibit B-2

Returns to Government

Personal Income Tax:	Production Salaries	x 14.5%	1.45 M	
	Management Salaries	x 21.5%	.215 M	
	Administrative Salaries	x 14.5%	.522 M	
	R & D Salaries	x 17.5%	0	
				$ 2.187 M
Corporate Income Tax (from page 2)				$ 3.712 M
Federal Sales Tax 12% x domestic sales				$ 6.0 M
Duty 15% x foreign purchases				$ 1.688 M
Business & Property Taxes				$ .204 M
Total Returns to Government				$ 13.791 M

Returns to Welfare Funds

CPP	production employees	x)		
	management employees	x)		
	administrative employees	x)	$88.20 - Employee	
	R & D employees	x)	$88.20 - Company	
				.154 M Employee
				$ .154 M Company
UIC	production employees	x)		
	management employees	x)	$70.20 - Employee	
	administrative employees	x)	$98.28 - Company	
	R & D employees	x)		
				.123 M Employee
				$ .172 M Company
WCB	production salaries	x 1.1%		$ .110 M Company

EXHIBIT B-3

GROSS DIFFERENTIAL IMPACTS

Subsidiary buys fewer Canadian Supplies vs. Innovator Basic Case

(Millions of Dollars)

Returns to Capital	
Use of Canadian Equity	$ (18.0)
After tax return to Canadian equity	$ (2.588)
Uses of Canadian Debt	Ø
Return to Canadian Debt	Ø
Returns to Labour	
No. of employees	(150)
Employee salaries after tax and deductions	(1.585)
Returns to Government	
Corporate Income Tax	$ 1.125
Personal Income Tax	(.341)
Federal Sales Tax	Ø
Duty	.844
Business and Property Tax	Ø
Returns to Welfare Funds	
Company and Employee Contributions	$ (.053)
Returns Through Canadian Suppliers	
(Marginal purchases x gross impact per sales dollar for innovating type of company)	
Purchases from Canadian Suppliers	$ (5.625)
Use of Canadian equity @ .36/sales $	$ (2.025)
After tax return to Canadian equity @ .0518/sales $	$ (.291)
Use of Canadian debt @ .0068/sales $	$ (.844)
After tax return to Canadian debt @ .0068/sales $	$ (.038)
Number of employees @ 38/sales $	$ (214)
Employee salaries after tax and deductions @ .2744/sales $	$ (1.544)

continued .....

Exhibit B-3

Corporate income tax - by supplier @ .0518/sales $	$	(.291)
- by debt holder @ .0068/sales $	$	(.038)
Personal income tax @ .0506/sales $	$	(.284)
Duty @ .0169/sales $	$	(.095)
Returns to Welfare @ .0153/sales $	$	(.086)

EXHIBIT B-4

NET BENEFIT CALCULATIONS

Subsidiary buys fewer Canadian Supplies vs. Innovator Basic Case

(Millions of Dollars)

Direct		
Returns to Canadian Capital		
After tax return to Canadian Capital	$ (2.588)	
Less opportunity cost on $18 million @ 8.2% less 50% tax	.738	$ (1.850)
Returns to Labour - (150) Employees		
Assuming entire net salary at benefit (i.e. without OCL)		$ (1.585)
Assuming additional jobs at minimum wage (net salary $3652/man) (i.e. with OCL)		$ (.548)
Returns to Government		
Corporate income taxes paid	$ 1.125	
Less opportunity cost of taxes paid on Canadian capital - ($18 million) x 8.2% x 35% taxes	(.516)	$ 1.641
Personal Income Tax - without OLC		$ (.341)
with OCL - 150 men @ $395/men		$ (.059)
Duty	.844	
Less opportunity cost	Ø	$ .844
Returns to Welfare		
Without OCL		$ (.053)
With OCL - (150) men @ $285/man ($112 paid by employee, $173 paid by company)		$ (.043)

continued .....

Exhibit B-4

Through Suppliers

Returns to Canadian Capital		
After tax return to Canadian debt and equity	$ (.329)	
Less opportunity cost on $2.869 million @ 8.2% less 50% taxes	.118	$ (.211)
Net Returns to Labour - 214 people		
Benefit without opportunity cost of labour		$ (1.544)
Benefit with opportunity cost of labour @ $3652/man		$ (.782)
Returns to Government		
Cooperate Income Taxes paid	$ (.329)	
Less opportunity cost on $2.869 million @ 8.2% x 35% taxes	.082	$ (.247)
Personal Income Tax - without opportunity cost of labour		$ (.284)
- with opportunity cost of labour @ $395/man		$ (.084)
Duty (no opportunity cost)		$ (.095)
Returns to Welfare		
Without OCL		$ (.086)
With OCL @ $285/man		$ (.061)

Continued .....

SUMMARY OF NET BENEFITS

SUBSIDIARY BUYS FEWER CANADIAN SUPPLIES VS. INNOVATOR BASIC

	Direct		Through Suppliers	
	With OCL	Without OCL	With OCL	Without OCL
Returns to Canadian Capital	(1.850)	(1.850)	(.211)	(.211)
Returns to Canadian Labour	(.548)	(1.585)	(.782)	(1.544)
Returns to Government	2.426	2.144	(.427)	(.627)
Returns to Welfare	(.043)	(.053)	(.061)	(.086)