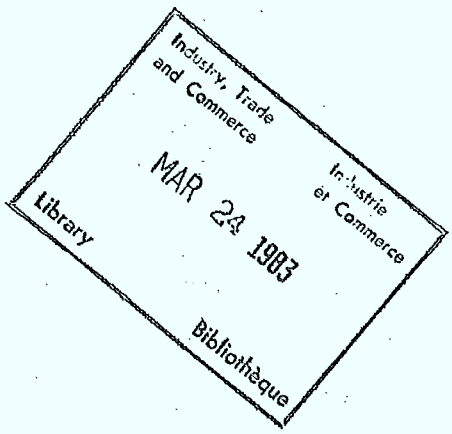
DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE

DEFENCE INDUSTRY PRODUCTIVITY PROGRAM (DIPP) EVALUATION STUDY

VOLUME 3

MINI CASE STUDIES; EXPERT OPINION; USER SURVEY; REGRESSION ANALYSIS; MARKETING

Peat, Marwick and Partners
Management Consultants



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JULY, 1980

DIPP EVALUATION STUDY

VOLUME 3

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ANNEX II TO THE DIPP EVALUATION STUDY:

MINI CASE STUDIES

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I - INTRODUCTION

Much of the work in the major case studies has attempted to answer two questions: whether projects funded by DIPP would have gone ahead had government assistance not been provided, and whether the DIPP assistance which was provided resulted in a net economic benefit to society. These two questions are fundamental in determining the effectiveness of DIPP, but they do not provide any insight as to why projects turned out as they did. In order to explain the results, a good deal of information was needed on the corporate context in which DIPP decisions are taken. To broaden the base of information provided by the major case studies, a series of mini-case studies was undertaken.

METHODOLOGY

Three studies were a random sample of DIPP development projects which were undertaken during the years 1970 to 1979. Overall, they accounted for approximately 5% of DIPP development projects started during this period and approximately 5% of the funds authorized. The R&D cases so selected also accounted for about 16% of the Non-major R&D case studies undertaken at this time. To ensure that a representative sample was selected, DIPP projects were classified into three groups as follows:

Size of DIPP R&D Project	No. of Projects Selected
Less than $100,000	7
$100,000 to $750,000	16
$750,000 to $5 million	8
over $5 million:	11 (reported in the Major Case Studies)

(In addition, 8 CA/SE projects were examined but in a different format).

SOURCES OF DATA

A variety of sources was used to obtain data on the companies and the projects. The two major sources were company interviews and questionnaires. Prior to undertaking the interviews, a study was conducted of the information available within the Department. The main sources of departmental data were files from the DIPP Program Office, Corporate Analysis Branch, and the Industry Sector Branches. This information was supplemented by interviews and discussions with ISB Officers. The subsequent corporate interviews were conducted on the basis of structured questionnaires to obtain data on each company and its projects. These questionnaires stressed both quantitative and non-quantitative factors in company decision making processes. The companies were also asked to complete our financial questionnaires which served as the data base for the quantitative analysis of economic benefits.

TOPICS INVESTIGATED

The main subject areas covered in the course of the interviews were:

- Corporate Decision-Making: the decisions of firms with respect to DIPP are not made in a vacuum but are affected by corporate objectives, policies, project evaluation procedures and the firms' view of its competition and its markets. Since these factors may have a bearing on the effectiveness of DIPP, companies were asked to provide information on them.

. Parent/Subsidiary Relations: the reaction of a Canadian subsidiary to DIPP may well be affected by its relations with its parent firm; the study was concerned, therefore, to explore the nature of this relationship.

. Program Rationale: in the past DIPP has been justified on the basis that it is equalizing the assistance provided to the defence industry in other countries and that it is contributing to Canadian defence objectives. The aim here was to determine the extent to which these rationales still have validity from the point of view of companies which have received DIPP funding.

. Risk: risk refers here to the possibility that the ROI (or some other performance norm) will not be met. This uncertainty about outcomes makes it an important factor in project decisions. Companies were asked for their views on risk and its relation to DIPP.

. Approach to R&D: companies were asked about a variety of topics concerning R&D, including planning, budgeting, R&D objectives, and the role of DIPP. The aim was to obtain a better understanding of the kinds of projects supported by DIPP and to determine whether the program actually increases the level of R&D spending.

. Company Views on DIPP: the aim was to obtain views on how DIPP recipients view the program - its positive features and ways in which it could be improved.

As well, companies were asked for their views on a variety of other topics, most notably on the subject of marketing, discussed in Annex VI of this report. Taken together the interview notes provided a notable amount of information on a variety of corporate activities related to DIPP. The following sections review in detail the main findings on the major topics covered in the interviews.

II - CORPORATE DECISION MAKING

One of the aims of the corporate interviews was to gain a better idea of the context in which investment decisions are taken. To this end, companies were asked to provide information about how they analyze investment projects and the criteria they use to rank investments. This information was collected on the assumption that corporate decision-making processes may have a bearing on the effectiveness of DIPP. Moreover, if the DIPP criteria better reflected how corporations make decisions, then the performance of the program could be improved.

INVESTMENT ANALYSIS

Economic theory suggests that the proper way for firms to assess investment projects (including R&D) is to perform a discounted cash flow analysis, taking inflation and risk explicitly into account. This type of analysis involves the estimation of the outlays for the investment and the future stream of incremental revenues and costs. It also involves the estimation of the firm's cost of capital, the inflation rate over the life of the project, and quantification of the major risk factors. If, after all factors are taken into

account, the expected net present value of the project is greater than zero, then the project is accepted. If not, the project is rejected. This is the theory. How do firms actually behave?

Most of the firms interviewed indicated that they perform some sort of quantitative analysis of investment projects, but not in the detail described above. Only one company - Garrett Manufacturing Limited - has a fully elaborated technique of investment analysis which examines the effect of the various risk factors (price, volume, etc.) on the range of outcomes. Other companies having sophisticated techniques included Aviation Electric and Litton. A still larger number of companies interviewed also make use of quantitative techniques but use a payback criterion rather than a discounted cash flow criterion (i.e., net present value or internal rate of return) for rating projects. This latter group of companies includes Varian, Collins, Erie and Space Research Corporation (SRCQ).

There was a significant group of companies which indicated that they do not perform quantitative analyses of investment proposals. This group includes such companies as Computing Devices, Leigh Instruments, C.R. Snelgrove and Optotek. One common characteristic of these companies is that they do a good deal of engineering work on a cost recovery basis*, thus not requiring a discounted cash flow analysis.

* That is to say they only undertake projects which are financed by the customer.

The companies having the most elaborate techniques for planning and project evaluation tend to be subsidiaries of American firms. There may be economies of scale in the development and use of advanced planning techniques. Since the parent firms are large and better established, they are more likely to have developed these techniques than the Canadian firms which are generally newer and smaller (on a total corporate basis). The transfer of management techniques from the parent to subsidiaries may give these subsidiaries a decided advantage over competitive Canadian-owned firms.

This advantage is important not only acquiring management techniques, but even more so in obtaining the marketing information and intelligence. The relative cost of acquiring information on market opportunities is a good deal less for subsidiaries of large multinationals than for Canadian firms. These economies of scale in the obtaining of market intelligence can also work to the advantage of large firms. The use of sophisticated techniques of market estimation is of no avail in military markets because of their extreme volatility. Market intelligence is of more use in these markets than the results of a methodological exercise, no matter how advanced.

CRITERIA OF SUCCESS

While economic theory suggests that the ultimate basis for the selection of a project is its internal rate of return or net present value, it is clear that ROI as normally assessed is not the only objective. While most of the companies interviewed did identify ROI as an important criterion - the "bottom line" - all indicated that they pursue other objectives as well. It is the pursuit of these other objectives which circumscribes the number of

alternative projects. The ROI is basically the means of systematically ranking these alternatives.

The evaluation criteria other than ROI fall into two groups: strategic factors and constraining factors. The former represent the different objectives of the firm such as product diversification, market share, and particularly growth. It is the market objectives in particular which define new investment projects.

These strategic objectives provide the firm with a good indication of what its priorities should be and define the type of activity to be undertaken to achieve their aims. The majority of firms said that, of the strategic objectives, growth is the most important, followed by product diversification and market share. Many firms pursue more than one of these objectives and try and maintain a balance between them. It was also pointed out that all the strategic objectives are intimately related to the "bottom-line" objective of maximizing ROI.

Strategic objectives are long-term in nature. A firm can increase its growth or market share in the short-term, but only at the expense of its short-term profitability. That is, a firm can maximize either market share or ROI in the short-term, but not both. Thus, a firm's ROI objectives are a constraint on the pursuit of its strategic objectives. If a project is desirable on the basis of diversification, growth, or market share, it may nevertheless be rejected because it is unlikely to be profitable.

The constraining factors represent restrictions on the firm's freedom of action, such as lack of fit with existing capabilities, lack of trained manpower or a lack of experience or credibility in the market. Generally and not surprisingly, firms will tend to go into new fields where they have some knowledge, and they avoid areas where they have little experience. The constraining factors are not evaluation criteria per se, but represent boundaries on what companies can profitably undertake. In other words, they channel the firm's efforts into areas where they are likely to have the greatest probability of success. Most of the firms interviewed indicated that the constraining factors play an important role in their decision-making.

EFFECT OF GRANTS ON PRICES

It might be expected that the effect of a grant would be to lower the prices which a firm charged for those products which, for example, used a "50% free" item of machinery. We found, in contrast, that, for the CA firms, the 50% "cost" was absorbed into general overhead, and the benefits were spread over all of the firms' products.

III - PARENT/SUBSIDIARY RELATIONS

Of the twenty companies represented in the mini case R&D studies, thirteen were subsidiaries of foreign firms at the time they received their DIPP grants. Foreign ownership of Canadian industry raises a number of important questions with respect to DIPP, including the following:

- what is meant by "autonomy"?

- are Canadian subsidiaries sufficiently autonomous to be able to take advantage of new product opportunities with minimum interference from their parent corporations?

- would Canadian subsidiaries receive money from their parents if DIPP financing were not provided?

- can DIPP be used by the government as a means of obtaining more autonomy for Canadian affiliates?

- is there any relationship between the degree of autonomy of Canadian subsidiaries and the effectiveness of DIPP?

Perhaps the best place to start on this topic is to briefly review the basic techniques of formal control in the modern multi-divisional, multi-national corporation. What emerges is that the control of such corporations can fall anywhere between extreme centralization and a high degree of decentralization. Under the former, the subsidiary basically has no autonomy, and nearly all decisions are made by the parent. Under the latter, the subsidiary operates in a highly independent fashion with little or no reference to the parent. Generally, the bulk of Canadian subsidiaries fall somewhere between the two extremes. A derivative question, then is, "how is the control exerted?"

Assuming even a modicum of decentralization, the usual rule is that operating decisions are left to the subsidiary while strategic decisions are made by the parent, with inputs from the subsidiary. The main instrument of control, but not the only one, is the budget which the subsidiary is responsible for preparing (as operating and capital documents) periodically. These planning documents are prepared within the context of explicitly stated corporate objectives and strategies.

BUDGETARY CONTROL

Budgets prepared by the subsidiaries or divisions of the firm are submitted to corporate management for review and approval. Usually the criterion for acceptance of budgets is the profitability (as a percent of sales or assets) which must be within range of the norm for the corporation as a whole. If the budgets are unacceptable to corporate management they are sent back to the subsidiary for reworking.

Capital budgets are somewhat more complex. If the subsidiary wants to purchase capital equipment, it must justify this purchase on the basis of its expected future profitability. This involves the estimation of cash flows five or ten years into the future. Generally, the criterion for the evaluation of capital projects is the net present value, internal rate of return or the payback period, in some cases adjusted for risk.

Once the budget is approved the subsidiary has operational authority and responsibility for achieving the planned levels of sales and profits.

Performance is evaluated on the basis of results achieved. Thus, for multi-dimensional corporations operating in this fashion, subsidiaries have a good deal of operational autonomy: they are relatively free to act as it sees fit within the context of the budget.

Within the framework of corporate planning and budgeting procedures, the subsidiary can have various degrees of freedom. One dimension of this is the spending authority. Usually, subsidiaries are allowed to spend up to a certain amount without review by the parent. This spending authority varies with the size of the subsidiary and the type of expenditure. Typically, the spending authority for operating expenses is a good deal higher than for capital expenditures. If the spending authority of the subsidiary is very limited, it cannot operate in a truly autonomous fashion because of the need for continuous consultation with corporate headquarters.

Another dimension of control is the frequency of budgetary and performance reviews. The greater the frequency, the higher the degree of control exerted by the parent over its subsidiaries. A third dimension of control is the responsibility for preparation of the budgets. A subsidiary preparing its own budget is likely to have all the necessary resources to plan its activities and hence act autonomously. On the other, hand a subsidiary which has to operate within a constrained framework specified by the parent is not likely to have the ability to plan on its own and will not have a high degree of autonomy.

The key point to be stressed here is that no matter how decentralized the management of a firm, the subsidiaries are subject to external control and the parent makes the important strategic decisions. At the same time, the more decentralized the management the greater discretion the subsidiary has, and the more flexibility to pursue objectives which are responsive to Canada's needs.

PRODUCT MANDATES

So far the discussion of autonomy has centered on how budgets are used as a means of control. There is another aspect of autonomy which is equally important, and for Canada, probably more important namely whether or not the subsidiary has a product mandate. Historically, foreign firms established operations in Canada in order to jump over the tariff barriers. As a result they tended to manufacture the same product line in Canada as in the home country of the parent. Thus, the Canadian operations were "miniature replicas" of the parent with production geared primarily to the domestic market. As tariffs were reduced this mode of operation became less feasible as the Canadian market opened up to foreign competition. The idea of the product mandate was (and will continue to be) a particularly effective response to this new international trading environment.

A subsidiary has a product mandate if it has worldwide responsibility within the corporation for a product or product line. Essentially, the product mandate is a way for a multinational corporation to rationalize its production internationally with each subsidiary responsible for a specified product line. A multinational firm which makes use of the product mandate concept

ensures that subsidiaries in different countries do not compete with each other by manufacturing the same products.

A product mandate can be either narrow or broad. A narrow product mandate is one where the subsidiary has responsibility only for the manufacture of the product, but none for R&D, design, marketing or sales. In contrast, a broad product mandate is one where the subsidiary has complete responsibility in the corporation for product development, production, marketing and sales for a given product line. Another form of product mandate occurs where a subsidiary has product responsibility for a specific geographic area, in other words a geographically limited product mandate. Clearly, the broader the product mandate of the subsidiary the greater are the advantages for Canada in terms of highly skilled jobs, in terms of potential exports, and in terms of the autonomy of the subsidiary.

In the context of the Defence Industry Productivity Program, the product mandate concept is of enormous practical significance since the main criterion of the program presently is export sales in relation to the DIPP contribution. The higher the ratio of sales to the Crown contribution, the more desirable is the project. Under these circumstances a Canadian subsidiary of a foreign firm is at a distinct disadvantage if it does not have a product mandate (or if it has only a geographically limited product mandate) because its markets are limited and it may have to compete with sister divisions of the corporation. On the other hand a subsidiary with a relatively broad product mandate will have far better, and more credible market prospects. If this is the case, DIPP can be used as a means of obtaining product mandates for Canadian subsidiaries of foreign corporations. In other words, DIPP money

would not be given to foreign subsidiaries unless they were able to show reasonably good market prospects based on a broad product mandate.

RESULTS

Now let us turn back to the question of autonomy and parent/subsidiary relations. Of the thirteen Canadian subsidiaries interviewed, all claimed that they operate with a good deal of autonomy particularly in operational matters. Generally, it appears that to the extent that the parent corporations are involved in the affairs of their subsidiaries it is in the decision-making process, particularly in capital investment and financing decisions.

This reflects the importance of budget decisions in parent/subsidiary relations. Some firms also indicated that their parents are involved in decisions in R&D, market planning and sales. Only in certain instances is the parent involved in operational matters. One notable instance of this is Dowty Equipment whose parent shares the responsibility for sales. There are other cases where the subsidiary makes use of the sales and marketing facilities of the parent (eg. Garrett and Computing Devices), but in these cases the subsidiary maintains operational responsibility for these functions.

When the firms interviewed mentioned the form of control exerted by corporate headquarters they usually referred to their budget submissions. In all the cases the companies said that they have to submit operating and capital budgets to corporate or divisional management on a regular basis. As well some firms said that the parent reviewed all major projects (e.g., Garrett and Varian). Generally, the format of budget submissions is prescribed by

corporate management so that all divisions of the company can be evaluated on the same basis. Financial reports are also prepared according to specified formats laid down by the parent.

DIPP's Impact

In the context of corporate procedures for the review of capital expenditures and major projects, DIPP appears to have an important impact. As noted earlier the subsidiary must demonstrate to corporate management that proposed capital expenditures and major projects will be profitable on a discounted cash flow basis. DIPP plays three roles in this framework. First, a DIPP grant can substantially increase the profitability of a project, thus making acceptance by the parent far more likely than before. Alternatively, the DIPP grant reduces the risk of the project, making it more attractive to the parent. Second, with DIPP assistance the resources required for completion of the project will be smaller than would otherwise be the case, i.e., the liquidity of the subsidiary is improved. Thus, the subsidiary can attempt larger projects with DIPP assistance. Third, participation by the Canadian government may serve to "legitimize" the project in the eyes of the parent. Nearly all the companies interviewed cited one or more of these factors when questioned on the impact of DIPP. It appears that DIPP is a way of giving the subsidiary resources to undertake projects that would normally be turned down by the parent.

On the subject of product mandates nearly all the subsidiary firms interviewed claimed that they had one. However, only three of the companies - Garrett Computing Devices and RCA - actually appear to have broad product mandates as defined in the preceding section. Garrett has product mandates in the area of

aircraft temperature control systems and hybrid microcircuits. Computing Devices specializes in subsystems (e.g., ASW equipment, projected map display systems) while the aerospace division of Control Data (the parent corporation) makes 'black boxes'. There is a complementarity between the defence products of Computing Devices and those of Control Data. RCA Canada has a product mandate for photosensors which includes all aspects of the product from development through to sales. Other firms interviewed also have product mandates in depth. For example, Litton has a product mandate in commercial inertial guidance systems, but their mandate in other product areas is not as clearly defined. As well, Westinghouse, Aviation Electric, Irvin, DAF-Indal Dowty Equipment and Varian all appear to have product mandates in certain product areas. It is not entirely clear whether these abovementioned firms have product mandates which are broad-ranging or well-established as those of Garrett or Computing Devices.

Some of these companies, most notably Aviation Electric Limited, credited DIPP with their being able to obtain a product mandate from their parent. Apparently, DIPP assistance was withheld until Aviation Electric obtained the product mandate in fuel controls from its parent - the Bendix Corporation.*

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* At present, it is not clear whether Aviation Electric is making optimum use of this product mandate. The company is a sole source supplier of fuel controls for Pratt and Whitney of Canada, but does not have any other significant customers in this product area. In the past, another Bendix division manufactured fuel controls for jet engines larger than those at Pratt and Whitney.

Other companies said that they had used DIPP in order to broaden their product mandate. For example, Litton uses DIPP assistance to launch itself into new product areas. Garrett claims that without DIPP (and DIR) assistance they would not be manufacturing microcircuits. Similarly, RCA used DIPP assistance to get itself into photosensors. From this it appears that DIPP has been used by the Sector Branches to increase the autonomy of Canadian subsidiaries and to help them obtain product mandates.

This was confirmed in interviews with a number of ISB officers who said that in the past there has been a good deal of informal bargaining with DIPP applicants. The ISBs told firms that their DIPP applications would not receive the support of the Branch unless certain conditions were met, including among them, a product mandate from the parent. Further interviews with ISB officials would provide more information on the nature and extent of this bargaining and whether it still goes on. However, on the basis of the available evidence, it is clear that DIPP has been used as a lever to obtain a product mandate (and/or more autonomy) for Canadian subsidiaries. To the extent that DIPP has been used this way the effectiveness of the program may have been significantly enhanced.

One other aspect of parent/subsidiary relations deserves further mention. This concerns the issue of whether Canadian subsidiaries would receive financing from the parent if DIPP assistance were not available. While companies were not directly questioned on this matter, the evidence provided in the interviews strongly suggests that the parent corporations do not provide financial assistance to their Canadian subsidiaries. When asked how they would finance projects if DIPP funding were not available, none of the

companies mentioned the parent as a source of funds. If the project was undertaken companies said that they would finance it through internally generated funds or through bank loans. Generally, for Canadian subsidiaries of foreign firms the main sources of financing are retained earnings and bank loans. Very few of the Canadian subsidiaries interviewed had significant amounts of long-term debt or shares outstanding. Thus, there appears to be very little reason to believe that parent corporations are a significant source of financing for Canadian subsidiaries.

IV - APPROACH TO R&D

R&D PLANNING

On the subject of R&D planning the main impression gained from interviews is the wide diversity in planning techniques from one company to another. Even though detailed R&D planning techniques vary considerably, there appear to be two basic approaches - "top down" R&D planning and "bottom up" planning.

Under "top down" planning R&D the overall budget and research priorities are established centrally in the firm and then the details are then filled in by the units affected. This approach implies that the main R&D effort is focused on product areas where the company has to do work to maintain or increase its share of the market. In other words, market requirements dictate the R&D priorities. The overall budget is usually set as a percentage of sales.

Only a relatively small number of companies use the "top down" approach, including Computing Devices of Canada, Varian Associates, Aviation Electric

and Garrett Manufacturing Limited. While the practices of these companies vary in detail certain common features stand out:

- the overall budget is set as a percentage of sales;

- research priorities are established after reviewing market requirements in each product area; and

- individual projects are selected on the basis of the ROI or the payback period.

"Bottom-up" planning is the reverse of top down R&D planning. Instead of setting the overall R&D budget and priorities centrally, project proposals are generated by engineers, scientists and market personnel in the main product areas and then reviewed centrally by the management of the firm. Under this approach there are usually more projects proposed than the company can afford to undertake. Only a subset of projects can be selected, usually on the basis of ROI (and payback period) and perceived market requirements. The main limiting factors to R&D are cash flow and manpower. The latter becomes a factor if engineers or scientists are occupied on other priority areas or if suitably trained manpower to do the project are not available.

Companies using the "bottom-up" approach include Litton, Leigh Instruments and Spar Aerospace. As noted earlier, there is considerable variation between companies in the way in which the "bottom-up" approach is carried out. The common denominator between different companies using this approach is the way

in which new projects are generated. Otherwise there are differences in the methods of project selection, the constraining factors and the objectives of R&D.

OBJECTIVES OF R&D

The interviews suggest that companies have one of two objectives for R&D: maintaining the firm's share of the market or diversifying the firm's product mix. These can be referred to respectively as the "defensive" objective and the "offensive" objective. Defensive R&D implies that the firm is continuously updating its base technology in order to remain competitive. Offensive R&D implies the development of new or "breakthrough" technologies which give the firm a significant lead on its competitors. Companies can pursue both objectives to varying degrees, but usually one predominates. Only one company, Litton Systems Limited, said that it pursues an offensive objective. Most of the other companies interviewed either did not state their objectives or indicated that they perform R&D in order to maintain their share of the market.

The fact that the majority of the companies interviewed pursue defensive objectives may be a reflection of their relatively small size and limited influence in international defence markets. Perhaps these companies are simply not large enough to do anything but attempt to maintain their market share. The pursuit of a offensive R&D objective may require manpower and financial resources which are simply not available to relatively small companies, particularly if the firm is trying to maintain its markets against larger competitors. Thus it is possible that unless the size of the firm is above a certain threshold, it may not be able to undertake offensive R&D.

FUNDING OF R&D

Nearly all the companies interviewed indicated that they fund R&D out of cash flow. Generally, R&D is considered a general and administrative expense (i.e., overhead). Thus, a major constraint to increased R&D spending is cash flow. Many of the companies use a percentage of gross sales as a yardstick for the R&D budget, with figures ranging from 2% to 8%. However, Litton Systems said that it would resort to outside financing if internally generated funds were insufficient. In their view "if a project is promising, cash flow is not a problem". On the other hand some companies, most notably Leigh Instruments, suggested that banks are unwilling to fund R&D activities or technology intensive companies. Thus, a program such as DIPP represents for them the best alternative source of financing if internally generated funds are not sufficient to permit desired projects to be undertaken.

THE ROLE OF DIPP

The interviews with the companies strongly suggest that DIPP plays an important role in their R&D planning, the type of R&D they perform and in their corporate strategy. Let us consider each of these in turn.

(a) Effect on R&D Planning

According to one conceptual model of the incrementality of DIPP, it is assumed that a company originally evaluated R&D projects assuming no assistance from DIPP or other programs. If the project is profitable then the company can go ahead without DIPP assistance. If, on the

other hand, the project is unprofitable, or marginal, than the company seeks DIPP assistance. In other words companies use DIPP assistance to make marginal projects profitable. How accurate is this view?

"Not very" according to the interviews with companies which have used DIPP. The majority of companies said that projects are planned from the outset with DIPP assistance in mind. DIPP assistance is factored in at the time the project is conceived, particularly if the project is large. This may be a reflection of cash flow constraints which may limit the amount of non-funded R&D which the company can perform. Another possible explanation is the fact that there is no incrementality criterion in the present version of DIPP. Thus, companies simply assume DIPP assistance because it is available and the project is likely to be eligible on the basis of other program criteria.

(b) Type of R&D

The U.S. military classifies R&D expenditures into four major types as follows:

6.1 Basic Research

6.2 Applied Research

6.3 Product Development

6.4 Manufacturing Technology

While DIPP is normally considered as an "R&D program", the evidence strongly suggests that companies use the program for 6.3 and 6.4 type projects. DIPP is largely a product development program and only

rarely supports research oriented projects. That DIPP should be development oriented should not be surprising since the main criterion - the ratio of sales to the Crown contribution - is commercial. Thus, only projects with a high probability of significant sales are likely to be supported and speculative R&D projects without clearly defined market prospects will be rejected. The return on sales criterion biases the program support away from projects with a significant element of research and towards projects which are relatively close to the market.

As well, it should be noted that many of the companies interviewed may be too small to conduct significant research activities.* Since for most of the companies interviewed cash flow is the main constraint on R&D spending, it is only natural that the R&D done by them should be on projects which are likely to have a relatively immediate payoff. "Blue sky" R&D is not likely to be a high priority in small companies.

(c) Effect on Corporate Strategy

One interesting facet of DIPP that came out in the interviews was the impact of the program on corporate strategy. This was the case particularly for foreign owned firms. A number of companies (Litton, Westinghouse, Computing Devices, Garrett) indicated that they use DIPP to acquire or to enlarge their product mandates. DIPP provides these companies with the funds to do R&D in new product areas. For example,

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* However, some of the smaller firms interviewed are 'R&D houses' which perform research projects for customers on a cost-plus basis (e.g., Optotek, Mega-Systems Design).

Litton said that their main objective in using DIPP was to diversify themselves into new product areas. If DIPP is actually being used in this fashion, then the program may be playing an effective role in getting Canadian subsidiaries into new product areas that they would not be in otherwise.

(d) Effect on R&D Spending

All the companies interviewed were asked to assess the impact of DIPP grants on their internally funded R&D spending. Not surprisingly, the majority of firms said that DIPP caused them to increase their internally funded R&D expenditures. However, this response is confirmed by the results of the Howe-McFettridge study which showed that DIPP was the only program that caused firms to increase their R&D funding.

Some companies stated that DIPP had no impact (e.g., Space Research, Dowty, Shefford) or that it caused them to reduce their own R&D spending (e.g., C.R. Snelgrove). The companies responding in this manner all tended to operate in the "engineering mode", i.e., they performed custom engineering for their customers on a cost-plus basis.

R&D IN SUBSIDIARY FIRMS

Generally speaking, the direct involvement of parent companies in the R&D activities of their subsidiaries is minimal. Parent companies get involved mainly as a "transmission belt" for R&D information generated in other parts of the company. This transfer of data may give subsidiaries an advantage over smaller, Canadian owned companies which do not have access to "free" R&D.

The international transfer of technology can take place in two ways in multinational enterprises. One is by the informal exchange of technical information between the subsidiaries of the firm or from the central research laboratories to other parts of the firm. The other form of technology transfer is the formal sale or grant of technology by the parent to the subsidiary. This latter form of transfer can take place when a subsidiary is given a product mandate. The granting of a product mandate may imply a significant transfer of technology by the parent, particularly if the subsidiary is given entirely new responsibilities for product development.

A fully effective product mandate implies that the subsidiary has been given all the necessary technology, information, and resources to develop the product without assistance from the parent. The only other way that a subsidiary can obtain this sort of product mandate is to develop technology on its own. Usually, subsidiaries are too small to do this sort of activity on their own without government assistance. Thus, government assistance programs such as DIPP can play a role in helping foreign subsidiaries move into new product areas without making significant demands on the resources of the parent.

IV - RISK

Most of the material on Risk gathered in the mini case studies has been incorporated into the Risk Appendix to the Covering Report (Volume 1 of the DIPP Evaluation Study). The discussion in this section focuses on those aspects or items of risk peculiar to these firms.

RISK ASSESSMENT

Pure risk avoidance, which implies a high sensitivity to risk, is practiced by Leigh, Optotek, Computing Devices, and Dowty.

Intuitive Risk Assessment - using informed judgement as the basis for weighing risks - is followed, in one form or another, by Litton, which factors the risk elements in to the budget estimates; and by Collins, which incorporates a risk premium in the ROI calculations.

Formal risk analysis is used by only one firm: Garrett.

RISK FACTORS

The interviews strongly suggest that among the various risk factors, the market risk (including market size, competition, etc.) is the most important. About two-thirds of the companies interviewed indicate that they assess sales forecasts when assessing risk. About one-third of the companies identified "political uncertainties" as a source of risk and account for it in their planning. Political uncertainties are usually more of a factor in military than in civilian markets. The main source of economic uncertainty appears to be the exchange rate risk. Companies identifying exchange rate as a risk factor all expressed concern that a rise in the value of the Canadian dollar could adversely affect their profitability and reduce their international competitiveness.

ROLE OF DIPP

DIPP is viewed in some quarters as a "risk-sharing program with the objective of (the government) sharing development risks with the companies". All companies confirmed this view by responding that DIPP funding had effectively reduced their risks through aiding liquidity and minimizing potential "up-front" losses. However, not all agreed that DIPP projects were necessarily the most risky ones. For these companies, other non-DIPP projects are more risky.

Since most companies view risk as an important decision-making factor, they were asked for their views on the desirability of a sliding scale for DIPP support (more risk = higher sharing ratio). About three-quarters of the companies approved of this idea, although many foresaw problems because of the subjectivity of risk. The companies who disapproved of the sliding scale generally felt that the quantification of risk would present insuperable administrative difficulties.

VI - COMPETING SUBSIDIES AND COUNTERVAIL

Most of the Mini-Case findings are analyzed in Appendix H to the Covering Report (Volume 1, DIPP Evaluation Study). This discussion deals with exceptions to the general findings.

AWARENESS*

Only one company, Garrett, was able to provide details on the assistance provided to its competitors in the U.S.

Interestingly, Litton took exception to the phrase "competing subsidies". In their view, R&D funded by the U.S. DOD is not a subsidy, but rather, the purchase of a service. Litton sees itself as competing not against subsidies but against massive U.S. procurement of military R&D.

The U.S. practice of permitting a certain percentage of each procurement contract to be allocated to the contractor's own R&D was viewed favourably - although perhaps not objectively.

COUNTERVAIL

For most companies interviewed, the existing DDSA/DPSA arrangements provide sufficient protection against countervail on military products. The advantage of these agreements is that the Canadian company is considered as equivalent to a U.S. Contractor by DOD. Whether this is actually the case is another question. Because most of the companies interviewed specialize in military products, the U.S. potential for countervail is not considered as a serious problem. However, to the extent that the companies also manufacture related civil products, countervail is a mounting concern. One final point: while

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* Note that in contrast to the fairly relaxed attitude to competing subsidies displayed by the Mini-Case Study firms, the Major Case aerospace firms expressed considerable concern on this point.

most companies consider DDSA/DPSA to be effective protection against countervail, many feel that DIPP is also necessary to gain penetration of U.S. and other foreign markets.

NON-TARIFF BARRIERS

Non-tariff barriers (NTBs) were identified by about half the companies as a constraint to their being able to effectively penetrate foreign markets. Perhaps the most commonly identified NTB was 'buy local' provisions which restrict purchases to indigenous suppliers and exclude imports. Aside from this there was no pattern in the responses. The NTBs identified include inter, alia, small business set asides, preferential relationships between the supplier and borrower, the 'not-invented-here' syndrome, bribes and licencing of imports. While many companies did identify specific examples, it generally appears that NTBs are not a pressing concern at present.

CONCLUSIONS

The responses of the companies to questions on competing subsidies, on freedom from countervail, and on non-tariff barriers all seem to indicate that while there is a general awareness of these barriers, they are not really a serious problem. When asked directly why they continue to operate in Canada despite these barriers nearly all companies responded by saying that the barriers are simply not a problem or that they possess certain advantages (lower costs, efficiency, patents, etc.) that make the barriers irrelevant. This should not be wholly surprising since DIPP recipients tend to be effective exporters. In fact firms would not be eligible for DIPP if they did not export. The fact

that DIPP recipients do export means that competing subsidies, countervailing tariffs and non-tariff barriers were, in the past, not sufficient in themselves to exclude Canadian products from entering foreign markets.

VII - THE IMPACT OF DIPP

In another section of the report we record the views of DIPP held by the firms which were interviewed. The results described in that section are highly general, pertaining to the overall benefits of the program, comments about its administration, and suggestions for improvement. In this section, we report the views of the firms on how DIPP has affected their planning and operations.

DIPP AND NEW MARKETS

One of the questions under examination was whether DIPP has given firms an entrée into new markets. Nearly all companies responded that DIPP had indeed played a crucial role in getting them into new markets or new product lines. Most of these same companies said that the probability is small that they would be in existing product lines without DIPP.

A smaller number of companies indicated that they would not exist if DIPP support had not been provided. Companies crediting DIPP with their survival include Litton, Leigh, DAF-Indal, Optotek, C.R. Snelgrove, and Erie. While it is difficult to confirm these claims, it is clear that Leigh would not be in existence without support from the program. During the 1962-64 period they received $504,000 from the government, while their sales over the same years totalled $569,000. Of course, the survival of the firm is not in itself a measure of economic benefit.

DIPP AND CORPORATE STRATEGY

DIPP is conceived as a "responsive" program in which the companies develop proposals and submit them to the Department for approval.

While the process of project review is considerably more complex than suggested above, the basic idea of firms initiating projects is substantially correct. Nearly all projects reviewed in the mini case studies were initiated by the company, not the government. Projects initiated by the government resulted from the Department becoming aware of a specific contract (and/or market) and notifying the company which had the most experience in the field.

Since the projects were generally initiated by the companies, it should not be too surprising that DIPP projects generally fit in with corporate strategy. This is supported by the finding that DIPP projects are evaluated using the same criteria and procedures as other projects.

VIII - SPIN-OFFS

One of the frequently cited reasons for the perceived effectiveness of DIPP is the possibility of "spin-offs" resulting from projects. Before discussing whether or not there is a factual basis for this assertion let us first define the terms.

In the context of DIPP a spin-off can be defined as the development (or the knowledge to support and develop) of one or more related products which would not have been created if the DIPP project had not taken place. A "spin-off"

can therefore be considered as a new product directly resulting from or attributable to DIPP, though not funded by it. Thus, the products directly funded by DIPP cannot be considered as spin-offs nor can products which would have been developed without DIPP.

The first question to be addressed was "How important are spin-offs?" Each company was asked to rate the development of "non-funded spin-off projects" as a general benefit of DIPP. Of the twenty companies interviewed, about half identified it as an important benefit of the program. In some cases, companies explicitly identified the potential for spin-offs as a criterion for the acceptance of R&D and engineering projects. We can safely conclude that about half the companies in the sample are aware of the importance of spin-offs and some 10% explicitly plan for them.

The next question to be addressed was whether the companies could document important spin-offs from DIPP projects. Here, the information is somewhat sparse. Despite the fact that half the companies specified non-funded spin-offs as an important benefit of DIPP, only six (of a total of twenty firms) were able to identify any which resulted from their projects.

A number of other companies also said they had spin-offs from their DIPP projects, but they were not specified in sufficient detail to be included in the above list. Companies falling into this class include Leigh Instruments and Westinghouse.

While spin-offs appear to be important on a few projects (notably Litton, DAF-Indal and Computing Devices) one is struck by their relatively small importance in the remainder of the cases. This is not to say that spin-offs are unimportant, but rather that it is rather difficult to predict their value at the time a project is undertaken.

Companies that try to maintain a presence in a field of technology - increasing their knowledge and exploiting it - are more likely to have spin-offs than companies who enter new areas on a "one-shot" basis. A company with a long history of experience with a technology is far more likely to have spin-offs than a company new to the field. The experience of Computing Devices in the ASW field and Varian in the microwave tubes field are good examples of this. An equally important determinant of spin-offs is the company's knowledge of possible uses and markets for its technology. Computing Devices considered alternative markets for the digital scan converter technology even after the U.S. Air Force cancelled the project. In short, spin-offs are, among other things, the result of persistence.

On the basis of the preceding arguments it is difficult to maintain that spin-offs, whether planned or unplanned, are a justification of DIPP. The ability to generate spin-offs is more the result of company planning than of DIPP per se. Spin-offs are not a feature of DIPP, but a result of providing funds to well-managed companies. Thus, spin-offs can be maximized by providing DIPP assistance only to companies which know how to make the best of the opportunities presented to them.

IX - COMPANY VIEWS OF DIPP

One of the aims of the interviews in the mini-case studies was to obtain from each company their views on DIPP. These views were obtained through structured questionnaires in which the companies were asked to rate the various aspects of the program. The most useful information came when the companies were asked to give their general views on the program. As well, many important aspects of DIPP were raised by the companies in the course of discussions on other topics. In this section the views of the companies are summarized on a topical basis.

GENERAL OPINION OF DIPP

All companies interviewed expressed strongly positive views of DIPP and firmly supported continuation of the program despite reservations about various aspects of program delivery. In nearly all cases the companies indicated that DIPP assistance had been crucial in enabling them to either maintain their existing markets or to enter new product areas.

It appears that the main reason for this satisfaction with DIPP lies in the flexibility of the program and relative looseness of the program criteria, particularly when compared with the Enterprise Development Program. In fact, a common thread running through many interviews was a clear hostility to EDP and a fear that the DIPP criteria could be made similar. Many of the companies indicated that projects that had received support under DIPP would not have been eligible for EDP assistance.

Another strongly expressed view was the success of DIPP overall despite the occasional "lemon". Some attributed the current strength of the defence/aerospace industry to assistance that was provided in the early seventies - a period when the industry was in very poor shape. Without this assistance the industry would not have been able to survive.

MAIN REASONS FOR THE SUCCESS OF DIPP

When asked how DIPP had assisted them, two factors stand out. The first is the impact of the program in reducing the financial risk in the development of new products. DIPP reduces this source of risk by decreasing the potential "up-front" losses of the company. The other way in which DIPP is helpful is in improving the liquidity of companies receiving assistance. R&D usually is a drain on cash flow and the provision of DIPP funding helps to mitigate this problem.

PROGRAM DELIVERY

To the extent that companies complained about DIPP, complaints focused on program delivery. Most of the complaints centered on delays in program delivery - both in the decision-making prior to the approval of funds and in the approval of claims were most often criticised.

The complaints about delays in decisions focus on the amount of time that passes between the submission of a written proposal and the approval of the contract. For some companies this creates a serious hardship, particularly if

their liquidity position is weak. A related problem is the amount of information which is requested in addition to that contained in the written proposal. As a result company officers may spend an undue amount of time servicing the DIPP proposal. The time spent in collecting this information also slows down the decision process. These delays in the decision process make it difficult for companies to plan their R&D activities because they cannot estimate when DIPP funds will be available.

On the administration side, the main concern is with the speed with which progress payments are processed. A number of companies said that there are long delays over relatively small amounts of money. As well, some firms complained that the work plans are too confining and that the time required to change the statement of work is too long.

CONTINUITY OF ISB OFFICERS

While not a general problem, some companies expressed a concern with the turnover of officers in the Sector Branches. This creates a problem for the company because each time a new officer becomes responsible for a company it takes a good deal of time for him to become familiar with the company and its projects. As well as requiring time and effort on the part of the company, the turnover of officers also creates delays in program delivery.

ADMINISTRATIVE RULES

Some companies indicated that they have problems with certain of the administrative rules of DIPP and DSS including the following:

(a) eligible costs - DSS does not allow interest, profit or selling expense. Most companies suggested that this be changed.

(b) engineering recovery - are the rules reasonable?

(c) data rights - on projects which are jointly funded by the U.S. military and DIPP there is a potential conflict between DIPP and U.S. contracting rules. Under the latter, U.S. military has rights to data on new products while under DIPP it is the company which maintains data rights. These conflicting rules can create a problem for DIPP recipients unless the issue is explicitly dealt with in the MOU with the U.S. Military service.

GAPS IN DIPP

As noted earlier there is general satisfaction with DIPP, but many companies offered suggestions for the improvement of the program. The one recommendation that came up most often was the idea of extending DIPP to support applied research. Many companies said that there has been no government support for "front-end R&D" since the cancellation of the Defence Industry Research Program (DIR) in 1975. (There has been a DIR element in DIPP since 1976, but none of the companies interviewed appeared to be aware of it). It was generally felt that if "front-end R&D" were to be supported the criteria should not be commercial, but on the basis of technical promise and/or company development. Another related recommendation suggested by many companies was

the revival of the Industrial Research and Development Incentives Act (IRDIA). In the view of these companies, an IRDIA-type program would be more effective than the existing R&D incentives.

Another commonly offered recommendation related to increased DIPP funding. Most companies suggested that funds allocated to DIPP be significantly increased without changing the criteria of the program. A number of companies also recommended a relatively larger increase in the funding of the Capital Assistance/Source Establishment elements of DIPP.

The firms recommending an increase in DIPP funding appear to believe that there are major opportunities in the U.S. and other foreign military markets, and that these opportunities can be exploited if there is an increase in program funding. As well many of these same firms also suggest that a cancellation or contraction of the program would impose serious opportunity costs on the Canadian economy (i.e., they believe that they cannot compete in foreign military markets without DIPP assistance). It is not unimportant to note that many DIPP recipients are members of the Air Industries Association of Canada, an organization which has made strong representations to the government on behalf of DIPP.

X - SUMMARY OF THE RESULTS

In the preceding sections we have covered in detail the main findings on each major topic discussed in the interviews with the mini case study companies. The object of this section is to review the main findings and discuss their relevance to DIPP:

CORPORATE DECISION MAKING

Most of the companies interviewed indicated that they make use of formal techniques of project evaluation, although there is a wide degree of variation in the sophistication of the techniques used. DIPP projects are generally considered to be no different from any other projects and are assessed according to the techniques and criteria which the company generally uses. There appears to be a pattern of larger companies using more advanced techniques for planning and analysis which may give them an advantage over smaller companies.

On the subject of corporate objectives, most companies interviewed indicated ROI is an important criterion - the "bottom line" - but strategic objectives are equally important. The strategic objectives pursued by firms include growth, market share and product diversification.

As well, there are certain constraining factors such as lack of manpower or lack of market experience which are taken into account. These objectives and constraining factors interact to channel the efforts of firms into new product areas most likely to meet with success.

PARENT/SUBSIDIARY RELATIONS

All the subsidiaries of foreign firms which were interviewed claim they have a good deal of operational autonomy. To the extent that the parent corporations exert control over their subsidiaries it is in decisions in the functional areas of finance and capital investment. This is entirely consistent with the parent exerting control via periodic budgets.

Another aspect of parent/subsidiary relations discussed in interviews is the subject of product mandates. All the subsidiaries interviewed claim that they have a product mandate from their parent, but only three companies were able to demonstrate that they have a "broad" product mandate covering all activities from product development through to postsales service. The product mandates of other companies tend to be narrower in scope.

Four companies said that to the extent that they have product mandates, DIPP is responsible. In effect, DIPP was used as a "carrot" to induce parent companies to grant their Canadian subsidiaries a product mandate. Such use of DIPP clearly enhances its effectiveness.

Generally, Canadian subsidiaries receive little or no financial help from their parent corporations. R&D investment projects in these firms are funded out of cash flow or bank borrowing. If financing is provided by the parent corporation it is usually on an "arm's length" basis.*

APPROACH TO R&D

Most of the companies interviewed indicated tht they build up their R&D budget on a bottom-up basis - that is to say, on a project-by-project basis with proposals originating in engineering or marketing units of the firm. Only four companies, all subsidiaries do their R&D planning on a top-down basis (i.e., priorities and overall funding levels set by management). This latter approach tends to be more sensitive to market requirements.

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* In fact, the flow of funds may be in the opposite direction - from subsidiary to parent - in the form of negotiated profits, management fees and royalties. It was not possible to confirm this since the data provided by the companies did not go into sufficient detail.

Nearly all companies indicated that they do R&D in order maintain their share of the market. This can be contrasted with "offensive" R&D, which is aimed at diversifying the firm's product mix and/or increasing market share. The prevalence of companies pursuing "defensive" R&D objectives can perhaps be explained by their relatively small size and insignificance in international military markets.

R&D tends to be funded out of cash flow and the main constraint to increased R&D spending is liquidity. Only one company indicated that it would be willing to use external financing as a source of funds for R&D.

DIPP plays an important role in the R&D planning of the companies by augmenting their cash flow and reducing the up-front risk of R&D projects. Generally, DIPP supports product development projects rather than applied or basic research. This appears to be a result of the market-oriented DIPP criteria (i.e., the ratio of sales to the Crown contribution), and the relatively small size of the companies restricting the amount of applied R&D that they can perform.

For some companies DIPP is intimately related to the carrying out of the corporate strategy. They use DIPP to enlarge or augment their product mandate. More generally, DIPP projects are usually undertaken on the initiative of the company and thus reflect corporate objectives and strategies.

RISK

Only a few companies make use of sophisticated techniques for assessing risk. Generally, there appear to be three general techniques for dealing with risk:

(i) Risk avoidance - on the basis of an intuitive assessment of risk, the company decides whether or not to go ahead with the project;

(ii) Intuitive risk assessment - the company assesses the risk factors and weighs the outcome according to the degree of risk;

(iii) Formal risk analysis - the firm assesses the impact of the various sources of risk on the outcome of the project.

Most companies tend to use techniques (i) and (ii).

As noted, the majority of companies said that DIPP reduces risk by minimizing the potential "up-front" losses and reducing their financial exposure.

THE IMPACT OF DIPP

Nearly all companies interviewed said that without earlier DIPP assistance they would not be in the same product lines as they are now. In a few cases, companies said that they would not exist if they had not received DIPP.

In nearly all the cases DIPP projects were initiated by the company rather than the Department. This supports the view that for the smaller projects DIPP is a "responsive" program.

SPIN-OFFS

About half the companies expressed an awareness of the importance of spin-offs as a benefit of DIPP. However, only six companies were able to specifically identify spin-offs from their projects. In any event, spin-offs appear to be a characteristic of good company planning and not an inherent feature of DIPP.

CORPORATE VIEWS OF DIPP

All the companies interviewed have a positive impression of DIPP and identified the main benefits as aiding liquidity and reducing risk. A significant number of firms complained about the slowness in the DIPP approval process and in the processing of progress claims.

CONFIDENTIAL

ANNEX III TO THE DIPP EVALUATION STUDY

EXPERT OPINION SURVEY

ANNEX III TO THE DIPP EVALUATION STUDY:

EXPERT OPINION SURVEY

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INTRODUCTION

The purpose of surveying the opinion of experts was to provide measures of the contribution of DIPP toward meeting its technological and defence objectives. These subsidiary objectives of DIPP have traditionally been included in the DIPP directives indicating that DIPP is designed to "develop and maintain the technological capability of Canada's defence industry". These objectives were addressed in this module from an historical point of view, i.e., how well they have been met and from a future oriented point of view, i.e., how information about technology and defence can improve the selection criteria for DIPP projects so as to improve the return on investment. In addition, the module provided an attempt to assess the risk involved in DIPP projects and the relation of risk to other objectives.

Our findings and those of other studies concerning the relation of government support for defence and technology to economic growth are discussed in Appendix E of the covering report in Volume 1.

I - STRUCTURE AND METHODOLOGY

The development of the methodology for this module was based on a number of considerations, especially the following:

- There is no satisfactory objective measure of the contribution of DIPP to its technological and defence objectives.

- The best alternative is informed, disinterested, subjective assessment made by experts.

- Given subjective assessment, an effort should be made to eliminate systematic bias. This can be done by obtaining and judiciously combining a number of subjective assessments for each project.

- In order to permit the subjective assessments to be used in statistical models, the opinions given by the experts should be carefully structured into a quantifiable format.

These considerations lead logically to the essential design characteristics of the module. The following sections elaborate on the various aspects of the design, showing how they are combined to provide data which meet the objectives of the module.

SAMPLE OF PROJECTS

In order to ensure that the measures of contribution to technology and defence could be used in the statistical model, it was necessary to select a representative sample of DIPP assisted projects. Our sample stratified projects by the amount of the DIPP contribution. First, the largest DIPP projects representing about 50% of DIPP contributions to date were included on a census basis to ensure that the assessment covered a large portion of DIPP funds. The remaining DIPP projects from 1970 to the present were divided into three strata according to the size of the DIPP grant. Within each stratum, projects were sampled randomly. We attempted to achieve a 20% sample from these strata. Due to subsequent developments, the final sample size for the three strata fell somewhat below 20%. A final breakdown of the sample, by stratum, is shown in Exhibit 1, opposite.

EXHIBIT 1 **CONFIDENTIAL**

SIZE OF STRATA AND SAMPLE

	Amount of DIPP Contribution	Total Number of Projects	Number of Projects in Sample	% of Projects in the Sample
Stratum 1	$1-200,000	73	13	18
Stratum 2	$200,001-750,000	60	12	20
Stratum 3	$750,001-5,000,000	56	10	18
	Subtotal	189	35	19
	Large Projects	12	12	100
	Total	201	47	23

THE EXPERTS

The usual approach to selecting panel members is to begin with a small number of known experts and then to follow up on their suggestions for additional experts. In our case, we began with names and institutions suggested by the team and by steering committee members, many of whom represented ISB's and so were knowledgeable about the projects. The main institutions from which experts were selected were NRC, DND, DOC and ITC. We attempted to exclude those persons who might have a vested interest in the projects. For this reason persons from industry were excluded.

In general, the procedure for securing experts' participation was as follows:

- We contacted experts by telephone and briefly explained the purpose of the module and the extent of involvement required.

- We asked for an indication of familiarity with DIPP and DIPP projects and then for an expression of interest or agreement to participate.

- We sent a letter including the list of projects to be assessed and a request for names of additional experts.

- We then made a second phone call, asking experts to indicate which of the projects on the list they were familiar with and could assess, and what additional names they could suggest.

- The second call was in some cases replaced by a written response from experts indicating the projects with which they were familiar.

- As we received a confirmation of the projects the expert could assess, questionnaires and project descriptions were forwarded to the experts.

- A system was developed to record the specific projects being assessed by experts to facilitate an orderly and comprehensive coverage of all projects.

In many cases, of course, some steps were skipped and others added. In particular, the large institutions were handled differently. In the case of DND and some branches of the NRC, the directors of the different branches delegated projects directly to their officers. In the case of DND, we had little contact with the experts who actually answered the questionnaire; however, the principle of individual and not institutional opinion was maintained. We received excellent cooperation from both individual experts and from institutions. A very small number refused to participate; most refusals were due to lack of familiarity with the projects. Most of those contacted were very eager to help, often undertaking to assess more projects than we would have presumed to request.

Exhibit 2, Overleaf, summarizes various aspects pertaining to the participation of experts on the panel. Exhibit 3, Overleaf, shows the experts' institutional affiliations. To ensure frank responses, experts were assured of the confidentiality of their responses. Accordingly, we cannot report which experts evaluated specific projects.

EXHIBIT 2

EXPERTS PARTICIPATION

Number of Experts contacted directly	35
Number of Experts participating	77
Number of refusals to participate	6
Maximum number of projects rated by one expert	14
Average number of projects per expert	2.4
Average number of ratings per project	
- large projects (12)	5
- 3 strata projects (31)	3.4
Number of Questionnaires sent to Experts	±215
Number of Questionnaires returned	183
Response rate	84%

EXHIBIT 3

INSTITUTIONAL AFFILIATION OF EXPERTS

Institutional Affiliation	Number of Experts	Number of Questionnaires	Number of Projects
NRC	12	25	16
MOSST	1	1	1
U. of alberta	1	14	14
Private Consultants	3	18	15
Science Council	1	12	12
U. of Manitoba	2	3	3
DOT	2	6	6
DOC - CRC	7	16	12
IT&C (Technology Branch)	8	26	25
U. of Toronto	1	1	1
DND	34	50	39
USAF LO OTTAWA	2	8	8
US Army	3	3	3
TOTAL	77	183	

THE QUESTIONNAIRE

The expert opinion questionnaire represents an attempt to translate the technological and defence objectives of DIPP into measurable terms, and to assess the extent to which DIPP supports risky projects. The central decision made in the translation attempt was to emphasize contribution to technological capability rather than contribution to technology (or "high" technology). This decision means that we took the view that DIPP projects should, as they are developed, increase the company's technological capability. This contribution may be closely related to the degree of technological inventiveness embodied in the project, but it is clearly not the same thing.

The next step was to define carefully the concept of "technological capability" and to identify the separate dimensions making up the concept. To accomplish this task, we conducted a number of personal interviews with people from NRC, MOSST, and the Technology Branch at ITC. These interviews clarified our thinking in general and also led to a number of specific questionnaire items.

The questionnaire went through a number of drafts; at each stage, team and steering committee members made suggestions for improvements and additions. The final questionnaire had three main parts: Technological Characteristics, Defence Capability, and Aspects of Risk. Following suggestions made in the personal interviews, the part on Technological Characteristics was further divided into three sections: Technological Characteristics of the Firm, The Technology Embodied in the Product, and Contribution of the Project to the Company's Technological Capability.

With few exceptions, the questionnaire is composed of 5-point scales. Each scale is a dimension bounded by a word-pair denoting the extreme positions on the dimension. The experts were asked, for each project, to enter an X at the appropriate point in the scale. This kind of scale allows us to average the individual rankings to get an overall score for each project on each dimension. In addition, a number of dimensions can be added together to obtain an overall score for the contribution of a given project to the company's technological capability.

To each questionnaire we attached a brief description of the project under consideration. These descriptions were, in most cases, prepared by ITC project officers responsible for the company or the project. Finally, each expert also received a summary sheet in which he was asked:

- to rate his knowledge of each of the subjects covered in the questionnaire, and

- to rank the projects he assessed relative to one another in terms of their contribution to technology and to defence, and the risk they involved.

ANALYSIS

The analysis of the data generated by the Expert Opinion Panel was used to address three major issues. These were:

- the historical issue: how well have the technological and defence objectives of DIPP traditionally been met?

- the future: what information has the survey provided about technological aspects of proposed projects which can help predict whether or not they will yield a high economic return?

- risk: what is the validity of taking into account the degree of risk involved in a project as an input into the decision on whether or not to support a proposed project?

Below we outline briefly how the data was used to illuminate each of these issues.

The Historical Issue

Questionnaire items concerning Technology and Defence were analyzed in order to see how many, and to what degree, projects contributed to these objectives. For example, we checked how projects were distributed along the dimension measuring overall contribution to technological capability. If most of the projects ranked high, we felt comfortable concluding that the technological objective was being met. From the same tabulation we also got the average rank of all DIPP projects on that scale and saw where this average fitted on our 5-point scale. A similar set of numbers was generated for the defence-relatedquestions. Because we had a statistically valid sample, these averages applied to the program as a whole, not only to the projects assessed by the experts.

The Future

By combining information about technological characteristics with information (from the mini-case studies) about economic performance, we found out to what

extent these aspects are related. We could then help answer questions about the extent to which projects with certain technological characteristics have a high probability of being economic successes.

Of particular interest in addressing these questions are those aspects of technological capability which are known or can be learned at the time of the decision on whether or not to support the project. Some of these aspects were contained in the questionnaire, including:

- Is the firm a leader-follower in its technology field?

- Does the product represent mature-embryonic technology?

- Does the project involve the firm in an area of technology new to it?

If we could establish that these items were related to the subsequent success of the project, these types of considerations could then be used as criteria for selecting projects.

Risk

The discussion of risk is complicated by two facts:

- there is no agreement on how risk is to be defined;

- there is repeated confusion of risk as an empirical attribute of projects and risk as a normative justification of the program (rationale).

The approach taken in the expert opinion module eliminates (though it does not resolve) the first of these problems: the questionnaire measures risks without attempting to define it. It is the second problem - the confusion of the empirical and the normative meanings of risk - which must be resolved before the role of this module with respect to risk can be described.

It should be the case that once the objective(s) of a program are determined, risk is treated essentially as an empirical attribute, not as a normative rationale. Risk may or may not be a useful variable for identifying projects which make the best contribution to the objective(s) of a program. Moreover, the presence or absence of risk may help explain why certain projects make a good contribution to the program's objective(s) while others do not. Assuming that the objective of the program is to contribute to economic growth, there are two prerequisites: it must sponsor incremental projects, and the projects must have a positive NPV. To examine the relevance of risk, then, we must look at three attributes, as shown in Exhibit 4, opposite.

We can divide DIPP projects (or DIPP dollars) into eight groups, corresponding to possibilities A through H. We can then examine one, or more, of the following:

(i) the proportion of DIPP projects (or DIPP dollars) which have gone to risky, incremental, positive NPV projects (A);

(ii) the proportion of all risky projects (or dollars) which are incremental with positive NPV compared with non-risky projects which are incremental with positive NPV (A/A+B+C+D vs. E/E+F+G+H);

EXHIBIT 4

THREE ATTRIBUTES OF PROJECTS*

Risky	Incremental	NPV
(1) YES	(3) YES	(5) POSITIVE
(2) NO	(4) NO	(6) NEGATIVE

Given any project, there are 8 possible classifications which take account of the three attributes. These are:

A. (1) - (3) - (5)

B. (1) - (3) - (6)

C. (1) - (4) - (5)

D. (1) - (4) - (6)

E. (2) - (3) - (5)

F. (2) - (3) - (6)

G. (2) - (4) - (5)

H. (2) - (4) - (6)

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* The same structure would hold for defence or technological capability as objectives. NPV (Positive, Negative) can be replaced by "Contribution to Technology" (high, low), etc.

(iii) the proportion of all risky projects (or dollars) which show positive NPV compared with the proportion of non-risky projects with positive NPV (A+C/A+B+C+D vs. E+G/E+F+G+H);

(iv) the proportion of all risky projects (or dollars) which are incremental compared with the proportion of non-risky projects which are incremental (A+B/A+B+C+D vs. E+F/E+F+G+H).

As is the case with the contribution to defence and technological capability, the information we generated about risk was used to address both the past and the future. From an historical perspective we tried to determine whether or not DIPP tended to support risky projects, and to what degree risky projects tended to meet the program's objectives better than non-risky projects. From a future oriented perpective, we isolated risk-related factors which are both known at the decision making time and are relevant to subsequent success. These factors could subsequently be incorporated into the DIPP selection criteria.

II - EXPERT OPINION SURVEY FINDINGS

In general, two types of findings from the expert opinion questionnaire are reported below. First, we report the frequency distributions of all the questionnaire items. This section contains information on all 47 projects which were covered by the experts. In the next section we report cross-tabulations showing relationships between aspects of technology, risk, and defence, and the relationships between these and measures of economic success. In the latter case, since the economic variables come from the case studies, sample size is reduced to 28.

DISTRIBUTIONS, MEANS, AND VARIANCES FOR QUESTIONNAIRE ITEMS

The following pages present the results obtained from the expert opinion questionnaire. For each scale we present a frequency distribution, the mean, and the variance. The mean provides a measure of how projects were rated on the average. The variance indicates how far from the mean projects tend to be. The larger the variance, then, the more disparate the distribution. The questionnaire items presented to the experts are reproduced above each scale to make clear exactly what the expert was responding to.

The distributions are presented in the same format as that of the questionnaire scales. The experts were asked to enter a single X per scale for each project they evaluated. To produce the tabulations reported below, the scores given to each project on each scale were averaged and rounded to the nearest whole number. Averages were calculated by assigning a value of low=1, medium-low=2, medium=3, medium-high=4, high=5. For each scale, then, we counted the number of projects whose score fell into a given box; this number of projects is recorded in the boxes below. Note that the means were calculated before the rounding.

Example:

3	7	20	10	7
LOW		MED		HIGH

In this example, 3 projects had a rounded average score of low. Seven projects had a rounded average score of medium, etc.

Technological Capability

In terms of technological sophistication, is this firm an international leader or a follower in its field?

	5	7	22	13
FOLLOWER				LEADER

MEAN 3.90
VARIANCE 0.86

The majority of firms receiving DIPP R&D are seen as international leaders in their field in terms of their technological sophistication.

To what extent did this project involve the corporation in an area of technology which was new to it?

	4	17	17	9
LOW		MED		HIGH

MEAN 3.57
VARIANCE 1.37

The majority of DIPP projects involved the firm in a technology which was fairly new to it.

Within its overall field, did this product represent "mature" or "embryonic" technology?

2	6	21	14	4
EMBRYONIC		MED		MATURE

MEAN 3.09
VARIANCE 0.66

Most of the projects are obviously judged as halfway between embryonic and mature technology.

There is a tendency of DIPP to support more mature technologies: 18 projects are on the mature side; 8 on the embryonic side.

Please indicate which of the following best describes this project:

0	Significant breakthrough in state of the art
10	Significant advance in state of the art
29	Imaginative application of existing technology
8	Routine application of existing technology

MEAN 2.67
VARIANCE 0.10

No project was judged as representing a significant breakthrough in the state of the art. This in fact made the question into a 3-point scale in which most of the projects are in the middle, i.e., representing an imaginative application of existing technology. Ten projects (over 20%) were seen as representing a significant advance in the state of the art.

The questions asking whether or not there was/is a Canadian technological base on which the project could build received a yes for 46 projects and no for none. This suggests that the experts felt that DIPP projects fitted at least reasonably well into Canada's industrial structure and that no "out of the way" projects were supported.

To what degree will/did this project facilitate the development of other products or processes either within or outside this firm?

1	8	14	13	11
LOW		MED		HIGH

MEAN 3.42
VARIANCE 1.19

The majority of products were judged to have a medium to high potential for facilitating spin-offs either within or outside the firm.

Please rate the project on its overall contribution to the development of technological capability in the company.

	5	9	21	12
LOW		MED		HIGH

MEAN 3.7
VARIANCE 1.05

No project was rated at the lowest point on the scale and 12 were given the highest possible rating. 33 projects, or 67% were rated medium high or high.

The following are dimensions of overall technological capability. Please rate the project on its contribution to each of these dimensions.

- To what degree did the project contribute to the company's ability to adapt to future developments in the field?

0	2	5	28	12
LOW		MED		HIGH

MEAN 3.97
VARIANCE 1.13

- To what degree did this project contribute to the development of company R&D staff and facilities (including test grounds)?

4	3	10	25	5
LOW		MED		HIGH

MEAN 3.43
VARIANCE 1.00

- To what degree did this project contribute to the development of the company as a viable continuing supplier of technologically sophisticated products?

0	6	5	23	13
LOW		MED		HIGH

MEAN 3.83
VARIANCE 2.24

- To what degree was this project instrumental to maintaining this company's capability during a difficult period?

3	7	14	16	6
LOW		MED		HIGH

MEAN 3.23
VARIANCE 2.40

- To what degree did the project contribute to the development of "state of the art" awareness in the company?

1	3	15	19	9
LOW		MED		HIGH

MEAN 3.63
VARIANCE 0.76

DIPP projects were judged, in general, to have made a significant contribution to all five of these dimensions of technological capability. There is a tendency to rate the potential for future contribution (adaptation to future development, viable continuing supplier) more highly than actual contribution (instrumental in difficult periods, R&D staff and facilities).

Defence Capability

For its cost, did this project yield a high value to defence capability:

- in the form of a product?

5	10	11	15	5
LOW		MED		HIGH

MEAN 2.99
VARIANCE 1.74

- in the form of knowledge capable of future exploitation?

0	9	11	16	10
LOW		MED		HIGH

MEAN 3.52
VARIANCE 0.95

With respect to defence capability, the experts think that more projects have a future potential rather than present value. This is similar to the tendency found in the case of technological capability.

What is the value of maintaining this firm's R&D capability:

- to Canadian defence

1	4	6	17	19
LOW		MED		HIGH

MEAN 3.90
VARIANCE 1.38

- in the form of knowledge capable of future exploitation?

0	9	11	16	10
LOW		MED		HIGH

MEAN 3.52
VARIANCE 0.95

With respect to defence capability, the experts think that more projects have a future potential rather than present value. This is similar to the tendency found in the case of technological capability.

What is the value of maintaining this firm's R&D capability:

- to Canadian defence

1	4	6	17	19
LOW		MED		HIGH

MEAN 3.90
VARIANCE 1.38

- to NATO defence

4	1	9	17	16
LOW		MED		HIGH

MEAN 3.80
VARIANCE 1.58

The experts judged the defence value of maintaining the R&D capability of DIPP supported firms to be very high. In the case of both Canadian and NATO defence, more than 70% of the projects have gone to firms whose R&D capability is judged to be of at least medium-high significance. What is surprising is the fact that there is so little difference between the value ascribed to Canadian and to NATO defence. We would have expected that the R&D capabilities of Canadian firms would have been assessed as less important to NATO than they are to Canada's defence.

Risk

If you had been judging the project at the time it was started, how would you have judged the probability that the project was going to be:

- Technologically successful?

0	1	9	25	12
VERY IMPROBABLE				VERY PROBABLE

MEAN 3.90
VARIANCE 0.63

- Commercially profitable?

0	3	22	17	4
VERY IMPROBABLE				VERY PROBABLE

It appears that DIPP supported projects do not tend to be very risky, either technologically or commercially. The technological risk is seen as lower than the commercial risk, as could be anticipated, given the type of technology the program supports.

But even the probability of commercial profits is judged by the experts as very high.

Since projects were seen as not risky (3 or higher), the following can be interpreted as the extent to which each factor helped reduce risk.

Please rate the impact of each of the following factors on the technological risk associated with this project at its inception:

- Calibre of scientific and technical staff

0	5	11	22	9

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.70
VARIANCE 0.87

- Number of R&D staff

0	10	22	14	1

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.03
VARIANCE 0.41

- Adequacy of R&D facilities

0	7	16	20	4

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.36
VARIANCE 0.49

- Lack of basic knowledge (i.e., pushing state of the art)

3	7	29	6	2

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 2.89
VARIANCE 1.04

- Inability to obtain the necessary information about the technology

7	14	23	2	1

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 2.47
VARIANCE 1.18

The most important factor for limiting technological risk appears to be quality of scientific and technical staff. This is followed quite closely by the adequacy of R&D facilities. The number of R&D staff is not as important as their quality. It appears that the accessibility of knowledge is not a crucial factor in determining technological risk. This finding fits well with the finding that DIPP tends to support reasonably mature technology for which, presumably, basic knowledge is on hand or can be readily acquired.

As in the case of technological risk, nearly all the projects were seen as not risky in the economic sense. Therefore, we again interpret the following data as indicating the extent to which certain factors contributed to reduction of economic risk.

Please rate the impact of each of the following factors on the economic risk associated with this project at its inception.

- Adequacy of financial resources

3	6	22	11	5

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.13
VARIANCE 1.66

- The firm's ability to translate the R&D into a product

	9	24	12	2

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.12
VARIANCE 2.44

- Adequacy of marketing capability

1	10	19	16	1

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.02
VARIANCE 0.90

- Availability of markets to a Canadian company

6	3	12	23	3

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.41
VARIANCE 1.89

- Technological risk

	6	26	14	1

NO IMPACT — VERY SIGNIFICANT IMPACT

MEAN 3.90
VARIANCE 0.86

Four of the five factors listed above appear to be of nearly equal importance in influencing the economic risk associated with projects. As expected, the one factor which tends to be more important is the availability of markets to a Canadian company.

RELATIONSHIPS AMONG SELECTED MEASURES OF TECHNOLOGY, DEFENCE, AND RISK

In this section we provide information on various topics covered by the expert opinion questionnaire. We concentrate, in particular, on two measures of technology included in the questionnaire: the degree of maturity of the technology, and the contribution of the project to the company's technological capability. These items were chosen because the first appears to be the most "usable" in terms of future selection criteria, and the latter is our main measure of the contribution of DIPP to its technological objective.

Exhibit 5, opposite, shows the relationship between the degree of maturity of the technology and the contribution of the project to Canada's defence capability. The questionnaire considered separately the contribution of the actual product and the potential contribution in the form of exploitable knowledge. The tables seem to indicate clearly that mature technology makes a significantly smaller contribution to defence than the other two levels and that medium and embryonic technologies make approximately equal contributions.

Table 1 in Exhibit 6, overleaf, shows the relation between the maturity of the technology and the likelihood of further spin-offs. Embryonic and medium technologies are almost twice as likely to lead to future spin offs as mature technologies. In this respect, mature technology, which has been shown to be more likely to generate a positive economic return, may be less beneficial economically than the more embryonic technologies.

EXHIBIT 5

TABLE 1 - VALUE OF PRODUCT TO DEFENCE CAPABILITY

		Low	High	Total
Maturity of Technology	Mature	13 (72%)	5 (28%)	18 (100%)
	Medium	9 (45%)	11 (55%)	20 (100%)
	Embryonic	4 (50%)	4 (50%)	8 (100%)
	TOTAL	26	20	46

TABLE 2 - VALUE OF PROJECT TO DEFENCE IN TERMS OF FUTURE KNOWLEDGE

		Low	High	Total
Maturity of Technology	Mature	11 (61%)	7 (39%)	18 (100%)
	Medium	6 (30%)	14 (70%)	20 (100%)
	Embryonic	3 (38%)	5 (62%)	8 (100%)
	TOTAL	20	26	46

EXHIBIT 6

TABLE 1 - THE CONTRIBUTION OF THE PROJECT TO DEVELOPMENT OF FUTURE PRODUCTS OR PROCESSES WITHIN OR OUTSIDE THE FIRM (SPIN-OFFS)

		Low	High	Total
Maturity of Technology	Mature	12 (67%)	6 (33%)	18 (100%)
	Medium	8 (38%)	13 (62%)	21 (100%)
	Embryonic	3 (38%)	5 (62%)	8 (100%)
	TOTAL	23	24	47

TABLE 2 - DEGREE OF COMMERCIAL RISK

		Low	High	Total
Maturity of Technology	Mature	8 (44%)	10 (56%)	18 (100%)
	Medium	10 (50%)	10 (50%)	20 (100%)
	Embryonic	3 (37%)	5 (63%)	8 (100%)
	TOTAL	21	25	46

TABLE 3 - DEGREE OF TECHNOLOGICAL RISK

		Low	Medium	High	Total
Maturity of Technology	Mature	7 (39%)	11 (61%)	0 (0%)	18 (100%)
	Medium	4 (19%)	11 (52%)	6 (29%)	21 (100%)
	Embryonic	1 (13%)	3 (37%)	4 (50%)	8 (100%)
	TOTAL	12	25	10	47

Tables 2 and 3 in Exhibit 6 concerning the maturity of technology show its relationship to commercial and technological risk, respectively. The degree of commercial risk varied very little among the different levels of technology. This estimate contradicts the finding that mature technology is much more likely to become a commercial success than embryonic technology. In terms of technological risk, on the other hand, the results are more in keeping with common sense: the more mature the technology, the lower the technological risk. One possible way of reconciling these findings is to assume that the experts were evaluating the commercial risk of a project given that it is a technological success.

Table 1 in Exhibit 7, overleaf, shows the relation between the two main variables of interest: maturity of technology and contribution to capability. The results show that mature technology makes the least contribution to capability. At the same time, medium technology makes a greater contribution to capability than embryonic technology. The reason for that may be that contribution to technological capability is related to economic success, which is higher for the medium technology.

Tables 2 and 3 in Exhibit 7 show that the contribution of projects to technological capability is closely related to their contribution to defence capability both in the form of a product and in the form of future knowledge.

The next few tables show the relationship of some of the factors which tend to increase or reduce the contribution of projects to technological capability. Table 1 in Exhibit 8, overleaf, shows projects which are new to the company are more likely to make a high contribution to technological capability than projects which are not new. While 81% of "new" products made a high contribution, only 57% of "not new" products did so.

EXHIBIT 7

TABLE 1 - CONTRIBUTION TO TECHNOLOGICAL CAPABILITY

		Low	High	Total
Maturity of Technology	Mature	10 (56%)	8 (44%)	18 (100%)
	Medium	2 (10%)	19 (90%)	21 (100%)
	Embryonic	2 (25%)	6 (75%)	8 (100%)
	TOTAL	14	33	47

TABLE 2 - PRODUCT CONTRIBUTION TO DEFENCE

		Low	High	Total
Contribution to Technological Capability	Low	11 (79%)	3 (21%)	14 (100%)
	High	15 (47%)	17 (53%)	32 (100%)
	TOTAL	26	20	46

TABLE 3 - CONTRIBUTION OF PROJECT TO DEFENCE IN THE FORM OF FUTURE KNOWLEDGE

		Low	High	Total
Contribution to Technological Capability	Low	12 (86%)	2 (14%)	14 (100%)
	High	8 (25%)	24 (75%)	32 (100%)
	TOTAL	20	26	46

EXHIBIT 8

TABLE 1 - PRODUCT "NEWNESS" TO THE CORPORATION

		not new (Low)	new (High)	Total
Contribution to Technological Capability	Low	9 (43%)	5 (19%)	14
	High	12 (57%)	21 (81%)	33
	TOTAL	21 (100%)	26 (100%)	47

TABLE 2 - DEGREE OF COMMERCIAL RISK

		Low	High	Total
Contribution to Technological Capability	Low	5 (24%)	9 (36%)	14
	High	16 (76%)	16 (64%)	32
	TOTAL	21 (100%)	25 (100%)	46

TABLE 3 - DEGREE OF TECHNOLOGICAL RISK

		Low	Medium	High	Total
Contribution to Technological Capability	Low	4 (33%)	7 (28%)	3 (30%)	14
	High	8 (67%)	18 (72%)	7 (70%)	33
	TOTAL	12 (100%)	25 (100%)	10 (100%)	47

It appears surprising that, as tables 2 and 3 in Exhibit 8 show, the degree of risk is little related to contribution to technological capability. This, however, may be due to the fact that capability is positively related both to technological newness and to economic success, and that these two are differently associated with risk.

Finally, we present six tables in Exhibits 9 and 10, opposite and overleaf, which show how different aspects (or sub-dimensions) of technological capability are related to overall technological capability. While all of these dimensions are related to overall contribution, there are differences in the strength of the relation. These differences may throw some light on the criteria which help choose projects which contribute to DIPP's technological objective. For example, projects which contribute to the development of the firm's R&D facilities and staff (Table 3 in Exhibit 9) clearly increase the technological capability more than projects which are instrumental in maintaining the company in difficult times (Table 2 in Exhibit 10).

RELATIONS AMONG THE THREE OBJECTIVES

In this section we report some findings concerning the relationships between some of the aspects assessed by the experts and two measures derived from the case studies: Net Present Value (NPV), and incrementality. We begin with a few comments about incrementality and then present tables about the relations among the three DIPP objectives. Where relevant, these relations are also discussed for only those projects which were incremental.

EXHIBIT 9

TABLE 1 - CONTRIBUTION OF PROJECT TO DEVELOPMENT OF OTHER PRODUCTS OR PROCESSES WITHIN OR OUTSIDE FIRM (SPIN-OFFS)

		Low	High	Total
Contribution to Technological Capability	Low	13 (93%)	1 (7%)	14 (100%)
	High	10 (30%)	23 (70%)	33 (100%)
	TOTAL	23	24	47

TABLE 2 - CONTRIBUTION OF PRODUCT TO "STATE-OF-THE-ART" AWARENESS IN THE COMPANY

		Low	High	Total
Contribution to Technological Capability	Low	13 (93%)	1 (7%)	14 (100%)
	High	6 (18%)	27 (82%)	33 (100%)
	TOTAL	19	28	47

TABLE 3 - CONTRIBUTION TO DEVELOPMENT OF FIRM'S R&D STAFF AND FACILITIES

		Low	High	Total
Contribution to Technological Capability	Low	13 (93%)	1 (7%)	14 (100%)
	High	4 (12%)	29 (88%)	33 (100%)
	TOTAL	17	30	47

EXHIBIT 10

TABLE 1 - CONTRIBUTION TO FIRM'S ADAPTABILITY TO FUTURE DEVELOPMENTS

		Low	High	Total
Contribution to Technological Capability	Low	7 (50%)	7 (50%)	14 (100%)
	High	0 (0%)	33 (100%)	33 (100%)
	TOTAL	7	40	47

TABLE 2 - INSTRUMENTALITY OF PROJECT TO MAINTAINING THE COMPANY DURING A DIFFICULT PERIOD

		Low	High	Total
Contribution to Technological Capability	Low	9 (64%)	5 (36%)	14 (100%)
	High	15 (47%)	17 (53%)	32 (100%)
	TOTAL	24	22	46

TABLE 3 - CONTRIBUTION TO DEVELOPMENT OF COMPANY AS A VIABLE "CONTINUING" SUPPLIER OF TECHNOLOGICALLY SOPHISTICATED PRODUCTS

		Low	High	Total
Contribution to Technological Capability	Low	7 (50%)	7 (50%)	14 (100%)
	High	4 (12%)	29 (88%)	33 (100%)
	TOTAL	11	36	47

Comments on Incrementality

The technological level of the project is a very good indicator of incrementality. For example:

- All projects making a "significant advance in the state of the art" were incremental, compared with only 50% of those described as routine applications.

- All "embryonic" projects and 90% of "medium" projects were incremental, compared with 60% of mature technology projects.

- 93% of projects which were new to the company were incremental, compared with 63% of projects which were not new.

Incremental projects tend to be more likely to contribute to DIPP's defence and technological objectives. For example:

- Among incremental projects, 67% were judged to have made a high contribution to technological capability, compared with 40% of the non-incremental projects.

- High contribution to defence in the form of a product was made by 20% of non-incremental, and 48% of incremental projects.

- In the form of knowledge capable of future exploitation, high contribution to defence was made by 20% of non-incremental and 50% of incremental projects.

Risk was also closely related to incrementality. Both technological risk and commercial risk were assessed as higher for incremental projects than for non-incremental projects. For example:

- Of incremental projects, only 19% were associated with low technological risk, compared with 80% of the non-incremental projects.

- All the non-incremental projects, but only 25% of the incremental projects, were judged to have had a low commercial risk.

Technology, Defence, and Economic Return

The questionnaire included a number of items which measured the technological "status" of the firm or the project. The relationship of these items to net present value is shown in Exhibit 11 (A to D), opposite. In all four comparisons shown in the exhibit, the lower level of technology has fared better than the higher level. Firms which are followers in their field get a better NPV than leaders.

Projects which are not new to the company are better than new projects; embryonic technology achieves significantly lower NPV than medium or mature technology; and projects representing routine applications of technology achieve a better NPV than those making a significant advance in the state of the art.

It is important to note that these relationships are greatly weakened, or even reversed, when only incremental projects are considered. When non-incremental

EXHIBIT 11

TECHNOLOGICAL CHARACTERISTICS

Net Present Value

A		Negative	Positive	Total
Company's Technological Status	follower	3 (43%)	4 (57%)	7 (100%)
	leader	10 (53%)	9 (47%)	19 (100%)
	TOTAL	13	13	26
B				
Project "newness" to firm	not new	5 (42%)	7 (58%)	12 (100%)
	new	8 (57%)	6 (43%)	14 (100%)
	TOTAL	13	13	26
C				
Maturity of technology	mature	4 (44%)	5 (56%)	9 (100%)
	medium	4 (36%)	7 (64%)	11 (100%)
	embryonic	5 (83%)	1 (16%)	6 (100%)
	TOTAL	13	13	26
D				
Technological Application	routine application	2 (33%)	4 (67%)	6 (100%)
	imaginative application	8 (53%)	7 (47%)	15 (100%)
	significant advance	3 (60%)	2 (40%)	5 (100%)
	TOTAL	13	13	26

projects are excluded, technological leaders do better than followers (44% vs. 25% have a positive NPV). Projects representing routine applications do less well than those representing advanced or imaginative applications (33% vs. 41% positive NPV). The 15% difference between projects which are or are not new to the firm is reduced to only 4% difference among incremental projects. And while the percentage of embryonic projects with a positive NPV remains at 16%, the percentage of mature projects which are positive falls from 56% to 20%, reducing the original 40 percentage point difference between these extremes to only 4 ("Medium" technology remains high on positive NPV: 64% of projects, 67% of incremental projects).

It appears, from this evidence, that the negative relationship between level of technology and economic return is not so much an inherent feature of advanced technology but a function of the fact that non-incremental projects almost always boost the low-technology - positive NPV cell. Once this "bias" is removed, it appears that the level of technology is not a good predictor of economic success. Perhaps the only guidance is provided by the fact that "medium" technologies are significantly better economically than both embryonic and mature technologies.

This finding, from this module, must be balanced against the regression analysis in which the technology factor was a significant positive variable with NPV for incremental projects, the difference being, of course, as between a "Go/No Go" measure (Positive/Negative NPV) and a continuous measure (NPV).

Nevertheless, it would be fair to speculate that the Technology factor is not a linear variable but one in which a good deal of the advantage is attained at the medium maturity level.

Exhibit 12, Part A, overleaf, shows that projects with a positive NPV make a higher contribution to the company's technological capability than projects with a negative NPV. The second part of the Exhibit (B) shows that the relation becomes stronger when only incremental projects are considered.

In Exhibit 13, overleaf, we show the relation between contribution to defence and economic return. The data indicate that projects which make a high contribution to defence are more likely to have a positive NPV than projects which make a low contribution. This relation remains basically unchanged when incremental projects are considered separately.

Overall, as Exhibit 14, overleaf, shows, risk and NPV are negatively correlated. Contrary to the rationale of supporting risk to encourage high economic return, the data show that low risk projects, in terms of both technological and commercial risk, do better economically than high risk projects. It should be noted, however, that this negative relationship is weakened significantly when only incremental projects are considered. Exhibit 14 shows a 35 percentage point difference, with respect to positive NPV, between low and high technological risk projects. Among incremental projects, the analogous difference is only 10 percentage points. With respect to commercial risk, the 21 percentage point difference reported in Exhibit 14 falls to only 3 percentage points among incremental projects. The reason for this large difference is to be found in the fact that the non-incremental projects were almost exclusively from the low risk-positive NPV cell. It follows, then, that while degree of risk is related to incrementality, it is not in itself significantly related to NPV.

EXHIBIT 12

CONTRIBUTION TO TECHNOLOGICAL CAPABILITY

Net Present Value
(All projects)

A		Negative	Positive	Total
Contribution to Technological Capability	Low	6 (46%)	4 (31%)	10
	High	7 (54%)	9 (69%)	16
	TOTAL	13 (100%)	13 (100%)	26

(Incremental projects only)

B		Negative	Positive	Total
Contribution to Technological Capability	Low	6 (50%)	1 (13%)	7
	High	6 (50%)	7 (87%)	13
	TOTAL	12 (100%)	8 (100%)	20

IBIT 13

ION TO DEFENCE

esent Value

egative	Positive	Total
3 (67%)	7 (31%)	15
4 (33%)	6 (69%)	10
2 (100%)	13 (100%)	25

Negative	Positive	Total
8 (67%)	7 (13%)	15
4 (33%)	6 (87%)	10
12 (100%)	13 (100%)	25

EXHIBIT 14

CONTRIBUTION TO DEFENCE

Net Present Value

A		Negative	Positive	Total
Technological Risk	Low	2 (25%)	6 (75%)	8 (100%)
	Medium	8 (62%)	5 (38%)	13 (100%)
	High	3 (60%)	2 (40%)	5 (100%)
	TOTAL	13	13	26

B		Negative	Positive	Total
Commercial Risk	Low	4 (36%)	7 (64%)	11 (100%)
	High	8 (57%)	6 (43%)	14 (100%)
	TOTAL	12	13	25

ANNEX IV TO THE DIPP EVALUATION STUDY

USER SURVEY

ANNEX IV TO THE DIPP EVALUATION STUDY:

USER SURVEY

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I - USER SURVEY

One of the methodologies selected for the evaluation of DIPP was a survey of all companies not covered in the major- and mini- case studies. The objective was to attain a larger, but less detailed, amount of information on a larger number of companies than were covered in either the major- or mini- case studies. These data would provide input to the statistical analysis.

The computer file Report GC-154, Schedule 3, prepared by the Financial Services Branch provided a preliminary list of companies and projects that had received DIPP assistance since 1970. That report, however, required additional information in several areas:

- many DIPP funded projects (about 20%) were missing;
- contract values and year were not always accurate;
- company names and addresses were often outdated.

These problems meant that an examination of DIPP Office, Industry Sector Branches, and Financial Services Branch files had to be undertaken in order to correct mistakes and fill in the gaps in the computer file. In the end, a complete list of DIPP funded companies, projects, and contract values was produced.

The unit of analysis for the survey and subsequent statistical analysis was a project defined either as the development by a company of a specific product, or, if the company received Capital Assistance, the production of a new product or machine. Because some DIPP projects, as just defined, have received DIPP funding on several occasions (research and development over several years), it was sometimes necessary, in identifying the population of products, to "link" together two or more of the items shown as "projects" in the ITC records. This linkage process was necessary because in the DIP Program, a new contract and project file is created each time a company received assistance, even if the assistance is for the further support of an existing project.

A final list of 117 companies and 215 projects was produced.

SAMPLING PROCEDURE

The sampling procedure involved selecting one project from each of the population of 117 companies. If a company had undertaken an R&D project, that project was selected to ensure that adequate weight was given to this type of assistance. If the company had two or more R&D projects, one was randomly selected. If a company had undertaken only Capital Assistance or Source Establishment projects, one of the Capital Assistance was randomly selected. Finally, if a company had received only Source Establishment assistance, one of these projects was randomly selected. The sample in total, therefore, was made up of 117 projects. (The questionnaire, it should be noted, covered both Corporate and Survey information so that, from the Corporate aspect, almost the total population of DIPP firms was contacted in one form or another).

In order for questionnaires to be mailed, the address and president's name for each company was obtained either from the Canadian Trade Index or by telephoning companies.

USER SURVEY QUESTIONNAIRE

All 117 companies were sent questionnaires asking for detailed company and project information. The major topics covered in the questionnaire were:

- selected company characteristics (sales, profits, R&D expenditures, number of employees);
- company involvement with the Canadian Forces;
- company participation in offset programs;
- the effect of DIPP on the company;
- project characteristics (type of technology, sales, incrementality, risk, reasons for shortfall in sales);
- company's opinion of DIPP.

The questionnaires were accompanied by a covering letter from the Deputy Minister of ITC as well as a letter from the DIPP Evaluation Task Force assuring the companies of complete confidentiality.

To increase the response rate, each company which had not replied after 7 weeks was contacted by telephone.

USER SURVEY CHARACTERISTICS

Approximately 55 (50% of the companies) returned completed questionnaires. The projects undertaken by these companies had received $20 million in DIPP of funding (2.1% of total DIPP funding between 1969 and 1979). The size distribution of these companies is shown in the following table:

NUMBER OF EMPLOYEES	PERCENT OF TOTAL
0 - 100	25.7
100 - 200	28.5
200 - 500	25.7
500 +	20.0
	100.0

Most companies were small (less than 200 employees), reflecting the fact that most (90%) were machine shops and had received Capital Assistance to produce specialized products.

Finally, most of the companies (88%) were Canadian-owned as opposed to foreign-owned.

INTERPRETATION OF DATA

Since the user survey was designed to provide input to the statistical models and analyses, the results of the survey as a separate entity are not reported in this study. Annex V gives a detailed account of the statistical analyses performed on these data.

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ANNEX V TO THE DIPP EVALUATION STUDY

REGRESSION ANALYSIS

ANNEX V TO THE DIPP EVALUATION STUDY:

REGRESSION ANALYSIS

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I - INTRODUCTION

The DIPP Evaluation Study, as is evident from preceding sections of this report, amassed a formidable data base on company and project characteristics related to the DIP Program. This data base was composed of elements from the sample user survey, the expert opinion questionnaires, and the major and mini case studies, with extensive interview data being recorded in the case studies.

One of the principal problems in analyzing a data base of this magnitude is to decide what kinds of information and statistics to examine and how to summarize the data in the most cogent and informative way. As an example of this problem, consider the combinatoric problem of dealing with three-way cross-tabulations. Clearly a description of return on investment (classified for illustrative purposes as positive or negative only), broken down by type of program (say research and development versus other), and company size (large or small), could be useful. Such a display would indicate how size of company affects economic return, and how this effect depends on the type of program. If we had only 100 characteristics (we have many more in our data base), the number of possible three-way tables, analogous to the one mentioned above, would be 128,700. Thus some way of drastically reducing the number of tables is required.

Objectives

We used regression analysis as our major tool for focusing on the important relationships, which were then displayed in standard tabular form. Thus the central purpose of this analysis was not to get precise estimates of effects but rather to identify the most significant relationships. These relationships could then be discussed and displayed in the context of all the other knowledge acquired in the course of the evaluation.

A secondary objective of the regression analysis was predictive. We tried to find out if a small set of project or company characteristics could explain and predict the economic results of a project (e.g., return on investment or incremental sales). If so, a score could be determined for each project before the awarding of a DIPP grant. This score would reflect the relative chances of success for a project from the perspective of the economic indicators used in the regression analysis. Such a score might then be taken into consideration in deciding whether a DIPP grant should be given.

Related to the previous two objectives of the regression analysis is a third - an informal testing of relationships. One way of addressing important questions such as "Do very innovative technological projects have relatively high economic pay-offs?" is through the use of regression. No statistical technique can prove cause-effect relationships, but one goal of our regression analysis was to shed further light on these kinds of important relationships, and explain as fully and informatively as the data permit exactly what the nature of these relationships is.

METHODOLOGY

Three separate sets of regressions were run: one involving only user survey respondents, one involving the mini and major cases, and one involving both the survey respondents and the case studies. The potential variables differed among the groups, and that was the major reason for analysing them separately. The size of each datum set was as follows:

- user survey: 46 projects, few variables;

- combined user survey and mini and major case studies: 80 projects, few variables; and

- case studies: 28 mini case studies and 6 major case studies. Seven major case studies were conducted, but the case study for Microsystems International Limited was not included in the statistical analysis. The company is now defunct, and little inforamtion was available. Thus, this datum set comprised 34 projects (28 + 6), with many variables.

The basic methodology used to derive final equations was as follows:

- an a priori choice of important dependent variables and all potentially relevant independent variables;

- exploratory data analysis, using step-wise regressions (all variables forced in), various all-possible-subset regressions, residual analysis, and examination of the correlation matrix. The examination of the

correlation matrix, together with principal component analysis (examination of relevant covariance eigenvalues) and plotting of variable F-values throughout all stages of stepwise regression, allowed us to master the multicollinearity problem;

- based on our exploratory data analysis, final model specifications. These specifications included all variables which appear to be important, even if they were not significant at the ordinary levels of statistical significance; and

- final regression calibration. This involved estimation of the final regression coefficients, F-values, and coefficients of determination.

Results of the regression analysis were communicated to all members of the DIPP evaluation team, to be used for deciding upon further tabulations for their own analysis, or to be used directly in support of their independent analyses and interpretations.

Variables

The dependent and independent variables used in the regression analysis of the user survey and user survey plus case study data are shown in Exhibit 1, opposite. Because the user survey approach was, by design, broad but not deep, many of the most important variables (e.g., NPV) were not included in this regression analysis. Nevertheless, the results are interesting in their own right and indicate some very important relationships. Exhibit 2, overleaf, lists the variables for the case study regressions. Although the list is longer, the fewer degrees of freedom available (i.e., a smaller sample size than the user survey) made the analysis very sensitive.

EXHIBIT 1

SURVEY AND SURVEY PLUS CASE STUDY REGRESSION VARIABLES

Dependent Variables

Variable Name	Meaning
1. PWODIP	A 1-5 scale, with low values meaning the DIPP grant was non-incremental, and high values indicating high incrementality, as perceived by the company*
2. TPTS	Total sales of the project
3. VARRISK	The variance of the expected return on investment before the project started; as the companies indicated the distribution of possible customers from the project (with associated probabilities). The standard variance formula was then applied to yield VARRISK, a measure of project risk.
4. PWODIP X TPTS	The product of incrementality and total project sales, indicating incremental sales. The model is that a PWODIP score of 1 implied a 100% chance of the project going ahead without DIPP, a score of 2 implied a 80% chance, etc.

Independent Variables

5. ASSIST	0 if project were capital assistance or source establishment, 1 if R&D
6. CX1	1 if project were defence, 0 otherwise
7. CX2	1 if project were both civil and defence, 0 otherwise
8. NOWNSHP	1 if company foreign-owned, 0 otherwise
9. ATSA	Average annual company sales (size of company)
10. EXPER	Average annual percentage of company sales due to exports
11. INDS1	1 if company were transportation, 0 otherwise
12. INDS2	1 if company were electronics, 0 otherwise
13. AVEQ	average annual owners' equity
14. VALUE	value of DIPP grant

* It should be noted that the scale for PWODIP has been reversed for regression purposes. On the questionnaire, low values of PWODIP mean high incrementality, and high values non-incrementality.

EXHIBIT 2

CASE STUDY REGRESSION VARIABLES

Dependent Variables

Variable Name	Meaning
1. NPV	Net present value (in millions)
2. INC	1 if project were considered incremental; 0 otherwise
3. NPV X INC	Incremental net present value, equal to INC multiplied by NPV

Independent Variables

4. ASSIST	1 if project were R&D; 0 otherwise
5. NOM	1 if project were nominated; 0 otherwise
6. CX1	1 if project were defence; 0 otherwise
7. CX2	1 if project were defence and civil; 0 otherwise
8. PROBEX	A 1-5 variable, with low values indicating a small chance the company would be existing in Canada without DIPP support
9. DEFPER	percentage of company's experts going to defence
10. AVTE	Average size of company (employees)
11. NOWNSHP	1 if company foreign-owned; 0 if Canadian-owned
12. RDINT	R&D intensity of company, as measured by proportion of expenditures in this area
13. SEPER	percentage of scientists and engineers in the company
14. MARINTE	marketing intensity of company, as measured by proportion of expenditures in this area
15. E1	average expert opinion on technological sophistication; low values on a 1-5 scale indicate the company tends to be a follower, and high values a leader, in the international field

EXHIBIT 2 Continued

Variable Name	Meaning
16. E2	average expert opinion of newness of corporation to this area of technology; low values on a 1-5 scale indicates the project did not, to any great extent, involve the corporation in an area of technology new to it.
17. E3	average expert opinion of embryonic - mature 1-5 scale; low values indicate embryonic technology and high values mature technology
18. E10	average expert opinion on contributions to development of technological capability in firm; low values on the 1-5 scale indicate low contribution
19. E16	average expert opinion on what values project yielded to defence capability in the form of a product; low values on the 1-5 scale indicate low value for its cost
20. E20	average expert opinion on technological risk; low values on 1-5 scale indicate high technological risk
21. E21	average expert opinion on commercial risk; low values on 1-5 scale indicate high commerce risk
22. INDS1	1 if project were in transportation, 0 otherwise
23. VALUE	discounted value of DIPP grant
24. INTVIE20	A 1-4 scale, with low values maeaning high company strength in R&D, and high values indicating low company strength, as perceived by the company.
25. INTVIE22	A 1-4 scale, with low values meaning high company strength in marketing, and high value indicating low company strength, as perceived by the company.

For each set of data (user survey, user survey and case studies, case studies alone) the final regression models, based on a priori variable selection and exploratory data analysis, are presented in the following pages. The results begin with the user survey dataset, followed by the combined user survey and case studies data set, and ending with the case studies data set.

II - REGRESSION ANALYSIS OF USER SURVEY DATA

INCREMENTALITY

The final regression model for incrementality of the projects examined in the user survey is shown in Exhibit 3, opposite. The dependent variable here was PWODIP, which, as indicated in Exhibit 1, is a 1-5 scale variable, with low values indicating a large chance of the project having gone forward without DIPP funding, and high values indicating a small probability of the project having gone ahead without DIPP funding. In other words, low values correspond to low incrementality, and vice versa.

how are they determined

As is evident in Exhibit 3, we did not get a particularly interesting regression fit for incrementality. The only variable of even marginal relationship (statistically significant only at P = .22) to incrementality was the ASSIST variable. The positive value of this variable indicates that R&D projects tend to be more incremental than the capital assistance and source establishment projects. Aside from this observation, we were unable to discern any other meaningful statistical relationships.

EXHIBIT 3

REGRESSION ON INCREMENTALITY (PWODIP)

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	-2.045			
ASSIST	.645	.514	1.58	.22

$R^2 = .034$

TOTAL SALES

Exhibit 4, opposite, shows the results of the regression using total project sales as a dependent variable. Two regressions were run with and without the risk variable VARRISK. The reason for this is that the regression equation could conceivably be used without VARRISK as a predictor of project sales. All the other independent variables are quite readily obtained prior to making a decision on whether to award DIPP funds. Risk, however, is clearly less objective and less stable since it is very dependent on who is doing the estimation, and it is for consideration as to whether to exclude it from a predictive equation.

The most important variable, in terms of a statistical explanation of project sales, was the ASSIST variable. Using -21200 as our coefficient estimate, we would interpret this value to mean that, everything else being equal, the sales arising from R&D projects are $21,200 less per project than those arising from capital assistance and source establishment projects.

The interpretation of the CX1 variable is that defence project sales were, on the average, $15,056 less per project than the corresponding sales in civil projects. No significant difference was detected between the civil and the combined civil-defence projects.

The coefficient for our risk variable was negative. This indicates that the higher the variance of expected outcomes for the project, the lower the total project sales. In other words, risky projects vary not only in their outcomes, but, overall, they do less well than non-risky projects. If this interpretation holds up under further analysis, it would call into question the justification for risk-support programs.

EXHIBIT 4

USER SURVEY REGRESSION ON TOTAL PROJECT SALES

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	25,547.33			
ASSIST	-21,200.27	17,527.31	1.46	.23
CX1	-15,056.26	14,362.45	1.10	.30
VALUE	0.03	0.02	1.47	.23
		R^2 = .116		
Intercept	39,571.94			
ASSIST	-31,543.74	16,905.18	3.48	.07
VARRISK	-817,547.39	463,212.61	3.12	.08
		R^2 = .116		

.s, one often justifies the support of risky projects because, ɜ variance of outcomes makes individual companies averse to going ɲ the project on their own, the actual expected outcomes should, in .e, be quite good. If, however, the overall expected results are both nd variable (risky), there is little reason to support such projects. It uld be borne in mind that the risk of the projects was estimated by company fficials long after the projects commenced. There might have been a tendency to specify projects which did not work out well as risky, even if this was not the opinion before the project commenced.

RISK

We performed a regression on VARRISK to see if we could uncover factors which might cause a project to be considered risky. The results of this regression are shown in Exhibit 5, opposite. Two variables appear to be important. The interpretation of the NOWNSHP variable is that the projects of Canadian-owned companies were considered riskier than the projects of foreign-owned companies. This does not appear to be due to foreign-owned company projects having better sales, and therefore being rated as less risky. We rejected that explanation because total project sales were included in the regression equation, and the correlation between sales and ownership was very small (.01). The low correlation was evident in the regression on total sales, where NOWNSHP was seen to be significant only at a level of .91. Thus our interpretation must remain that these data indicate that Canadian companies perceived as riskier their projects, than the projects of foreign-owned firms.

The total sales variable was also important. The coefficient indicated that the higher the total project sales, the lower the perceived risk. This

EXHIBIT 5

USER SURVEY REGRESSION ON RISK

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	.017			
TPTS	-.00000005	.00000005	1.35	.25
NOWNSHP	-.0067	.0041	2.71	.11
VALUE	-.00000001	.000000001	2.07	.16

R^2 = .1578

relationship was discussed previously in the section describing the regression on total sales, and it is not a particularly surprising conclusion.

INCREMENTAL SALES

This regression, the results of which are shown in Exhibit 6, opposite, used as a dependent variable PWODIP X TPTS, i.e., total project sales weighted by perceived incrementality. Thus high values for this variable indicate high sales on an incremental project, while low values indicate low sales on a non-incremental project. Because we felt that the 1-5 incremental scale represented a level of probability regarding incrementality, we thought it would be more meaningful to use these values to weight sales rather than to simply divide sales into deterministic categories of incremental and non-incremental sales.

The civil-defence variable is also highly relevant in explaining incremental sales. Civil projects had the highest incremental sales, followed by projects which were both civil and defence. Defence projects performed less well on incremental sales than the other two.

The ASSIST variable has a very negative coefficient, indicating that capital assistance-source establishment projects do much better than R&D projects in generating incremental sales.

The risk variable, although not statistically significant here at low significance levels, does show a relationship to incremental sales. The high-risk projects generate fewer incremental sales than similar low-risk projects. As

EXHIBIT 6

USER SURVEY REGRESSION ON INCREMENTAL SALES

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	169,313.44			
CX1	-79,071.43	60,336.83	1.72	.20
CX2	-31,541.98	44,603.00	.50	.48
ASSIST	-105,716.11	71,077.64	2.21	.14
VARRISK	-2,218,575.17	1,906,826.60	1.35	.25

$R^2 = .127$

discussed previously, this result calls into question the justification for risk-support programs.

SUMMARY OF THE SURVEY REGRESSIONS

The major economic indicators for these user survey data were total project sales and total project incremental sales. We found that the civil-defence variable was of principal importance, with civil projects doing much better than defence projects. Also important was DIPP grant size, with high-value grants leading to better project results.

Another important variable was the R&D-capital assistance split. Capital assistance-source establishment projects tend to do much better than R&D projects on our major indicators.

Our analysis also indicated that perceived project risk was related to four variables in our data base: ownership, sales, incremental sales, and the value of the grant. Riskier projects were ones which did not, relatively, turn out too well on the basis of sales and incremental sales, i.e., projects which turned out well tended to be low-risk. We also found that Canadian-owned companies tended to undertake riskier projects than foreign-owned companies.

Some of the variables not appearing in the regressions are worth noting. The size of the company, whether measured by total sales or equity, was unrelated to any of the indicators in the regression. The sector of the company (transportation, electronics, or other) likewise showed no relationship to any of

our dependent variables. Ownership (Canadian or foreign) was related to the risk variable, but it showed no association with any of the economic indicator variables. We also examined a variable which indicated to what extent the company was involved in exports (ratio of export sales to total sales). This variable also showed no correlation with any of our dependent variables.

III - REGRESSION ANALYSIS OF USER SURVEY AND CASE STUDIES DATA

The dependent and independent variables used in the regression analysis of the user survey and case study data are the same as discussed previously for the user survey data only. They are displayed in Exhibit 1. Since some of our conclusions are different from those reached in the user survey analysis, each regression will be described in turn.

INCREMENTALITY

The final regression model for project incrementality is shown in Exhibit 7, overleaf. The dependent variable PWODIP takes on low values for low incrementality and high values for projects which would not have gone ahead without DIPP funding.

Our final model was considerably better specified than the one obtained with the survey data only. We observed that two variables were highly significant. The NOWNSHP coefficient, -.87, indicates that Canadian firms are much likelier to be involved with incremental projects, everything else being equal. As found previously, the significant ASSIST variable means that R&D projects tend to be more incremental than capital assistance and source establishment projects.

EXHIBIT 7

USER SURVEY PLUS CASE STUDIES REGRESSION ON INCREMENTALITY (PWODIP)

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	-2.07			
ASSIST	.69	.332	4.28	.04
NOWNSHP	-.87	.346	6.13	.01

$R^2 = .10$

EXHIBIT 8

USER SURVEY PLUS CASE STUDIES REGRESSION ON TOTAL PROJECT SALES

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	8619.79			
CX1	-45199.05	13532.19	11.16	.0014
EXPER	625.45	233.34	7.18	.0093
VALUE	.01	.00085	165.14	.0001

$R2 = .74$

TOTAL SALES

For the variable total project sales, an extremely well-fitting equation was produced with only three variables. As shown in Exhibit 8, on page 107, the value of the DIPP grant is the single most important variable.

The CX1 variable indicates that everything else being equal (including the DIPP grant sizes), the civil projects exceeded the defence projects in sales by an average of $45,199 per project. Finally, the variable EXPER, which relates to the percentage of export sales in the company, was found to be statistically significant. If one company exceeds a similar company by 10% in overall export sales, it will have average sales of $6,255 more per DIPP project (everything else being equal).

RISK

The results of our risk regression are shown in Exhibit 9, overleaf. Ownership is seen to be the most important explanatory variable. Canadian firms, according to these numbers, tend to undertake significantly riskier DIPP projects than their foreign-owned counterparts. We also see that DIPP grant size is universally related to risk: the higher the grant size, the less the perceived project risk.

INCREMENTAL SALES

Exhibit 10, overleaf, describes the results of our analyses of incremental sales (PWODIP X TPTS). We found that risk was the most significant factor,

EXHIBIT 9

USER SURVEY PLUS CASE STUDIES REGRESSION ON RISK

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	.0160			
VALUE	-.00000001	.000000001	1.54	.22
NOWNSHP	-.00385	.0031.	3.22	.08

R^2 = .115

EXHIBIT 10

USER SURVEY PLUS CASE STUDIES REGRESSION ON INCREMENTAL SALES

Variable	Coefficient	Standard Error	F-Value	Significance
Intercept	144,049.26			
ASSIST	-102,379.95	42,516.66	1.57	.21
VARRISK	-2,091,172.00	1,668,593.37	5.80	.02

R^2 = .133

with higher risk being associated with fewer incremental sales. This indicates that even though incremental projects are expected to be risky, maximization of incremental sales will nevertheless result from non-risky projects.

The other variable which manifested some relationship to incremental sales was ASSIST. The negative sign for this variable indicated that R&D projects resulted in fewer incremental sales than similar capital assistance/source establishment projects.

SUMMARY OF USER SURVEY PLUS CASE STUDY REGRESSIONS

The major economic indicator of project success in this analysis was total project sales. As in the survey analysis we found that civil projects, high DIPP grant projects, and capital assistance/source establishment projects tended to be associated with good economic payoff. We also found that riskier projects did not yield as good results, and that risk was related to size of grant and ownership. Companies which were heavily involved in exports tended to do better on total sales (this variable did not emerge as significant in the analysis of the user survey results).

IV - REGRESSION ANALYSIS OF CASE STUDIES DATA

Because of the importance and complexity of the case study regression, we are presenting the results in a different form from that used in the previous analyses. Exhibits 11 and 12, overleaf, show the analysis of net present value in the new presentation format.

EXHIBIT 11

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ANALYSIS OF NPV

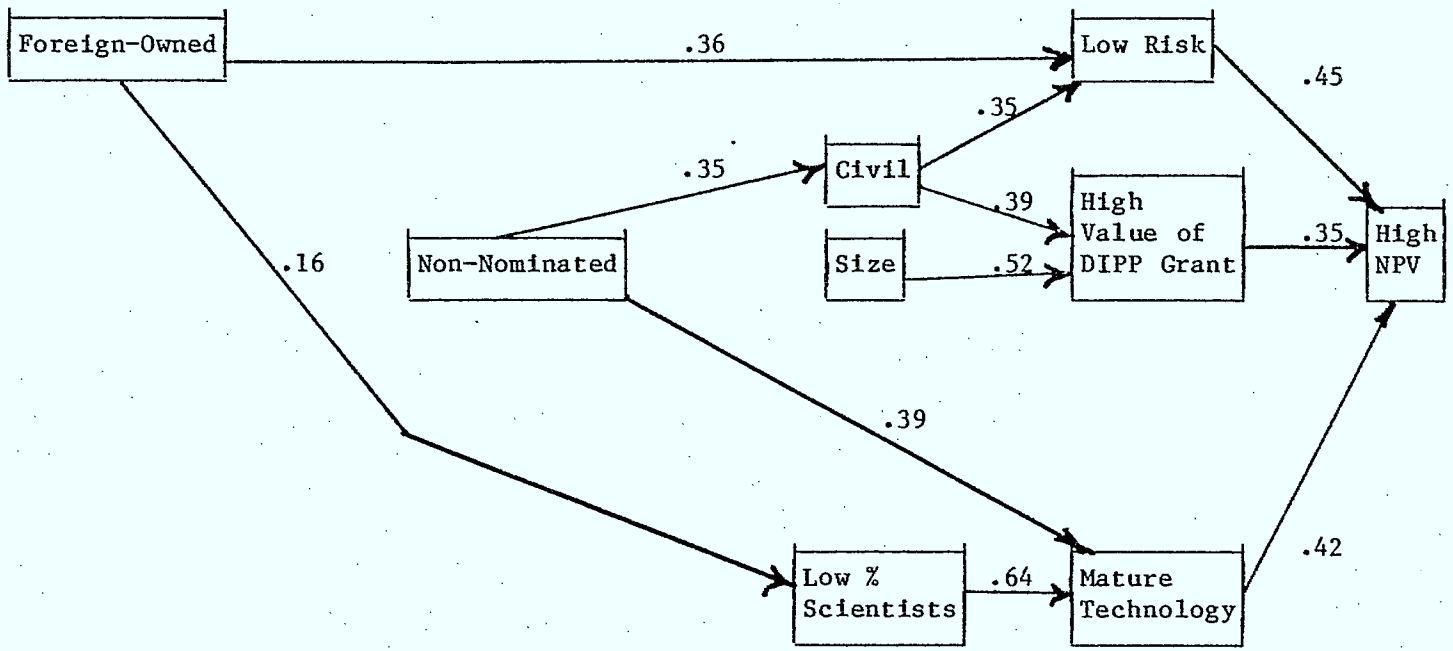

EXHIBIT 12

ANALYSIS OF NPV (HIGH)

Variable	Direct	Indirect	Total
Low Risk	.45	0	.45
High DIPP Grant	.35	0	.35
Mature Technology	.42	0	.42
Civil	0	.29	.29
Size of Company	0	.18	.18
Low % Scientists and Engineers	0	.27	.27
Non-Nominated	0	.27	.27
Foreign-Owned	0	.20	.20

Equation for Direct Effects

$$NPV = -64.96 + 12.32E21 + 8.76E3 + .00000103 \text{ VALUE}$$

$$R^2 = .793$$

The net present value (NPV) is the dependent variable of interest. Three independent variables are directly linked to this variable in Exhibit 11: risk, value of DIPP grant, and type of technology. These variables were identified by means of the regression methods discussed previously. If the results were presented in an analogous form to the survey results, these would be the only variables considered. The analysis, however, has been extended in order to present as complete a picture as possible of what the data show. We have also performed regressions on the various independent variables. A combination of these regressions plus common sense (both are required to obtain a structure like that shown in Exhibit 11) result in the diagrams shown in this section.

The numbers shown represent B (beta) regression coefficients. For example, the risk variable was regressed on the ownership and civil-defence variables, with beta coefficients of .36 and .35, respectively, resulting from these regressions. The strength of the relationships are indicated by the size of the beta coefficients.

One way of summarizing the numbers in Exhibit 11 is as shown in Exhibit 12. The direct effects are merely the beta coefficients for the variables directly linked to the dependent variable. The indirect effects are found by appropriate multiplication and summation. For example, the civil-defence variable operated indirectly on NPV by its effect on risk and the value of the DIPP grant. The effect of this variable was obtained by adding .35 x .45 (the effect of the civil variable on NPV mediated by risk) to .39 x .35 (the effect of the civil variable on NPV mediated by DIPP grant size). This number, equal to .29, is shown as the indirect effect in Exhibit 12.

These diagrams are similar to those used in path analysis. However, unlike standard path analyses, our analyses and diagrams are descriptive, not confirmatory. In other words, we are presenting an illustration of what the data themselves show. We are not examining or confirming a pre-determined model. This should be borne in mind when using these results.

The interpretation of the coefficients is as follows, using the .45 risk coefficient. An increase of our standard deviation in the risk variable (.84 on our scale) can be expected to increase NPV by .45 standard deviations ($20.77 million).

NET PRESENT VALUE

As shown in Exhibits 11 and 12, the most important influences on obtaining a high NPV are risk and technology. Projects which were considered to be of low commercial risk (as indicated by our expert panel) had the best chance of resulting in a high NPV. Projects involving mature, as opposed to embryonic, technology also tended to result in high NPV's. Because the effects in regression are estimated simultaneously, our figures indicate that even if two projects are considered equally risky, the one with the more mature technology would be expected to yield a better NPV, all else being equal. In other words, the effect of technology on NPV was not due only to its relationship to risk, since it exerts an additional direct influence on the economic payoff.

The value of the DIPP grant was also seen as a direct explanatory factor for NPV: high DIPP grants are associated with high NPV's. For interpretive purposes, grant size might be considered as a covariate only. In other words,

the size of its effect may not be particularly interesting but is included in the analysis in order to remove its effect before analyzing the other variables.

The most important indirect effects on NPV are the civil-defence factor, the percentage of scientists and engineers in the company, and the nominated-project variable. Because civil projects tend to be low risk with high DIPP grants, they are associated with high-NPV's. Companies with a relatively small percentage of scientists and engineers tend to carry out projects involving more mature technology and thus tend to have projects with higher NPV's. Projects which are not nominated are civil, as opposed to defence, and usually operate in mature technology areas. For these reasons, they are associated with relatively high NPV's.

INCREMENTALITY

Our analysis of incrementality is illustrated in Exhibits 13 and 14, opposite and overleaf. The dependent variable here is INC, which equals 1 if the project were deemed incremental and 0 if it were deemed non-incremental.

The two direct effects identified were risk and embryonic technology, with risk being by far the most important. Not surprisingly, incremental projects tended to be the ones identified as high-risk, while non-incremental projects had a much higher proportion of non-risky projects. Even if risk and other factors were the same, projects whose technology was relatively embryonic would be much likelier to be incremental than a mature-technology project.

EXHIBIT 13

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ANALYSIS OF PROJECT INCREMENTALITY

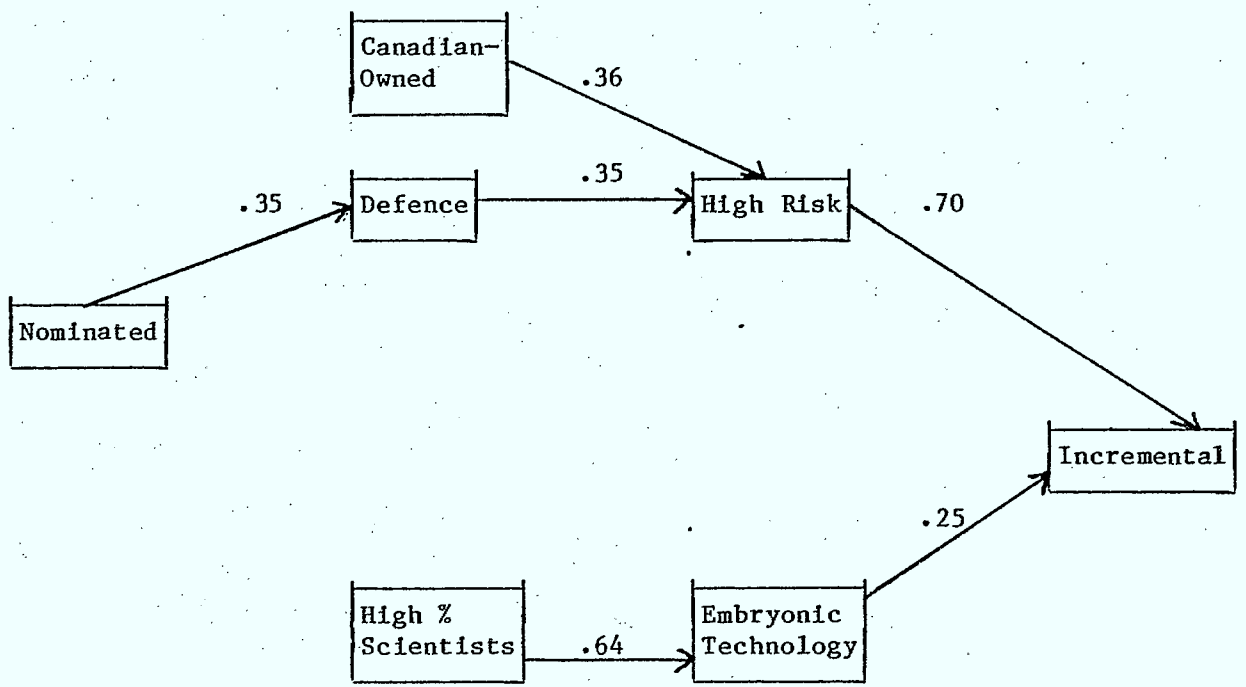


EXHIBIT 14

ANALYSIS OF INCREMENTALITY (HIGH)

Variable	Direct	Indirect	Total
High-risk	.70	0	.70
Embryonic	.25	0	.25
Canadian-Owned	0	.25	.25
Defence	0	.25	.25
High % Scientiest and Engineers	0	.16	.16
Nominated	0	.09	.09

Regression on the Direct Effects

$$INC = 2.23 - .32E21 - .12E3$$

$$R^2 = .649$$

The major indirect influences on project incrementality are the defence-civil variable and ownership. Because defence projects are relatively high-risk, it was found that defence projects tended to be incremental (as compared to civil projects). The fact that Canadian-owned firms carry out a relatively large number of risky projects means that these firms also tend to do a relatively large number of incremental DIPP projects.

NPV in Incremental Projects

Because of the importance of the incremental projects, NPV was analysed within those projects which were considered incremental. The results of this analysis are shown in Exhibits 15 and 16, overleaf.

Within the sample of incremental projects, ownership grant size and technology type were the major explanatory factors regarding NPV. The projects with large DIPP grants resulted in higher NPV, and foreign-owned companies tended to carry out projects with higher final NPV's. Mature-technology projects also tended to do better than the embryonic ones.

The most important indirect influence was company size. Because company size was so strongly related to size of DIPP grant, this variable manifested a strong relationship with NPV. Similarly, although less strongly, civil projects were associated with high NPV, and this appears to be due to their being associated with large DIPP grants. Companies with a low percentage of scientists and engineers also tended to do better, apparently because of their emphasis on mature technology.

EXHIBIT 15

CONFIDENTIAL

ANALYSIS OF PROJECT INCREMENTALITY

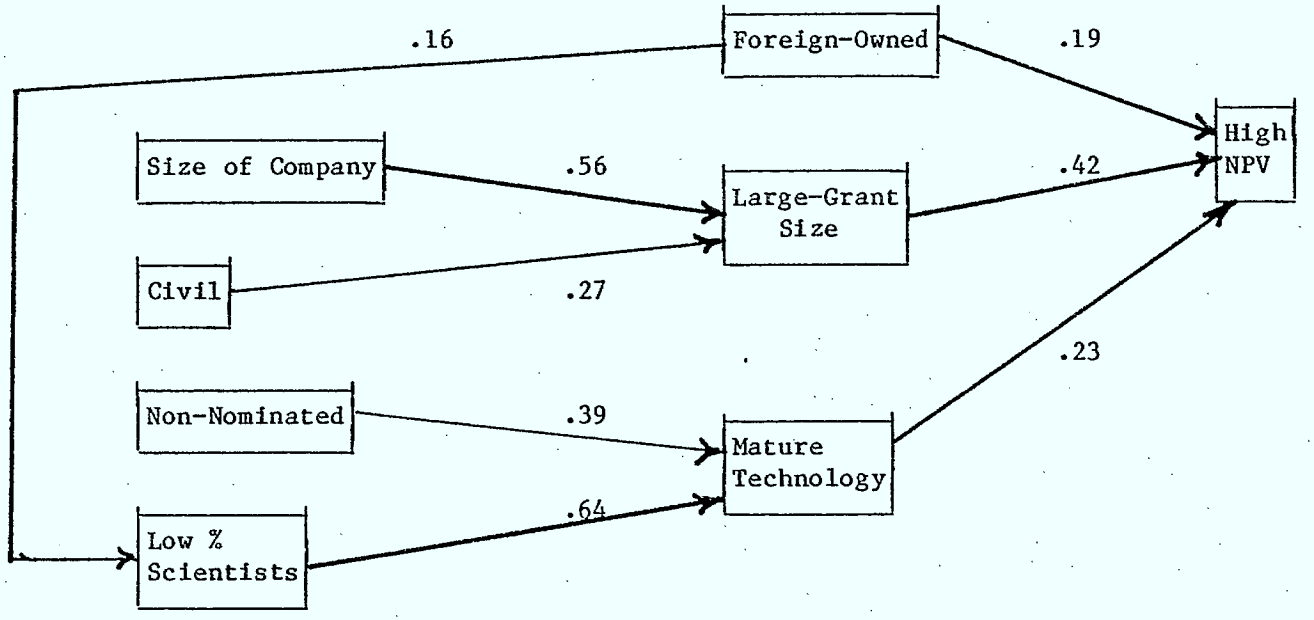


EXHIBIT 16 (HIGH)

ANALYSIS OF THE NPV FOR INCREMENTAL PROJECTS

Variable	Direct	Indirect	Total
Foreign	.19	.02	.21
Large Grant Size	.42	0	.42
mature Technology	.23	0	.23
Size of Company	0	.24	.24
Civil	0	.11	.11
Non-Nominated	0	.09	.09
Low % Scientists	0	.15	.15

Results of the Regression of the direct Effects

$$NPV = -15.47 + 6.85\ NOWNSHP + .00000086\ VALUE + 3.43E3$$

$$R^2 = .393$$

USE OF RESULTS

There are several ways in which our results could be used in decision-making regarding funding of DIPP projects. If the objective were to maximize NPV and incrementality, the Department could use directly the results shown in Exhibits 14, 15 and 16. In other words, a scoring rule could be derived, based on risk and technology type, to decide whether the project is incremental. Then, if it were considered incremental, a scoring rule based on ownership, grant size, and technology type could be derived to see if the NPV is of a reasonable expected magnitude. Unfortunately, this approach has two drawbacks. One is that it treats incrementality as the primary variable. The second is that it removes from consideration projects with low incrementality but high NPV.

If selecting high-NPV, non-incremental projects is considered the better course to follow, we suggest the following strategy:

- first screen out poor economic-payoff projects by using a rule based on risk, value of DIPP grant, and type of technology (the determinants of NPV).

- assign priority to the projects with high expected NPV based on incrementality. Incrementality could be calculated based on a scoring rule using risk and technology, or it could be directly assessed in the subjective way done in this study. The choice of method would depend on the time available and the abilities of the people examining the incrementality question.

There are various ways of implementing this approach to decision making. Clearly, one important question is the relative weight of NPV and incrementality, and how these should be considered in the final assignment of priorities. One possible method is illustrated in the following section.

EXAMPLE OF ASSIGNING PRIORITY

Suppose two projects, call them A and B, are being considered for DIPP funding. Project A is of moderately-high risk (2 on our 1-5 scale where 1 represents the highest risk), of medium maturity in technology (3 on our embryonic-maturity scale), and is asking for a total discounted grant of five million dollars. Project B represents a relatively low-risk (4 on our scale), mature-technology (4 on our scale) Project B, seeking a discounted grant of one million dollars.

According to the scoring rule shown in Exhibit 12, the expected NPV's for the two projects are as follows:

Project A: $-64.96 + 12.32\ (2) + 8.76\ (3) + .00000103\ (5{,}000{,}000) = -8.89$

Project B: $-64.96 + 12.32\ (4) + 8.76\ (4) + .00000103\ (1{,}000{,}000) = 20.39$

The incrementality estimates for these two projects, based on the equation in Exhibit 14, are as follows:

Project A: $2.23 - .32\ (2) - .12\ (3) = 1.23$

Project B: $2.23 - .32\ (4) = .12\ (4) = .47$

Since the original dependent variable for incremental was 0-1 (1 for incremental), the estimates can be interpreted as probabilities of being incremental. Thus project A is almost certainly incremental, where there is a 50% chance of project B being incremental. Since project A is a projected loser, (expected NPV of -8.89 million) while project B is a projected winner (expected NPV of 20.39 million), project B is probably a better one to support, even though its incrementality is not certain.

V - ROI AND THE ORIENTATION OF THE FIRM

To give an additional perspective on the factors which contribute to positive economic benefits, an analysis was done of the relationship between orientation of the firm (i.e., R&D oriented, production oriented, market oriented) and return on investment (ROI). Specifically, the ROI for individual projects was regressed on the companies' strength in each area. Strength in R&D, production an marketing was measured on a 1-4 scale, with "1" meaning very strong. The regression results for R&D strength and marketing strength are shown in Exhibit 17, opposite. The regression model with strength in production produced an insignificant coefficient.

The results indicate that as company strength in R&D decreases, ROI increases. In contrast, the more market oriented the firm, the greater the ROI on its projects.

The result for R&D strength tends to confirm the analysis discussed in the Report where NPV was related with various independent variables, including type of technology (embryonic or mature). It was found that mature products

EXHIBIT 17 CONFIDENTIAL

ROI AND COMPANY STRENGTH IN R&D AND MARKETING

REGRESSION: ROI ON INTVIE20 (R&D STRENGTH)

VARIABLE	COEFFICIENT	STANDARD ERROR	F-VALUE	SIGNIFICANCE
INTERCEPT	-120.383			
INTVIE20	68.117	34.811	3.83	.0693

R^2 = .2034

REGRESSION: ROI ON INTVIE22 (MARKETING STRENGTH)

VARIABLE	COEFFICIENT	STANDARD ERROR	F-VALUE	SIGNIFICANCE
INTERCEPT	133.024			
INTVIE22	-66.60	37.235	3.20	.0939

R^2 = .1758

VARIANCE (R&D) = .8857

VARIANCE (MARKETING) = .4952

tended to have higher NPV's than embryonic products. In addition, companies with a relatively small percentage of scientists and engineers (low strength in R&D) tended to carry out projects involving more mature technology and yielded higher NPV's.

VI - SUMMARY

The regression analyses conducted on the three data bases (user survey, user survey plus major and mini case studies, and major and mini case studies) have enabled us to identify the factors which affect economic payoff.

The results of the first two analyses indicated that civil projects, large DIPP grant projects, and capital assistance source establishment projects tended to yield good eocnomic payoffs.

The third analysis, on the case studies data set, included many more independent variables. The variables directly linked to NPV were found to be:

- risk

- value of DIPP grant

- type of technology

The civil/defence variable does not enter directly into the final regression equation due to its indirect relationship with NPV through the risk variable.

This final regression equation was used to produce a scoring model which permits priority to be assigned to potential projects. By simply rating projects in terms of their technology and level of risk and taking into account grant size, two or more projects can be compared in terms of their expected NPV's.

ANNEX VI A TO THE DIPP EVALUATION STUDY

MARKETING

ANNEX VI A TO THE DIPP EVALUATION STUDY:

MARKETING

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd.)

EXHIBITS

I - INTRODUCTION

This segment of the overall Marketing Module examined the marketing practices of Canadian firms as they perceive and, in fact, execute them. The results of this part of the marketing study and of the associated part on "DIPP Markets" are integrated in the covering report.

Major sources of evidence were:

- the Major and Mini Case Studies; marketing personnel participated in a selected number of these interviews, and the marketing aspects of all the interviews have been used;

- the User Survey;

- observations by ITC market research officers.

The key questions addressed were:

- How well do DIPP firms plan and execute their marketing operations?

- To what degree does the potential exist for greater and more profitable sales through improvements in these operations?

- What specific actions should be undertaken in this area?

As with the study of DIPP markets, the major focus is the U.S. defence market; however, observations on the U.S. civil market and the non-U.S. defence market are also given.

II - INDUSTRIAL MARKETING PERFORMANCE

In considering the DIP Program and its effect on Canadian industry, two major industrial sectors must be examined, and within these sectors, particular products in which Canada has specialized require comment. These sectors are aerospace and electronics. They absorb the largest percentage of expenditures for Research and Development made under the Program.

Canadian products have been developed for relatively narrow market segments. The philosophy of Canadian companies has been to examine the market broadly, determine a market niche which offers a reasonable sales volume and in which, preferably, competition is not too strong, and develop a product to match the customers' needs. This approach has advantages and disadvantages. Although the Canadian company becomes recognized as possessing specific expertise, there is usually a critical level of sales potential within the segment which, if exceeded, results in intensified competition. The Canadian company may find itself unable to compete with international companies. The company may be deficient in resources and financing, or it may have a restricted product and market base. In the case of avionics products, the company may lack a system engineering capability. There are exceptions to this situation, e.g., in the aerospace sector; however, in general, for most Canadian companies receiving DIPP R&D funding there is a definite limit to their growth potential in their current postures.

AEROSPACE PRODUCTS

The primary aircraft companies (Canadair and de Havilland) are government owned. Both companies have major programs aimed at various market applications. Canadair has developed the Challenger aircraft which is designed for general aviation and for specialist applications such as light cargo. The company also produces the CL-215 Water Bomber and the CL-89 Reconnaissance Drone. Advance sales of the Challenger have been excellent - in excess of 100 - and the CL-215 is continuing to sell in a relatively small market segment. The CL-89 has sold successfully in Europe and is considered a mature product; however, follow-on developments are taking place in this surveillance market to broaden Canadair's product line.

De Havilland has produced a line of small to medium transport aircraft ranging from the DHC-2 through the DHC-3 Otter and DHC-6 Twin Otter to the DHC-5 Buffalo and DASH-7. The Otter series has sold extremely well. However, the market is declining, and the Otter is expected to be partly superseded by the new DASH-8 30 passenger aircraft which is being developed and by a build-up in sales for the DASH-7. An extension in market life is expected for the DHC-5 Buffalo which has received civil certification. De Havilland is estimated to hold approximately 7% of the world turboprop market; Canadair has 8% of the general aviation jet market.

At present, Canada's aircraft are in a relatively good market position overall. Although in the past decade our aircraft market in the U.S. has not been large, the Twin Otter continues to be sold, and the DASH-7 is beginning to sell to the U.S. commuter market.

Military Products

Military systems, however, have been distinctly unsuccessful in the U.S. The DHC-5, a medium tactical transport designed initially for the U.S. Army, failed to achieve its market target, and the Canadair CL-84 vertical take-off vehicle was entirely unsuccessful. The CL-89 Drone also failed to sell to the U.S. military, in spite of intensive marketing efforts. Political pressure (lobbying) in the U.S. is considered to be one of the major reasons for the lack of military sales.

In other geographic areas, we have been more successful. The DHC-5 has sold to third-world countries in reasonable volume (in excess of 100), and the CL-89 has been marketed successfully to European nations. Overall commercial sales to the U.S. and overseas markets are expected to increase substantially in the next decade due to the impact of the newer de Havilland transport aircraft and the Challenger.

Aircraft Engines

Canada also specializes in aircraft engines, particularly small gas turbine and turbofan. Pratt and Whitney as a major case in point produces this product line and has achieved an over 50% world market penetration in small turboprop engines, primarily in the general aviation market. Engines are installed in over 35 types of aircraft world-wide, and the company enjoys a strong reputation with the major general aviation manufacturers, e.g., Piper, Beech, and Cessna in the U.S., and Embraer in Brazil. Pratt and Whitney has sold over 10,500 turboprop and 1,600 turbofan engines to date. Sales are expected to continue to increase in the 1980's, and the company should be able

to retain and strengthen its market position. Company sales in 1979 totalled $463 million which represented a 43% increase over 1978. The company currently has a two-year backlog of work.

Specialists

Second tier aerospace manufacturers in Canada also possess specialist development skills, in addition to providing production capability in support of the industry generally. Examples of Canadian companies with specialist expertise include Aviation Electric in fuel controls, Menasco in landing gear, Garrett in temperature controls, and Spar in space hardware and electronics. All these companies have received support from DIPP.

In overall terms, Canada holds less than 3% of the world trade in aerospace products, and 75-80% of Canadian production is exported.

ELECTRONICS

DIPP support has been provided to electronics firms in two specialized areas: primarily to companies engaged in the development and production of avionics equipment, air and ground, and also to firms concerned with certain parts of the telecommunications sector. Companies in avionics produce very specialized equipment for particular market segments.

These avionics/telecommunications firms have great difficulty achieving a significant size by international standards for several reasons. Frequently, they are unable to supply complete hardware packages, or to establish a demonstrated expertise in systems engineering, i.e., the capability of

assembling the various different items of equipment into functioning systems. These are two of the major factors inhibiting growth. In the military area, the purchases of DND are usually "off the shelf". Little development work is required of Canadian concerns, which severely restricts their ability to participate in complex development programs. Some moves have been made by Transport Canada to encourage Canadian companies to gain systems experience with the JETS Air Traffic Control System and the Vessel Traffic Management system in which Canadian companies were allowed to "prime" the installations. This experience will, it is hoped, lead to international sales in these areas.

Probably one of the weakest areas is in airborne avionics. We do have some good specialist capabilities, e.g., in navigation systems, displays, and data processing. Overall, however, the lack of domestic programs requiring the development of a systems capability in airborne avionics restricts the development of a systems capability by Canadian companies.

The move to the "higher plateau" of providing complete systems appears to depend critically on assuring Canadian firms of access to system acquisitions domestically, and, in this way, facilitating the development of a systems engineering capability. Paradoxically, foreign ownership may be of some help in resolving the difficulty of lack of systems engineering expertise, as these firms may be able to readily develop/transfer these skills.

III - UNITED STATES MARKET

Due to the prime importance of the United States in the export of Canadian high technology products, a brief description of the market situation is provided below.

OVERALL MARKET

Potentially, the U.S. represents an enormous market for high technology products developed under the DIP Program. The U.S. military currently spends some $50 billion a year in overall procurement, of which approximately $30 billion is for hardware purchases. Indications are that these amounts will increase substantially in the 1980's since President Carter recently announced plans for increased defence expenditures. In order to evaluate what these amounts mean to the Canadian manufacturer, however, we must examine how much the U.S. procures "off-shore" and in what areas. The total DOD procurement for all goods and services obtained from outside the continental U.S. is a difficult figure to establish precisely. Derived estimates of the hardware purchases range from 0.5% to 7%. Our best estimate is that 2% of this budget goes to foreign firms. This U.S. defence trading pattern appears to have changed little in the past 30 years and is unlikely to do so in the future.

In the commercial area, trading patterns in aerospace and electronics, the two major sectors for Canadian advanced technology products, are generally similar to those in the military sector. In 1978, the U.S. exported some $9 billion in aerospace products (38% of total shipments), representing approximately 60% of the world trade in this area. U.S. imports, on the other hand, were only

$648 million for the same period, which resulted in a positive trade balance of $8.5 billion. A review of historical data indicates that this pattern has prevailed for some time.

AIRCRAFT AND RELATED PRODUCTS

Commercial

U.S. imports are concentrated in specific product areas and are principally from the United Kingdom, France, and Canada. Canada held first place in 1977 primarily due to its export of small gas turbine engines manufactured by Pratt and Whitney: the latter contributed in excess of $100 million to an export total of $236 million. Canada supplied 67% of the total value of aircraft engine imports in that period. Finished aircraft were a small portion of Canadian exports to the U.S. The remainder of the total consisted of aircraft and engine parts.

Since Canada's trade in aircraft engines depends on the market projections in the aircraft on which they are used, it is useful to examine this area. Three principal U.S. aircraft manufacturers are involved: Beech, Piper, and Cessna. Beech and Piper have produced new models, and Pratt and Whitney is projected to capture 52% of their total market requirements for turboprop engines. Pratt and Whitney's engine exports to the U.S. should amount at least to upwards of $100 million per annum to 1985. Pratt and Whitney also has a strong market position with Cessna for turbofans. In succeeding years the sale of engine spare parts will double the engine sales figure. In essence, Canada should be able to maintain or improve its current engine trade patterns with the U.S.

Will there be changes in the product mix of Canadian products sold in the U.S. market in the 1980's? Indications are that the emphasis will shift toward finished aircraft such as the Canadair Challenger, de Havilland DASH-7, DASH-8, and to a lesser extent, the DHC-6. A large expansion is expected in the U.S. commuter market, resulting in a strong demand for aircraft such as the DASH-7 (which is already selling to U.S. commuter airlines) and the DASH-8. Both aircraft carry Pratt and Whitney engines, and increased sales of parts and engines for replacement should result. These aircraft sales, coupled with sales of the Challenger, which has experienced a remarkable number of orders prior to production, should boost Canadian aircraft exports to the U.S., from the current level of $10 million to at least $150 million by the mid-80's. Canada's total aerospace exports to the U.S. should exceed $500 million per annum by 1985.

Military

Canada has been unsuccessful in selling military aircraft to the U.S. over the last twenty years. In the early 1960's, the DHC-5 Buffalo was developed by de Havilland in conjunction with the U.S. Army to provide a medium tactical transport for Army use. For various reasons, including political pressure, only four aircraft were sold to the U.S. De Havilland succeeded in making sales in other geographic areas, primarily to third world countries. However, it has taken some twenty years and several re-designed programs to sell a total of some one hundred aircraft. Other aircraft such as the Canadair CL-215 Water Bomber (used primarily by government agencies rather than the military) and CL-84 Vertical Take-off Aircraft did not sell in the U.S. Again, the CL-215 did realize a market in other geographic areas (45 sales to

date, primarily in Europe). Canadair attempted to market the CL-89 drone in the U.S. However, in spite of intensive efforts, no result was achieved (again political pressure was involved). Sales to European countries, however, were appreciable and in the case of Germany, have led to follow-on developments of more sophisticated systems. (Canadair Ltd. is discussed in detail in Annex IB).

Canada's current aircraft development strength lies in two areas. De Havilland has a product line with the DHC-6 Twin Otter at the lower end of the scale, progressing to the DHC-5 Buffalo (now also produced in a civil version), and the DASH-7. With the DASH-8 which will be produced in the early 1980's, the product line will be complete, filling the gap between the DHC-5 and the DHC-6. In the late 1980's, de Havilland may develop a larger aircraft than the DASH-7, using powered lift. Canadair's major project at present is the Challenger which is primarily aimed at general aviation but which also has application to other markets such as specialist cargo.

Conclusions

In viewing Canada's situation overall, certain facts are evident:

- Sales of finished aircraft or systems to the U.S. military appear to be virtually impossible to achieve. Some engine sales are still possible, although the market is declining.

- Military end product developments should therefore be based on non-U.S. requirements, and attempts should be made to optimize designs to meet those needs. The commercial applications must also be considered to

broaden the sales base and to be responsive to the timing of market opportunities i.e., the commercial market may be first to develop.

- Sales to commercial customers in the U.S. are possible, particularly in market segments in which the U.S. is not overly competitive. These areas include small turboprop engines, certain lower thrust range turbofans, and commercial aircraft of the type produced by de Havilland and Canadair.

- Canada's room for maneuvering in aircraft engine development is becoming more restricted. With the introduction of the PT-7, Pratt and Whitney has probably gained as much marketing mileage as is possible from its turboprop series. In turbofans, the upper power limit for Pratt and Whitney's JT-15 seems to have been reached. Above that range, Garrett appears to have a stranglehold on the market.

- More latitude for development is available in aircraft, with possible product improvements to the Challenger series, the incorporation of technical improvements for future aircraft, and product extension to existing models in de Havilland's line.

ELECTRONICS

The major procurer of electronics systems and equipment in the U.S. is the Department of Defense. Other large government users are NASA and the Department of Transport. The total value of the shipments of electronic products in 1979 is estimated to be $17.1 billion, an increase of approximately 11% over

1978. It is difficult to identify precisely the amount expended by DOD on electronics since much of the money is included in the amount allocated to the procurement of major weapon systems. The Electronics Industries Association, however, estimates that 27% of the total procurement budget for hardware is allocated to electronics which would result in approximately $8.6 billion in expenditures for fiscal year 1979. In the area of Research and Development Test and Evaluation, the estimated electronic expenditure is 38% of the total allocation, or $5 billion in fiscal year 1979. The real growth in the electronics systems and equipment industry is estimated to be 16% from 1978 to 1983.

The U.S. exported some $1.5 billion in electronics systems and equipment and imported approximately $1.0 billion in 1978. Imports peaked in 1976 and have since declined.

Although the U.S. Government consumes the major portion of the U.S. industry's output, it is not the prime purchaser of imports: imports are concentrated mainly in lower technology consumer products such as CB radios. The trade gap in electronic products in favour of the U.S. is widening and is expected to continue to do so into the 1980's.

To assess Canada's export position to the U.S. relative to the type of electronic product development funded by the DIP Program is difficult. However, indications are that exports are currently in the region of $50-70 million (end products only). The U.S. absorbs some 60% of Canadian electronic product exports, amounting to approximately 10% of the U.S. total imports for this type of product.

Canada's position in this market is not encouraging - this observation is supported by a "Sector Profile" issued recently by the E&E Branch of the Department - and, with current policies two results seem inevitable:

- Avionics companies will continue to be heavily dependent on DIPP to supplement R&D due to inadequate profit margins and sales volume.

- Canadian companies will become primarily sub-contractors to large American and European companies and will gradually lose development capability and marketing expertise.

Some means must be found to exert additional marketing leverage within the U.S. (see recommendations on using primes and parent relationships) and to enable Canadian firms to expand to a sufficient size to be competitive in the export market.

IV - MARKETING CHANNELS FOR CANADIAN DEFENCE "END PRODUCTS"

INTRODUCTION

Marketing channels which are used to sell Canadian end products, i.e., those which can function as "stand alone" items, have been examined in order to discover the most effective method of marketing products developed under the DIPP program. The following questions were fundamental to identifying the best method:

. What volume of business is done through each channel, and what percentage is represented by "End Products"?

. What types of DIPP firms use the various channels and why?

. What types of products are sold via the various channels and why?

CHANNELS

Exhibit 1, opposite, illustrates the various channels used in contracting in the defence industry. Exhibit 2, overleaf, provides a statistical overview of the value of business contracts let by the three major contracting methods. These exhibits use the following ITC/CCC terminology:

- "Prime Contracts": those let through CCC on behalf of the various Defence agencies to Canadian companies.

- "Direct Primes": contracts made directly between Defence agencies and Canadian companies.

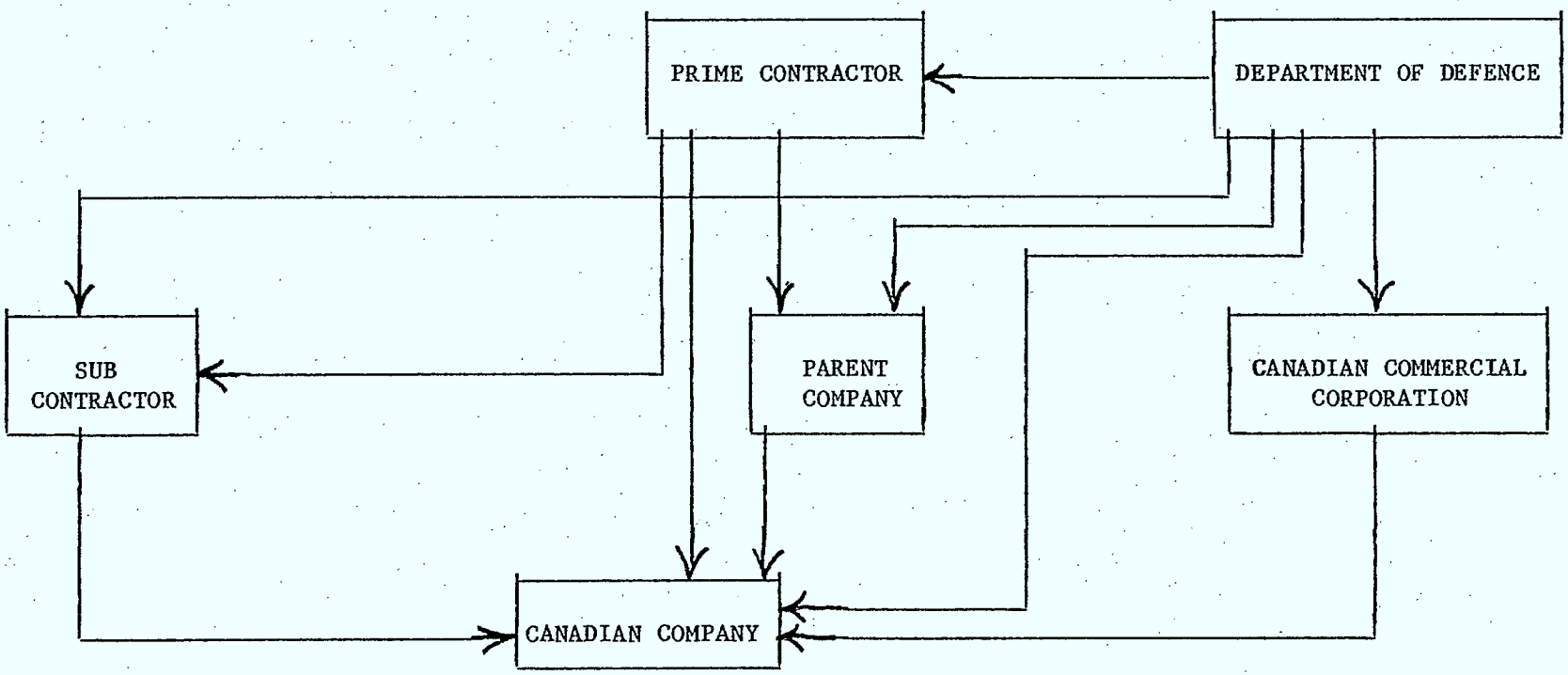
- "Subcontracts": contracts between Canadian concerns and:

  . subcontractors providing equipment to defence agencies or "prime" contractors ("prime" in this sense meaning companies responsible for developing/producing major systems on behalf of the defence departments); or

  . directly from "prime" contractors.

EXHIBIT 1 **CONFIDENTIAL**

SOURCES OF DEFENCE CONTRACTS



DEFENCE CONTRACT ACTIVITY – OVERSEAS AND UNITED STATES

Market Research & Analysis Division, ITC (MRAD) (Contract Value and %)
March 1980

Purchasing Geograph Loc.	Marketing Channel Classification	Product Area	1975 $Mil.	% of Total	1976 $Mil.	% of Total	1977 $Mil.	% of Total	1978 $Mil.	% of Total
Overseas	Prime Contractors (CCC)	End Products	1.7	7.5	9.5	11.2				
		Other	20.8	92.5	75.7	88.8				
		Sub-Total	22.5		85.2					
	Direct Prime Contracts	End Products	14.4	40.6	52.4	62.3				
		Other	21.1	59.4	31.7	37.7				
		Sub-Total	35.5		84.1					
	Sub-Contracts	End Products	1.9	5.5	.2	1.4				
		Other	32.4	94.5	14.1	98.6				
		Sub-Total	34.3		14.3					
Overseas Annual Grand TOTAL			92.3		183.6					
United States	Prime Contracts (CCC)	End Products	8.7	10.1	7.5	11.2	19.0	18.1	7.1	7.7
		Other	77.2	89.9	59.2	88.8	86.0	81.9	8.5	92.3
		Sub-Total	85.9		66.7		105.0		92.1	
	Direct Prime Contracts	End Products	0	–	0	–	0	–	0	–
		Other	10.3	100.0	7.8	100.0	7.5	100.0	9.9	100.0
		Sub-Total	10.3		7.8		7.5		9.9	
	Sub-Contracts	End Products	5.3	5.7	8.2	6.8	35.9	17.9	22.6	14.1
		Other	86.9	94.3	111.8	93.2	164.1	82.1	137.4	85.9
		Sub-Total	92.2		120.0		200.0		160.0	
United States Annual Grand Total			188.4		194.5		312.5		262.0	

NOTES: End products are: Medium to High Technology Items which are capable of functioning as "stand-alone" products.

Explanation: Primes – Contracts let through CCC to a Canadian company on behalf of a Military Agency.
Direct Primes – Contracts from a Military Agency let directly to a company.
Sub-contracts – Defence contracts on a "company-to-company" basis.

The percentage of total contract value of end products contracted via the "subcontracting" channel with U.S. companies has shown a definite increase between 1975 and 1978, as shown in Exhibit 2. The other major method of selling end products is through CCC.

In overseas markets the most common means of contracting for end products is through defence departments, i.e., Direct Primes.

END PRODUCTS BY CHANNEL

Exhibit 3, overleaf, contains a list of Canadian defence exports to the U.S., 1975-1978.

Prime Contracts

Products contracted for via CCC have the following characteristics:

- Most of the products have been accepted into the U.S. inventory, i.e., contracts represent "follow-on" procurement for equipment already accepted by DOD.

- Some equipment represents "product improvement".

- Dollar amounts are concentrated in each year in a relatively few products.

Subcontracting

End products produced by Canadian subcontractors have the following characteristics:

EXHIBIT 3

CONFIDENTIAL

CANADIAN DEFENCE EXPORTS TO UNITED STATES – 1975-1978

Primes – CCC

End Products

MRAD
March 1980

Canadian Company	U.S. Agency	Product Description	$ Value in 1975	$ Value in 1976	$ Value in 1977	$ Value in 1978
Canadian Marconi	Army	GRC-103*	636,058	1,934,417	4,159,709	3,473,406
Dominion Aluminium Fabricating	Navy	Helicopter Recovery* Assistance System and Traverse System	639,029	447,612	528,819	18,946
Gadriel of Canada	Army	Shock Absorbers	–	121,535	969,184	1,020,875
Hermes Electronics Ltd.	Navy	Sonobuoy*	7,430,355	4,896,057	12,604,906	6,349,619
Irvin Industries Canada	Air Force	Automatic Inflation Modulation (AIM) Escape System	–	–	386,379	–
Magline of Canada Ltd.	DSA	Snowshoes, Trail Magnesium	–	143,016	367,959	2,637,576
		TOTAL	8,705,442	7,542,637	19,016,956	7,150,803

NOTES: *Equipment already in U.S. Inventory
Some products are not "DIPP" type but are included to illustrate the breadth of U.S. purchases

Subcontracts:

Canadian Company	U.S. Company	Company Classification	Government Agency	Product Description	$ Value in 1975	$ Value in 1976	$ Value in 1977	$ Value in 1978
Bell Aerospace	Bell Aerospace	Prime Contractor	Army	Voyager Air Cushion Vehicle	4,079,249	–	–	–
CDN Marconi Company	Sikorsky Aircraft	Prime Contractor	Army	UTTAS Eng. Instruments	67,533	38,324	239,436	2,801,828
" " "	Hughes Helicopters	Prime Contractor	Army	AAH Eng. Instruments	–	–	40,000	41,344
" " "	Martin-Marietta	Sub-Contractor	Army	UTTAS Eng. Instruments	–	–	19,852	–
" " "	Singer	Sub-Contractor	Army	UTTAS Eng. Instruments	–	–	–	15,592
" " "	McDonnell-Douglas	Prime Contractor	Navy	Alpha Numeric Displays	–	–	68,730	7,925
" " "	Singer Simulation	Prime Contractor	USAF	Area Navigation Equipment	–	64,500	–	–
" " "	McDonnell-Douglas	Prime Contractor	Navy	Omega Systems	–	–	–	98,496
CAE Electronics	Lockheed	Prime Contractor	CDN Navy	CP-140	–	–	23,305,000	–
Computing Devices	Chrysler Corp.	Prime Contractor	Army	Fire Control System XM-1 MBT	–	–	3,883,888	4,893,568
Fathom Oceanology Ltd.	Raytheon Co. Submarine Div.	Prime Contractor	Navy	Towed Array Handling System	387,140	–	–	–
Gadriel of Canada Ltd.	AM General Corp.	Sub-Contractor	Army	Shock Absorber Commando Vehicles	–	–	–	32,869
Hypernetics Ltd.	Control Data Corp.	Prime Contractor	Army	Digital Indicators for AYK-14 Digital Computers	–	–	98,000	–
International Harvester	International Harvester	Prime Contractor	DSA	Motor Trucks	725,376	7,458,099	5,497,281	10,111,119
Litton Systems Canada Ltd.	Ford Aerospace	Prime Contractor	Not. Specif.	Satellite Ground Terminal	–	–	–	2,368,000
Pratt & Whitney A/C of Canada	Beech A/C Corp.	Prime Contractor	Army	Infra-Red Surpression R&D	10,000	–	–	–
United Tire & Rubber Company	Cadillac Gage	Prime Contractor	Army	Bullet Proof R&D	–	682,658	812,783	2,240,631
				Run-Flat Tires		R&D Involved	R&D Involved	
				TOTAL	5,269,298	8,243,581	35,964,970	22,611,372

- The majority of the products represent significant levels of R&D expenditure, i.e., they are "new" developments.

- The customer base is much wider than the base for end products marketed through CCC.

- The majority of the customers are "prime" contractors to the U.S. military and are responsible for the development of major systems.

- Extensive inter-company relationships are developed through this channel. For example, Canadian Marconi Engine Instruments are sold to Hughes and Sikorsky which are "prime" contractors for Army helicopter programs and to Martin Marietta which is a subcontractor for the weapons system on the Hughes helicopter.

- Contracts resulting from of Canadian defence purchases are obtained through this channel, e.g., CAE is a subcontractor to Lockheed for the CP-140 aircraft.

- The majority of the American companies involved have strong commercial programs which may represent additional markets for Canadian products.

Overseas

Statistical data were available for two years only. Further study of this area is therefore warranted; however, certain trends appear to be evident. Exhibit 4, opposite, shows Canadian defence exports overseas for 1975-76.

EXHIBIT 4 **CONFIDENTIAL**

CANADIAN DEFENCE EXPORTS OVERSEAS - 1975-76

Primes — End Products

Canadian Company	Purchasing Country	Product Description	$ Value in 1975	$ Value in 1976
Sparton of Canada	Australia	AN-SSQ-47 Sonobuoy	-	589,088
Collins Radio	Italy	Direction Finder	80,470	-
CAE Electronics Ltd.	Germany	Alpha Jet-Sea King Simulators	-	9,159,941
National Flight Simulators Ltd.	Tanzania	GAT-1 Flight Simulator	35,397	-
Pratt & Whitney of Canada	Venezuela	PT6T-3 Turboshaft Engine	180,391	-
System House Ltd.	Australia	Automap System	1,431,075	-
Direct Primes		End Products TOTAL	1,727,333	9,749,024
Canadian Marconi	Singapore	AN/GRC-103	257,976	-
De Havilland Canada	Peru	Twin Otter A/C	830,000	-
" " "	Togo	DHC-5 - 2A/C	11,191,434	-
" " "	Ethiopia	Twin Otter	-	2,950,910
" " "	Kenya	DHC-5D	-	25,172,400
" " "	Zaire	DHC-5D	-	15,800,000
Sparton of Canada	France	AN/SSQ-47 Sonobuoy	1,288,530	-
Pratt & Whitney	Chile	PT6A-27 Turboprop	217,800	-
" "	Italy	PT6T-6 Eng. Kits	-	7,840,000
" "	Spain	PT6-20/28 Engines	-	330,000
Hermes Electronics	Germany	AN/SSQ-36 Sonobuoy	-	346,200
" "	France	AN/SSQ-36/41 Sonobuoy	641,732	-
		End Products TOTAL	14,427,472	52,439,510

CANADIAN DEFENCE EXPORTS OVERSEAS - 1975-76

Subcontracts				
	Overseas Purchasing Country			
DAF	Scott Lithgow Dry DOCK - Britain	Telescopic Helicopter Hangar	86,000	-
"	Mazagon Dock Ltd. India	Helicopter Handling System	1,156,000	-
"	Cantiery Shipyard Italy	Telescopic Helicopter Hangar	617,000	-
CDN Marconi	Norway	AN/GRC-103	-	6,503
Hermes Electronics	Krupp Atlas Germany	AN/SSQ-41	-	34,060
International Technical Prod.	Saudi Arabia	ICT 200 Six Sider Control Tower	-	182,175
		End Products TOTAL	1,859,000	222,738

Direct Prime (Canadian Company to Defence Departments)

- Channel accounts for over 80% of end products sold to the overseas market.

- Items represent large dollar expenditures and major end products, e.g., aircraft, engines, and electronic products.

- Countries purchasing aircraft are less developed.

- Engine Purchasers have aircraft in which PT6 engines are installed (e.g., Chile); national programs for aircraft construction incorporating PT6 engines (e.g., Spain); and agreement for license manufacture (e.g., Italy).

- Buyers of electronics (sonobuoy) have major anti-submarine warfare programs (Germany, France).

- Products represent items on which considerable DIPP development funding has been expended.

Prime Contracts (Through CCC)

The value of end products sold through this channel is much lower than that sold by Direct Prime. Sales through this channel appear to consist of "one shot" purchases. The sales pattern also seems to illustrate the preference of certain countries, e.g., Australia, to use the CCC method of contracting. Individual contracts generally are smaller in monetary value but, except for aircraft which are not sold through this channel, the types of end products sold are similar to those sold through Direct Prime Contracts.

CONCLUSIONS

United States

Initial end product sales of items developed under DIPP can be performed most effectively through the subcontracting channel, specifically by subcontracting to "prime" companies responsible for major product development and production.

Unlike the overseas market, the sale of major systems (e.g., aircraft) does not appear to be evident through U.S. contractors. Items are parts of a system of sub-assemblies.

Few contracts appear to be derived from parent/subsidiary relationships. (The exception is vehicles; contracts are probably the result of the Auto Pact). The potential for joint parent-subsidiary marketing would appear to be considerable. Subsidiaries may not be utilizing this channel to as great an extent as possible and thus are losing marketing "leverage".

Canadian companies seeking U.S. markets must be able to achieve good inter-company relationships, and to establish a strong rapport with U.S. prime contractors in development projects for the U.S. military. In the market assessment envisaged in a modified DIPP, weight should be given to the use of the subcontract (non DOD) channel, and ITC personnel posted to the U.S. should be alerted to the worth of projects which foster these relationships.

Overseas

- Unlike the U.S., sales of major products, e.g., aircraft, are possible through this channel particularly to less developed countries.

- The ability to deal directly with military agencies is very important - relationship with subcontractors are relatively less important.

V - MARKETING LEVERS

OFFSETS

One of the major "marketing levers" possessed by Canada in recent years has been the opportunity for offset sales of DND purchases. In spite of this sales opening, however, Canadian high technology companies feel they have benefited very little from long-term projects. The offset projects are referred to by the companies as "black box" or "build to print", even though offsets should include:

(a) licensed production and assembly of the equipment being purchased;

(b) the supply of parts or components of the defence equipment;

(c) the supply of parts or services from Canada to the foreign manufacturer or his subcontractor for incorporation into other products;

(d) joint venture, technology transfer, and other arrangements to benefit Canadian industry.

Companies which are particularly critical of the way offsets currently work are those which have extensive in-house development capability. These companies feel that they can contribute extensively in R&D and that efforts should be directed to providing work in this area.

The lack of development opportunities in the offsets is particularly felt since Canadian defence procurement is characterized by "off-the-shelf" purchases with little development work involved other than product adaptation. Canadian contractors participating in this activity are usually awarded contracts to manufacture products which have already been developed. They manufacture components and may perform final assembly and testing. In addition, the short production runs result in higher costs.

This DND procurement policy, quite understandably, concerns the DIPP firms as it aims for the most efficient purchase decision from DND's viewpoint - and necessarily without consideration of possible economic benefits from support of industrial R&D. It may be that, from an overall government viewpoint, it would be worthwhile to supplement DND (and other departmental) funds to advance an R&D goal.

Whatever viewpoint is accepted, certain facts are clear:

- Canadian high technology companies do not consider that they are benefiting from offsets.

- Even though joint venture, technology transfer, and other similar arrangements are listed among the objectives in arranging offsets, none of the companies interviewed mentioned having participated in such activities.

- On a positive note, the establishment of straight-forward production facilities has the side benefit of easing DND's problems in providing full maintenance support for the products so produced.

- There is a feeling that offsets have developed into a game, with major contractors attempting to use even unrelated purchases as offsets. It becomes a "number balancing" exercise.

A study should be undertaken to balance the costs and benefits of the use of government procurement to support industrial R&D activities.

DPSA AND DDSA

Companies interviewed generally stated that the Defence Production Sharing Agreement (DPSA), with the U.S. was of major assistance in selling defence equipment in the U.S., although some commented on the restrictions which have developed around the Agreement such as Small Business Set Asides.

In relation to the DDSA however, companies were more divided in opinion on its effectiveness in yielding good R&D opportunities in Canada. Criticisms were as follows:

- It was very difficult to have projects accepted by the U.S. as worthwhile;

- The projects which have been instituted tended to be of low priority and of small importance relative to U.S. requirements;

- The U.S. was not seriously attempting to make the arrangement function;

- The projects do not generally offer production opportunities;

- Projects are directed by the U.S., and the company has little latitude in changing direction in development.

The one company which used DDSA extensively and was in favour of the method stated:

- It has the advantage of 100% outside funding;

- A customer interest has been demonstrated;

- It aids in the development of customer contact and rapport;

- It provides an entrée to further advanced and engineering development with the U.S. and the possibility of follow-on production.

The company stating this opinion had an extremely strong relationship with the U.S. military. The DDSA appeared to be used as a strategy for maintaining and enhancing this status, and the company appeared to be willing to accept the very long period before "pay-off" (if it occurred at all) as part of the method of doing business. The fact that each development project was funded completely from outside the company no doubt greatly influenced the company's attitude toward DDSA.

Recommendation

Due to the generally negative view of DDSA as a means of promoting R&D, it is recommended that other methods be examined. One alternative would be to use DIPP funding to establish company-to-company agreements on joint development or other joint ventures and providing government support as necessary to further this objective. Obviously further study is required, but it is equally obvious that the present method using DDSA is not working to the general advantage of Canadian companies.

VI - COMMERCIAL MARKETING

Since DIPP funding is applied to the development of civil related products as well as military, the ability of high technology companies to take advantage of commercial market opportunities is assuming greater importance, particularly in those projects which absorb high levels of R&D funding. Examples of these projects include Pratt and Whitney's gas turbine engines, de Havilland's line of transport aircraft, Canadair's general aviation aircraft, CAE's simulator, and Canadian Marconi's avionics products.

The market for civil products differs from that for military products. The "end customer" may vary from the very knowledgeable, e.g., aircraft manufacturers and airlines to the less sophisticated, e.g., general aviation owners and industrial companies.

MARKETING TO KNOWLEDGEABLE CUSTOMERS

The characteristics of selling to very knowledgeable customers are as follows:

- The buying approach is very structured, with the accent on operational performance, technical design, product reliability, and demonstrated cost effectiveness.

- Presentations to the customer rely heavily on very detailed information which is supportable.

- The customer knows what he wants in terms of performance; the equipment supplier must convince the customer that he has it.

- The product must be certified by the appropriate regulatory body.

- Equipment must conform to various specifications, e.g., ARINC in case of airlines.

- Lengthy evaluations of equipment are usually required and are often competitive.

- The customer is usually conservative; he demands proof of claims made.

- He leans heavily on firms with a good company reputation.

- He is loyal to proven suppliers.

- He does not make quick decisions.

- The supplying of spares is important; the customer often has good "in-house" repair capability.

- Usual sales promotion activities such as advertising and exhibitions may not be very effective, i.e., it is necessary to have face to face customer discussions.

MARKETING TO "NON-EXPERT" CUSTOMERS

Selling to the less sophisticated customer differs from selling to knowledgeable customers.

- Specifications for equipment are somewhat less stringent in the case of general aviation for example, but they are gradually becoming more rigid.

- The customer does not perform analysis on equipment in the same depth; he is more flexible regarding performance.

- The important considerations are product support (time to effect repair, location of spares support), ease of maintenance, distribution network, company reputation, and the technical expertise of company representatives (they must be well versed in equipment operation and maintenance).

- The equipment supplier must be flexible in equipment design and willing to try new ideas to develop markets. The general aviation market is usually willing to try a new approach if evaluation hardware can be provided.

- It is possible to test market products sometimes using ground demonstration equipment, e.g., cockpit instrumentation.

- A very close relationship is necessary with customer in after sales support.

- Sales promotion techniques (advertising, exhibitions) are more effective in influencing this type of customer.

- The customer base is very broad and requires considerable product support staff to service it adequately.

- The customer is usually very price conscious.

- Customer confidence, based on demonstrated company performance, must be established.

- It is helpful to have an extensive product line, such that the customer can standardize on the product line of one supplier.

CANADIAN COMMERCIAL MARKETING PERFORMANCE

In terms of the fullness of a product line, Canadian capability is spotty. No company has a complete avionics product line. De Havilland, when it develops the DASH-8, will adequately cover the small to medium aircraft transport market - DHC-6 to DASH-7. Pratt and Whitney covers a certain power range with the PT-6 gas turbine and a narrow market segment with the JT-15.

Canadian high technology companies generally appear to find it difficult to provide the marketing effort and back-up product support necessary to operate in the commercial market, particularly in selling to less sophisticated customers. The resources required to provide satisfactory distribution channels and sales outlets represent major problems to those companies which are used to selling to government customers. Pricing structures can also present problems, as can market timing.

Many Canadian companies do not adequately investigate the total market available for a product using a certain technology. the company may then be confined to a small market base with demanding customer requirements and limited sales opportunities.

VII - CANADIAN SUBSIDIARY COMPANIES

The mandate of subsidiary companies (primarily American subsidiaries) covers a wide range of latitude for marketing action. This latitude varies from a confining policy of restricting product development to very narrow channels to an almost unlimited mandate for R&D. The one common denominator however is financial control which usually takes the form of an annual budget which must be approved by "head office". Once the budget is approved, the subsidiary is usually free to perform the necessary development and exploit the product commercially. The following are considered to be some of the advantages and disadvantages of being a subsidiary:

ADVANTAGES OF PARENT/SUBSIDIARY RELATIONSHIPS

- If there is a firm division between the parent/subsidiary of product lines and market segments without overlap, the subsidiary can usually develop products over a reasonably wide range of applications.

- The sales and other resources of the parent can be used to supplement those of the subsidiary.

- The "company image" of the subsidiary can be enhanced considerably by use of the parent's name.

- In most parent/subsidiary relationships, the transfer of technology is encouraged.

- The parent sometimes aids the subsidiary in market planning. Should the subsidiary wish to pursue new market opportunities, the parent may be of help in this connection.

- The subsidiary can benefit from management techniques in use by the parent.

- License/Joint Venture may be possible which may establish the subsidiary in a new product line or enhance his present business situation.

- Subsidiary may act as a subcontractor to the parent as a result of parent sales.

- Subsidiary may develop a product to fit in with parent's product line. This allows parent to market the product in a more effective manner and enables the subsidiary to extend his marketing position without additional development.

DISADVANTAGES

- In certain companies a very narrow view is taken by the parent regarding product mandate. In one case observed, the subsidiary was free to implement development programs only if there is no conflict with the parent's product line (the parent's line is extensive).

- The parent is free to place budget restrictions on product development and marketing activities.

- There is a tendency on the part of certain parents to restrict the marketing channels available to subsidiaries, i.e., certain markets are considered "parent territory".

- The subsidiary is subject to the effects of the overall company business position, i.e., although the subsidiary may be in good business health, the corporation may not be. This can restrict the subsidiary's ability to effect business and development programs.

- Corporate policy may restrict the subsidiary in pursuing certain inter-company relationships.

- Political pressure may be imposed on the parent which is reflected on the subsidiary.

- Subsidiary may exist only to serve national markets and act as a sales outlet for parent's products, i.e., limited marketing mandate.

SUMMARY

In summary, it is not possible to generalize regarding parent/subsidiary relationships due to the variance in corporate policies. In funding DIPP projects, the maximum leverage should be used to ensure that the parent recognizes the mandate of the subsidiary to exploit the product fully and the effect of the development should be examined relative to the position of the subsidiary within the overall corporation. Examples of significant questions:

- Does the development fit in with the corporate product lines?

- What is the corporation's market position for a competitive viewpoint?

- What leverage can the parent exert to sell the product?

- What market resources does the parent have relative to the product?

- Does the corporation have current development programs in which the product can be used?

- Is the parent involved in R&D which would complement the proposed development?

The main point is that the parent/subsidiary relationship should be treated as an entity from a market viewpoint and an assessment of the degree to which DIPP should attempt to modify or support that relationship should be performed of the overall strength of that entity.

VIII - AEROSPACE AND ELECTRONICS: CANADA'S INTERNATIONAL MARKET POSITION

In considering Canada's international market position in these two sectors several factors should be considered:

- The "leverage" which Canadian firms can exert in effecting foreign sales should be assessed. In the military area, the DPSA allows Canadian firms to compete on an equal basis with American and other companies in the U.S. Examination of our exports to the U.S., however, indicates that Canadian companies have great difficulty in selling "end products" to the Department of Defense (DOD) and that the bulk of our sales are either parts or components. It appears that it is more productive to market our products through a U.S. prime or sub-contractor which in turn sells the overall system, containing the Canadian product, to DOD rather than attempting to market directly to DOD. This channel can also be used for commercial products. Sales of "end products" to non-U.S. areas appear to be relatively easier to achieve, particularly to the less developed countries.

- Indications are that the advantages of the Defence Productivity Sharing Agreement (DPSA) are becoming eroded through protective legislation, American buying policies, and a closer relationship which has developed between the U.S. and European countries by means of Memoranda of Understanding (MOUs), Offsets, and the recent program of Rationalization, Standardization, and Interoperability (RSI). Certainly it is becoming very difficult to duplicate successes such as the sale of the Canadian Marconi Radio Relay (AN/GRC-103) and Doppler equipment in the early 60's (The radio relay is still selling to the U.S. in an improved version).

- The attitude of Canadian companies to the other major instrument in our U.S. market relations, the Defence Development Sharing Agreement (DDSA) is mixed. Generally companies do not feel that this agreement is particularly effective in yielding good R&D opportunities and, noting the result in terms of production, this viewpoint appears to be valid. Some technological gains have resulted from these projects. However, indications are that these could have been achieved in many cases with less R&D expense. If Canada is to have an effective presence in R&D activity in the U.S., a means must be found to augment the DDSA.

- One of the avenues which appears to show promise as a means of effecting joint development is through U.S. prime companies (which could be the parent companies in the case of subsidiaries). These companies are influential in the U.S. and are involved with both U.S. military programs and commercial development. Dealing through these companies would allow Canadian concerns to become involved in major programs without the necessity of bidding or dealing directly with the U.S. Government. Certainly

as a means of marketing products this method appears to be more productive than attempting to sell directly to DOD. Joint development with prime companies is a common method of sharing the risk in commercial aircraft and engine development, although Canada appears to have used this method much less often than some other countries. It is recommended that this approach be explored in more detail in order to determine what leverage could be exerted through DIPP to enable Canadian companies to undertake worthwhile development projects on a "company-to-company" basis.

. Canada's policy on the procurement of the products of Canadian high technology companies acts as a particular constraint on the commercial development of these firms. This has been the subject of many briefs from Industry Associations and special task forces. Suffice to say that of all the major western nations, Canada appears to be the only one "out of step" in not having a definite policy to purchase domestic products. It is very difficult to explain to prospective customers why they should buy equipment which is not bought by our own government. In addition, the negative effect on a company's competitive position of not having a domestic base from which to operate is obvious. Northern Telecom, our largest electronics company, illustrates the advantage of having an adequate domestic sales volume from which to operate in the export market.

These factors do not, of course, establish the case for a change in Canadian policy. They do, however, provide a prima facie case for the examination of the full range of costs and benefits of that policy.

- Although DIPP has been formulated primarily as a defence R&D Program over the years, the product applications have been broadened to include "civil related" items. In fact, many of the projects funded under DIPP have either no defence market application or a very marginal one. The program may be viewed now as an R&D support mechanism for advanced technology industry generally. This change has had a decided effect on companies using the program. In many cases, companies have been able to broaden their marketing bases to commercial applications which have significantly expanded the available sales volume. This has led to company growth and stability since the broader market makes it easier to maintain a certain level of business activity over a period of time.

- While the broadening of the DIPP market base has been good for high technology industry generally, government marketing mechanisms do not appear to have kept pace with the requirements to sell the resulting products. To cite an example, industry should be able to contact one area within the Department of Industry, Trade and Commerce which would be responsive to the market needs generally - market planning, market requirements, and customer contract. At present, these functions are fragmented within the Department, resulting in a reduction in overall effectiveness.

- The Department should establish a more definitive policy regarding the marketing and product mandate of foreign-owned subsidiary companies. A survey of subsidiaries indicated a wide variety of parent policies on mandates. A restrictive policy on the part of the parent obviously can inhibit the growth of the subsidiary and its ability to develop products

with a significant market volume. This in turn can reduce the effectiveness of DIPP funding.

. The leverage which Canadian subsidies could derive from joint marketing activities with their parents should be examined. Subsidiaries do not appear to exploit this relationship fully. Part of the reason appears to be the desire of the subsidiary to establish a degree of autonomy. While this attitude is understandable, it may reduce the expertise and opportunities available to expand the subsidiary's market position.

ADDENDUM TO ANNEX VI A: PRATT AND WHITNEY AIRCRAFT - A CANADIAN AEROSPACE SUCCESS STORY

Pratt and Whitney is a Canadian aerospace company which has been successful in meeting world wide competition, establishing an international reputation in its product area, and capturing a major portion of its market segment. The ingredients of its success are pertinent to Canadian companies generally.

Pratt and Whitney's PT-6 Engine has established a leading world position in turboprop engines for general aviation and small commuter aircraft. The recently announced high powered PT-7 should maintain or extend its position due to the expected expansion in the commuter market in the U.S. and in world markets for aircraft in the 30-40 seat category of aircraft. PT-6 engines are installed in over 35 different makes of aircraft in the U.S., Europe, Brazil, and Canada. Pratt and Whitney also produces the JT-15 turbofan which is used in the popular Cessna Citation series of aircraft. The company has produced 10,500 PT-6 Engines and almost 1,600 JT-15s. Major competition to the PT-6 is

Garrett which holds 30% of the market; there is no competition to the JT-15 in its market segment, i.e., 2,000-3,000 lbs. thrust.

FACTORS PROMOTING SALES

Pratt and Whitney's success in the market is judged, based on our evidence, to be due to the following factors:

(1) A sensitivity to market requirements. Pratt and Whitney has strong in-house capability for market analysis and customer liaison. Its contacts with potential customers are extensive, and there appears to be good rapport on both sides.

(2) Product Characteristics:

- not the lowest price but offers other compensating factors;

- higher horsepower rating than competitors in turboprop;

- ease of maintenance: more servicing can be done on the aircraft without returning the engine to depot.

(3) Extensive product support network and quick reaction.

(4) A reputation for reliability in product design.

(5) A strong company position with major U.S. general aviation manufacturers (Beech, Piper, Cessna) and other foreign and domestic manufacturers. Pratt and Whitney can therefore use the marketing leverage provided by these companies to help sell its engines.

(6) Use of the Pratt and Whitney (U.S.) name, at least initially, to establish a company image. This is less important now than it was when the company was first becoming established.

(7) The use of its relationship with the parent company to strengthen its market position, particularly in the U.S.

(8) A firm product and marketing mandate within its particular market segment.

FACTORS INHIBITING SALES

Some inhibiting factors faced by Pratt and Whitney in marketing their products are as follows:

(1) In the R&D area, the support given by U.S. DOD in funding military programs has led to at least one competitor entering the small turboprop market - General Electric. Although, theoretically, DOD funding is not applicable to commercial projects, the obvious advantage of 100% R&D funding spills into the commercial area.

(2) Even though the major U.S. manufacturers use Pratt and Whitney engines, a "Buy U.S." attitude prevails among some personnel in potential U.S. customers.

(3) Some political pressure has been evident, such as the U.S. Department of Justice anti-trust suit in connection with the proposed joint development by Pratt and Whitney and Rolls Royce of the RB-401 Engine.

(4) The contracts awarded by NASA to companies in competition with Pratt & Whitney in the area of R&D provides significant help in "bridge financing". In addition, NASA provides considerable technical data and expertise to U.S. companies as a result of "in-house" R&D projects. NASA has also supported American companies in obtaining patents to protect technologies.

(5) In countries areas other than the U.S., nations tend to choose their own engines.

(6) Exports to Eastern bloc countries run into problems in that the import of certain sizes of aircraft engines are restricted.

(7) Company to company agreements, i.e., joint ventures, may lock Pratt and Whitney out of programs, e.g., SAAB (Sweden) and Garrett (U.S.) are jointly developing a light transport aircraft.

(8) Offsets may be necessary in order to make sales, i.e., other countries may require licensed production or other offsets.

(9) Pratt and Whitney does not appear to pursue joint development opportunities. Joint development may be a requirement in order to sell in certain countries, e.g., Alfa-Romeo (Italy) and Rolls Royce (U.K.) have jointly developed the RB-418 Engine, which competes with the PT-6. Japan has extensive agreements with U.S. and European companies.

(10) Aircraft manufacturers are concerned about the security of supply. Beech, Piper and Embraer are very dependent on Pratt and Whitney. Although they would prefer to have a second source, another manufacturer's engines would be very difficult to institute in general aviation due to proprietary rights, standardization, and the extensive product support requirements. The single source appears to be something general aviation manufacturers have to "live with". However, an engine firm such as Pratt and Whitney must be constantly aware of the need to maintain confidence that the company is a stable source of supply.

(11) A dependence on the end customer (aircraft manufacturer) to effect sales of its aircraft and thus engine sales. To some extent, the engine manufacturer is operating in a marketing environment he does not control. A very close relationship is necessary between the engine and aircraft manufacturers in market planning.

In summary, viewing Pratt and Whitney's market position, certain facts are evident:

- The company has been successful in developing the right product for the right market at the right time, and at a suitable price. This requires extensive market planning, customer contact, and an ability to invest adequate sums in R&D.

- Use of the name of a powerful parent which recognized in the aircraft engine market throughout the world.

- A definite marketing and product mandate which provides a complementary line of engines to those provided by the parent. The corporation as a whole is thus able to establish a cohesive marketing strategy.

In general, Canadian advanced technology subsidiaries should exploit the leverage afforded by the parent relationship more fully.

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ANNEX VI B TO THE DIPP EVALUATION STUDY

THE DIPP MARKET

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I - INTRODUCTION

This part of Annex VI reports on the characteristics of the markets for DIPP firms, with major emphasis on the U.S. Department of Defense (DOD) component. It also examines the interaction of the marketing practices of DIPP firms with those markets.

The aim of the marketing module was to determine the market factors which affect sales, and the means whereby, and the extent to which, DIPP firms could better adapt to these market conditions.

The study involved an examination of the procurement policies and practices of DOD and of prime contractors or original equipment manufacturers (OEM).

Interviews were conducted by Peat, Marwick, Mitchell & Co. (Washington) personnel who were familiar with these systems. In this phase of the study, one Canadian firm which was rated relatively highly as a "marketer" was used as a reference point by which to judge the relative marketing performance of Canadian firms.

II - CURRENT ATTITUDES TO MARKET PLANNING

Canadian companies are now selling products which, for the most part, are merely improvements of products developed a decade ago. High technology products have a long gestation period. So any decision to change DIPP ought to anticipate the world market for high technology in the year 2000 and take into account what share Canada should seek, based on studies of how much

it might cost to obtain that share. We have found almost no evidence of such long range market planning in either ITC, External Affairs, National Defence, or the major DIPP companies. Three explanatory factors come to mind.

DIPP was instituted after the cancellation of the Avro Arrow. The Arrow was cancelled on the grounds that ICBM's would replace manned bombers, a market forecast we now know to have been wrong. Many of today's DIPP recipients had been Avro subcontractors. The experience with the Arrow may have resulted in a distrust of market forecasts. It has appeared difficult to forecast at the sub-system level, which is the level that has prevailed since the government decision to cancel the Arrow.

Whatever the technical merits of the Arrow, the marketing insight of Avro was myopic, and even their sales force was inadequate. The first explanation is that marketing never matured, and its development has been "traumatized".

For a second explanation one would turn to a behavioral theory of the firm, and the attendant concepts of incrementalism and local search to achieve satisfactory performance. Rather than organize for the year 2000 or even 1990, it is a lot easier to make small improvements to existing products and processes. Few customers impose unreasonable requests for improved performance or lower cost, so the company can satisfy customer requests as they come. The product evolves incrementally in a way that marketing could never have foreseen or planned. For example, at Pratt & Whitney more than half of the engineering work to design an engine is done after the first version has been delivered. So long as the original design is sufficiently robust, there will be room to adapt. If the sales force showers engineering with a

continual stream of customer requests and competitive insight and management sets a high standard of "satisfactory" performance, then this process of incrementation will yield good results with no need for long-range market planning. The government departments have tended to accept this apparently successful commercial strategy.

A third explanation may be derived from comparing DIPP with high technology conglomerate corporations. Conglomerate corporations, which employ sophisticated management techniques, ensure that low growth, low market share products and the companies that produce them either improve their market share or go out of business.

By way of contrast, in DIPP there is every political pressure to keep such businesses alive because of their employment and their maintenance prospects. DIPP has no mechanism for deliberately liquidating businesses so as to free money which could be better diverted to other products. Some companies have a low market share in very high growth industries. Even to maintain market share they will require large infusions of cash to keep up with the growing need for new facilities and for product development. The life time cash flow that comes from having a low market share is inadequate, and so the task of headquarters is to help the product manager either to overtake his rivals by gaining their market share or to go out of business now.

DIPP makes no such demands of its client companies, hence it does not force them to specify the schedule by which they will surpass their competitors, nor is it willing to fund such activity. DIPP does not demand to be informed on the business's strategic decisions on low growth, low market share products or on products which are growing slowly. Similarly it does not demand the

marketing information necessary as input to those decisions. DIPP has never demanded market planning and even if the corporation has done such planning for its own decision making, the inherent confidentiality of such plans means that they will not be shared voluntarily.

Fundamentally, then, DIPP is seen to be responsive and unable to guide a market strategy approach. These factors are seen to form the genesis of current attitudes to market planning. Given the growing importance being attached to marketing, the current period may well provide an opportune point at which to make market planning a prerequisite for participation in DIPP. This observation will be reinformced if vertical sector strategies are adopted.

III - SIZE AND POTENTIAL OF THE U.S. DOD MARKET

In order to do an adequate planning job, we would like to know the 1990 U.S. Department of Defense budget, broken down in detail by product line. This budget will depend on Soviet military actions and budgets, on the composition of Congress (especially Congressional Budget and Armed Services Committees), and on the staff work done by the Pentagon and by the President. In this section we will discuss in qualitative terms some of the relevant trends.

PERSPECTIVE ON CANADIAN DEFENCE SHIPMENTS TO THE U.S.

The U.S. Arms Control and Disarmament Agency (ACDA) published "World Military Expenditures and Arms Transfers 1967-1976".* From Table VII the following three points can be developed.

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* See also the discussion of the U.S. DOD foreign purchases in Annex VIA, Marketing. The ACDA figures are judged to be somewhat low in their estimates. This does not, however, modify the major implications.

1. The U.S. DOD buys American an overwhelmingly large percentage of the time.

During the years 1967-1976, the U.S. imports of defence equipment totalled $1535 million, compared with a DOD procurement budget that averaged about $50 billion a year for each of the ten years. In actuality the percentage of American procurements is lower because subcontracts that U.S. firms let to foreign firms are not included in the $1535 million imports. The Pentagon is surveying U.S. firms to gather this data, and should have results by late 1980.

No matter how generously one adjusts the data, the foreign market share of DOD procurements remains a small percentage. The implication is that most U.S. procurement officers have no experience with foreign procurement, let alone know how to compare a Canadian DPSA with a Dutch MOU.

2. Canada is the largest supplier with 50% of the US defence equipment import market.

The four largest foreign vendors of defence equipment* to the U.S. in the 1969-1978 period were:

Canada	$785 million
UK	495 million
Germany	101 million
France	31 million

* These figures are, again, from ACDA.

If the subcontract data were available the Canadian total would be even larger.

3. Of the nine major arms exporting nations, only Poland is more dependent than Canada on a single customer.

The economic measures of market concentration shows how rapidly sales drop off with customer rank. In the case of arms shipments, the raw data are more vivid than concentration indices. Poland depends on its Soviet market. Canada depends on its U.S. market.

Czechoslovakia is less dependent on its Soviet market. Least concentrated, France has a broadly diversified portfolio of customers. The customer data are in $ millions for the period 1967-1976.

Exporter		Poland		Canada		Czechoslovakia		...	UK		France	
Each	1	USSR	801	USA	785	USSR	690	...	USA	495	S.Afr	365
Exporter's	2	Libya	95	Neth	105	Syria	140	...	Saudi	451	Libya	325
Top 10	3	GDR	60	Peru	80	Egypt	140	...	Iran	270	Pak	265
Customers	4	India	45	Brazil	50	Iraq	125	...	Chile	145	Germ	265
By Rank	5	Czech	30	Iran	45	Libya	90	...	Austl	115	Saudi	225
	6	Syria	21	Venez	40	India	55	...	Brazil	105	Greece	201
	7	Iraq	15	Spain	30	GDR	50	...	India	75	Spain	161
	8	Bulg	15	Norway	20	Poland	30	...	China	75	Brazil	155
	9	Hung	15	Malay	20	Moroc	21	...	Kuwait	71	Egypt	125
	10	Viet.N	10	Ecuad	15	Pakis	20	...	Malay	65	Venez	125

Between 1967 and 1976, the U.S. market took a marked downturn. A decade ago U.S. military expenditures were 40% higher than they are now (constant dollars). Military salaries rose to support an all volunteer army, and fuel and food costs rose faster than inflation. The D.O.D. procurement budget was reduced at a steady 5% per year for the '67-'76 decade. Although the procurement budget is now being increased by 40% by 1985, the heritage of the past still has its effect. We will summarize the past in three sections dealing with the U.S. stock market's perceptions of the aerospace defence industry, the perceptions of U.S. financial executives, and the institutionalized procurement practices.

PERCEPTIONS OF THE U.S. STOCK MARKET

Exhibit 1, overleaf, is based on reported financial statistics and NYSE stock market data. Even during the height of the Vietnam War, the price/earnings ratio of aerospace companies only just equaled the industrial average and from then on declined to half. The price earnings ratio of stock reflects what investors anticipate the prospects of the company will be. Assuming that the price of share equals the discounted expected future dividends (as finance theories claim it does) we can infer that by the middle of the decade investors expected a bleak future and were discounting that future at a high rate of interest to account for the high uncertainties. With DOD orders decreasing at 5% per annum and the cost of capital so high, the 1970's was not a decade in which U.S. defence companies appropriated capital for company owned new plant and equipment.

EXHIBIT 1

COMPARATIVE FINANCIAL DATA: 425 INDUSTRIALS AND THE AEROSPACE INDUSTRY, 1965-1974

A. Profit Margins on Sales [1]

B. Net Income (as a percentage of sales)

	Composite Data [2] 425 Industrials	Aerospace		Composite Data [2] 425 Industrials	Aerospace
1974.....	15.4	7.1	1974.....	5.3	2.5
1973.....	15.8	6.9	1973.....	6.0	2.6
1972.....	15.0	6.6	1972.....	5.3	1.8
1971.....	14.6	5.2	1971.....	5.0	1.1
1970.....	14.5	5.1	1970.....	5.0	1.0
1969.....	15.4	6.5	1969.....	5.7	1.5
1968.....	15.8	6.4	1968.....	6.1	2.4
1967.....	15.6	6.1	1967.....	6.1	2.2
1966.....	16.4	6.6	1966.....	6.6	2.7
1965.....	16.2	7.7	1965.....	6.8	3.1

C. Price/Earnings Ratios

	Composite Data [2] 425 Industrials		Aerospace		Aerospace P/Es as Percent of Industrials P/Es	
	High	Low	High	Low	High	Low
1974.....	11.6	7.2	5.5	3.9	47.4	54.2
1973.....	15.1	11.6	8.1	4.8	53.6	41.4
1972.....	19.6	16.5	15.6	13.2	79.6	80.0
1971.....	19.4	16.6	21.9	15.8	112.9	95.2
1970.....	19.0	14.0	20.3	11.3	106.8	80.7
1969.....	19.0	16.0	24.1	13.0	126.8	81.3
1968.....	19.2	15.4	15.9	13.2	82.8	85.7
1967.....	18.9	15.2	22.3	15.4	118.0	101.3
1966.....	17.1	13.3	18.5	12.0	108.2	90.9
1965.....	17.9	15.7	16.1	9.1	84.4	58.0

1 Operating income is usually the balance left from sales after deducting operating costs, selling, general and administrative expenses, local and state taxes, provision for bad debts and pensions; but before other income and before deducting depreciation charges, debt service charges if any, federal taxes, and any special reserves.

2 Based on Standard & Poor's Industry Group Stock Price Indexes.

Source: Adapted from Standard & Poor's Industry Surveys: Aerospace, October 30, 1975, pp. A-33, A-34, and A-35. Copyright, 1975, Standard & Poor's Corporation. The 425 industrials include the 8 firms that make up the aerospace industry in this comparison.

PERCEPTIONS OF U.S. FINANCIAL EXECUTIVES

In 1977 the U.S. Conference Board interviewed senior U.S. financial executives about the U.S. defence industry. Their findings were published as "The Defence Industry: some perspectives from the financial community". The following is a brief summary.

Banks have been the key institutions in financing defence subcontractors. Life insurance companies and investment banks have played a smaller role. Typically, defence-contractor financing needs are oriented towards working capital, usually to finance inventories or accounts receivable.

Bankers have negative opinions of both prime contractors and subcontractors. A bank prefers a relatively high profit, low risk client. In both these respects, the defence contractors fared less well than U.S. manufacturers as a whole.

Profits have not been large enough to allow firms to raise either equity funds or long-term debt financing because:

- Inflation is not adequately provided for in escalation clauses.

- The allowed percentage of payment against costs incurred is not high enough.

- There is a widely held view that the Department of Defense has taken an unreasonably hard line in attempting to settle differences arising out of cost overruns or order changes.

- The demands for extra weapons capability, especially after the contract has been concluded and production commenced, has adversely affected the profit position of many firms.

- Interest costs should be taken into account in the cost base. It makes a significant difference as to whether a contract will produce a profit or a loss if the interest rate is 5% or 10%.

The financial world views the uncertainty that is common to defence contractors as the second major problem. The environment is poor for seven reasons:

. Annual funding by Congress makes it unlikely that a contract will be completed as planned.

. There is always some possibility of policy changes and contract cancellation.

. Delays and order changes are a real possibility.

. The government is no longer certain to bail out a contractor in the event of cancellation.

. Much longer development and production periods add to the uncertainty.

. The high turnover of senior Department of Defense personnel has contributed to a lack of continuity.

. Senior bankers do not have an in-depth understanding of the intricacies of fulfilling a technically complex defence contract.

These views pertained not only to prime contractors but also to defence subcontractors. In fact, those surveyed appear to be even more pessimistic in their assessment of loaning money to subcontractors. As the bankers see it, the problems are various:

- These smaller firms find that because the equity market is closed to them, they must pursue debt financing, which increases their chance of bankruptcy.

- Many of the subcontractors are linked to a prime contractor and are producing only one product. This dependency leads to added risk.

- Their business seems to fluctuate greatly. They can be severely affected by stretchouts and delays.

- They are often rather shaky on management talent.

The equity market would not support capital expansion. Nor would the debt market, as these comments make clear. Little capital expansion occurred.

U.S. PROCUREMENT PRACTICE

Historical Background

Broadly speaking, it can be alleged that the U.S. approach to acquisition of defence systems after World War II and during the advent of the Cold War was

to procure weapon systems in great haste. System performance and schedule received a great deal of management attention. The rush to get the best weapon system into the inventory as soon as possible was "managed" by making large sums of money available to contractors.

Gradually, performance of systems was placed in the equation of "cost-effectiveness" so that, as the Cold War began to warm up, schedule was perceived as less important than it had been during the late 1940's and and 1950's. Trade-offs, cost analyses, cost-effectiveness, and systems analyses were concerns in the 1960's.

The complex situation of the Vietnam war requiring huge defence expenditures (along with enormous weapon systems cost-overruns, occurring at a time when the economy appeared worsening), brought in an era in which the factor of costs became a dominant consideration. During the 1970's and, especially during the later period, both performance and schedule began to be keyed to costs. "Cost-growth","cost- overrun", "should cost", "design-to-cost", "life cycle cost", "affordability", and similar concepts became and are dominant.

Current Criteria

The point of these broad generalizations of the past thirty-five years is that program managers and procurement officers throughout the entire defence community practice acquisition and procurement philosophies that accord with the prevailing trends of time. Where once they were concerned with "schedule" and "best" performance, then with "cost-effective performance", they have been for several years, and are now, concerned with cost and contractor performance.

Greater numbers of adequate, simpler, more maintainable and reliable systems at the lowest possible unit production cost are becoming procurement goals, rather than best, sophisticated, costly systems to compensate for manpower shortages. The program managers and the entire acquisition procurement community seem uniformly disposed toward minimum required performance at the least cost.

While this general approach of the U.S. defence procurement community is considered valid, there are other important corollary points to be made. Contractor performance in meeting delivery schedules, especially for component and subsystem hardware, is a major concern because slippages not only raise costs but place the program in real jeopardy of being cancelled. Thus, schedule is important, but not necessarily so that the troops will have the systems in their hands at the earliest possible moment (although, understandably, few would admit this), but because the higher costs incurred by delays in program development expose the program to the risk of cancellation, expecially in Congress.

One U.S. government official stated that there may be instances where a particular component was so critical to a system that a decision might be made to award the contract to a U.S. firm in order to better "control" the item. This possibility reemphasizes the need for good marketing intelligence by Canadian firms to avoid the pursuit of such an item if the contract is, in fact, bound to be awarded to a U.S. firm. Apart from this caveat, individuals who were interviewed stated as a consensus ". . .that if U.S. firms A, B, and C were in a source selection competition with Canadian firm D, the evaluations would be made completely objectively toward the best (i.e., most appropriate)

item for the lowest price - no matter who had it". This approach to source selection evaluation, in the opinion of the Peat, Marwick (Washington) personnel, is sincerely and even heatedly proclaimed.

Current DOD Procurement Practices

Cost considerations dominate the current acquisition practices of the U.S. Department of Defense. This focus will likely continue through the early 1980's (despite shortages) because bureaucratic procedures are slow to change.

In early 1979, Peat, Marwick, Mitchell & Co. summarized discussions held with the Defence Systems Management's School and a federal procurement committee. Half the comments emphasized cost management and cost reduction. Typical quotes include:

- The manager's job is to determine the rate of change that is digestible.

- Once in development I want to move towards a freezing process rather than trying for the latest state of the art.

- The mistakes or errors in judgment I can accept, but not surprises. Implement "design to cost" for all programs.

- There are loads of problems with "design to cost", but it might be the salvation of DOD; it requires skills I do not see a plenitude of.

- You require a system for pricing change as it occurs, not a year later.

- Cost reduction "Tiger teams" should be established in the services.

- Provide greater discussion of affordability in the DCP's.

- An extended planning annex to the FYDP should be created covering a time period 6 to 15 years into the future as part of our emphasis of eventual usage and total life cycle cost.

- Better use of cost estimating techniques will reduce the enticing of contractors into submitting unrealistic proposals.

- We are considering profit rates based partly on contract investments, but progress has been poor to date. I believe that this is due to the fact that government/contract relations must be improved.

- The plant rep, the procurement officer, the ACO, the QC, and production reps, and the resident auditor of DCAA must learn to work together as a team.

- Selecting people is more important than use of management tools.

- Tendency to manage by document in lieu of people is recognized as bad.

Courses in military procurement are now taught at dozens of universities across the U.S. By rough count half the courses deal with procurement law. The other half deal with the economics of incentive contracting to cut costs and the legal questions of the determination of allowable, allocatable, and

reasonable contract costs, both direct and indirect. In summary, a decade of budget austerity has had its effect on procurement practices. The 1970's ended not on "a bigger bang for the buck" but on "shave a cent and keep the program alive".

PRESENT PROCUREMENT PRACTICES OF LARGE COMPANIES

As long as the U.S. Department of Defense wrote purchase contracts which contained a one-year cancellation clause, the industry's practice was similarly to write purchase contracts that would be unenforceable beyond one year. Boeing changed that practice.

After Boeing became illiquid and almost bankrupt in the late 1960's due to negative cash flow problems associated with the 747, it slashed employment in all areas except market planning. In fact, Boeing developed very elaborate computer models to help each airline predict its passenger seat mile requirements a decade ahead. Many airlines found the Boeing could predict their long-term future better than they themselves could. Furthermore, Boeing learned every nuance of tax law in different countries and the details of industrial incentive programs which its clients might use. For each airline Boeing simulated not only fleets of Boeing aircraft but also fleets containing competitive aircraft. Working with one client airline gave it insight into the details the operating characteristics expected by each kind of aircraft. Boeing then used this insight in dealing with the next airline, and so on.

The result was that Boeing developed an exceptionally clear understanding of the niche within which each airliner was best and prepared very good forecasts

of the total aircraft sales within each niche. By the mid-1970's Boeing was back-logged with two years of actual orders plus a very clear understanding of its expected flow of orders through 1985. In other words, Boeing understood its costs and its demands.

Given this understanding of its demands, Boeing purchasing executives felt confident enough to write five year purchase orders with subcon-tractors. Subcontractors used such Boeing purchase orders as bank collateral. Many became captive to Boeing. On the one hand subcontractors were quitting the aerospace and military business, and on the other hand Boeing was signing up others in a way that removed them from the market place. The number of "free agent" subcontractors

The economic theory of vertical integration, according to which a company should buy out its suppliers at some point, has never been well developed because the underlying process is unstable. As long as there are lots of suppliers, a company can avoid the coordination headaches of vertical integration. As the number of suppliers decreases, the company becomes increasingly vulnerable to an interruption of supply, and it is willing to pay a premium to ensure delivery. The unequivocal way to ensure delivery is to buy out the vendor. Nevertheless, most aerospace companies lacked the financial resources to acquire their suppliers. They had to content themselves with a big expansion of their legal staffs, who could write purchase contracts which anticipated that the vendor might have to set priorities on his customers.

It is particularly interesting to notice how contenders for the Canadian new fighter aircraft contract have lined up offset vendors in Canada. McDonnell

Douglas created a thirteen-person team which visited many cities. In each city, the largest ballroom of the main hotel was hired, and a truck load of component parts was displayed to potential vendors. In each province, the provincial Ministry of Industry and Tourism used their networks of contacts to invite potential vendors. McDonnell Douglas tried to find vendors who could sell hours on their numerically controlled machines. The company provided the computer tapes for numerical control, so that in reality only machine time was being rented.

Two observations must be made. First, the two published lists of offset benefits by province and by product are very different for the F-16 compared with the F-18. In keeping with the U.S. pattern, it appears that Canadian vendors were being forced to declare themselves as team members for either the F-16 or the F-18, rather than being free to sell components to whichever company won the contract. The second observation is that the two aerospace companies were evaluating Canadian vendors in terms of their capability now. Neither was attempting to nurture vendors. Neither sought to identify sequences of components which would permit the vendor to start on the simpler components (which can be manufactured to sloppy tolerances) and proceed to successively more and more advanced components. Again, this is in keeping with the U.S. procurement practice of being unwilling to make commitments beyond one year.

BACKLOGS AND SHORTAGES OF 1980

On February 4, 1980, Business Week published a six page analysis of bottlenecks in the U.S. defence production. Among the aircraft parts are:

landing gear	39 months' backlog
radar	32 months' backlog
aircraft engines	29 months' backlog
ejection seats	28 months' backlog
batteries	24 months' backlog
transmissions	23 months' backlog
aircraft air conditioning	19 months' backlog
hydraulic pumps	17 months' backlog
bearings	15 months' backlog
wheels and brakes	15 months' backlog
instruments	14 months' backlog

Due to a shortage of jet engines, McDonnell Douglas will build some F-15s without engines through mid-1981. The Business Week article concludes by reviewing a 1976 report by the Defence Science Board. At that time, when business was bad and there was excess capacity, the DSB study concluded that the defence industry would need two years if asked to boost its output dramatically. At the present, it would probably take longer because of the press of other business.

It seems likely that a hierarchy of defence priorities will be imposed in the 1980's, rationing the availability of scarce metals, semi-conductors, forgings, and components. There are three reasons why this action is likely:

- A decade of cost conscious purchasing will not suddenly be pushed aside. The Department of Defense is extremely unlikely to use prices to allocate scarce items but rather will view price increases as profiteering.

- Priority ratings such as DX, DL, and DO already exist (DX is highest and requires the President's signature). Given that procurement offices are now well staffed with lawyers, they will tend to apply for priority ratings because that is how lawyers think.

- Priorities tend to escalate. The lawyer for a firm whose vital raw materials have been cut off will sue to "show cause" as to why the needs of his client should not be given equivalent priority. A proliferation of priorities will emerge, monitored by large legal staffs, and adjusted by administrative hearings and law suits claiming "irreparable" damages.

If DIPP is to be effective, it may be prudent that the Canadian government assure our companies of adequate supplies of components by thoroughly understanding, following, and influencing the allocation of purchasing priorities DX, DL, DO etc. By 1985 the U.S. defence procurement outlay will be almost $30 billion, up from $15 billion in 1976. In 1980, the backlog of unspent money, the unobligated appropriations balance, is $85 billion: two and a half years of appropriations are dammed up by production bottlenecks. There is every indication that wide ranging priorities will be imposed soon.

PROSPECTS FOR DOD PROCUREMENT

The lowest procurement budget (in real dollars) occurred in 1977-78. The Department of Defense Annual Report for Fiscal Year 1981 was issued in January, 1980 and is replete with detail.

Three factors appear to have influenced the DOD's assessment of the threat posed by the Soviet Union:

1. In the Soviet Armed Forces the officer class are Russians; there are very few officers from other Soviets. Western demographers of the Soviet Union are now sure that twenty years ago the birth rate started to drop in most of the Soviets, and especially in Russia. By the end of the 1980's the Soviet Union will be short of troops and especially short of officers.

2. By the end of the 1980's the Soviet Union will be extremely short of oil, even for its own internal use and may be tempted to acquire some abroad.

3. Presumably the Soviet Union knows about the current sorry state of U.S. Forces, and also knows that it will be improved by the end of the decade.

From this view point the decade of the 1980's will be dangerous. The Soviet Union will have an opportunity to impose its will as it has never had before, and may not get again. This relative strength was foreseen in the 1970's and ammunition, maintenance, spare parts, and fuel were cut back to allow procurement of the F-14, F-15, F-16, F-18, and A-10 aircraft, the Patriot, Sparrow, Harpoon, Phoenix, Side Winder, TOW, and Pershing missiles, the XM1 tank and XM2 personnel carrier, plus a new generation of ships. It now appears that U.S. procurement increased more slowly than planned because costs rose more rapidly than anticipated, necessitating stretched out deliveries so as to fit within annual budgets. Prospects for DOD procurement can, therefore, be summarized as follows: priority ratings will be imposed on machine builders so

as to overcome bottlenecks. Existing military equipment is still undermaintained, and inventories of consumable goods are inadequate. Priority ratings will probably be attempted in all areas, perhaps even in maintenance, despite its complexity and subjectivity. Planning deadlines will get very tight.

PROSPECTS FOR RIVALRY BETWEEN U.S. CONTRACTORS

During the 1960's and 1970's the DOD appears to have worked to keep a variety of contractors alive and in the military business. During the 1980's, the U.S. government is less likely to continue to spread the wealth (notwithstanding the bail-out of Chrysler Corporation), because there is an increasing tendency in Washington to rely on the market place. Furthermore, with an expanding market, DOD will see less need to preserve competition. Finally, the DOD no longer has time to nurse firms along.

Some companies will fail. They are likely to be eclipsed in the scramble for priority ratings. They may be stuck with penalty payments for late delivery caused by subcontractors of needed components who failed to deliver on time (perhaps deliberately). Even if penalty clauses are imposed, the absence of special incentives will have the same effect as penalty clauses because the rate of inflation on components will exceed that of the general economy (on which most inflation adjustments are based). There is also likely to be more personnel raiding, done selectively to cripple a rival by removing its few managers who are capable of coping with complexity. Other mechanisms will be found in addition to these listed.

Over the last fifteen years U.S. corporate planning theory with respect to rivalry has evolved. The Boston Consulting Group, basing its approach on experience curves, maintains that an industry is viable when there are at most three competitors. The time for dealing with rivals is the time when the market is expanding. A rival can be left behind with the same annual sales, not realizing the he is losing his market share and is being preempted from evolving technological developments and markets. Antitrust law, which limits what a rival can get away with, is now more clearly understood and consequently less feared by U.S. managers.

PROSPECTS FOR CANADIAN COMPANIES

For twenty years DIPP has sustained Canadian companies in high technology, in part with an expectation that a time would come when product demand would permit them to operate to a higher degree on their own. That time is now. If Canadian companies are unable to profit now, and compete on their own, then we will have to say that to some degree DIPP has failed. There will be anxious moments however, as subcontractors in Canada are used as unwitting pawns in the rivalry between U.S. prime contractors.

IV - INHIBITORS TO THE U.S. MARKET

High technology engineers appear to believe that superior quality is sufficient to sell a product successfully. In fact, the product may not sell because it is not superior, or the company sales force has not approached the buyer's procurement force, or inhibitors block the way. If a company is having trouble selling, the natural tendency is to exaggerate the importance

of the inhibitors to avoid having to acknowledge that its product is getting obsolete, and its sales force is inadequate.

There are two kinds of inhibitors. First, from a U.S. point of view, given the way in which Americans do business with their own contractors and subcontractors, what additional road blocks do they place in the way of Canadian companies? Second, from a Canadian viewpoint, the fact that Americans do business among themselves differently from Canadians is itself a significant inhibitor. There is, in addition, a second level of question: whether it is worthwhile for Canadian firms to attempt to pierce the American market at all.

SIGNIFICANCE OF INHIBITORS

People feel very strongly about inhibitors. Knowledgeable Canadians we interviewed gave numerous examples of the problems Canadian firms face in the U.S. On the other hand, knowledgeable Americans interviewed perceived no inhibitors peculiar to Canadian firms.

The resolution of this apparent contradiction lies in distinguishing between "barriers" and "bias". The U.S. procurement system totally excludes Canadian firms from large domains. In the remaining admittedly much smaller area, Canadian and American firms are allowed to compete as equals. Within this smaller domain there are several substantial barriers to Canadian firms, i.e., obstacles to achieving sales. But there is, nevertheless, a remaining area beyond those barriers, and in that area, the U.S. system operates without significant bias against Canadian firms.

the two regions (barred/open). The obstacles which the barriers represent can so discourage a Canadian firm that it does not focus on what is possible, and consequently does not make the marketing effort required to succeed in the open area. Thus, the perception of bias is reinforced by the firm's own failure to take the initiative required in marketing.

Canadian Attitudes to Inhibitors

Although U.S. government contracts may last for many years, they contain a one year cancellation clause. An American businessman accepts this clause as part of doing business with the government because he knows that the U.S. Congress refuses to fund beyond one year. Canadian businessmen understand this intellectually, but they are anxious lest the one year cancellation clause be used against them.

Many of the Canadian businessmen interviewed used images of being excluded. They were fully aware that 65% of procurement is directed, i.e., it is not open for free bidding. This leaves 35%, seventy times greater than Canadian exports. Yet many focused only on the areas closed to Canadian vendors.

This attitude may well be the principal barrier to Canadian companies increasing their exports to the U.S. Department of Defense. DIPP gives no direct help in dealing with this psychological problem, though it may help indirectly by "legitimizing" the Canadian businessman. The U.S. interviews laid bare some general evidence that U.S. industry perceives the Canadian government as tending to "coddle" Canadian industry, whereas the U.S. government tends to hold U.S. industry at arms length, or in an adversary relationship.

We interviewed a number of Canadian government officials, formerly and presently based in Los Angeles, Dallas, Chicago, Detroit, and Washington who facilitate Canadian defence sales to the U.S. Those currently in their position tend to be diplomatic. Former incumbents seemed rather disgusted with Canadian businessmen. They told stories of Canadian businessmen who would arrive and act disoriented and overwhelmed. When given an offer, they sometimes took the offer back to the factory rather than being willing to sign on the spot. The businessmen had legal signing authority, but those chose not to exercise it until they had consulted with their colleagues back home. In other words, they had not done their homework.

SECOND SOURCING

The U.S. government avoids relying on any one vendor. Even though it may be cheaper to source the entire production from one vendor, U.S. procurement regulations demand second sourcing. In reality, of course, these regulations are sometimes waived, particularly in the early days of a product's development, or if the procurement is small and economies of scale great. No Canadian defence exports appear to all into this waived category. Thus, Pratt and Whitney of Canada developed gas turbine engines for helicopters and then saw the U.S. government deliberately create General Electric of Lynn, Massachusetts, as a second source rival. Conversely, Litton Systems Limited of Canada became second source for cruise missile guidance systems, even though it might well have been cheaper and more reliable to have concentrated all production in the Litton's guidance division plant.

For each DIPP project which it is hoped will be unique in supplying the Department of Defense, DIPP should explicitly anticipate that second source capability will be demanded by the DOD, either as an obligatory licence or by the deliberate creation of a rival. Sometimes this requirement harms Canada, as in the Pratt and Whitney Canada case referred to earlier. At other times, this requirement aids Canada, as in the case of Litton Systems Limited. On balance, it would seem that a technological follower (Canada) would have more to gain than to lose from U.S. insistence on second sources.

SMALL BUSINESS ADMINISTRATION (SBA)

In the U.S., a small business is one employing fewer than 500 employees. In some industries political pressures have led to a higher limit; for example, in automobile assembly, American Motors Corporation is designated as a small business. Thus all but a few of our DIPP companies are what an American would classify as small business. U.S. small businesses have preferred access to U.S. government markets.

The SBA was established as an independent federal government agency in 1953. It was created by Congress to "aid, counsel, assist, and protect the interest of small business concerns in order to preserve free competitive enterprise and to maintain its strength in the overall economy of the nation". For 25 years, SBA engaged in counselling clinics, loans and loan guarantees, and the creation of equity capital in small business investment companies. Moreover, for many years the SBA was viewed as an unexciting place to work, and its emphasis on facilitation did not appeal to hard-working, hard-driving, interventionist civil servants. Those quieter days are now coming to an end.

Sales by SBA firms to the DOD now total $12.3 billion per year; the SBA market share rose from 19.7% in 1977 to 21% in 1978 and is expected to increase to 30% by the end of the decade.

The SBA issues "certificates of competence" to small U.S. businesses based on its on-site study of the company's resources, management, performance record, and financial state. If the SBA is convinced that a company possesses or has access to the necessary credit and technical capability to perform the contract successfully, the agency issues a certificate of competence that is binding on the U.S. contracting officer. The certificate is valid only for the specific contract involved, but one small business can obtain many certificates. The government contracting officer has to honour the vendor's SBA certificate of competence, even despite his better judgment. Nevertheless, a certificate of competency is only the removal of a negative. It is not a positive action.

Legislated Requirements

In July, 1978, an Act of Congress (which overrides an executive agreement such as the Canada-U.S. Defence Production Sharing Agreement) required that contracting officers display affirmative action in the involvement of small business. Two of the provisions will have critical effect on DIPP.

1. Items of a particular class such as "hydraulic cylinders" are being set aside for small business. Once an item has been set aside for small business, the procurement agency cannot obtain bids from big business or from foreign business. Once items of a class have been set aside by one procurement agency, a legal precedent has been established which other

procurement agencies must follow. As a result of the 1978 Act, the Office of Federal Procurement Policy has had to make explicit its rules for class set asides.

Army regulations DAC 76-19 are typical. Once a small business has successfully completed a contract for an item, all items in that class are henceforth set aside for small business, so long as there are at least two responsive bidders from small business. From then on, cost is not a factor (except between small business bidders), and, while the onus for completion of the contract rests with the small business, the contracting agency has an obligation to provide all assistance possible; a similar obligation is laid on the prime contractor, and on the SBA Technology Utilization Division. In the past, government procurement officers rarely challenged the SBA when it awarded certificates of competence to particular small businesses. Now that the certificates of competence have, in essence, become perpetual, some procurement officers are starting to challenge the SBA. But it is an unequal battle. The law is definitely on the side of the SBA, and in every detail the U.S. is becoming a society of laws.

2. Each prime contractor is now obligated to furnish a subcontractor plan which spells out in detail how it will use Small Business. In the U.S., a large prime contract usually goes through several phases of bidding. The subcontractor plan is to be revealed, and evaluated, only at the last phase. It is expected that if a second from lowest bidder has a better subcontracting plan, then the better plan will dominate the cost saving.

Nevertheless, the precise rules for trade-off have not yet been established. Canadian corporations who wish to become prime or first-tier subcontractors in U.S. contracts will have to find subcontractors among U.S. small businessmen. They will have to develop plans to establish both formal and informal relationships with small U.S. businesses.

Consequences of These Requirements

Large U.S. businesses feel discriminated against. However, they are in a dilemma. Normally they would sue. But in this case, to bring suit in U.S. District Court would surely be to lose and to run the risk that the judge's decision would be even more explicit than Army Regulation DAC 76-19.

Instead, a "corporate shell" game has started. Just as multi-national companies create patterns of legal intersubsidiary ownership with an eye to taxation on a global basis, so it appears to be in the interest of large corporations to affiliate to themselves small businesses. The legal affiliation is sufficiently loose to satisfy the Small Business Administration that no acquisition has occurred, yet sufficiently tight that most of the profits flow through to the large corporations.

Canadian small businesses are not honorary U.S. citizens. They will be excluded unless they use superior corporate lawyers. Unfortunately, most Canadian businesses do not employ adequate U.S. counsel. For example, CAE sees no alternative but a withdrawal from items whose class has been set aside for SBA. Lower profile Canadian companies appear to be creating dummy small businesses in the U.S.

"BUY AMERICAN"

The "Buy American" Act of 1963 is waived for defence products coming from Canada. This DPSA agreement is written into Section 6 of the U.S. Defence Acquisition Regulations (DAR). As part of the DIPP evaluation, we interviewed two senior administrators in the Office of Federal Procurement Policy, part of the U.S. Office of Management and Budget in the Executive Office of the President.

One administrator noted that the Office is now in the process of replacing the Federal Procurement Regulations (FPR) with the Federal Acquisition Regulations (FAR). He claims that it is the Office of Management and Budget's intention to include in the Federal Acquisition Regulations the same exclusion of the "Buy American" Act for Canada in all federal agencies. His colleague cited the A-109 draft regulations now being circulated, wherein paragraph 11-b states "alternative system design concepts will be solicited from a broader base of qualified firms. In order to achieve a most preferred system solution, emphasis will be placed on innovation and competition; to this end, participation of smaller and newer businesses should be encouraged. Concepts will be primarily solicited from private industry; and when beneficial to the government, foreign technology and equipment may be considered". This should apply not only to Defense, but to all U.S. government departments.

The challenge Canadians will face will be to show that Canadian technology and equipment will be beneficial to the U.S. government. Because imports from Canada reduce the number of jobs available in U.S. industry and worsen the U.S. balance of payments, our claims will have to rest on the technological advantages we possess, our lower price, or our more immediate availability.

Where once there was an absolute prohibition, now there is the chance that we will be allowed to have our day in court. At present, it remains a chance only, because the new Federal Acquisition Regulations (of which A-109 is one example), are merely at the discussion stage. Even if we get our day in court, FAR would not override SBA set-asides, minority considerations, bids from labour surplus areas, or other preferential treatments.

SECURITY

Security provisions are sometimes cited by Canadian businessmen as inhibitors. They are as much a nuisance to Americans as they are to Canadians. Nevertheless, four comments should be made. First, compared with other foreign companies, sophisticated Canadian firms such as SPAR have an advantage because they are allowed to purchase components on the "critical technologies list".

Second, there are, nevertheless, certain areas such as nuclear hardening which are strictly off limits to any but U.S. companies. The approach taken by Canadian firms in these areas is to rely on DND and the armed forces of other nations for information and to keep working on the fundamental physics or chemistry of the problem, hoping that a breakthrough will occur that will interest the U.S.

Third, potential projects based on embryonic technology are too immature to have received a security classification. If a U.S. company official approached a U.S. procurement officer with such a idea, the procurement officer could, on verification of his security classification, share with him

some of the context and background of the problem so as to help him refine the potential project into an acceptable unsolicited proposal. If, however, a foreigner shows up with a similar idea, the U.S. procurement officer is bound to be more cautious in explaining the background of the problem, for, by so doing, he could be later accused of having passed secret information to foreigners. Canadians are foreigners. So until the technology is well enough understood to receive a security classification, it is likely that Canadian companies will have to proceed on their own, getting little of the assistance which helps an American proposal writer.

Fourth, security is sometimes used as an excuse for competitive rivalry. For example, in the area of infra-red technology, U.S. General Electric is a subcontractor to SPAR of Canada. On the grounds of national security, GE is not making available its technical drawings to SPAR. In that same technical area, SPAR used to be a member of the U.S. Government Committee called Infra-Red Information Exchange (IRIX). When its contract was not renewed, it lost its membership. Now that SPAR has a new contract in infra-red, it cannot regain its membership. Through their membership in IRIX, GE and Hughes have access to all the SPAR reports. Because it is not a member, SPAR does not have access to their reports. The Canadian response has been for DND to apply for membership in IRIX, but this application has suffered administrative delays, including having become lost. SPAR is not contemplating legal action, nor is the Canadian Government contemplating legal action against General Electric.

V - U.S. DOD PERCEPTIONS OF CANADIAN MANUFACTURERS

Selling to any specialized market calls for specialized expertise. This certainly holds true in selling to the U.S. Department of Defense. A corporate novice in this market, regardless of nationality, will stamp on toes, be oblivious to hints, and will not know why its bid requests are considered "non-responsive".

A few Canadian firms have made the necessary investment in learning how to sell. They are deemed by James Bond of the Canadian Embassy in Washington to be as experienced at marketing to DOD as experienced U.S. rivals. Of the companies with U.S. marketing experience listed by Mr. Bond, we randomly selected Canadian Marconi for intensive case analysis.

PERCEPTIONS OF CANADIAN MARCONI

If Canadian Marconi has problems with inhibitors, then the inhibitors are probably real. If Marconi does not have problems with what other Canadian companies view as inhibitors, then those inhibitors are probably derived from the other companies' inexperience.

Methodology

Our methodology was to interview U.S. procurement contract officers who had dealt with Canadian Marconi. We realized that interviewers affect the person being interviewed. To reduce the artificial responses that an unknown Canadian interviewer might evoke, two American interviewers were used:

Dwight Brooks and Antony Manganello of the Washington office of Peat, Marwick, Mitchell & Co. They wrote a working paper from which this section has been excerpted. Each has many years of DOD procurement experience, and was therefore more likely to use familiar language which would eliminate barriers to openness. Furthermore, each started their interview series with men they had known for years so as to have a datum against which to measure the openness of later interviewees. They interviewed four procurement officers who had dealt with Canadian Marconi. (At their request, names are omitted here).

Procuring Contracting Officer
U.S. Army Aviation Research and Development Command
St. Louis, Missouri

Procuring Contracting Officer
U.S. Naval Air Development Center
Warminister, Pennsylvania

Procuring Contracting Officer
U.S. Army Communications and Electronics
Fort Monmouth, New Jersey

Director of Procurement
Space Division (Global Positioning System)
Air Force Systems Command
Los Angeles Air Force Station
Los Angeles, California.

Each interview touched on the following points:

- Given your (the interviewee's) experience with Canadian Marconi, do you perceive any particular problems in dealing with Canadian firms in general?

- What was your impression of Marconi's performance on all aspects of the procurement?

Questions were also asked about the circumstances in which Marconi became involved with the procurement in the first place.

Findings

Responses were perceived as uniformly open and honest. Comments made were remarkably non-controversial in nature. They revealed few significant insights into any barriers that might be perceived to exist to Canadian firms entering in the U.S. defence market. Despite the fact that each individual contacted would have had good and sufficient reason to decline to comment on Marconi's performance on the contracts about which we were inquiring, all readily provided this information. Each contracting officer was favorably impressed with Marconi's abilities to meet all technical, schedule, cost, and administrative requirements. Some were very enthusiastic in their praise.

The interviews produced the following key points concerning Marconi's success in doing business in the U.S. defence market:

- Marconi won the one competitive procurement discussed (AN-GRC 103 Radio Set) not only by establishing a superior technical reputation for the product but also by bidding the lowest cost.

- Marconi was described by several interviewees as being scrupulous about meeting delivery schedules and satisfying the "software" or administrative requirements of the contract. (These are two factors that U.S. producers have been known to neglect on occasion).

- One interviewee observed that he felt Marconi was very aggressive in marketing the product to other customers.

PERCEPTION OF INHIBITORS

The following environmental and institutional inhibitors to Canadian firms, or absence thereof, were revealed in these interviews:

- Each interviewee stated that he saw no reason to treat Canadian firms differently from U.S. concerns in source selections and knew of no instances where factors other than the merits of each competitor entered into a competition involving Canadian firms.

- One individual felt that the Canadian Commercial Corporation's role as an intermediary between Canadian producers and U.S. customers was an inhibiting factor. He felt that their involvement delayed the process of contracting with a Canadian source, and it was, therefore, an unwelcome intrusion.

- One interviewee related how his procurement agency experienced difficulties with the U.S. Customs Service over shipments of products from Canada. (This problem stemmed from an erroneous interpretation of U.S. law by U.S. Customs and has apparently been resolved).

- Another minor complaint was made that "communications" with Canadian suppliers is difficult. He explained that it takes three weeks for his letters to reach Marconi or vice versa.

Two of these comments require further discussion. The fate of Canadian proposals in U.S. source selections is of course a controversial subject. It is difficult to dismiss the altogether reasonable suspicion that, all other things being equal, an occasional U.S. source selection authority might select a U.S. source over a Canadian just because it is a U.S. company. It would be ridiculous to deny that such patriotic tendencies exist.

On the other hand, each of the interviewees felt that the existence of a Canadian proposal in a competition greatly increased the necessity for everything to be "by the book". Competitive source selections involving only U.S. firms may be influenced by considerations such as broadening the industrial base for a particular type of product, increasing competition, maintaining long standing relationships, or just plain personal prejudices ("Co. X failed on the last project they won, they're not going to get a second chance"). By contrast, it seems possible that the inclusion of a Canadian proposal increases the anxiety of the DOD official involved to avoid provoking intervention by the State Department, the Department of Commerce or Congress into the process. (As a whole, DOD can be described as seeking to avoid such

"civilian" inquiries and inputs). Thus, the regulations are likely to be closely followed, and the outcome is less likely to be influenced by other considerations.

The comment concerning the Canadian Commercial Corporation (CCC) also merits further discussion. This organization was formed to promote and facilitate the conduct of business between Canadian firms and U.S. customers and offers numerous advantages to each party. Nevertheless, CCC participation can be construed by U.S. customers already disposed to contract with Canadian sources as an unneeded, extra step that complicates the process of arriving at a signed contract. In such circumstances, the CCC might consider interpreting its role as one of educating a Canadian firm how to compete in the U.S. defence market, assist it until it is ready to go on its own, and then withdraw, thereafter merely monitoring the firm's success or failure.

Among the specific comments made by individual procurement officers were the following:

- Has experienced no problems of any sort dealing with Marconi.

- Can foresee no difficulties in contracting with other Canadian firms.

- Stated that Marconi's record on this procurement "...is a clean sheet...".

- Knows of no instance where Marconi has had any difficulties satisfying the contract's administrative requirements.

- Technical people in the Navy are apparently highly satisfied with Marconi's product.

- States that there are "...usually no problems..." in dealing with Canadian contractors.

- Has had no problems dealing with Marconi on this contract; the engineering group is satisfied with the product and Marconi has also satisfied all administrative requirements.

- Stated that Marconi is "...one of our better producers."

- Explained that Marconi has built Radio Set AN-GRC 103 on both a sole source and a competitive contract. Marconi has won the competition for the procurement contract by proposing an excellent product (as expected by the Army) and bidding the lowest cost (not expected by the Army). Sixty percent of spare part procurements are competitive, and Marconi has won most of the business because of low cost bids.

- Marconi has delivered on schedule and satisfied all administrative requirements of the AN-GRC 103 contract throughout the 4+ years that he has been involved with the procurement.

- Foresees no problem in dealing with Canadian firms in the future. He treats them just like U.S. bidders in competitive procurements. He does not feel that Marconi's success with this product was enhanced by the fact that the development of this item was a joint effort between the U.S. and Canada.

- The Army is procuring the vertical instrument display system for use on OV-1, Blackhawk, and AAH. He feels that Marconi has been very aggressive in marketing the product to the Army and to other potential users (he cited Boeing and Lockheed for the L-1011).

- Procurement of one system is single source with no plans to go competitive. He can think of no reason, however, why a Canadian firm would be treated any differently from a U.S. company in a source selection.

Two observations should be made. First, some Canadian government officials view as an inhibitor to Canada the fact that about three-quarters of DOD procurement is directed contract. Certainly, the directed contract appears as an inhibitor until it is remembered that there are Canadian firms such as Marconi who are in single source relationships themselves.

Second, the comments about the AN-GRC 103 Radio Set are worth considering. Marconi proposed an excellent product (expected by the Army) and bid the lowest cost (not expected by the Army). By U.S. procurement points, Marconi would have been awarded the contract even if their price had been somewhat higher. So long as it is really believed that inhibitors are pervasive, Canadian contractors aim at a lower profit than is warranted.

U.S. PERCEPTIONS OF CANADIAN COMPANIES IN GENERAL

Ten other government officials and eight corporate officers were similarly interviewed. Their names and identifying titles are omitted here, but their programs and corporations indicate their backgrounds.

Major Systems Acquisition
Office of Federal Procurement Policy
Office of Management and Budget
Executive Office of the President
Washington, D.C.

Office of Federal Procurement Policy
Office of Management and Budget
Executive Office of the President
Washington, D.C.

Contracting Officr
Naval Electronics Systems Command
Washington, D.C.

Industrial Engineer
Naval Electronics Systems Command
Washington, D.C.

Contract Administrator
Defense Contract Administration Services
(Naval Electronics Systems Command)
Washington, D.C.

Mark 48 Torpedo Program
Naval Sea Systems Command
Washington, D.C.

Advanced Attack Helicopter

Army Aviation Research and Development Command

St. Louis, Missouri

Harpoon Missile System

Naval Air Systems Command

Washington, D.C.

Harpoon Missile System

Naval Air Systems Command

Washington, D.C.

Air Force Audit Agency

Washington, D.C.

General Electric Company

Valley Forge Space Center

Philadelphia, Pennsylvania

Hughes Helicopters

Division of Summa Corporation

Culver City, California

Hazeltine Corporation

Washington, D.C.

Lockheed Aircraft Corporation
Washington, D.C.

Harpoon Missile System
McDonnell Douglas Astronautics Corporation (EAST)
St. Louis, Missouri

General Electric Company
Philadelphia, Pennsylvania

United Technologics Corporation
Washington, D.C.

TRW, Inc.
Washington, D.C.

Interviews were conducted in an informal, conversational manner with the following sequence of subjects raised in eliciting responses.

- Discussion, generally, of the contract PMP Ottawa has with the Canadian Government and the part played in this study by the Washington PMM&Co. office.

- Discussion of their perceptions, attitudes, and ideas of Canadian firms (1) in the light of their experience with such firms, and (2) if they had had no experience, their reactions if presented with source selection competitions involving Canadian firms.

- Perceptions of the "experienced" firms, especially Canadian Marconi, and "inexperienced" firms.

- Generally, how they perceived Canadian firms fare (or would fare, depending on their experience) in source selection competiton with U.S. firms: advantages, disadvantages, etc.

- Any other information they could or would offer on related matters.

Limitations of Findings

Two qualifications should be made. First, the subject matter of the interviews was prone to subjective interpretation and somewhat nebulous in nature. We were, in fact, asking individuals to state their opinions and observations about hypothetical situations in some cases, and we were dealing as much with intentions and perceptions as with factual occurrences. In addition, it was thought that the subject matter might possibly be construed by some parties as controversial or threatening in nature. For these reasons, all interview results must be viewed as of uncertain validity because of the difficulty in dealing in concrete language with the topic under discussion and because interviewees might provide misleading responses about subjects which they might have perceived as risky. These fears, as it turned out, did not materialise to the extent anticipated.

The second caveat is that the individuals interviewed were by no means a scientific sampling of the entire procurement community within the U.S. complex of government and defence industry. The budget available permitted only an informal canvassing of conveniently accessible sources. Nevertheless,

much thought went into the selection of interviewees. Care was taken to provide a mixture of points of view on the question from varying levels within government and industry. The results, however, cannot be extrapolated to the entire procurement community, and the results must be viewed in the light of the limited size of our sample. Subject to these two qualifications, the following conclusions emerged.

Findings

The interviewees generally made very few adverse comments about Canadian companies. The most frequently used expressions were made in a tone of some surprise such as "...Why, I consider them just the same as U.S. companies..." in quality of product, personnel, reliability, administrative capabilities, and technology. Another common expression was "...I don't really consider them to be foreign companies..." obviously in the context of considering as foreign that Asian, European, or other areas. They said almost as often that they treated them "...just as if they were American firms...". They tended to cite the common language, common border, common defence interest in North America, and common culture (except for French).

As a matter of interest, there were some perceptions that, rather than the U.S. procurement officers having any adverse feelings, they tended to treat Canadian contractors as if they were U.S. contractors and thereby earned a rebuff. Canadian executives made it clear that they were not U.S. contractors; they represented companies in another sovereign power and were Canadian. No one seemed to fault the Canadians for an understandable pride and independence; rather, U.S. personnel were surprised or taken off guard.

Another attitude which surfaced without any prompting during the interviews was that, while there was a common language, this excluded the idea of the use of the French language in Quebec. They indicated that they would hesitate to contract with a firm in Quebec which used French exclusively. One U.S. Navy Captain said, by way of example, that they currently have a French firm (France) under contract which uses only English in all written and spoken communication which they (U.S. personnel) appreciated since the U.S is notoriously deficient in foreign language expertise.

It was also pointed out that in interviews the language used by U.S. procurements officers contains its fair share of esoteric jargon and that American use of the English language is often less than pure. Thus there is some need, they pointed out, for caution in negotiating and executing contracts in the "common language" because words sometimes have quite different nuances or connotations in the two countries. These differences can be important in interpreting the language used in the contracts.

The discussions during the evaluability phase of this DIPP study made it clear that there is some suspicion that the ability of Canadian firms to compete in the U.S. defence market is inhibited in some way by U.S. perceptions of Canadian manufacturers. This suspicion presumably results from the lack of success of some Canadian firms to make sizeable inroads into this marketplace.

The results of this study, however, are remarkably consistent in supporting the conclusion that no such psychological or prejudicial inhibitions exist. It is hardly reasonable to expect an individual being interviewed by a total stranger to admit openly to prejudice toward doing business with Canadian

firms. Nevertheless, the large number of friends and long standing acquaintances included in our list of interviewees, the generally open and honest manner in which virtually all interviewees responded, and the almost total absence of negative comments on the technical and management abilities of Canadian industry lead us to an encouraging conclusion. U.S. perceptions of Canadian manufacturers probably do not seriously limit Canadian opportunities to do business in the U.S. defence industry, if indeed these perceptions have any effect at all.

These findings still leave unanswered the question of why Canadian companies are not more successful in this marketplace. If our conclusions are correct, the problem must lie somewhere within Canadian industry itself. Canadian firms must improve in some way in order to increase their business with the U.S. defence industry.

Views on Canadian Marketing Performance

Comments solicited in our interviews did not include any specific criticisms of the technical abilities of Canadian manufacturers (i.e., their ability to produce a quality product), or of the manner in which Canadian firms are managed. Comments were made, however, on the manner in which Canadians market their products and in which they demonstrate their desire to do business with potential U.S. customers. More than one source indicated that Canadian companies do not do enough to make themselves known in the U.S. Canadian firms can do better at marketing their company's image, name, abilities, and desire, in addition to selling particular products. Their names must become familiar to decision makers. They must seek to get themselves on record as potential sources of products.

CONCLUSIONS

The need for this kind of marketing effort is reinforced by our belief that most Canadian firms see their greatest chances of success as third or fourth tier subcontractors on major defence acquisitions. They should market themselves to potential first and second tier subcontractors and to potential prime contractors, as well as to the U.S. DOD.

No single factor is likely to explain the inability of Canadian manufacturers to increase their penetration of the U.S. defence marketplace. The marketing approach discussed above may be only the first of a succession of steps necessary to improve the situation. It does seem clear, however, on the basis of our limited survey, that Canadians need not view U.S. attitudes or perceptions as a major obstacle in this quest.

Our limited survey did not produce enough evidence to prove conclusively that Canadian firms generally fail to market their products aggressively in the U.S. defence marketplace. Nevertheless, there were indications that this might be true. One senior industrialist was vehement in stating that it extremely difficult to find out which Canadian firms produce what products at what locations. He has Canadian Marconi currently under contract and is very positive about their performance. He thought that Canadian firms were more complacent, less aggressive, and tended to wait for government action to bring them business. (One notable exception to this belief is Canadian Marconi, who are considered to market their products aggressively and effectively.)

Another vice-president talked at some length about the good relationships they have with Canada and Canadian firms; however, they were mostly selling to Canada and not buying. When pressed twice as to why they were not buying, his answer suggested that they were "not finding mutually beneficial matches". It is likely that this manufacturer sold more aggressively to Canada than Canadian manufacturers sold to his company.

Despite risks of generalizing broadly, our perception has grown and persisted through this interview survey that less "gentlemanly conduct" and more aggressiveness on the part of Canadian manufacturers might well pay dividends in terms of more contracts for more sales.

VI - REALITIES OF THE U.S. DOD MARKET

There is no mistaking the fact that any new corporation trying to do business with DOD faces formidable difficulties. Many American firms have gone bankrupt in their attempts to pursue lucrative military contracts. Many Canadian firms, particularly those surveyed in the mini case studies, talked about the risk associated with doing business with the U.S. DOD. It is a substantial risk, and the Canadian businessmen talk of it as being beyond their control; they say that things just happen.

Canadian Marconi is said to have invested 10 years in becoming familiar with the U.S. defence market, and this seems to be a low estimate. Unfortunately, an investment in an intangible such as learning how to gain access to a market does not appear on the corporation's balance sheet. For this reason, the decision to get involved in the U.S. DOD market has to represent a strategic

commitment on the part of the corporation. The negative cash flow is endured for many years because of the hope of a greater positive cash flow in the future, but, whereas the negative cash flow now is spent with certainty, the future benefits are uncertain. The risk is increased because the benefits are at the discretion of U.S. procurement officers whose decision rules appear "unknowable" to Canadian businessman. To make concrete the necessary investment in marketing, we will now discuss what can be controlled, secondly, the petty nuisances, and thirdly, the anxiety of being excluded.

CONTROLLABLE FACTORS

The U.S. Department of Defense buys to military specifications. These are extremely detailed, extremely precise, and rather expensive to meet. Sometimes little relationship is apparent between the military specifications of components and the desired performance of the completed product. It may be that some Canadian companies with the capability to supply the U.S. DOD will decide not to do so. For example, Canadian Aviation Electronics produce simulators. They have developed their own standards for quality that they believe are appropriate, a quality high enough that their product is purchased by both Swissair and KLM. In selling flight simulators to the German Air Force for the NATO AWACS, Canadian Aviation Electronics was able to persuade the Germans to purchase a standard Boeing 707 simulator. The German Air Force got a much cheaper product, for which spare parts are readily available. The U.S. Air Force also has AWACS simulators, which function just as satisfactorily, but the components are built to military specifications, and the product as a whole is much more costly.

DIPP should investigate the possibility of maintaining a full set of U.S. military specifications on microfiche cards in Canada. A Canadian company would then be able to obtain, overnight, a photocopy of the specification it needs to make sense of a U.S. request for proposal. Then it can decide whether or not it wants to respond and can proceed accordingly.

Canadian companies dealing with DOD must learn DOD terminology. Words and phrases have very different meanings in the U.S. from those they have in Canada. U.S. contract language has precise legal meaning, buttressed by judicial rulings and the interpretations of thousands of contract lawyers. In the U.S.legal fees for contract lawyers appear to range between two and four percent of the contract price. Canadian businessmen are not used to including such expenses in their cost estimates, are uncomfortable about viewing U.S. government as an adversary, and seem to be very poorly connected with the network of major U.S. law firms who specialize in U.S. DOD contract language.

In Canada it appears to be the practice that if a businessman reads a Request For Proposal (RFP) and has a better idea, he will propose the better idea, even if it does not meet the letter of the request for proposal. The procurement process of DOD is so legalistic that when proposals are received and opened, they are first checked for "responsiveness". There may be 200 items which a proposal must address to be considered responsive. If it fails to be responsive to <u>any</u> one item, the proposal is summarily rejected. Only responsive proposals can be evaluated.

PAPERWORK

Paperwork is always a problem. In the U.S. DOD, it is a special problem and a huge expense. A new twist to DOD paperwork was discovered during the course of our interviews. The U.S. Navy, overwhelmed by its paperwork, is now contracting out much of its paper handling to private business. The private service company is paid a fee for each page of paper it processes. The unintended consequence is that the service company increases its profit as it finds ways to request yet more paper from contractors and potential contractors.

Part of doing business with the DOD involves learning how to set up office procedures to cope with paper flow. The manufacture of written paper can be likened to a production line, with designers, workers, and quality control. DIPP should consider hiring consultants who can help a few selected Canadian companies speed up in the handling of their U.S. DOD paperwork. Competent consulting firms exist, and effective programs can be instituted.

PETTY NUISANCES

Security clearances are frequently mentioned as a problem faced by Canadian businessmen who want to sell to DOD. The businessmen must apply for a visa clearance through the Canadian Department of Supply and Services (DSS). DSS then approaches the procurement command. If the Canadian manufacturer is sufficiently well known that the procurement command has requested his visit, the security clearance will go through without delay, unless there is a genuine security question. Usually, however, there are some delays. A U.S.

businessman faces somewhat similar requirements for security clearance, and a similar need to keep up-to-date with security clearances since they expire after three months. In other words, "rush" approvals are difficult to get for both Canadians and Americans. On an on-going basis of systematic renewals, there are two minor differences between the clearance available to an American as compared to a Canadian.

First, the Canadian's badge is of a different colour, clearly designating him as an alien foreigner. Until Americans are thoroughly familiar with the adequacy of the Canadian's security clearance, they cannot help but be reserved in their conversation.

Second, the Canadian businessman's security clearance allows him in on a "need to know" basis rather than to undertake a shopping or browsing expedition. Obviously, DSS attempts to write a sufficiently broad definition of the businessman's interests so as to expand his "need-to-know" to a desire to explore. Nevertheless, he has to establish a personal trust and build relationships over the years because Americans of high security classification tend to feel uneasy about snoopy foreigners. It is interesting to note that representatives from the Canadian government who possess an adequate security clearance are allowed to shop around, and in general are not obligated to show their need-to-know. From a Canadian businessman's point of view, maintaining valid U.S. security clearances is not unduly costly; it is simply another activity that has to be planned ahead of time.

REQUESTS FOR PROPOSALS

A number of Canadian businessmen complained that they are discriminated against by not having enough time to respond to Requests For Proposals (RFP). Canadian companies generally do business through the CCC. Therefore, in the U.S., the lists of approved bidders include the CCC but not the Canadian company. Unfortunately, an RFP frequently has a tight deadline. Mail from the U.S. to Canada moves slowly. After the RFP reaches the CCC office in Ottawa, several more days are consumed matching the RFP to Canadian companies who might be interested. Canada Post is slow. So by the time the RFP reaches the corporation there is not enough time to submit a proposal before the deadline.

In reality, a company is sadly out of touch with its market if it learns of a Request for Proposal only on receiving it. A good marketing man would have been helping the U.S. procurement command draft the RFP. Only in that way would he learn whether it is intended for another company, and only in that way can he bias the language of the proposal in his own favour.

A "cosmetic" solution to the problem would be for CCC to open an office in Detroit, or some other border town, to receive RFPs, copy them for the Canadian companies who might be interested, hand carry them across the international border, and post them or arrange for the company's courier to pick them up.

ANXIETY

Throughout the interviews conducted as part of the mini case studies frequent suggestions and, often, outright statements were made that Canadian businessmen were not sure how long they would be welcome in the U.S. They viewed their involvement in the U.S. Military market as a major investment which ought to yield benefits years in the future. But the benefits are unknown. They fear that if the benefits are greater than expected, the U.S. government will change the ground rules for their being there. In other words, their benefits could be truncated from above.

VII - REQUIREMENTS FOR THE U.S. CIVIL MARKET

In the U.S. civilian market, a Canadian company could probably sell its products at a higher price than it could get from DOD. In return for this higher price, however, the Canadian company has to pay for five changes.

First, the company needs a sales force, far more aggressive, persistent, and imaginative than is required in selling to the U.S. Department of Defense. The structure of RFPs, bidders' conferences, formal point systems for the evaluation of bids, and so on is rarely provided by a civilian buyer, and so a larger and more aggressive sales force is necessary.

Second, the marketing staff at headquarters has to be larger and has to work harder. Budget fluctuations for capital appropriations at DOD are mild compared with the budget fluctuations for capital appropriations of civilian companies. Within the buying company, the network of those who can influence

a purchase decision is usually quite complex. The vendor's salesmen-marketing team has to do much of the staff work for the buyer as he tries to get the purchase order through his capital appropriations committees, reviews by outside bankers, etc. The network of "influencers" and "blockers" differs more among customer corporations than among U.S. procurement offices.

Thirdly, reliability takes on a different dimension. In selling to DOD, the would-be supplier knows what the quality specifications are. They are written and available to anyone who takes the trouble to obtain and read them. A civilian buyer rarely develops specifications for the performance of components. The buyer wants the overall system to function. For critical components or sub-assemblies, he is under no compulsion to purchase from the lowest bidder. Thus a Canadian firm must manufacture and market an item which is compatible in form, fit, and function with the item which the Canadian supplier hopes to replace. The Canadian item itself must be easy to replace if it fails. This requirement must be met if the Canadian product is to be considered in the first place.

Fourth, whereas the U.S. DOD handles its own maintenance and stocks its own supplies of spare replacement parts, U.S. civilian buyers expect and demand that maintenance depots be established and that they be kept stocked. Furthermore, such depots have to be available to provide service at any time of the day or night, 365 days a year. Finally, the customer requires assurance that replacement parts will be available years into the future.

Fifth, the customer has to <u>believe</u>. The Canadian company must be known to be worthy of confidence. Credibility would be easy if it could be bought with a

few advertisements. Actually, years of image enhancement are required. CAE provides an example. CAE sold flight simulators to Swissair. Other European carriers such as KLM trust Swissair and therefore trust CAE. After KLM and Swissair had bought simulators, British Airways decided to do so. Air India tends to look to British Airways for guidance, so it bought. A number of newer Asian airlines take their cue from Air India. In such a sequence of following precedents, the first few sales are the most difficult, and the time horizon is at least a decade. In some technologies, a cluster of civilian buyers tend to follow the lead of the U.S. military.

Where they do, a Canadian company may well be advised to accept the difficulties and expenses entailed in selling to the U.S. DOD in order to establish its reputation in the world market. In developing military skills which it knows it will not want to keep, the company may appreciate the help of DIPP. For example, an unusually heavy investment in front-end marketing and sales expenses is likely. This investment does not appear on company balance sheets; it does appear as a reduction in profitability each year and hence imperils the company's relationships with its banks and others who cannot see beyond financial statements.

Although many Canadian companies will function as first and lower tier subcontractors to U.S. prime, contractors, probably only a few Canadian companies have the will and gusto to create world-wide marketing capabilities.

Once a company has invested in creating a civilian reputation in high technology and it becomes known as the best or the second best in the world, then that company has all the benefits of portfolio diversification of its

customer base, and is much less vulnerable than a business which supplies only the U.S. Department of Defense.

VIII - PROCUREMENT LIFE CYCLES

In our examination of procurement life cycles (of which two major examples are described in detail in a working document filed with the ITC DIPP Evaluation Coordinator) we found no standard pattern which would permit increased benefits through use of a uniform strategy. The volatile nature of the military market is a major factor in procurement life cycles, as it is in the entire question of military sales. Where a military project is viewed by DOD as highly urgent our study showed that it was advantageous but very risky to get in early. With other, more deliberate projects, a potential supplier can "shoulder" his way in with more cost-effective components at almost any stage.

The best answer for a DIPP firm seems to be to have efficient products ready at any time so as to be able to submit these for a variety of military projects, rather than to try to focus all its energies on gaining entry into a particular large project.

IX - SUMMARY OF MAJOR RECOMMENDATIONS ON MARKETING

The major recommendations proposed in the marketing module are summarized below:

1. The Canadian government should start early planning to take advantage of the anticipated widening of Canada's exclusion from "Buy American", which would permit "equal" entry to all U.S. federal agency procurement.

2. It seems likely that a hierarchy of defence priorities will be imposed in the U.S. in the 1980's, in effect rationing the availability of scarce metals, semiconductors, forgings and components. It may be prudent that the Canadian government assure Canadian companies of adequate supplies by mastering the allocation of purchasing priorities and seeking to influence them.

3. Joint development with U.S. prime companies should be explored in more detail to determine what leverage DIPP could exert to enable Canadian companies to undertake worthwhile development projects on a company-to-company basis. Canadian companies should focus their marketing efforts on Original Equipment Manufacturers rather than DOD, and within this group, they should pay as much attention to seeking subcontracts from prime and first and second tier subcontractors as from third and fourth tier subcontractors.

4. Canadian policy on the procurement of the products of Canadian high technology companies should be examined to determine if a "Buy Canadian" policy would yield net benefits.

5. Canadian firms must invest in marketing. Despite the likelihood of a long payback period, such an investment is essential to the long-term improvement of profitability.

6. Canadian firms should adopt a more aggressive approach in marketing. They must take action to get themselves known to potential customers and to demonstrate the technological advantages of their products and their reliability.

7. Industry should be able to contact one area within ITC which would be responsive to market needs generally.

8. A general policy should be established regarding the criteria of acceptability (or worth) of the various types of product mandates in subsidiary companies. DIPP should actively seek to extend the influence it has had on broadening Canadian subsidiaries' product mandates.

9. Canadian subsidiaries should be encouraged to develop the marketing leverage which could be derived from parent relationships.

10. For each DIPP project hoping to be unique to DOD's requirement, DIPP should explicitly anticipate DOD demanding second sourcing capability.

11. Canadian companies should nurture both formal and informal relationships with small U.S. businesses since these businesses have a considerable amount of legislated access to U.S. government procurement.

12. For complete systems products, product characteristics should be aimed at non-U.S. markets.