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DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE  
DEFENCE INDUSTRY PRODUCTIVITY PROGRAM (DIPP)  
EVALUATION STUDY

VOLUME 1

COVERING REPORT



Peat, Marwick and Partners  
Management Consultants



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*L. Poat, Mawick and Partners*

DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE  
DEFENCE INDUSTRY PRODUCTIVITY PROGRAM (DIPP)  
EVALUATION STUDY

VOLUME 1  
COVERING REPORT

JULY, 1980





Peat, Marwick and Partners

Management Consultants

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July 10, 1980

PRIVATE

Mr. E. M. Hahn  
Director  
Program Evaluation and Performance  
Measurement Branch  
2nd Floor East  
235 Queen Street  
OTTAWA, Ontario  
K1A 0H5

Dear Sir:

We have pleasure in attaching the final report arising from our evaluation of the Defence Industry Productivity Program.

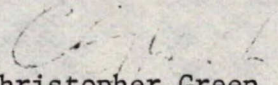
The report is written in four volumes:

- Volume 1 - Executive Summary, Covering Report, and Key Appendices.
- Volume 2 - Major Case Studies.
- Volume 3 - Mini Case Studies; Expert Opinion; User Survey; Regression Analysis; Marketing.
- Volume 4 - Program Delivery.

We enjoyed working on this challenging assignment, and wish to express our gratitude for the significant support and assistance from yourself, Mr. Roy Atkinson, our Project Director, and the many other officers of the Department of Industry, Trade and Commerce who so generously gave us their time and ideas during the course of the assignment.

Yours very truly,

PEAT, MARWICK and PARTNERS

  
Christopher Green  
Managing Partner

CG:wc

## DIPP EVALUATION STUDY

## VOLUME 1

TABLE OF CONTENTS

	<u>PAGE</u>
EXECUTIVE SUMMARY .....	i
STRUCTURE OF THE REPORT ON THE DIPP EVALUATION STUDY .....	xiv
COVERING REPORT .....	1
APPENDIX A: TERMS OF REFERENCE .....	A-1
APPENDIX B: STRUCTURE OF THE EVALUATION STUDY .....	B-1
APPENDIX C: THE DIP PROGRAM - BASIC INFORMATION .....	C-1
APPENDIX D: ECONOMIC AND RELATED BENEFITS .....	D-1
APPENDIX E: DEFENCE RATIONALE FOR DIPP .....	E-1
APPENDIX F: THE "TECHNOLOGY" OBJECTIVE OF DIPP .....	F-1
APPENDIX G: RISK .....	G-1
APPENDIX H: COMPETING SUBSIDIES .....	H-1



## DIPP EVALUATION STUDY

## VOLUME 1

TABLE OF CONTENTS

	<u>PAGE</u>
EXECUTIVE SUMMARY .....	v
STRUCTURE OF THE REPORT ON THE DIPP EVALUATION STUDY .....	xiv
I - INTRODUCTION TO DIPP AND THE EVALUATION .....	1
DIPP: A Brief Overview .....	1
Evaluation Study: A Brief Overview .....	6
II - GOAL ACHIEVEMENT .....	12
Impact of DIPP on Its Defence Objective .....	12
Impact of DIPP on Its Technological Objective .....	13
Impact of DIPP on Economic Objective .....	15
Additional Benefits .....	26
Additional Goals .....	28
Discussion and Summary of Goal Achievement .....	28
III - WHY DIPP PERFORMS AS IT DOES .....	30
Factors Contributing to an Economic Impact .....	30
Economic Measures .....	30
Incrementality .....	32
Economic Benefits from Incremental Projects .....	33
User Survey .....	33
Discussion and Summary .....	33
IV - CORPORATE INFLUENCES ON PROGRAM PERFORMANCE .....	35
Introduction .....	35
Corporate Attitudes .....	36
Decision-Making Factors .....	37
Firms' Perception of Themselves and of Competition .....	43
Parent-Subsidiary Relationships .....	43
Technological Spin-Offs .....	48
Government/Corporate Interaction .....	49
Overview of Corporate Environment .....	50

	<u>PAGE</u>
V - MARKETS AND MARKETING .....	51
Introduction .....	51
U.S. DOD Market .....	52
Non-Defence U.S. Markets .....	57
Non-U.S. Foreign Defence Markets .....	58
Canadian Marketing Practices .....	59
Influence of Domestic Sales .....	63
Defence Sharing Arrangements .....	64
Summary .....	66
VI - COMPETING SUBSIDIES .....	68
Introduction .....	68
Relative Levels of Support .....	68
Effect of new GATT .....	70
Corporate Attitudes on Competing Subsidies .....	71
The Competing Subsidy Rationale .....	73
VII - PROGRAM FINDINGS AND PROGRAM DESIGN .....	74
Redesign Features .....	74
Funding Level .....	75
Relative Performance of DIPP Components .....	76
Incrementality of Repayable Grants .....	77
Financing Risk and Liquidity .....	78
Repayment of Excessive Profits .....	81
Politico-Economic "Tone" (Repayments) .....	82
Summary .....	82
VIII - PROGRAM DELIVERY .....	84
Introduction .....	84
Delivery Time .....	85
Compliance with Directive .....	86
Strengths of the Current Delivery System .....	86
Weaknesses of the Current Delivery System .....	87
Current Operational Philosophy and Characteristics .....	92
Some General Problems in Program Delivery .....	93
Modified System .....	94
Additional Measures .....	100
Matrix Aspect .....	102
Increased Resources .....	102

	<u>PAGE</u>
IX - INTERPRETIVE DISCUSSION .....	103
Reality of DIPP Assumptions .....	103
Features of a Re-oriented Program .....	104
An Integrating Perspective .....	105
Technological Spin-offs .....	106
Other "Spin-Off" Effects .....	107
Goals .....	108
Transition Problems .....	108
Relationship to Industrial Sectors .....	109
Relation of Findings to Other Studies .....	111
Worth of High Technology .....	112
Capital Assistance .....	113
Relation to Howe-McFettridge Findings .....	113
Stability of Funding and Large Projects .....	113
Summary of Major Findings .....	116
Summary of Findings .....	116
X - RECOMMENDATIONS .....	117
Major Recommendations .....	117
Confidence Limits .....	118

#### EXHIBITS

#### OPPOSITE PAGE

1. DIPP Expenditures (Actual) by Program Element by Fiscal Year 1959-1980 .....	5
2. DIPP Expenditures by Program Element by Fiscal Year 1959-1980 (1969 Dollars) .....	5
3. Summary of the Studies of DIPP and Its Major Projects .....	11
4. Expert Opinion on Development of Technological Capability .....	14
5. Economic Payoff of DIPP .....	19*
6. Rate of Success and Failure of DIPP Projects .....	20*
7. Net Present Value of DIPP Projects .....	22*
8. Summary of Regression Results for Economic Impact .....	30
9. Possible Flow of DIPP Projects .....	98*
10. Robustness of Recommendations .....	118

\*These Exhibits are on the page as marked.

APPENDICES

A.	Terms of Reference .....	A-1
B.	Structure of Study .....	B-1
C.	The DIP Program - Basic Information .....	C-1
D.	Economic and Related Benefits .....	D-1
E.	Defence Rationale for DIPP .....	E-1
F.	The "Technology" Objective of DIPP .....	F-1
G.	Risk .....	G-1
H.	Competing Subsidies .....	H-1



EXECUTIVE SUMMARY

BACKGROUND

The Defence Industry Productivity Program (DIPP) began its life in the Department of Defence Production in 1959. Its genesis was largely the concern for maintaining defence trade balance and a defence industrial base subsequent to the termination of the "Arrow" fighter aircraft project, and the attendant loss of defence industry skills and capabilities to other countries.

In the twenty years since its inception, the program's goals have been subject to a variety of influences and have evolved accordingly. For instance, DIPP became the vehicle for supporting Canada's role under DPSA's and DDSA's negotiated with the U.S. and certain European and Scandinavian governments. In 1968, DIPP was given a civil-related products mandate and since then it has been more strongly oriented toward civil-related projects than previously.

Accordingly, the program has operated with multiple objectives. Certain of these are quantifiable (e.g., direct economic benefits). Other objectives are not readily quantifiable (e.g., defence capability, technological capability, the "value" of a competent design team, etc.). Some of these objectives may be in harmony; others may be in conflict, at different stages of program evolution.

The evaluation of DIPP is therefore complicated by the evolution and changing emphasis of program goals.

### EVALUATION EMPHASIS

In accordance with the terms of reference, the evaluation of the DIP Program focused primarily on the economic objective; study was also devoted, however, to the defence and technological goals.

### GOAL ACHIEVEMENT

The evaluation indicates that the intervention of DIPP has created certain beneficial effects. The Program has made progress towards overall achievement of its goals.

The evaluation of program performance against the economic objective used the accepted "norm" of 10% ROI as the critical measure. This may be a rigorous standard against which to measure an R&D program which has funded ventures into embryonic technology and research and development projects. In addition, it was not possible to quantify all of the benefits streaming from the Program.

- On an overall basis, using the 10% ROI as a norm, DIPP yields a positive Net Present Value (NPV) of \$61.1 million ('69\$) for an ROI of 10 3/4%.
- On an incremental basis (counting only projects that would not have been undertaken in the absence of DIPP funding) the Program yields a negative NPV of \$96.6 million ('69\$) for an ROI of 7 1/2%. The 2 1/2% shortfall from a 10% ROI could be regarded as the "cost" of achieving other Program goals. It should, of course, be borne in mind that the Program has never had a formal incrementality criterion.



- On an incremental basis, the individual program components have ROI's of
  - R&D 7 1/4%
  - Capital Assistance (CA) 10%
  - Source Establishment (SE) 10+%

The R&D figure is judged to be robust; the latter two are less so.

- DIPP has contributed to an understood defence objective. To be worthwhile, however, this objective requires complementary DND policies and plans; from an admittedly non-exhaustive study of those policies and plans there is a serious question as to the degree to which they are, in fact, complementary. The fit between DIPP and DND objectives, therefore, requires development and clarification; based, however, on our limited study the current position would be that broadening of the program would not be inconsistent with current DIPP programs.
- DIPP has contributed to the maintenance of a technological capability; this evaluation has not been able to capture precisely the degree to which this capability has translated itself into economic benefits; our best rough estimate is \$18 million ('69\$), an amount which would not change the thrust of our overall findings but which would increase the incremental ROI from 7 1/2% to near to 8%.

#### WHY DIPP PERFORMS AS IT DOES

- The projects which yielded the best economic returns tended to be those which had lower associated risks, used more mature (but still high) technology, received substantial funds, and were aimed at the civil market.

- Incremental projects had almost inverse characteristics: they were high risk, used embryonic technology, and aimed at a defence market.
- A reoriented program using the changed selection criterion identified in the study could yield a 10% incremental ROI with 80% of the program funds, based on the assumption of a continuation of historical characteristics.

#### CORPORATE INFLUENCES

- The greatest risk in the projects tends to be in the marketing area rather than in the technical area.
- DIPP projects have not been highly risky in a technical sense.
- Firms are, however, fairly cautious in their overall commercial risk assessment so that without a program such as DIPP some economically worthwhile projects would not go ahead.
- DIPP has been instrumental in attracting companies to locate subsidiaries in Canada.
- The parent/subsidiary relationship in foreign-owned Canadian firms has not inhibited the performance of DIPP. The program has been used as an effective lever in enabling Canadian subsidiaries to obtain product mandates and increased autonomy.



- The DIPP firms do almost no pure research and, with the exception of the large aerospace companies, little development. Significant engineering is undertaken. The strongest constraint on their R&D activities is probably not their budget but, rather, the nature and extent of their human resources available for R&D.
- Technological spin-offs have resulted from DIPP projects but have not been found to yield substantial economic pay-offs. This is not to imply that economic payoffs have not been earned but rather that it was not possible to measure them fully during this evaluation.

#### MARKETS AND MARKETING

- The U.S. DOD market has certain features which severely reduce its attractiveness:
  - . There are major barriers arising from legislation and U.S. national security considerations; as for defence markets in general, they are quite volatile.
- In the operation of the DOD procurement system, bias against Canadian firms was not found.
- Relative to other U.S. allies, Canada does well, but its favoured position is being diluted.
- In the marketing area, Canadian firms have developed reasonable selling practices, but they should strengthen their performance in the broader activities of market development and analysis.

- The defence-sharing arrangements (DPSA, DDSA, MOU's) have been effective in facilitating sales and projects.
- The joint cost-shared ("nominated") projects have not performed economically even as well as other defence projects.
- Overall, marketing deserves more emphasis, but the improvements foreseen would not in themselves change the thrust of the findings.

Whilst we recognize the total potential defence market may increase over the next decade, given the current "hawkish" mood subsequent to Iran and Afghanistan, we do not envisage the market characteristics changing significantly.

#### COMPETING SUBSIDIES

- Compared to the support given by other nations, DIPP is not relatively generous.
- But the firms (non-aerospace in particular), have developed means of doing business which do not require universal and uniform support to match foreign competing subsidies.
- On balance aid to neutralize competing support should be available in specific instances and particularly for the aerospace industry.

#### PROGRAM FINDINGS AND PROGRAM DESIGN

- The program should be broadened to apply to all "High Technology" industry.



- Based on the historical evidence of this study, the current funding level should be at least maintained; large projects (above \$10 million) should be separately funded, which, on average, would effectively increase funding by about 5%, assuming that historical patterns continue.
- There should be no funding arrangements which do not have repayment provisions, but the repayment provisions should be on quite generous terms.
- We found no compelling reason to change the funding from the current 50:50 (private:public funds) in R&D projects.
- CA and SE projects should each receive about 10% of the program funds; the CA funds should be expended on a loan/repayable grant (50:50) basis; the repayment provision would be a change from the present arrangement.
- 20% of the funds should go as loans to low-incrementality R&D projects.
- The remaining 60% should be used to provide repayable grants to R&D projects.
- To attain the incremental ROI norm, all of the instruments should operate under criteria which give greater weight to projects with low risk/civil market/mature technology characteristics. Attention should also be paid to the factors of funding adequacy and continuing support.

- The foregoing views are based on the past results and could be viewed as applying to a "steady state". They do not address the question of how to treat the current backlog of projects or the question of whether a new, profitable defence market has recently developed in the U.S.

#### PROGRAM DELIVERY

- With the exception of delivery times which average 12 months for R&D projects, and the full implementation of monitoring and control, the current system has reflected the philosophy of the current directive.
- There are, however, certain problems with this system: program goals are not clear; priorities do not emerge; responsibility is elusive.
- A modified system has been recommended to overcome those problems. Changes would include: a revised directive; published guidelines for submissions; project teams with increased continuity for analysis and monitoring; use of a two-step project scoring system which would filter first for high NPV and then on incrementality; greater use of planning instruments; and improved methods of monitoring and control.
- The system would be directed by a two-tiered committee system: a Program Committee (ADM level) to give overall direction, and a Project Committee (DG level) to ensure consistency and quality in project assessment.
- Large projects (above \$10 million) would be treated on the basis of negotiations under the supervision of the Program Committee.

- The degree of priority as between the Vertical Sector Strategy vs. a Horizontal Program should be resolved before the delivery system is modified.
- The envisaged delivery system would require additional resources (about \$1 million/year), but these expenditures would be cost-effective.

#### INTERPRETIVE DISCUSSION

- DIPP should be continued but on a broadened basis and with a rationale which recognizes the need for government intervention in commercially risky situations.
- The creation of a family of technology support programs, of which DIPP would be a member, should be examined.
- The development of the "large project" negotiation approach may provide a flexible means of resolving certain past issues, such as the following:
  - . At what point should government support of large projects cease?
  - . How should projects which address multiple government goals be designed and funded?
  - . How should large-scale government/company projects be managed?
  - . To what degree should corporations, as opposed to projects, be supported?



STRUCTURE OF THE REPORT ON THE DIPP EVALUATION STUDY

The Report on the DIPP Evaluation Study is divided into four volumes.

Volume 1 contains the Covering Report, which presents a summary of major findings, conclusions, and recommendations, and an interpretive discussion. The Appendices which accompany the covering report are related to particular topics which have an overall bearing on the DIPP Program.

Volume 1 contains the following:

EXECUTIVE SUMMARY

COVERING REPORT

- APPENDICES:
- A. Terms of Reference
  - B. Structure of the Evaluation Study
  - C. The DIP Program - Basic Information
  - D. Economic and Related Benefits
  - E. Defence Rationale for DIPP
  - F. The "Technology" Objective of DIPP in Relation to Industrial R&D and Economic Growth
  - G. Risk
  - H. Competing Subsidies

The work undertaken in conducting the Evaluation Study was organized into operational modules. An Annex has been written for each of these modules, and

the remaining three volumes of the report contain these Annexes. Volume 2 is devoted to the Major Case Studies, and Volume 4 is devoted to Program Delivery. Volume 3 contains several Annexes.

Volume 2 contains the following:

ANNEX I: MAJOR CASE STUDIES

Introduction

IA CAE Electronics Limited

IB Canadair Limited

IC Canadian Marconi Company

ID de Havilland Aircraft of Canada

IE McDonnell Douglas of Canada Ltd.

IF Microsystems International Ltd.

IG Pratt and Whitney of Canada Ltd.

Volume 3 contains the following:

Annex II MINI CASE STUDIES

Annex III EXPERT OPINION

Annex IV USER SURVEY

Annex V REGRESSION ANALYSIS

Annex VI A MARKETING

Annex VI B DIPP MARKETS

Volume 4 contains the following:

Annex VII	PROGRAM DELIVERY
	Introduction
	VII A Overview of Project Management
	VII B DIPP Delivery System
	VII C Program Management
	VII D Program - Wide Issues
	VII E Remedial Action

Each volume contains its own Table of Contents. In addition, a detailed Table of Contents is provided at the beginning of each of the appendices in Volume 1, and at the beginning of each Annex in Volumes 2, 3 and 4.

ADDITIONAL DOCUMENTATION

The ITC DIPP Evaluation Coordinator has on file several relevant working documents which, for reasons of length, have not been included in the study. These include:

- an extensive report written by Dr. Alex Polianski, then of ITC;
- a study on procurement life cycles, written by Professor D. Rutenberg of Queen's University, Kingston;
- copies of all the questionnaires used in gathering data for the study, including a questionnaire completed by ITC personnel;
- a computer file containing the data derived from the questionnaires.



I - INTRODUCTION TO DIPP AND THE EVALUATION STUDY

This document contains a covering report on the evaluation of the Defence Industry Productivity Program (DIPP) and associated appendices. References are also made to the Annexes in the accompanying volumes; these Annexes, which are listed in the preliminary pages, provide fuller accounts of the material contained in this covering report. In the introductory section, salient features of the program are noted to provide a background of information and to underline certain aspects which are of particular relevance to the evaluation study.

DIPP: A BRIEF OVERVIEW

The historical background, objectives and program components are discussed, as well as the reasons for conducting an evaluation study.

Background

DIPP is an industrial assistance program operated by ITC. It is perhaps the oldest program of the Department, having arrived via the Department of Industry from the Department of Defence Production. It is one of the largest contribution programs of ITC at \$45 million a year, and it has provided close to three-quarters of a billion dollars of assistance to industry over 20 years.

The genesis of DIPP was largely the concern for maintaining defence trade balance and a defence industrial base subsequent to the termination of the "Arrow" fighter aircraft project and the attendant loss of defence industry skills and capabilities to other countries.

In the twenty years since its inception, the Program's goals have been subject to a variety of influences and have evolved accordingly. For instance, DIPP became the vehicle for supporting Canada's role under DPSA's and DDSA's negotiated with the U.S. and certain European and Scandinavian governments.

In 1968, DIPP was given a civil-related products mandate, and since then it has been more strongly oriented towards civil-related projects than previously.

Accordingly, the program has operated with multiple objectives. Certain of these are quantifiable (e.g., direct economic benefits). Other objectives are not readily quantifiable (e.g., defence capability technological capability, the "value" of a competent design team, etc.). Some of these objectives may be in harmony, and others may be in conflict at different stages of program evolution. The evaluation of DIPP is therefore complicated by the evolution and changing emphasis of program goals.

#### Objectives

The present program directive describes the objectives of the program as follows: "To develop and sustain the technological capability of the Canadian defence industry for the purpose of generating economically viable defence exports and related civil exports". This objective is currently interpreted quite literally by senior ITC management. Generating economically viable exports, and thereby contributing to Canada's economic growth, is seen as the ultimate objective of the program. The development of defence-related technological capability is seen as being instrumental, a means towards the economic objective, rather than an end in itself. In view of the varying weights which have been attached to the different objectives over time, the

study has examined not only the economic objective, but also the defence and technology objectives both as aims in themselves and as "feeders" for the economic goal.

In its emphasis, the evaluation of the program has focused most closely on the economic goal of the program, but the results must be interpreted in the context of the evolving, multiple objectives of the program during the twenty year period under review.

#### Environmental Perceptions

DIPP has operated also within a perception that there were certain factors that required or justified its existence:

- that high technology inevitably means high risk, particularly in the defence field; this degree of risk must be offset by compensating government support;
- that the various forms of support given to foreign competitors in this field require matching support if Canada wishes to have a defence industrial base;
- that the future of Canadian industry rests on its ability to support a high-technology sector and that the health of this sector in turn depends on its participation in projects in the defence field.

The study, accordingly, has examined these assumptions.

Program Components

In order to meet its objectives, the DIP Program supports four types of projects: Research and Development (R&D), Capital Assistance (CA), Source Establishment (SE), and Non-recoverable Costs Support (NRCS). Briefly, these four components of the program operate as follows:

R&D or innovation projects (about 73% of funds to date). Under this heading, DIPP provides funds to firms to develop new products for export sales. The funds are provided as grants for a portion (usually 50 percent) of the R&D costs. A particular component in this category comprises the joint (shared-cost) programs funded entirely and equally by Canada and cooperating governments.

Capital Assistance (about 14% of funds to date). This portion of the program provides funding (50% loan, 50% contribution) for industry modernisation. Funds are given to companies which need to upgrade their capabilities for producing defence and defence-related products. The need for modernisation often arises when the company attempts to secure a U.S. Department of Defense (DOD) contract.

Source Establishment. This component of the program provides for a sharing of acceptable costs of a non-capital nature which are associated with the establishment of a Canadian resident company as a qualified supplier of materiel, components, or equipment for defence or defence-related export markets. The cost sharing is normally on a 50% basis.



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EXHIBIT 2

DIPP EXPENDITURES BY PROGRAM ELEMENT BY FISCAL YEAR 1959-1980

Deflated to 1969 Dollars

Year	Capital Assistance	Source Establishment	R & D Innovation	Total
- millions of 1969 dollars -				
1959/60	-	-	2.360	2.360
1960/1	-	-	3.721	3.721
1961/2	-	-	5.562	5.652
1962/3	-	-	10.088	10.088
1963/4	-	-	23.515	23.515
1964/5	0.476	0.097	24.788	25.361
1965/6	2.784	0.073	27.984	30.841
1966/7	8.549	10.509	25.366	44.424
1967/8	11.008	0.395	24.680	36.083
1968/9	5.663	3.053	22.168	30.884
1969/70	6.114	18.562	23.823	48.499
1970/1	6.363	12.383	24.453	43.199
1971/2	8.710	6.966	29.509	45.185
1972/3	4.927	11.493	26.232	42.652
1973/4	6.060	4.568	35.820	46.448
1974/5	4.811	4.087	25.040	33.938
1975/6	3.758	1.372	19.554	24.684
1976/7	3.179	1.312	21.418	25.909
1977/8	2.322	3.760	17.224	23.306
1978/9	3.182	6.587	16.688	26.457
1979/80	<u>6.311</u>	<u>3.511</u>	<u>16.901</u>	<u>26.723</u>
TOTALS	84.217	88.728	426.984	599.929

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EXHIBIT 1

DIPP EXPENDITURES (ACTUAL) BY PROGRAM ELEMENT BY FISCAL YEAR 1959-1980

Year	Capital Assistance \$ million	Source Establishment \$ million	R & D Innovation \$ million	Total \$ million
1959/60	-	-	1.815	1.815
1960/1	-	-	2.902	2.902
1961/2	-	-	4.420	4.420
1962/3	-	-	8.000	8.000
1963/4	-	-	19.000	19.000
1964/5	0.394	0.080	20.500	20.974
1965/6	2.378	0.062	23.898	26.338
1966/7	7.626	9.374	22.626	30.626
1967/8	10.215	0.367	22.903	33.485
1968/9	5.425	2.925	21.237	29.587
1969/70	6.114	18.562	23.832	48.499
1970/1	6.656	12.952	25.578	45.186
1971/2	9.407	7.523	31.870	48.800
1972/3	5.582	13.022	29.721	48.325
1973/4	7.502	5.655	44.346	57.503
1974/5	6.865	5.832	35.733	48.430
1975/6	5.938	2.167	30.895	39.000
1976/7	5.509	2.273	37.118	44.900
1977/8	4.305	6.972	31.933	43.210
1978/9	6.278	12.996	32.926	52.200
*1979/80	<u>13.683</u>	<u>7.612</u>	<u>36.641</u>	<u>57.936</u>
TOTALS	103.877	108.374	507.885	720.136

\*1979/80 figures represent allocations

NOTE: The above data are for contributions only. The amounts for CA loans are not included but are equal to the amounts shown for the CA contribution (Column 2).

Non-recoverable Costs Support (NRCS). This form of assistance is closely allied to source establishment assistance Funds are provided for pre-production engineering and services, for special tooling costs (of a non-capital nature), and for the supply of prototypes. However, a bid for a defence contract is normally involved, and the need for assistance to offset adverse cost conditions unique to the Canadian suppliers, or to offset costs which foreign competitors have already amortized, or to offset foreign government support to competing firms must be substantiated. The cost sharing is normally on a 50% basis and is assumed only if the company is successful in its bid for the contract.

SE and NRCS assistance has constituted about 13% of funds to date. They are treated together in this report as a single element under the SE designation.

#### Expenditures

A summary of the funds spent on each of these components is provided in Exhibit 1, opposite. Exhibit 2, opposite, reduces these expenditures to constant 1969 dollars.

It was decided last year by ITC management that the DIP Program should undergo a thorough evaluation for several reasons:

- DIPP has been in operation for 20 years, and although a number of partial assessments have been made, no overall study of the program has ever been conducted;
- During these 20 years, both the structure of the program and the environment in which it operates have undergone significant changes. The

original emphasis of the program on defence products was broadened (in 1968) to include civil-related projects. In the mid-sixties, the Capital Assistance and Source Establishment components became part of DIPP. International trade in defence products has also undergone changes since 1959, as has Canada's role in Western defence;

- In addition, there have been changes in the governmental environment, with more demands being put on departments to evaluate their programs and to tie these evaluations to the continuation of programs.

All these factors led to the decision to carry out a comprehensive evaluation of the effectiveness, structure, rationale, and the future of the DIP Program.

#### EVALUATION STUDY: A BRIEF OVERVIEW \*

The first phase in the evaluation of DIPP was an evaluability assessment of the program to determine whether an evaluation was possible and practical and, if so, to create the design for such a full-scale evaluation. The evaluability assessment of DIPP indicated that the program was basically evaluable, since there exist clear and measurable indicators for the program objectives, and the underlying program structure is logical; that is, the cause and effect linkages between program components, immediate outputs, intermediate objectives and effects, and ultimate objectives could be established.

The evaluability phase identified the issues and questions to be addressed in the evaluation. These issues can be grouped into the following categories (the parenthetical references indicate the titles of the covering report sections in which the issues are addressed):

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\* Appendices A, B, and C to the Covering Report provide further details on terms of reference, structure, and basic information.



- Program Objectives. How well have the program objectives been met, and how do they relate to each other? (Goal Achievement)
- Validity of Objectives. How valid are the objectives individually and in combination with one another? (Goal Achievement and Interpretive Discussion)
- Criteria and Priorities. What criteria and priorities have been used in the past, and which of these should be incorporated in the future program to maximize program effectiveness? (Why DIPP Performs As It Does; Program Findings and Program Design; Program Delivery)
- Program Rationale. How valid are the rationales of matching foreign government support, risk-sharing, and freedom from countervail, and, if valid, how can they be better incorporated into program delivery? (Corporate Influences; Competing Subsidies)
- Specificity of Funding. How do company accounting methods and bidding rules influence the use of DIPP funds as opposed to the use of company funds for particular projects and how can the program instruments best direct DIPP funds to intended goals? (Corporate Influences)
- Marketing Environment. How successfully have the products of DIPP-funded projects been marketed, and what have been the reasons for the success or failure? Also, what changes to the program or external institutions and agreements should be pursued to best meet the improved sales objective? (Markets and Marketing)
- Program Delivery System. How well has the DIPP delivery system been performing in terms of effectiveness, efficiency, and control, and what changes are required to optimize the delivery of the program? (Program Delivery)

### Overall Design and Methodology

The evaluability phase developed the evaluation design and the methodology for the study. The methodology consisted of a series of inter-related and mutually supporting modules. These modules were designed to ensure that the study addressed all the relevant issues and questions, that it had sufficient breadth and depth of coverage to support reliable answers to the research questions, and that it yielded useful, practicable recommendations.

The eight operational modules which composed the evaluation were:

- A series of seven major-case studies covering 11 projects which received 59% of all DIPP funds through FY 77/78\*;
- A series of mini-case studies on 31 R&D and 8 CA/SE projects; these projects, selected by a probability sample, received an additional 4% of all DIPP funds through FY 77/78\*;
- A mail-out questionnaire survey of 117 firms (Note that the combined result of these three modules was that every DIPP company was contacted in one way or another);
- a questionnaire survey of technical experts regarding the major (11) and mini (35) case projects;
- An analysis of the particular problems and opportunities related to defence export marketing, which included the results of interviews with U.S. procurement agency offices and TCS personnel;
- Quantitative analysis (primarily statistical) of the data developed in the other modules;

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\* These case studies provided the material for the economic analysis in the Annex I, Major Case Studies, Annex II, Mini Case Studies, and in Appendix D, Economic and Related Benefits to the Covering Report. The methodology for this analysis was approved by Prof. G. Jenkins, Harvard University.

- A study of the DIP Program and project management and operations;
- A study of competing subsidies and countervail, and their relation to the DIP Program.

The evaluation was, however, more than the sum of these modules because the evaluators developed overall project designs and integration techniques which meant that more than one source of independent evidence could be drawn on to interpret and verify findings.

#### Module Design and Methodology

A brief description of the methodology used and of the issues addressed in each module is provided below.

The first four modules - major case studies, mini case studies, user survey, and expert opinion - were designed primarily to provide information on the objectives of DIPP, their achievements, interrelations, and the factors contributing to their attainment. The expert opinion survey drew on a panel of 77 experts who answered questions about the defence and technology contributions of the DIPP projects in the major and mini case studies. The major case studies were designed to provide detailed coverage of the projects and firms selected for examination. These projects account for more than 50% of DIPP funds. In depth interviews with company officials and analysis of the books supplied reliable estimates of the economic benefits and the incrementality of the largest projects supported by DIPP. (Incrementality is the extent to which DIPP assistance was necessary in order to induce the company to undertake the project). The mini case studies provided similar

information with less depth and more breadth (39 projects)\*. These projects were chosen at random from 3 groups of projects stratified by the size of the DIPP grant. The user survey provided considerable added breadth by including one project for each of the DIPP firms not covered by the case studies.

The quantitative analysis module was designed to analyze data from the previous four modules singly and in combination. Various techniques of statistical analysis were used, resulting in:

- . conclusions about interrelationships among objectives and suggestions for project selection criteria;
- . feedback to the modules which generated the data, to help identify and clarify significant findings.

The program delivery module provided a comprehensive examination of program and project management and operation. It included a file review of a stratified random sample of projects funded between 1969 and 1979. It also included an internal questionnaire, distributed to ISB officers and advisory staff, and a series of interviews with managers within ITC.

Finally, two studies were devoted to specific topics: one on marketing and one on competing subsidies and countervail. Each of these studies is based on a synthesis of information from previous studies and on interviews with

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\* Corporate and project information was obtained for 39 mini cases (31 R&D and 8 CA/SE). Full financial information could be obtained for all 8 CA/SE projects but only 19 R&D projects. There were 11 Major Case projects for which full financial information was obtained. Hence, certain tables discuss 30 R&D and Major Case projects (19 & 11). In addition, in a few cases, certain individual project characteristics could not be identified and are therefore missing from the relevant tables.

EXHIBIT 3SUMMARY OF THE STUDIES OF THE DEFENCE INDUSTRY PRODUCTIVITY PROGRAM AND ITS MAJOR PROJECTS

NO.	DATE	LENGTH	REQUESTED BY	CHAIRMAN	RECOMMENDATION/FINDINGS
1.	Mar./67 - Jan./68	10 months	S.S. Reisman	H. Wright	No change
2.	Jan./68 - Feb./68	2 months	IMDE Chairman	L.A. Lynch	No change
3.	Dec./68 - Mar./69	3 months	T.B.	Wagner	To set up interdepartmental committee
4.	Mar./69 - Dec./72	2½ years	T.B.	Wagner/Kniewasser	Minor changes
5.	Aug./72 - Aug./74	2 years	T.B.	J.D. Howe/W. Tait	(Pratt & Whitney C/B study) Procedural changes
6.	Dec./72 -		T.B.	J. Orr (MOSST)	No change
7.	June/74 - Sept.75	15 months	Min. (DOITC)	L. Drahotsky	No change
8.	1975		Min. (DOITC)	Howe/McFettridge	No recommendations. Evaluation of R&D incentives.
9.	Nov./75 - May/76	6 months	Min. (DOITC)	G.R. Sharwood	Fundamental review to be carried out.
10.	1976		Min. (DOITC)	R. Saberton	(Pratt & Whitney C/B study) Continue support for Pratt & Whitney
11.	1979		Min. (DOITC)	R. Atkinson	Generally, program not overly generous but wide variations between projects.



individuals involved in these fields in Canada and in the United States, and personnel in the Trade Commissioner Service.

Taken as a whole, then, this research design and methodology provided for a comprehensive study of the program itself, its impact, and the environment in which it operates.

#### Other Studies of DIPP

As a final background point on the evaluation, it is of interest that DIPP has been studied directly or indirectly eleven times since 1967. A full list is shown in Exhibit 3, opposite.

Three of the most significant studies were:

- a) Howe-McFettridge: which found DIPP was more cost-effective than four other programs in getting R&D performed;
- b) Sherwood: which found that technological expertise had been created but which did not establish its cost-effectiveness;
- c) Atkinson: which concluded that, in general, DIPP was not overly generous but that variations in competing foreign support make a simple DIPP formula inefficient, and that the bulk of the DIPP funds are going to civil-related projects.

To anticipate the conclusions of the present evaluation study, its findings were consistent with these previous findings.

## II - GOAL ACHIEVEMENT

This section presents and discussed the findings related to the first evaluation issue: the impact of the program on its objectives. The objectives are treated in order of historical importance: defence, technology, and economic viability.

### IMPACT OF DIPP ON THE DEFENCE OBJECTIVE \*

DIPP has operated throughout its life with a definite defence objective. This objective - to develop and support a defence industrial production base - has received formal and informal government blessing. It has long suffered, however, from a lack of clarity. Nevertheless, in view of communications from the government, the department would have been open to criticism if it had not responded to this objective.

To assess how well the DIP Program has met the defence objective, the experts' questionnaire included several questions concerning the contribution of projects to Canada's defence capability. Experts were asked to comment on the extent to which, for their cost, projects contributed to defence capability. The experts felt that in the form of a product, the overall contribution to defence capability of DIPP projects was medium (3 on a 5-point scale), but the contribution was rated as higher in the form of knowledge capable of future exploitation (3.6 on a 5-point scale).

DIPP's effectiveness, however, in fulfilling its defence objective depends on certain DND policies and programs being complementary. Our admittedly

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\* See Appendix E, Defence Rationale for DIPP.

limited study of DND policies and programs which impinge on DIPP raises a question as to the degree to which they are, in fact, complementary. The fit between DIPP and DND objectives, therefore, requires development and clarification.

At present, it is our judgement that DIPP could be broadened - as suggested later in this study - without becoming incompatible with defence program objectives. Should the defence concepts evolve, this point would require re-examination. In any case, however, the relationship between the defence program and DIPP should be developed and clarified.

#### Summary

- DIPP is assessed as having contributed to an understood defence objective;
- based on limited evidence, the related elements of the defence program do not appear to complement DIPP's defence objective.
- accordingly, under present concepts the program could be broadened without becoming inconsistent with defence policy.
- the defence-related objectives of the program should be more clearly articulated to reflect present day requirements;

#### IMPACT OF DIPP ON ITS TECHNOLOGICAL OBJECTIVE \*

The expert opinion questionnaire was also used to elicit opinion on the extent to which DIPP has contributed to the development of the technological capability of Canadian industry. The experts were asked to rate each project in the sample (the major and mini case studies) on a number of aspects related to its

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\* See Appendix F, The "Technology" Objective of DIPP, and Annex III, Expert Opinion.

EXPERT OPINION ON DEVELOPMENT OF TECHNOLOGICAL CAPABILITY

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

1	2	3	4	5
0	5	9	21	12
LOW		MED		HIGH

MEAN 3.70  
VARIANCE 1.05

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

1	2	3	4	5
0	4	17	17	9
LOW		MED		HIGH

MEAN 3.57  
VARIANCE 1.37

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

1	2	3	4	5
0	5	9	21	12
EMBRYONIC		MED		MATURE

MEAN 3.09  
VARIANCE 0.66

Please indicate which of the following best describes this project:

4	0	Significant breakthrough in state of the art
3	10	Significant advance in state of the art
2	29	Imaginative application of existing technology
1	8	Routine application of existing technology

MEAN 2.67  
VARIANCE 0.10

contribution to technology. The responses to a selection of these items is presented in Exhibit 4, opposite.

According to the experts, DIPP supported projects made quite a high contribution to the technological capability of the firms which undertook them; only 5 of 47 projects were given a rating lower than the medium on this dimension. A similar pattern is seen in terms of the "newness" of products to the corporation. Most of the projects were considered fairly new; at the same time, the technology involved in most of these projects was not considered to be "state of the art". The two questions probing this dimension produced similar results which show a tendency for DIPP projects to be "middle of the road" in terms of their technological advancement.

Our overall judgement is that when the development of the technological capability of Canadian industry is viewed as an objective, it is the case that DIPP has contributed significantly toward that objective.

However, it is also important to note that it is not the most advanced technology projects which make the most effective contribution to the firm's technological capability. Rather, it tends to be the more "middle of the road" projects, which, through their economic success, tend to build this kind of capability. It is success in production and marketing, and not normally in technological breakthroughs, which establish and sustain the technological capability of firms. The experts, it seems, believe that this capability normally develops from innovation rather than from invention.



However, technological spin-offs discussed subsequently, have not been found to yield economic benefits of sufficient size to justify the DIP Program economically.

IMPACT OF DIPP ON ITS ECONOMIC OBJECTIVE \*

Study Approach

Our evaluation of the contribution of DIPP to its economic objective is based primarily on the evidence from the mini and the major case studies. For direct economic benefits, two measures were calculated for each project: return on investment (ROI) and net present value (NPV).\*\* Both of these measures are based on discounted cash flow analysis of social benefits, i.e., they include both corporate (private) and public benefits. These measures are related to each other as follows:

- An NPV = 0 implies that the ROI = 10%;
- A negative NPV implies that the ROI is less than 10%;
- A positive NPV implies that the ROI is more than 10%.

It should be noted that while 10% ROI is the accepted "norm" for Canadian federal economic programs, its applicability to DIPP has been the subject of debate. In considering DIPP's ROI, a number of factors could be borne in mind:

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\* See Appendix D, Economic and Related Benefits, and Annexes I and II.

\*\*See Annex I, Introductory section, for a discussion of the projects used as units of analysis. It should be noted, at this point, however, that these projects are generally not identical with the DIPP definition of a project as they include not only development but the production, sales (real and expected) and servicing phases of a particular product or technology. Most of the major cases and three of the mini cases encompassed more than one DIPP project.

- if an ROI of 10% is not achieved, DIPP may nevertheless be more cost-effective than many other programs with significant R&D content;
- many economic benefits created by DIPP are not fully or precisely quantifiable, or have not been addressed in this evaluation, for example:
  - . the long-run sales of spin-off products created from apparently unsuccessful DIPP-funded projects
  - . the economic value of maintaining a defence industrial base
  - . the economic value of sustaining high technology industries
  - . the economic value of retaining pools of specialist expertise.
- the difference between DIPP's ROI and an ROI of 10% could be regarded as the economic cost of sustaining a defence industrial base and developing technological capability.

A second general point is that as we are trying to estimate the effect of DIPP on the economic objective, it is necessary to distinguish between the overall economic return on all DIPP-supported projects and the economic return on incremental projects, i.e., those which would not have been undertaken without government support. Given the aim of supporting projects which are economically worthwhile from a national stand point, the economic return from projects which would have gone ahead in the absence of government support (non-incremental) should not be credited to the program.

To reach a decision on whether or not a project was incremental, the evaluation team considered the following factors:

- Project profitability. An attempt was made to determine the profitability prospects of the project as they appeared to a private investor at the

time at which the project was undertaken. The degree of risk involved was incorporated into this estimate of prospective profit. The better the prospects for profits, the less likely is the project to have been incremental.

- Availability of funds. In addition to profit prospects, liquidity problems and/or capital market problems could have made it impossible for a company to raise the necessary funds within the private sector. A number of factors, including company size, project size, and the company's overall situation, influence the ability to raise funds. The harder it was to raise funds, the more likely is the project to have been incremental.
- Other factors. Since the case studies involved us in a more or less intimate understanding of the developments leading to the projects, other factors, often specific to a certain company, helped us reach the decision concerning incrementality. These factors include alternative firms which could have produced the product, parent company policies, company's approach to R&D, and so on. Also, all joint (cost-shared) projects were considered to be incremental.

#### Economic Benefits from Overall Program

The major effort in this phase of the analysis was devoted to the major case studies, all but one of which were R&D, and to the mini case studies, roughly 80% of which were R&D.

The CA and SE components were also addressed. Due to the narrower data base available, these results could not be derived with the same precision and are not as robust as for the R&D component. As discussed in Appendix D, the findings for the incremental ROI of these two components were:

- Capital Assistance: 10%
- Source Establishment: 10+%

At these rates, the NPV of these two components is carried at zero and, thus, does not affect the NPV aggregations.

With this zero NPV for the CA and SE projects, then, the overall economic payoff from DIPP is shown in Exhibit 5, overleaf. The table first shows the NPV for incremental and non-incremental projects, and the total NPV for DIPP. Program Delivery Cost, estimated at \$29 million, is then subtracted from incremental benefits and from total benefits. Net Program Impact accordingly shows our best estimate of the economic difference between having had and not having had the DIPP program. Program Total shows the total NPV of the program, regardless of incrementality.

As Exhibit 5 shows, whilst the program has generated an ROI of 7.5%, the economic impact of DIPP has historically been negative on strictly quantifiable economic grounds. According to our estimates, the economy is less well off than it would have been without DIPP by about 97 million ('69) dollars. This, of course, is based on the assumption that if left in the economy, DIPP funds would have generated the normal return on investment of 10 percent.

EXHIBIT 5

Economic Payoff of DIPP  
(All R&D projects plus McDonnell Douglas)  
Millions of '69\$

	<u>Net Present Value</u>		Total
	<u>Incremental*</u>	<u>Non-Incremental</u>	
Major Cases	-41.2	29	-12.2
Mini Cases*	-26.4	128.7	102.3
Total DIPP	-67.6	157.7	90.1
<hr/>			
Program Delivery Cost	-29.0	-	-29.0
Net Program Impact	(7.5% ROI)** -96.6	-	-
Program Total	-	-	61.1 (10.75% ROI)

\*Population estimate, based on factoring up the sample results

In interpreting this data, it must be borne in mind that the goals of the program have not historically been the maximization of incremental new economic benefits. Maintenance of the defence industrial base has been an understood goal of the program. Legitimate expenditures under the program in this respect need not necessarily generate quantifiable economic benefits. Maintenance of major defence producers through the lean years of the early 1970's may have been achieved through DIPP support even though the economic benefits were recognised at the time as likely to be marginal.

The defence industry's relative strength might have been less than it is today without the assistance provided by DIPP over the last decade. In this sense, it could be argued that the quantifiable returns over the review period should

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\* Note that for at least two of the cases (McDonnell Douglas and the Aviation Electronic Fuels System) there are differences between the study's assessment of non-incrementality and the ITC staff view that these were incremental. If both of these were added to the incremental category, the incremental ROI would become roughly 8.5%.

\*\*With a norm of 10%, a 7.5% ROI means an effective loss of 2.5%



be considered relatively attractive under the prevailing circumstances. Alternatively, it could be argued that defence industry and technological capabilities have been maintained or enhanced at a relatively modest cost to the economy of Canada.

Economic Benefits by Project Category

In Exhibit 6, below, we show the distribution of DIPP projects according to their NPV. The projects are grouped according to a number of characteristics such as whether or not they are incremental, their industrial sector, their ownership and whether they are civil or defence projects.

EXHIBIT 6

RATE OF SUCCESS AND FAILURE OF DIPP PROJECTS  
(NUMBER OF MAJOR AND MINI CASES AND % OF ALL DIPP FUNDS)

		NET PRESENT VALUE		
		NEGATIVE	ZERO	POSITIVE
Total (30)*	(100%)	16 (34%)	4 (3%)	10 (63%)
Incremental (24)	(81%)	14 (30%)	3 (2%)	7 (49%)
Non-incremental (6)	(19%)	2 (4%)	1 (1%)	3 (14%)
Electrical & Electronics (19)	(34%)	12 (23%)	2 (2%)	5 (9%)
Aerospace (8)	(62%)	2 (8%)	1 (0%)	5 (54%)
Other (3)	(4%)	2 (3%)	1 (1%)	- (0%)
Civil (4)	(27%)	2 (1%)	- (0%)	2 (26%)
Defence (19)	(53%)	11 (20%)	3 (2%)	5 (31%)
Both Civil & Defence (7)	(20%)	3 (13%)	1 (1%)	3 (6%)
Canadian-owned (10)	(45%)	7 (14%)	- (0%)	3 (31%)
Foreign-owned (20)	(55%)	9 (20%)	4 (3%)	7 (32%)
Major Cases (10)	(59%)	5 (15%)	- (0%)	5 (44%)
Mini Cases (20)	(41%)	11 (19%)	4 (3%)	5 (19%)

\* In this and other Exhibits, the number of cases in each category may not add to the full total as it was not always possible to fully categorize each case. Also, see the footnote on page 10 regarding the number of cases. In this Exhibit, the % values are from the Major Case Studies and a factoring up of the Mini Case Studies.

The data in Exhibit 6 show that 10 of the 30 projects we studied had a positive NPV, while 16 had a negative NPV. If we define success as a positive NPV, the rate of success among non-incremental projects is seen to be higher than the rate for incremental projects (3 out of 6 vs. 7 out of 24).

Based on these historical data, aerospace projects would be judged to have more than twice as high a probability of being successful as E&E projects (5 out of 8 vs. 5 out of 19). Defence projects tend to succeed less often than civil or mixed projects, while Canadian and foreign owned firms\* do about equally well (or badly) with DIPP funds. Finally, large projects (major cases) have a considerably higher rate of success than the small projects (5 out of 10 vs. 5 out of 20).

Exhibit 6 has shown the number of projects which had negative or positive NPV without consideration of the magnitude of gain or loss. In Exhibit 7, opposite, we combine the information in Exhibits 5 and 6, by showing for each category the sum total dollar value of the NPV. These totals are shown separately for incremental and non-incremental projects.

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\* See the Major Case Studies, Annex IE, for a reference to the repatriation of funds by foreign owners.

EXHIBIT 7

NET PRESENT VALUE OF DIPP PROJECTS  
(ALL R&D PROJECTS PLUS MCDONNELL DOUGLAS)  
MILLIONS OF 1969 \$

	TOTAL**	NET PRESENT VALUE	
		INCREMENTAL	NON-INCREMENTAL
TOTAL	90.1	-67.6	157.7
E&E Sector	-74.82	-94.62	19.8
Aerospace	166.9	29.0	137.9
Other	-19.8	-1.98	-
Civil	17.32	-10.36	27.68
Defence	35.7	-35.58	71.28
Both Civil & Defence	37.08	-21.66	58.74
Canadian-owned	-98.26	-98.26	-
Foreign-owned	188.36	30.66	157.7
Major Cases	-12.2	-41.2	29.0
Mini Cases**	102.3	-26.4	128.7

\*\*Values given are based on Major Case Studies and a full R&D population estimate based on the sample of Mini Case Studies.

Exhibit 7 shows a number of interesting patterns. A striking difference can be seen between the Electrical/Electronics and the Aerospace sectors. In terms of impact (incremental projects), we see a negative impact of about 95 million dollars in the Electrical/Electronic sector and a positive impact of 29 million dollars in the Aerospace sector. The Civil, Defence, and Both Civil and Defence projects show similar NPV's; the overall negative impact of the program is divided more or less equally among these types of projects. Significant differences appear between foreign and Canadian owned firms. All the NPV generated by projects undertaken by Canadian firms was incremental. The impact of these is close to a negative \$100 million. Much of the NPV generated by foreign firms was considered non-incremental, but for these firms, the overall NPV is positive both for incremental and for non-incremental projects. (These observations should not, however, be taken as definitive, but rather as indicative. Causal relations are discussed in the next section of this report.)

As part of the economic benefits analysis, the ROI's were studied to see if they exhibited any particular trend in these over time - for example, getting better or worse. Over the period 1970-1979, which was the time covered by the large bulk of the projects, there was no discernible pattern.

No analysis of economic benefits will not capture the totality of such benefits due to a lack of data or of conceptual frameworks. This analysis is no exception. In our judgement, however, the figures stated here give a just portrayal of the economic performance of the program.

### Incrementality

Finally, referring back to Exhibit 6, it can be observed that regardless of NPV, 20% of the R&D projects were non-incremental (6 out of 30). (This figure, derived from the case studies, was confirmed by the Program Delivery module.)

The complementary figure of 80% being incremental R&D projects may strike some readers as high, particularly in comparison with other government programs. It should be observed, however, that the DIPP projects are viewed by firms as quite risky and are therefore viewed by the firms as requiring outside support.

The analysis of incrementality has, inevitably, been affected by the combining in some cases of more than one project (as defined by the Program) into a single analyzed project. The effect of this grouping has been examined and it is judged that:

- it results in a marginally high estimate of incrementality;
- it does not significantly affect the statistical relationships amongst the causal variables.

(It does, however, affect the the interpretation of these relationships, as discussed in the Sub-section entitled "Stability of Funding and Large Projects".

### Export Sales

The vehicle for the attainment of the economic objective referred to in the program directive is export sales. This element, as opposed to sales in



general, has not been isolated in reporting the economic benefits. (The split between domestic and export sales had to be taken into account to calculate the foreign exchange benefits from each project.) This aggregated sales approach has been adopted because, from the perspective of economic benefits, exports have no inherent advantage over domestic sales.

The export aspect was studied, of course, in the project. Our findings are stated below.

- The proportion of overall corporate sales which were for defence (and which are very largely exports) were:

Major Case Firms	28%
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Non-Major R&D Firms	56%
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CA Firms	58%
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In general, the major case firms expected this proportion to decline; the other firms expected it to hold steady;

- In terms of the particular DIPP projects, the split between overall export and domestic sales was:

Exports	94%
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Domestic	6%
----------	----

- For incremental sales the split was:

Export	89%
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Domestic	11%
----------	-----

Summary of Economic Benefits

In summary, we conclude that the best estimates of the ROI's, based on incremental projects, are:

R&D Component	7½%
CA Component	10%
SE Component	10+%
Overall	7½%.

The DIPP program has not, therefore, historically, achieved the 10% ROI used in this study as the norm for the economic objective. The overall economic impact has been negative. It should be noted, however, that when the program as a whole is looked at, without consideration of incrementality, the NPV of the DIPP portfolio is positive. This means that the selection process does seem to be effective in choosing successful projects. However, unless it can be shown that the assessment of project incrementality is incorrect, or unless the opportunity cost assumption is relaxed, the overall portfolio result is no basis for judging the strictly economic impact generated by the program.

ADDITIONAL BENEFITS

DIPP has related to the economic goal in other ways. It has supported the ability of firms to participate in the offset arrangements, and it has encouraged firms to locate in Canada.

Offsets

Based on the evidence from the firms, the DIPP community has participated quite extensively in the Offset program. This has been true of the following percentages of all firms in each category:

Major Cases	67%
Mini R&D Cases	36%
CA/SE Firms	20%

Of those firms which had participated, the following percentages stated that DIPP had aided this participation:

Major Cases	33%
Mini R&D Cases	7%
CA/SE Firms	10%

The value of this contribution was included in the Technological Spin-off estimates.

It is notable, also, that most DIPP firms are not enthusiastic about the work they are called upon to undertake in connection with the Offsets, as it generally involves straight production rather than design and engineering. (See Annex VIA, Marketing).

Location

The following proportions of the firms indicated that they were in Canada (at least with their current products) because of DIPP:

Major Cases	33%
Mini R&D Cases	21%
CA/SE Firms	0%

The characteristic of being located in Canada because of DIPP overlaps with a number of other characteristics, such as being a large firm and receiving large grants. This pattern of factors is further discussed under "Stability of Funding and Large Projects" in Section IX of this report.

#### ADDITIONAL GOALS

Besides the three goals discussed in this section, there are additional goals to which DIPP might contribute. One of these is the provision of scientific and technical jobs as an end in itself and aside from any economic benefits. The study of such a goal has not been included in our mandate, and it has not been examined in any depth. Our impression is, however, that at least in comparison with other technological support programs, it cannot be presumed that DIPP would make a greater contribution than other actual or potential programs.

#### DISCUSSION AND SUMMARY OF GOAL ACHIEVEMENT

The goals of the DIPP have been given fairly strict interpretations in this evaluation. These interpretations have not been the ones under which DIPP has historically operated. Deviations from the attainment of the goals as interpreted in the study should not be used, therefore, as the basis for criticizing the management of the program. Moreover, even in terms of the economic goal, there are certain possible benefits which have not been assessed. One example would be the training of technical manpower.

In contrast, it must be noted that a number of assumptions have been made in the course of the economic analysis which have been fairly generous to DIPP. In our judgement, these various factors strike a reasonable balance.

Noting these interpretive points, this section of the study concludes that:

- In terms of the defence objective, the program has contributed to an understood version of such an aim, but the goal requires restatement and clarification. Related defence elements do not appear to be complementary to DIPP so that the program can be broadened without being inconsistent with defence policy; the relationship between DIPP and the defence program requires development and clarification.
- In terms of the technological objective, the program has contributed to the maintenance of a technological capability; this capability has translated itself into economic benefits only to a limited extent. There was no substantial benefits over and above those which were already incorporated in the payoffs of the projects we studied.
- In terms of its economic objective, DIPP has generated a 7 1/2% ROI and has therefore fallen 2 1/2% short of the 10% ROI which could reasonably be expected if the program had not existed, i.e., if DIPP funds had been put to alternative uses.
- The 2 1/2% shortfall in expected ROI could be regarded as the cost of contributing to other objectives of the program. It could therefore be argued that it would not be unreasonable for DND, in the future, to fund all or part of the below 10% ROI deficit in exchange for some influence on project selection. This rationale may have relevance if DND wishes DIPP to maintain its current level of support for defence projects. This proposition has not been dealt with further in this report.

EXHIBIT 8

SUMMARY OF REGRESSION RESULTS FOR  
ECONOMIC IMPACT

A. Factors associated with high NPV for R&D projects are:

DIRECT

- Low Risk
- Mature Technology
- Large DIPP grant

INDIRECT

- Civil
- Low % of Scientists and Engineers
- Non-Nominated Projects
- Foreign-Owned

B. Factors associated with incrementality in R&D projects are:

DIRECT

- High Risk
- Embryonic Technology

INDIRECT

- Defence
- Canadian-Owned
- High % Scientists and Engineers
- Nominated

C. Factors associated with high NPV within incremental R&D projects are:

DIRECT

- Foreign-Owned
- Large DIPP grant
- Mature technology

INDIRECT

- Company size\*
- Civil
- Non-Nominated
- Low % Scientists and Engineers

D. Factors associated with High Incremental Sales are:

Low Risk  
Civil

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\* The larger the firm, the higher the NPV.



### III - WHY DIPP PERFORMS AS IT DOES

#### FACTORS CONTRIBUTING TO AN ECONOMIC IMPACT

In order to understand the factors which relate to net present value and to incrementality, regression analyses were carried out the data from the major and mini case studies and from the expert opinion questionnaire. So as to provide as complete a picture as possible, a two-step process was followed. For each variable of interest (e.g., NPV), regression analysis first identified the factors which affect it directly. Next, regression identified variables which affect these factors. These variables are the indirect effects on the original variable of interest.

In addition to the regression analysis on the case studies, a parallel analysis was done on the data from the User Survey. The results of this analysis, as they relate to the case study analysis, are also described. Exhibit 8, opposite, summarizes the results of the regression analysis on economic impact. Annex V contains a detailed account of this phase of the Evaluation Study.

#### ECONOMIC MEASURES

Our regression analysis indicates that the most important direct influences on obtaining a high NPV are Risk and Technology. The variable "Technology" as used in the statistical analysis reflected the degree of maturity of the technology used in a project. The variable ranged from "Mature" to "Embryonic" on a five-point scale. It should be emphasized that "Mature"

technology still falls within the category of "high" technology; it simply indicates technology which falls towards one end of the spectrum of technologies encompassed by the term "high"\*. 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 on the average 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 occurs not only via its relationship to risk, but it exerts an additional direct influence on the economic payoff.

The value of the DIPP grant is also seen as a direct explanatory factor for NPV: large DIPP grants are associated with high NPV's, and not just as an economic multiplier; the size of the grant influences the economic efficiency, itself, of the project.

Subsequently in this report (section on Recommendations), the positive effect of large DIPP grants has been interpreted to be the result of such projects receiving funds which are clearly adequate to enable them to realize their potential benefits. We have not observed collateral evidence that would indicate that large projects, in themselves, are economically superior to small projects. (A possible alternative interpretation, that the category "large grants" effectively designates only continuing projects, is considered in the Discussion section.)

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\* This topic is further discussed in Annex III, Expert Opinion.

The most important indirect influences are the defence-civil variable, the percentage of scientists and engineers in the company, and the nominated project variable. Civil projects tend to be low risk with large DIPP grants, and, hence, they are associated via this factor with high-NPV projects in the Regression Analysis. 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, the non-nominated projects are associated with relatively high NPVs.

#### INCREMENTALITY

The regression analysis\* identified a number of direct and indirect effects associated with incrementality. 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. It is also the case that even if risk and other factors were the same, projects whose technology was relatively embryonic would be much more likely to be incremental than a corresponding mature-technology project.

The major indirect influences on project incrementality are the defence-civil variable and ownership. Because defence projects are relatively high-risk, we see that defence projects tend to be incremental (as compared to civil projects). The fact that Canadian-owned firms carry out a relatively large

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\* See Annex V, Regression Analysis.

number of risky projects means that these firms also tend to do a relatively large number of incremental DIPP projects.

#### ECONOMIC BENEFITS FROM INCREMENTAL PROJECTS

Because of the importance of the incremental projects, the factors were analyzed which affected the NPV within only those projects which were considered incremental. Within the sample of incremental projects, ownership, grant size, and type of technology 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 corresponding embryonic ones.

#### USER SURVEY

The regression analysis of the User Survey data confirmed the case study data. The factors which correlated most closely with high incremental sales were Low Risk and Civil. Although sales are clearly not the same as NPV, these two economic characteristics are also clearly associated. Consequently, the thrust of the findings regarding the causal factors can be viewed as having a solid quantitative base.

#### DISCUSSION AND SUMMARY

Our analysis of the factors which contribute to efficiency of government investment, namely, NPV/\$ of Grant, did not reveal any significant pattern.

These results, then, mean that guidance can be provided on how to increase the total NPV (or ROI) benefits from the Program, but that fine tuning to achieve optimization in terms of, for example, Aerospace vs. Electronic projects is not available. (Hence, to repeat, the remarks on pages 21 and 23 can be regarded as indicative only.)

From a practical\* point of view, this analysis indicates that in the selection of projects, greater weight should be given to projects which are civil and use mature technology, noting that these are factors which, in themselves, lower risk. Projects which have sufficient funds to realize the project potential should also be given priority. Note that this would not mean that only projects which had these characteristics would be chosen. In the project selection/scoring process, it may very well be that a project with, for example, high risk would score higher due to its overall characteristics. The factors which have been identified as favourable should be given greater emphasis but should not be made prerequisites. (This, and the associated process of selection for incrementality, are discussed further in the Program Delivery Annex.)

These, then, are the major results of the analysis of the factors affecting net present value and incrementality. Before considering how they should be integrated into program design we must first deal with factors that might not themselves show up in these variables but which could affect the Program's performance.

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\* "Practical" in this sense means to neutralize the factors of foreign-owned and or large firms, as being out of harmony with larger governmental objectives; moreover, the flow of dividends to foreign-owned firms, as already noted, reduces the economic benefits from this source.

IV - CORPORATE INFLUENCES ON PROGRAM PERFORMANCE \*

INTRODUCTION

The preceding sections have described how well DIPP performs and the factors which "drive" these results. These analytical results provide certain clear indications of the direction in which the program should be modified to yield increased economic benefits. It is conceivable, however, that study of the environment in which DIPP operates might:

- reveal factors which the analysis did not identify; or
- indicate that the factors should be given particular interpretations.

In particular, it is necessary to have some assurance that small changes which could lead to much improved performance are not being overlooked. It is also important to determine whether there are factors which would significantly impair the performance of even a greatly changed DIPP.

This section, and the following two address these points. This section considers the internal corporate environment within which DIPP operates. The two subsequent sections discuss the external environment as formed by the market itself and by the way in which firms directly interact with the environment through their marketing practices. In addition, the effects of Canadian government intervention to provide support for the DIPP firms and of foreign government intervention to provide support for competitors are examined.

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\* See Annex II, Mini Case Studies for detailed discussion.



The purpose in this examination is twofold:

- To see if considerations of these environmental influences would effectively modify the findings on the economic effects
- To identify possible improvements in the program which could be brought about by changes in these environmental areas.

The discussion of these topics is not all-encompassing but focuses only on those aspects which are germane to DIPP.

#### CORPORATE ATTITUDES

As a background to the topic of corporate decision-making, the corporate decision-makers' views of DIPP are briefly recorded as well as the views of those within government with whom they deal. This climate of opinion helps to form the environment in which both groups operate.

Generally speaking - and it should be underlined that we are discussing a heterogeneous group of firms - corporate decision-makers hold the view that they "deserve" DIPP. For them, DIPP provides "high quality" jobs for the community; it yields tax revenue for governments; it helps to create a defence industrial base. Moreover, despite the fact that, individually, many decision-makers indicate that competing subsidies are not a great problem (further discussed in Section VI of this report), there is a feeling that foreign competitors are receiving aid which "should" be matched. In addition, they are pleased that the program involves the government as a partner in activities which the firms judge to be in the interests of society. This belief in the worth of the projects is genuine: by and large, these

decision-makers believe strongly in what they are doing (but which they view themselves as being unable to undertake as commercial propositions on their own) and in the resulting benefits to the community. Although this study refutes a good deal of their rationale for DIPP, the existence of their attitudes creates a factor which should be dealt with - a point to which we will return in the Discussion section (Section IX of this report). Our impression is that a good many of the government officers associated with DIPP hold similar views, which, of course, strengthens the status quo and could make change more difficult to implement if change is desired.

One point worth emphasizing is the frustration which the DIPP firms feel with regard to their inability to sell to DND. This will be referred to later in the Marketing section (Section V), but it is worth noting here that the general corporate attitude towards DIPP makes it doubly difficult for them to understand the "lack of support" from DND.

These views form the general framework for the corporate attitudes to DIPP. When it comes down to specific project decisions, however, the economic factor becomes, not surprisingly, the dominant consideration. For these decisions, the effect on the bottom line is what matters. The following discussion of corporate decision-making should be read, therefore, with this perspective in mind.

#### DECISION-MAKING FACTORS

This study of corporate decision-making is narrowly focused on two aspects of DIPP:

- are there elements in that decision-making (particularly in the foreign parent/Canadian subsidiary relationship) which erode DIPP's performance;
- what characteristics of that decision-making process should DIPP take into account?

We have found that the general perspective of the corporate decision-maker could be summarized as a desire for an environment which minimizes his economic risk, permits him to make a good return, and is stable.

Risk\*

To consider risk, the following aspects must be examined:

- how do the firms treat it?
- what level of risk they are willing to take and what contributing factors do they see?
- how do they react to it?

First, what does the term mean? As used here, risk refers to the danger of a shortfall in return, i.e., exposure to the chance of financial loss.

In assessing risk, firms - Canadian owned firms in particular - rely primarily on their judgement. The use of this non-analytical approach was not due to a down-playing of the risk element of projects. In terms of a scale in which 100 represented "absolute risk" and zero "no risk", the average overall risk level as perceived by the firms was 75; clearly, the risk perceived by the firms in DIPP projects has been significant.

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\* See Appendix G, Risk.

What contributed to this overall assessment of riskiness? Although DIPP is primarily associated with high technology it is the marketing and, to a lesser extent, financial risks which are most troublesome to the companies. Firms are naturally conscious of the technology/development elements, but, when they are probed, it is such matters as sales and liquidity which come to the fore as the major concerns. As described more fully in the Risk Appendix to this report, the averages of the levels of perceived risk for the Major Cases and the Mini Case R&D projects rated on the same scale, were: Marketing - 64; Technical - 71, Financial - 66. The problems which actually arose, however, as opposed to the perceived likelihood of problems arising were assessed at the following levels of importance on a 0-100 point scale:

	<u>Average</u>
Marketing Problems	76
Financial Problems	52
Technical Problems	40

When the information gained from the interviews is added to this assessment, the ranking Marketing - Financial - Technical emerges as the best estimate of the hierarchy of risk components.

The primacy of the marketing element is also supported by the perception of the ITC personnel who responded to an internal questionnaire.

In general, then, the risk judgement is applied mainly to the market forecast, and then to the financing question. One reason why technology ranks lower than marketing and finance is that DIPP projects are not tremendously risky from a technical point of view.

Technical Risk - The technical experts rated DIPP projects on the average at 22 on the same 100-point scale. They also rated the technical risk somewhat lower than commercial risk, thus reinforcing the perception that the technical component is smaller than the marketing/financial component.

Parameters of Risk - The corporate judgements can be put into perspective by considering the degrees of risk which the firms are willing to run. These levels are relatively low: the R&D group, on average, indicated that they would "rule out" a project which had a 10% probability that a loss equal to 2% of gross sales would result. These same firms indicated that they would require nearly a 50% probability that the return would equal their corporate norm, i.e., more than breaking even. They also wanted a fair assurance of making about a 17% return.

To support this point, well above 50% of even the lower-risk projects were incremental; i.e., they required the support of DIPP before being undertaken.

Relation of DIPP to Risk - Leaving the financing/liquidity factor aside for the moment, the picture which emerges is that:

- DIPP firms are clearly cautious with their funds

- DIPP projects are not highly risky from the technical standpoint; they are viewed as risky, however, due to the losses which can occur.
- The consequent effect on corporate decision-makers is that, without some form of protection against downside risk (i.e., loss or sub-normal returns), some projects which are worthwhile from the standpoint of the national economy would not go ahead.
- Consequently, there is some role for government in providing this risk protection so as to increase the net benefit to the nation.

Financial Risks - The assessment of this study is that liquidity is the second major risk element for many DIPP firms. Put starkly, firms have difficulty persuading private sector financial institutions to advance funds. In the judgement of this study, this difficulty should not be taken as proof of a lack of economic worth in all of the projects for which funds have not been obtainable in the private sector. Rather, this difficulty simply reflects the modus operandi of private financial institutions and thus reinforces the justification for some government intervention. Overall, the institutions cannot be faulted in their commercial assessments, as the negative incremental NPV testifies. But, when considering future program philosophy and design, it is important to note that a process could be instituted\* which would, on average, select projects with a positive return; this process could similarly have been instituted by the financial institutions. Even if such a process had been available to them, it is doubtful that the private institutions would have used it, since alternative investments would be more attractive.

A further point is that, although Canadian financial institutions are seen to be unusually conservative and risk averse, the evidence from the Marketing

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\*See Program Design, Section VII of this report.



module is that U.S. banks are similarly cautious in their approach to U.S. defence/high technology firms.

#### Summary of Risk

On the basis of the characteristics of corporate decision-making, the following conclusions can be drawn:

- the usual formulation of the Risk rationale for DIPP appears to over-emphasize the technical element at the expense of the marketing and financial components;
- the potential net economic benefits from high-technology industry would not be fully attained without some risk protection from a program such as DIPP;

The nature and level of the support which should be provided for the program is a separate question.

#### Corporate Returns

The second item desired by the decision-maker was a good return. For the R&D firms on the average, a good return is 17%; for the CA firms it is 10%. The R&D firms are not necessarily being greedy. They operate in a somewhat riskier environment than the CA firms and, accordingly, are probably seeking a risk premium. (Risk here should be thought of as including market instability, i.e., a market which is volatile and cyclical.) Evidence for the need for such compensation is seen in the ROI norms for one Major R&D firm for different types of projects: No Risk - 15%; Normal - 20%; High Risk - 25%.

#### Stability

The third element desired by the corporate decision-maker is stability, which, in a sense, is another variation of risk. This need manifested itself in the

case studies most strongly in the desire to develop proprietary products. The companies realize that this development is not often possible, but it is a "safe harbour" for which they are always on the lookout. With such products, sales are much more certain and are easier to attain.

#### FIRMS' PERCEPTION OF THEMSELVES AND OF COMPETITION

The description of the characteristics of the "ideal" environment just given should not be taken to mean that the DIPP firms view themselves as weak entities. In the main, these companies take pride in the positions which they have been able to attain. On a 100 point scale, with 100 as "absolutely stronger", they rate themselves at 75 ("stronger") than the competition; and this competition is often world-wide. This pride is based on the considerable expertise and the technical/production capability which many DIPP firms have developed to the point that they are strong performers in the (generally narrow) market niches which they have carved out for themselves.

#### PARENT-SUBSIDIARY RELATIONSHIPS \*

Since a considerable proportion of the DIPP firms are foreign-owned, the nature and characteristics of the parent-subsidary relationship are important elements in the corporate environment.

These characteristics, in general, could be described in the following terms:

- Operating decisions (including R&D and marketing strategies) are left to the subsidiary;

\* See Annex II, Mini Case Studies; Annex VIA, Marketing; and Annex I, Major Case Studies.

- Major strategic decisions are made by the parent but with very considerable input from the subsidiary;
- The main instrument of control is the budget, which forms a framework within which the subsidiary has complete freedom (given that the subsidiary does stay within it), and whose formulation facilitates the discussion of the major strategic questions;
- All the subsidiaries studied claimed to have a product mandate.

In two respects DIPP has most significantly affected this relationship:

- 33% of the Majors and 21% of the other firms with R&D projects, stated they were in Canada because of DIPP. The degree to which they are now captive is not easy to assess. It is clear, however, that if DIPP were totally eliminated, some of the business conducted by the subsidiaries would flow out of the country. The decline might amount to about 15% of dollar value in sales.
- DIPP has had some effect (probably in about 20% of the R&D firms) as a lever in obtaining product mandates from parent companies. It is also clear, however, that these "product mandates" can cover a variety of forms or levels. They may vary in geographic extent (e.g., Western Hemisphere vs. World); in product range (e.g., components vs. systems); and in development and production depth (e.g., from R&D onwards vs. simple production). Some of the existing mandates are quite narrow. In some cases, the mandates were for sub-systems tied directly to the larger products marketed by their parent.
- The existence of the parent/subsidiary relationship does not guarantee that, if DIPP funds were withdrawn, the parent would simply supply

(replace) these funds. Also, although financial institutions feel more comfortable funding a subsidiary of a large multi-national corporation than a similar but independent Canadian firm, the ability of a subsidiary to arrange funds as a substitute for DIPP funds cannot be taken for granted.

In considering these results in comparison with other studies of the characteristics of Canadian subsidiaries, it should be borne in mind that the DIPP firms are self-selected to be export- and high-technology oriented. They cannot not be viewed as typical.

#### R&D

As DIPP is oriented towards product development, the attitudes of the firms toward R&D has naturally been a major concern. It is a concern which, in the case of the subsidiary companies, may be affected by the parent-subsidiary relationship.

#### Planning

The way that R&D is planned appears, in general, to be similar to the way DIPP companies assess risk: a wide variety of techniques is used, but by and large, R&D planning is rather informal. Further, as with formal planning as a whole, Canadian firms tend to do less formal R&D planning than subsidiaries do.

The major features of interest in the R&D planning process are:

- Firms tend to use a percentage of expected gross sales as a guide to setting the company's R&D budget, with values ranging from 2% to 6%; there would be concern if this budget level was significantly exceeded;
- The selection of projects is probably more constrained by the "fit" of a project into a firm's perception of its capabilities and markets, and by the type and strength of the human resources available for the development than by budget considerations;
- Nearly all of the firms fund R&D out of cash-flow, with R&D being treated as an overhead. Since a significant proportion of these firms have cash-flow problems, it is understandable that they are nervous about increased R&D spending;
- Firms do not, however, try to use DIPP funds improperly. In 85% of the cases, these DIPP funds were either added to the money which the firm had already allocated, or the company share was in fact increased given the assurance of DIPP funding;
- The majority of firms plan on having DIPP funds right from the concept of a project; that is, they do not plan a project and then decide whether DIPP is "required". This mode of operation may have come about in the absence of an incrementality criterion in DIPP.

#### Types of R&D

What type of R&D do the firms undertake? In the sequence of research, development, design and engineering, DIPP firms break into two groups: aerospace and the others. The aerospace companies place a much heavier emphasis on development than do the others, who largely concentrate on design and engineering.

Looking at the projects from the viewpoint of technological "status", it will be recalled that, according to the technical experts, the projects distributed themselves as follows:

Breakthrough in Technology	0%
Significant Advance	21%
Imaginative Application	61%
Routine Application	18%

When looked at from the standpoint of maturity of technology, the projects tended towards the mature end of the scale, and none were rated as having involved embryonic technology.

Within the various industrial groups, the large aerospace firms tended to rank higher on the development scale than the mini case study R&D firms.

It can be seen that DIPP is largely a product development program which only rarely supports projects in which the innovation cycle starts with research. In this connection, it is interesting to note that very few firms were aware of the residual industrial research element in DIPP.

Further evidence which indirectly supports this thesis is that only about 30% of firms have a portfolio of R&D projects. Rather, they concentrate their resources on items which they are confident will yield commercial returns (as, of course, the DIP Program requires) - and this means steering away from research or even basic development.



Nevertheless, in spite of this overall approach, nearly 80% of the firms judged that they were in an R&D intensive segment of industry, and they stated that 85% of their sales came from products which they had developed. The resolution of this apparent paradox lies in the meaning and scope of "R&D". For these firms, product or process development (for example, learning how to machine titanium) is quite appropriately included.

#### Assistance from Parent Firms

Regarding the parent/subsidiary relationship as it affects the performance of R&D, subsidiaries are assisted but not to the degree which might be supposed. On a scale of 100, with 100 representing "Full Assistance", and zero representing "Nil", the average for aid in basic or applied research was about 40. Somewhat more help was given in the form of guidance or making facilities available than in actual participation.

#### TECHNOLOGICAL SPIN-OFFS \*

The possibility of technological spin-offs is occasionally quoted by the firms as a justification for DIPP. They find it extremely difficult, however, to cite specific instances or to establish a tight causal relationship between the sales\*\* of a subsequent product and an earlier R&D project.

In conjunction with the mini case studies, an estimate of the level of net economic benefit attributable to DIPP as a whole from this factor was

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\* See Annex II, Mini Case Studies; Annex III, Expert Opinion.

\*\*In some cases, firms will have been able to market services as well as products; this element may well have been underestimated in their responses.

derived as being about \$18 million (\$69); it is not a major item. (As the \$18 million ('69\$) was a best estimate and not of the same level of precision as the NPV's, it was not included in the ROI calculations. If it had been, it is judged that the 7 1/2% (incremental ROI would become 7 3/4% to 8%.) Moreover, the evidence did not point to any readily identifiable project characteristics as being well correlated with commercially worthwhile technological spin-offs. Our conclusion from these observations and from the literature is that there is no reason to prefer support of any one technological assistance program or industrial segment over another from the point of view of spin-offs. Spin-offs will occur, but they should be regarded as a bonus rather than as a basic justification for a program.

Nevertheless, the corporate environment has some effect on the production of spin-offs: firms that have a continuing commitment to a field are more likely to produce beneficial spinoffs than those entering on a "one-shot" basis; the former companies are much more likely to have a long-term plan to which such spin-offs could contribute.

#### GOVERNMENT/CORPORATE INTERACTION

A final feature of the corporate environment as it affects DIPP, which is partly internal and partly external, is the interface between ITC and a firm. This topic is raised for one specific reason: it has been observed in this study that in cases where the Department has, in a sense, pushed a corporation into a project, the project has tended to turn out badly. There have not been sufficient cases to provide a well-founded quantitative base; consequently, the point is raised as a caution only. Nevertheless, it fits in with the

general theme of the findings in this area that program design should create a climate and that, within this climate, normal commercial decision-making should be permitted to operate freely.

OVERVIEW OF CORPORATE ENVIRONMENT

The examination of the internal corporate environment yields evidence that the DIPP firms operate in a sensible commercial manner:

- They avoid risk and use DIPP to reduce it;
- They husband their funds and use DIPP to supplement them;
- Accordingly, if a firm has to be pushed in undertaking a project, the project is likely to be risky and worth re-examining.

V - MARKETS AND MARKETING \*

INTRODUCTION

This section examines the markets, especially the defence markets, in which the DIPP firms operate, as well as the ways in which the firms carry out their marketing functions. The prime questions which were kept in mind in conducting this aspect of the study were:

- . What is the realistic market potential for the DIPP firms?
- . Are there fundamental barriers (inhibitors) to their realizing this potential?
- . What could be done to improve the firms' performance of the marketing function?

Marketing has long been recognized as an important facet of DIPP. Its importance was underlined in the primacy of the market risk which emerged in this study. These factors supported the emphasis given to the topic in this study.

Certain characteristics of Canadian firms have a significant bearing on this whole topic and should be borne in mind. Generally, the DIPP firms find themselves operating within a relatively small domestic market, with limited resources, and with a capability which is limited in scope, e.g., for sub-systems rather than systems. Given this situation, they have, in one respect, made a virtue out of a liability by developing high technical expertise in fairly narrow market niches, niches in which there is a

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\* Seen Annex VIA, Marketing, and Annex VIB, DIPP Markets.

reasonable sales volume and not an overwhelming amount of competition. This stance affects their whole approach to marketing, as will be discussed more fully below.

The original orientation in DIPP was to support defence export sales, and this aim is reflected in the current directive. The broadening of the program to include civilian (defence-related) projects has altered this orientation somewhat. Currently about 60% of the non-aerospace business is in the defence export field; for the aerospace majors it is less than 30%. Nevertheless, in order to conduct a thorough study of the original orientation and the major existing market, the bulk of the attention in the Marketing module was devoted to the U.S. Department of Defense (DOD) as a client.

#### THE U.S. DOD MARKET

##### General Features

There can be little doubt that, to many firms, the DOD market appears to offer highly attractive opportunities.

Certain features of this market limit its real potential:

- Defence imports into the U.S. are estimated to account for less than 5% of DOD materiel purchases; whilst this provides Canada with a potential market of \$3 billion annually (5% x \$57 billion U.S.), it is a highly competitive market with legislated barriers to Canadian penetration;
- Canada already provides about 50% of these imports;
- It is not a highly profitable market, at least not for U.S. military contractors. This fact is evidenced by the following:

- . the stock market, through its price-earnings ratios, rates U.S. defence contractors at only 60% of industrial stocks in general;
  - . the profit margin of U.S. defence contractors is only 50% of industrial firms in general;
  - . the same ratio applies for net income;
  - . the U.S. business community as a whole views defence as a generally unprofitable line;
  - . the banks - who are closely involved in such assessments - subscribe especially strongly to this point of view;
  - . their basic reasoning applies to Canadian firms operating in this market as well as to the U.S. firms: sales, even with contracts, are far from certain due to policy changes or strategic shifts.
- The immediately foregoing point bears emphasis: as is true of all defence markets, sales to DOD are highly volatile. There is no driving consumer demand; rather, there are shifting strategic perceptions, operating within politically sensitive budgetary limits.

It can fairly be concluded that the U.S. DOD market does not, in general, offer highly attractive prospects. On this evidence alone, there are good grounds for broadening the marketing orientation both within and outside the defence arena. (Whilst we recognize that the total market may enlarge with the current "hawkish" mood, subsequent to events in Iran and Afghanistan, we do not envisage the market characteristics changing significantly.)

DOD Procurement Policy

One of the reasons why this market is not particularly attractive is the procurement philosophy which has evolved over time in the DOD. For several historical reasons, this philosophy has moved from "get the best system" ('40s and '50s), through "cost-effectiveness" ('60s and early '70s). to "affordability" (late '70s).

This change in policy has had a negative impact on commercial pay-offs. It should also be noted, however, that it has some potential benefit for Canadian firms in that, if a firm is cost-competitive, there would be considerable pressure to award it a contract, regardless of its national status.

Such a procurement philosophy, which was a reaction to the budget squeeze and the strategic perspectives of the recent past, may now have to undergo some relaxation (though not elimination) due to the increase in the Soviet threat perceived by the U.S.. It is clear that there has been and will be some increase in DOD equipment acquisition. This increase has already resulted in the creation of production bottlenecks and some turning to Canada as a source.

Two distinct points flow directly from these recent developments:

- . The first is a particular administrative point. The existence of bottlenecks in U.S. defence production necessitates the use of formal purchase priorities in the U.S. Priority ratings already exist and may well be widened. (This topic is further discussed in Annex VIB.) The Canadian government should be prepared to intervene to ensure that Canadian firms are treated equitably if the normal U.S. supply of materials or parts to



these firms is threatened. In some cases, if the scarcity seems likely to last a long time, the government might examine the establishment of a Canadian source for import substitution, if not export;

- . The second point is fundamental: if defence industry firms are expected at some time to prosper on their own, then this era of heavy U.S. defence purchasing is the time. As a corollary, if DIPP support for these firms, or even the defence industry orientation of the program, were to be diminished, the current conditions provide an ideal time to do this, since the reduced availability of DIPP funding to defence firms could possibly be offset by the increased opportunities for sales perceived by the firms.

#### Barriers and Bias

Despite the overall impression of the inherent unattractiveness of the DOD market, we found no evidence of an anti-Canadian bias in the operation and administration of the DOD procurement program. This perception, however, must be put into perspective.

There are several strong forces which operate to reduce foreign sales to DOD:

- . About 65% of DOD equipment contracts are "directed" (awarded without open competition). These contracts are so awarded for a variety of U.S. national security reasons: the perceived need to have guaranteed access to a firm; the wish to retain tight control over a technology or a design; the existence of a special capability in a firm; or the desire to develop a component of their defence industrial base. Accordingly, very few of these contracts go to Canadian firms. It is quite clear that for the U.S. DOD, Canadian firms are not identical with U.S. firms. Although

there are certain exemptions, Canadian firms, even though they are often subsidiaries of U.S. firms, are still foreign;

- . Contracts directed to (U.S.) small businesses now account for 30% of the materiel budget. (The 65% and the 30% overlap, so they should not be added; at the minimum, however, it can be said that a major portion of the 30% is not included in the 65%.) Such contracts may well grow because whole classes of items have been designated to be the sole preserve of small business. In addition, prime contractors have been directed to give them preference as subcontractors;
- . The security problem can be both a real hindrance in entering the DOD market and a real nuisance even when a foothold is achieved.

Canadian firms are naturally very conscious of these and the other difficulties which they face in the DOD market. On the other hand, it may very well be that the firms exaggerate these problems beyond their admittedly significant level and that, in so doing, they miss some of the opportunities which do exist.

In particular, the evidence is that for those segments of the market where there are no U.S. legislatively created barriers and where there are no overriding U.S. security reasons, there is no significant bias against Canadian firms in the administration and operation of the DOD procurement system\*. (In fact, since a charge of bias against a Canadian firm would be an

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\* Many ITC personnel, based on their own experience disagree with this observation on the absence of bias. If the ITC view is correct, two inferences could be drawn: these U.S. actions should be susceptible to diplomatic counter-pressure; the presence of bias would strengthen our basic conclusion that this is not a highly attractive market.

"international incident" involving the U.S. State Department, U.S. procurement officers take some care that they cannot be so charged.0

In addition, there are features of the U.S. system which, although they may operate against Canadian businesses, can also be turned around. For example, DOD tries to avoid single sourcing for production items; as a result, some single source Canadian suppliers have had to compete against companies created in the U.S. by DOD. But have Canadian companies been sufficiently alert to opportunities to become second sources themselves?

The study has placed some emphasis on this topic of "bias" versus "barriers" since it relates directly to the question of remedial action. If it had been found that U.S. DOD markets were being denied to Canadian companies by bias, that matter could be dealt with directly through diplomatic channels. We have not found this to be the case; the blockages are "overt" barriers which the U.S. has imposed for its own reasons and which would require a major political initiative to remove.

The barriers are undoubtedly an obstacle. Nevertheless, we gained the impression that Canadian firms could do a great deal more to exploit the opportunities that exist outside the barriers and to increase the awareness of potential customers in the U.S. of what they have to offer.

#### NON-DEFENCE U.S. MARKETS

The beneficial effect of broadening the DIPP concept to include civilian (defence-related) products is discussed subsequently. There is a particular U.S. market aspect to this, however.

Information gathered in the course of this study indicates that it is the intention of the current U.S. administration to broaden the exemption for Canada from "Buy American" to include all U.S. federal agencies. In doing so, the balance which it appears the U.S. will try to strike is between the benefits of superior technology (which the Canadian firm must demonstrate) against the loss of U.S. jobs. At the minimum, this opening up should give Canadian firms greater access to and opportunity in the market for civilian high technology goods and services.

#### NON-U.S. FOREIGN DEFENCE MARKETS

In its defence exports as in its civilian exports, Canada has exhibited a pattern of extraordinarily high dependence on the U.S. market. Since 1976, that dependence has eased somewhat, and recent overseas sales of defence products have been roughly 80% of U.S. sales.

The question of non-U.S. defence sales is critical since sales of finished aircraft or complete systems to the U.S. military appear to be virtually impossible to achieve. Some engine sales are still made although the market is declining. Serious consideration should be given, therefore, to aiming any military systems development at non-U.S. requirements.

Note that ITC DIPP officers express reservations concerning the non-U.S. defence market. Our impression is that these reservations are due to their awareness of the much more open favouring of domestic firms in areas such as Western Europe. A counter-argument to this attitude, however, is that because of the closer (and more Canadian-like) government-corporate links in Western

Europe (in contrast to the avowed U.S. arm's length relationship) and because the industrial base in Western Europe is smaller, government-to-government deals can be made. Once made, they will be likely to remain solid and yield actual sales.

#### CANADIAN MARKETING PRACTICES

This section began by recording certain characteristics typical of the DIPP firms, specifically their narrowly developed expertise and markets. Certain marketing practices have developed as a consequence of this overall approach.

The firms have naturally tended to develop selling practices appropriate to their immediate circumstances. Firms such as Pratt and Whitney (Canada), which are perceived as being good at not only selling but the broader activity of marketing, have had to develop this capability because they were dealing with a fairly broad market (i.e., several airframe manufacturers) with a high technology element but not too highly specialized a product. Other firms, which operate in the more usual manner of selling to a narrow market segment, have tended to sell on an engineer-to-engineer basis by fitting their equipment to the customer's special needs. They have, in fact, effectively carried out this aspect of marketing. Overall, the study has found that the DIPP firms have developed not unreasonable selling practices consistent with their situation. But selling practices are only a small part of marketing. With notable exceptions, the companies' overall marketing performance has been inadequate.

It should be observed, parenthetically, that the broadening of DIPP from a narrow defence product orientation to one which includes civilian (defence related) products has been of considerable help in the marketing area. Companies have been able to widen their marketing bases to include commercial areas and thus attain greater sales volumes. The commercial sales levels, moreover, are more stable and more reliable than military sales, and market reliability aids the overall corporate position. Finally, in some instances, companies have been able to use their ability to meet rigorous military standards to gain an advantage in civilian markets. This capability is not always a bonus, however, since the higher price which can be charged to military goods (because they meet more rigorous specifications) must be adjusted downwards for the civil market, in which the standards are lower.

(If the program were to be extended still further into the civilian area, a much greater marketing effort will be necessary on the part of the companies.)

Having noted the "reasonableness" of the selling approaches which have been developed, it must be repeated that some of the approaches are unnecessarily self-limiting: they can tend to restrict the firm to the current set of customers and/or products, and they do not encourage it to raise and broaden its marketing horizon. This observation is one facet of a more fundamental point which should be made: the firms perform the selling function quite well, but they are weaker in the broader marketing function which requires a systematic approach to questions of market strategy and analysis.

The DIPP firms generally do not forcefully seek out new products, new ways to use their current products, or new classes or groups of customers. One of

their major weaknesses is in the area of marketing strategy. This weakness will normally may not be significant if only a single product is being considered, but is of greater import for the overall health of a firm. Associated with the lack of market strategy is a weakness in market analysis. Here, DIPP could have an early influence through permitting and encouraging the inclusion of market research components in overall project costs.

These are major overall conclusions; but before expounding on them, it may be worthwhile to review briefly how well the firms are doing with their marketing.

The two major Canadian airframe firms (both Crown-owned), have succeeded in achieving highly respectable sales volumes in U.S. and overseas markets. Interestingly, they have done this by adopting an approach very similar to that which the findings of this study would support: they have gone into the civilian market with relatively mature technologies and with projects for which the technical risk was not great. These firms, however, have not been successful in the U.S. DOD market with even a small-scale system (the Canadair drones).

Pratt and Whitney has exhibited a similar pattern, although, as noted, some of its engines have been sold to DOD. The company has aimed its products largely at the civilian market, using fairly well-established technologies. Beyond this, Pratt and Whitney, by emphasizing reliability and service and by shrewd use of its parent firm, has realized a very considerable proportion of the market potential.



In electronics, again it is the successful firms which have carved out their own market niches.

The evidence gathered in the study has pointed to the following actions as ways to improve marketing effectiveness:

- . Marketing to DOD generally requires a considerable "front-end" investment of financial and human resources. This requirement should be recognized and deliberately built into the marketing plan from the start;
- . The difficulties in marketing directly to DOD have been described. On the other hand, sales through a U.S. prime appear more accessible and should receive greater emphasis. Use of such a channel may, moreover, facilitate civilian sales;
- . Increased attention to non-U.S. markets also looks worthwhile;
- . Canadian subsidiaries may very well be able to use the marketing leverage which they should have through their U.S. parents. This relationship, as discussed previously, varies widely but, in general, the impression gained is that Canadian subsidiaries may be hyper-sensitive regarding their independence, to the point that they are overlooking possibly beneficial combined marketing approaches;
- . In this connection, while DIPP has been quite useful in aiding firms to acquire product mandates from their parents, there is still considerable room for expansion, e.g., in the deepening into the R&D area and in broadening the product line;
- . A clear official acknowledgement that DIPP is not primarily defence-oriented but, rather, is technology-oriented would assist DIPP firms' marketing efforts. If this were done, it would facilitate establishment of a "one-stop" marketing service function in ITC to

provide services in market planning, market requirements and customer contracts.

Implementing all of these recommendations would do much to improve market opportunities for Canadian firms. However, the onus is on the companies themselves to improve their marketing efforts. Rather than allowing the difficulties to limit their vision, they should be actively seeking new opportunities in the marketplace by doing market research, gathering market intelligence, planning market strategies, and promoting awareness of their companies where it matters - among potential customers.

#### INFLUENCE OF DOMESTIC SALES

A repeated theme from the firms, throughout the study, has been the difficulty they have in explaining to foreign agencies why DND has not purchased their product. Foreigners, accustomed to the practices of their own governments, naturally assume that the goods must be quite inferior not to have been accepted "even" at home. The nuances of the DND cost-benefit approach escape them.

While oft-repeated, this theme can, of course, be exaggerated and used as a "crutch". Moreover, it could not be automatically accepted that Canada would receive net benefits if the policy were changed. And, finally, if DND were "guided" in this direction, then the responsible allocation of funds would mean that ITC should provide the funds, with the foregoing caveats. Such a modification in policy appears a topic worthy of study.

## DEFENCE SHARING ARRANGEMENTS

There is an additional facet of the environment within which DIPP operates which, while not strictly marketing, seems to be most appropriately discussed at this point: the Defence Sharing arrangements and the joint development projects which flow from them.

### DPSA

There can be no doubt that the Defence Production Sharing Agreement (DPSA) with the U.S. is beneficial to Canada. Even though this Agreement does not have the status of law in the U.S. and, therefore, can be and has been overridden, the evidence from the input to the study from Ottawa, Washington, and from the firms is very clear that the DPSA has facilitated sales. The extent of this influence is another question. The U.S. is opening up defence sharing not only with Canada but with its other NATO allies as well. Correspondingly, Canada's once favoured position is becoming eroded; Canada is still the front-runner, but its relative status has declined.

### DDSA and Joint Projects

Concerning the Defence Development Sharing Agreement (DDSA), our findings were as follows:

- . To 1979, 71 joint (cost-shared) projects were started with the U.S. and 58 completed;
- . The sales/investment ratio of 12:1 was somewhat lower than the ratio of 15:1 identified for DIPP projects as a whole;
- . This is consistent with the finding that the ROI for these projects was less than for other projects;

- . Joint projects absorb 240% of the administrative effort of "normal" projects;
- . In the administration of joint projects, there still seems to be some orientation towards purely defence goals as opposed to economic goals.

Amongst the firms, opinion regarding the DDSA generally (not universally) tends to be negative for the following reasons:

- . It is difficult to get projects accepted;
- . Those which are accepted are of generally marginal interest to the U.S. due to U.S. national security concerns, previously referred to;
- . They offer minor production opportunities;
- . The technological fall-out which has resulted could have been achieved at less expense.

The relatively few joint-shared development projects with Western Europe,\* while not overwhelming successes, do not appear to suffer to the same degree from these problems. This may be due to the fact that the smaller industrial base in Western Europe means that there are probably fewer domestic complaints (in contrast to the U.S.) and, thus, a greater willingness by these governments to press on.

For the U.S., a "double-jointed" relationship, i.e., Canadian company/U.S. company plus Canadian government/U.S. government arrangement, may be a means to neutralize criticism from U.S. firms and, hence, lead to an increase in the effectiveness of the DDSA. This relationship would mean that the Canadian firm would take on a U.S. firm as a partner in a project. Such an arrangement

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\* Such projects are, of course, facilitated by the Memoranda of Understanding with the various countries.

might improve the "quality" of joint projects and could mobilize the U.S. firm to counteract U.S. domestic criticism.

SUMMARY

The findings on markets and marketing can be summarized as follows:

- . The U.S. DOD market has proven to be meretricious and is not likely to fulfill its apparent attractiveness;
- . Canadian firms are not "star" marketers. They have adapted their sales techniques reasonably well to their circumstances but fall short in overall marketing performance;
- . The defence sharing arrangements have had a modest success; the introduction of U.S. firms into development projects under these arrangements may improve their payoff;
- . There are certain measures which the firms, in general, could adopt to improve their performance; these centre around improving their market strategies and market analysis; an emphasis on dealing with U.S. primes; more non-U.S. emphasis for defence systems; and for subsidiaries, greater use of parents' leverage.

These findings should be considered in conjunction with other study findings that:

- . Marketing risk and problems are a major influence on DIPP firms;
- . The greater the perceived strength in marketing of a firm, the higher the economic benefits from a project; whereas the higher the perceived R&D strength, the lower the economic benefits.\*

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\* See Annex V, Regression Analysis

These last two points underline the importance of not only understanding the marketing findings but also of taking positive action to increase consciousness and concern about marketing in the DIPP firms and in the Department. The more DIPP support is shifted to this area - even at the expense of technical perfection - the higher will be the economic return.

Having made these points, it should also be recorded that it is doubtful if, in the absence of the other policy modifications indicated as necessary, DIPP projects would achieve the 10% ROI performance norm. In other words, improving marketing performance by itself will not be sufficient to raise performance to the norm.

VI - COMPETING SUBSIDIES \*

INTRODUCTION

As one of the original rationales for DIPP was to match or "neutralize" the aid given to foreign firms in the defence and civil/defence-related areas, considerable attention was devoted to this topic within the study. Dr. Alex Polianski, then of ITC, undertook a major study, a copy of which is on file with the ITC DIPP Evaluation Coordinator. This aid takes a variety of forms including non-tariff barriers (NTB's), and legislative prohibitions or directions (as noted in the U.S. DOD market section). Accordingly, although the topic has been labelled "Competing Subsidies" to conform with understood terminology, it has been broadly treated.

RELATIVE LEVELS OF SUPPORT

When judging the relative level of assistance given to industry by DIPP, all forms of government aid must be examined to get a true picture. In these terms, Canada is clearly not generous relative to other nations, ranking in the lowest half by one measure, in the lowest third by two others, and in the lowest fifth in still two more. DIPP support levels should not be lowered on the grounds that they are relatively generous. In fact, support levels would have to be increased by about one-third to match foreign levels.

The aerospace industry was found to be a particular target for support abroad. This is especially the case for military and large (prestige) civil projects. Such support was pervasive and continuing, and it took many forms.

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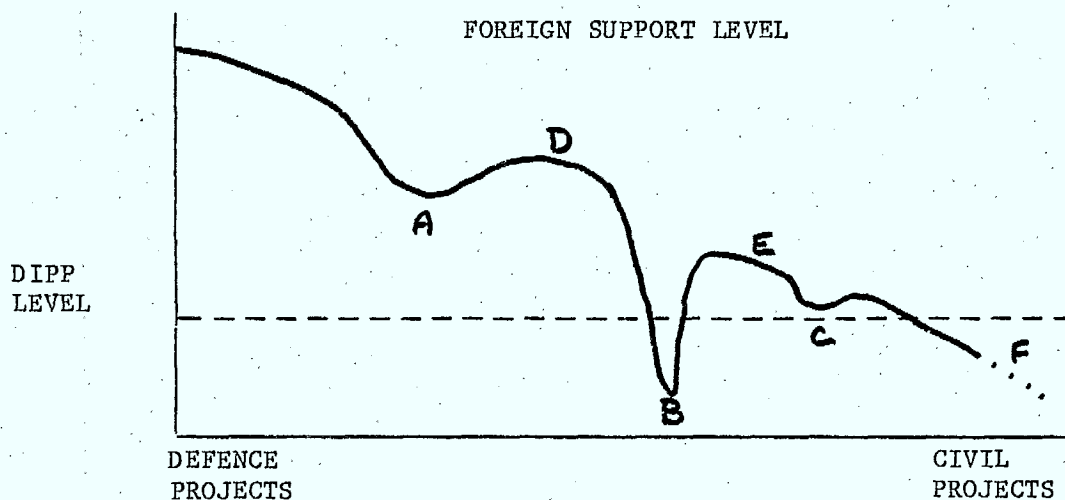
\* See Appendix H, Competing Subsidies.



It is not, however, automatic and universal, and, in general, is lower in the general/business aviation sector. The current economic orientation of DEPP, combined with the study findings regarding the historical economic performance level of the program and the factors that lead to this performance mean that the DIPP support level should not be raised regardless of the levels of foreign subsidies. Put another way, the neutralization of foreign assistance should not be the *raison d'être* of the Program. In terms of economic benefits, simply increasing the support level would not be sensible; other changes, without increasing the support level, could yield a satisfactory economic performance level.

Parenthetically, even in terms of the original rationale, a universal support program is not efficient, since the variations in foreign support levels are quite wide. In this circumstance, universal support means that some support is unnecessary; other support may be insufficient.

These points can be illustrated by the following diagram, which has been suggested in discussion with ITC staff.



- The more civil a project's orientation, in general, the less the foreign support.
- There are niches or windows (B,C) in the foreign support in which Canadian firms can develop profitable business.
- There are also areas such as D and E in which Canadian firms can compete (with high quality products) despite foreign support.
- There are still other areas (F) in which universal support from DIPP would be wasteful, by definition. For example, if foreign support levels are less than the level of traditional DIPP support, negotiations could take place to limit the level of DIPP support to that of foreign countries.

#### EFFECT OF NEW GATT

An associated question remains as to whether the present (subsidy) assistance level of DIPP will be made more effective or less effective by the new GATT:

- . The evidence is that nations will continue to provide different forms of protection. DIPP will not increase in relative generosity.
- . On the contrary, the concept of some form of national support for high technology industry can be rationalized on the basis of certain features of the new GATT: the potential to invoke "essential national interests" as a protective cover; the exclusion of a number of high technology items from the general opening-up of government procurement; and the allowance for domestic programs such as the U.S. Small Business Act;
- . DIPP has become less relevant, however, to the protection from countervail against aircraft exported from Canada. Under the new civil aircraft clause, military R&D expenditures are to be charged against any

benefiting civil aircraft. DIPP will not, therefore, provide a cloak against countering measures;

. There are additional features of the new GATT which are germane to possible modifications in DIPP:

a) Any form of repayments will increase the acceptability of the aid provided;

b) Support which does not distinguish between domestic and export markets is, in general, quite acceptable.

. Finally, the Government should consider support for Canadian firms to help them in the legalistic jungle which the new GATT agreement may create.

#### CORPORATE ATTITUDES ON COMPETING SUBSIDIES

The DIPP firms are conscious of the support foreign governments give to their domestic firms. Nearly all Major Case and R&D firms testified to such knowledge. They were very much aware of their absolute exclusion from certain foreign markets and of the total or very high support given in particular to foreign defence firms.

In the product areas in which they had developed markets, however, the limited evidence collected from the mini cases indicated that the perceived level of support averaged about 15% of selling price. The the non-aerospace firms\*

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\* The views of the aerospace firms were not inconsistent with those of the study: that competing support was both broader and deeper in this area.

indicated that, in general, this level of support did not greatly concern them. With the expertise and markets which they have developed they are selling primarily on performance; in quality technical goods, the relatively marginal foreign assistance is not a significant factor. Put another way: the firms were able to live in the market niche which they had identified or developed. The attitude of the firms can be summed up by noting that in only 12% of the R&D cases was the existence of competing (foreign) assistance a factor in requesting a DIPP grant. However, major aerospace and avionics firms do feel that competing subsidies feature strongly in international competition in their industries.

The relationship between the support given to CA projects and competing subsidies has been a topic of some concern: is the 50% repayable grant/50% loan an appropriate level, or is it, for example, too generous? This study would conclude that the support level is not generous relative to foreign assistance measures. This conclusion is not sufficient in itself, of course, to maintain the level. Do the firms really require this level? One test here is incrementality. Our conclusion, recalling that the incrementality level for the CA projects is at least 80%, is that the support level is not too high. This view is not inconsistent with our finding that the competing subsidy factor for non-aerospace firms is not a critical item in the DIPP rationale. It may very well be the case that the original basis for the high level of support was invalid; but in this instance the evidence is that the action (i.e., support level) is still required to bring about the desired result.

THE COMPETING SUBSIDY RATIONALE

It can fairly be concluded that:

- Judged solely as a response to competing (foreign) support, DIPP provisions have not been excessively generous compared to the level of foreign support;
- Competing support did not emerge in the statistical analysis as an independent relevant factor in the economic performance of DIPP projects;
- The new GATT, in itself, makes DIPP marginally less effective in protecting against countervail;
- With the new GATT, provisions in industrial aid programs for repayment and non-discrimination between domestic consumption and export will reduce counter-measures by other governments against DIPP;
- The provision of neutralizing aid to specific aerospace projects may very well be required. Such aid, to the level required to permit fair competition, should be available on a case-by-case basis and would be an appropriate matter for the negotiations which such (major) cases require;
- In general, for non-aerospace DIPP firms, this neutralizing aid is not universally required under current conditions. Should these firms expand their marketing horizons, this topic may require re-examination.

## VII - PROGRAM FINDINGS AND PROGRAM DESIGN

Several of the preceding sections have examined the effect of the environment, both internal and external to the corporation, on DIPP's performance. It is evident that environmental factors do not materially change the thrust of the findings as to the level of economic performance or to the causal factors behind that performance. This section concentrates, accordingly, on how the design of the program itself could be altered to accommodate those basic findings, as well as the collateral findings on the internal and external environment, to pursue the economic goal more effectively.

### REDESIGN FEATURES

Although we have not found that all defence projects have poor economic results, a shift to civil projects would improve the results to the point that a positive NPV could be attained for the program as a whole. This shift is supported by the evidence of the:

- Statistical analysis of the major and mini case studies which correlated NPV and civil-related projects; and the
- Statistical analysis of the sales figures of the User Survey firms.

Such a shift would be consistent with the correlation which emerged between marketing strength and NPV, since we perceive that firms which are more heavily in the civilian market tend to put more emphasis on marketing. Other factors promoting a shift towards civilian products are the difficulties inherent in defence marketing, the relatively weak performance of joint (cost-shared) projects, and the relative instability of defence markets.

A major feature of any re-design, therefore, should be a broadening of the program to make it applicable to the high-technology industry in general, rather than to the narrower "Defence high-technology" industry.

Broadening the program to include all high-technology industry would confront the Department with the acute problem of defining the meaning of "high technology" in such a way that resources are in reasonable balance with demands. If the broader program is adopted, the definition should also be able to encompass the wider desired range of projects. A possible definition has been provided in Appendix F to the covering report, but this would need considerable refinement.

Clearly, a broadened program would permit emphasis on those types of projects which the analysis has indicated would yield the highest economic benefits. The broader scope would not, however, automatically yield this result; identifying the most promising projects requires a means of selection and of assigning priority. Such an instrument is available in a project scoring model which would make the appropriate allowance for the factors of risk, maturity of technology, and other identified influences. (A possible model is discussed in the Program Delivery Annex.)

#### FUNDING LEVEL

The study has estimated that a positive incremental pay-off of \$66 million ('69 \$) would have resulted from both an application of criteria which would reflect the higher pay-off factors and a reduction in funds to 63% of current levels. With the current program, use of these criteria would mean that the



10% ROI point (i.e., Zero NPV) would be estimated to occur at about 80% of current funding on the assumption that past project characteristics are repeated. On the other hand, it could be anticipated that a broadening of the program would result in more higher pay-off proposals being submitted. These considerations, together with the Government's commitment to increased funding for R&D mean that it would be judicious to leave the funds at least at current levels, assuming major projects are funded separately.

Beyond this reasoning, it should be remembered that the above estimates of ROI are based on historical data and assume a continuation or repetition of past experience. It may be that, with the increased U.S. DOD budget, past patterns will change, and an increased number of profitable projects may be in the offing. This is a matter on which the Department will have to make a judgement.

A further point is that this study has not addressed the question of how to deal with the "queue" of projects which has recently developed. The above estimate assumes an historically based, "steady state" condition.

#### RELATIVE PERFORMANCE OF DIPP COMPONENTS

The findings on economic performance for R&D projects, at 7.5% ROI, and for CA projects at 10% ROI, could be described as well founded.

(An implication of the CA finding is that the funding level for this component should be kept at its present level, i.e., this component meets the norm.)

For the SE component, however, the relatively small volume when McDonnell-Douglas (Canada) is removed provides too small a base of projects to permit reliable statistical findings to be made. The basis is, therefore, observation and judgement:

- . As the SE grant is made only when a contract is won, there is plainly less risk involved, and the minimum commercial results will be higher than for even the CA projects;
- . It could be judged, therefore, that as this is the smallest program element (a bit above 10%), the current funding level could be maintained for this component also.

Parenthetically, in their use of the CA component, firms almost universally spread the benefit from the grant over their whole output rather than using it as a means to lower the price on the "aided" products.\*

#### Incrementality and Repayable Grants

It will be recalled that roughly 20% of the DIPP projects and funds were judged non-incremental, i.e., would probably have gone ahead even without DIPP support. An operative word here is "probably". The assessments were the study's best judgement. There is, however, some chance that these were incorrect, particularly for any individual project. Consequently, the wisest course for the future seems to be to continue some degree of support for projects with low incrementality assessments but to lower the level of support. One way of doing this is the replacement of the grant elements by interest-free loans for low incrementality projects.

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\* This point is discussed more fully in the Economic and Related Benefits Appendix to the Covering Report (Appendix D).

This course would have the advantage, also, of confining the changes in the program to a type with which companies could live and, hence, would serve to mute their criticism.

The preceding remarks still leave open, however, the question of the proper form of support for the incremental R&D projects.

#### Financing Risk and Liquidity in R&D

It could be argued in the case of incremental projects that funds intended to ease liquidity problems and funds to deal with risk could each be supplied by non-grant types of support. Liquidity could be dealt with through low interest or interest-free loans and risk by means of risk insurance. There is, nevertheless, still a case for the supply of these funds through the use of a repayable grant provision which could meet the support requirement at least cost to the Crown.

Essentially, this case rests on the need to provide support which would neutralize the concerns of the firms in such a way that the project would appear worthwhile to them. The firm's subjective assessment of the project's value will include an estimate of the chance of a heavy loss and also the much higher probability that the project might not yield the corporate ROI norm. The former contingency (heavy loss) can be handled by risk insurance; the latter case, while theoretically capable of being handled that way, would probably not provide the encouragement or the convenience of a grant. Such a grant would become repayable only after some net return which was both 3-4 times the absolute amount of the grant and  $1\frac{1}{2}$  times the corporate norm for ROI on the project as a whole.

It is also worth noting that the difference between a combination of interest free loans and risk insurance, on the one hand, and repayable grants on the other, is really a matter of degree. The selection of the appropriate parameter values under the former concept can make it identical with the latter. The choice of label and of weight as between the various elements should, perhaps, depend upon the political and economic "climate" at the time of the decision. The insurance approach would, of course, "stretch" the budget.

Aside from the nature of the funding instruments, is the level of support appropriate? Our judgement, based on the evidence of the major and mini case studies, would be that there is no compelling reason to change the current 50/50 level, subject to later comments about the need for negotiating the funding of large projects individually.

The level of incrementality provides collateral evidence for this. If the level of incrementality were 100% it could be argued that if degree of support were reduced, there would still be worthwhile incremental projects. If the level of incrementality were very low, it could be argued that as most projects would go ahead anyway, the degree of support was not drawing out the projects for which support was required. The 80% figure is bracketed by these two levels, and, combined with the risk perception which we have observed in the firms, leads us to believe that a lower degree of support would cause some worthwhile projects to be abandoned but that a higher degree of support would be unnecessary.

Our view is, then, that, noting the incrementality of level, the current 50/50 funding should remain intact; but that the Crown's share should be repayable at a point where the firm has realized a good return; that this point should be well defined (as indicated) and lower than the current "trigger" point for repayments.

A final decision on this topic of financing brings in factors beyond the scope of this evaluation. The study is able, however, to contribute the following to its consideration:

- . Assistance for liquidity and risk protection is required;
- . The 50/50 level is reasonable, but the Crown's 50% need not be "free";
- . Whatever elements are designed must allow for the fact that corporate decision-makers do not consider that they have come out even if they gain more than the norm one year and fall short by the same amount the next. The instruments should be designed in such a manner that the expectation from a project is greater than the norm, so as to overcome the greater subjective penalty of falling short. If an approach is adopted which does not allow for the corporations' risk assessment, then economically worthwhile projects will be lost.

#### CA/SE Funding

In the case of CA/SE, similar considerations hold. The high incrementality levels for these components argue that anything beyond a moderate tightening of funding conditions would turn off worthwhile projects, whereas the 10% ROI indicates that there is little danger of economic "waste". Nonetheless, on several grounds it would be worthwhile to convert the 50% grant into a repayable grant under the same "relaxed" repayment conditions as for the R&D cases. This approach would:

- Provide a consistent system of financing the various components;
- With the repayment condition, it would bring the corporate decision-making closer to the "normal" corporate case; the desirability of this norm is discussed in Appendix F to this report;
- Repayment would also add to the "defence" for the program under GATT and would help to reassure internal (Canadian) decision-makers regarding the stewardship of public funds.

#### Repayment of Excessive Profits

As noted in the Program Delivery Annex, the degree to which there have been repayments of excess profits in the Program is very small. It could, therefore, be considered for elimination. The argument against this action would be:

- . The proposed program delivery system puts much more weight on project monitoring; consequently, if the current system is modified, keeping track of profits should not be an extra burden;
- . It would seem to be unwise in a public program not to have the type of "escape" mechanism or safety valve which this element would provide for the possible extraordinary case.

In any case, the suggested modifications in program design would make this consideration irrelevant because all funding would have a repayment aspect which would be related to profits. However, if these modifications are not accepted, other options for handling the repayment of excess profits are included in the Program Delivery Module.

POLITICO-ECONOMIC TONE (REPAYMENTS)

This last point is worth underlining. Other considerations aside, the existence of a repayment component in all funding would provide an element to the program which would be beneficial both politically and economically. Politically, it would help to neutralize the "corporate welfare bum" image which, unfair as it may be, is sometimes associated with industrial support programs. Economically, it would cause the corporate decision-making to follow more "normal" lines, an approach supported by the evidence in Appendix F to this report.

SUMMARY

In the light of the findings related to the Program and based on the history of DIPP to date, the study concludes that:

- the program should be broadened to apply to all "High Technology" industry;
- the funding level should be at least maintained;
- CA and SE projects should each receive about 10% of the funds which should be expended as 50% loans and 50% repayable grants for CA and 50% repayable grant for SE;
- 20% of the funds should go as loans to low-incrementality R&D projects;
- the remaining 60% should be used to provide repayable grants to R&D projects;
- the funding provisions should permit good corporate returns before repayment is required;



- all of these instruments should operate under criteria which give greater weight to projects with civil, mature technology characteristics (and hence, lower risk) and which are not skimmed for funds; these instruments would provide the basis for setting priorities in the program.

VIII - PROGRAM DELIVERY\*

INTRODUCTION

The DIP Program delivery system has undertaken some 1000 projects over a 20 year period, at a cost to the Crown of about \$700 million. It has done this at a delivery cost of \$29 million ('69 \$) and with a current annual resource bill of \$2.6 million and 39 person years.

The nature of the technology involved has resulted in the delivery system having a narrow focus in ITC: only five (half) of the Industry Section Branches (ISB's) use the program. Within these ISB's, most of DIPP lies within two branches, TIB and E&E, which account for 90% of all projects and 95% of all expenditures in the period between 1969 and 1979.

The program responsibilities, as opposed to project responsibilities, are divided between three ADM areas and operate in the manner of a matrix. The principal user is the ADM Industry and Commerce Development, to whom DIPP is a major tool of industrial development and to which he devotes 3.5% of his budget. The secondary user is the ADM TCS and International Marketing through joint projects with other nations, such projects being delivered and administered by the ISB's. The ADM Finance is responsible for program management.

The operational performance of program delivery is discussed in the next few sections. The amount of time that it takes to deliver a project is discussed first, since it is an aspect of program delivery that is of concern both to

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\* Annex VII contains a detailed consideration of all aspects of Program Delivery.

the companies and to the Department. Some strengths of the delivery system are described, followed by an account of major operational and structural weaknesses.

DELIVERY TIME

On the average, it takes about 12 months from receipt of a company R&D application to issue of contract. This is divided on the average as follows:

From Company Application to	
DIPP Committee Recommendation	130 days
to DM/TB Approval	71 days
to Encumbrance of Funds	53 days
to Request for Contract	13 days
to Contract	<u>110 days</u>
	377 days

The companies would like to see processing completed within three months and claim that this would be the time required for internal corporate processing of this type of decision. Our view is that 3 months plus a contract processing time of two months should be attainable.

Delays are due primarily to:

- Lack of knowledge on the part of companies as to what information is needed in a submission;
- Late referral of submissions to participants such as advisors and DSS;
- A reliance on conditional approvals, arising out of the two foregoing points, with all the associated recycling of paper which that entails;
- Inability to process submissions quickly due to human resource constraints;

- Some inefficiency due to a multiplicity of forms;
- Procedures within DSS, notably the DSS practice of sending secondary submissions to Treasury Board.

#### COMPLIANCE WITH DIRECTIVE

Generally speaking, the system has ensured that projects have complied with the directive insofar as the overall objective is concerned. That is, the system has delivered projects that sustain the technological capability of the Canadian defence industry; it has supported selected development projects and the acquisition of equipment, and it has supported the establishment of production capability.

#### STRENGTHS OF THE CURRENT DELIVERY SYSTEM

Many aspects of the overall DIP program delivery system are soundly designed. We examined alternative systems, and our recommendations are intended to improve the functioning of the present system rather than replace it with an entirely new system, subject to some fundamental preliminary decisions by management.

The DIPP project delivery system, a very important element of program management, may be divided into six main stages, some of which exhibit some strengths. They are summarized below:

Initiation stage: Initiation procedures are flexible; projects are pre-screened, and there is opportunity for early input by advisors;

Proposal preparation and evaluation: Checks and balances in this stage plus the use of specialized expertise minimize the risk of major errors;

Approval Process: The interdepartmental DIPP committee broadens TC perspectives. Its advisor members can direct the Committee's attention to particular aspects of projects;

Contract Negotiations: Contracts are processed by professional contract designers and negotiators;

Project Execution: Monitoring and Control: The directive provides for company progress reports, PRG meetings, and ISB reporting to ITC. Properly executed, these activities should provide ITC with adequate control over projects;

Final Evaluation: The directive provides for a follow-up system to retrieve sales for program evaluation.

#### WEAKNESSES OF THE CURRENT DELIVERY SYSTEM

The design for program delivery is basically sound in many respects. However, its operational performance has fallen short of the requirements of the present directive. A description of its current performance and the reasons for its shortcomings are provided in Annex VII to this study. There are two chief reasons. Extensive re-organizations have occurred within the Department without corresponding adjustments being made to the DIPP delivery system. In addition, human resources have declined at the same time that projects have increased in complexity and number. These two factors are in large measure responsible for the most serious deficiencies in the current delivery system. The primary deficiencies are discussed briefly below.

### Project Selection and Approval

Project selection has operated without priorities, i.e. interproject selection has not been undertaken. The absence of criteria for assigning priorities is further discussed under "Current Operational Philosophy and Characteristics", later in this section.

Additional deficiencies arise out of the unclear matrix organizational structure and the dispersion of responsibility.

These deficiencies in the early stages of project selection and approval impair authority, control and accountability.

### Monitoring and Control

As set out in the DIPP directive, the company progress report, the progress review group meetings, and the ISB management reporting system, are sound and effective methods for monitoring and control. All the evidence gathered in this study indicates that these activities are not being performed effectively or frequently enough. Officers openly acknowledge that they give precedence to project approval work because of the pressure of their considerable workloads. Monitoring and control accordingly have received very low priority.

The efficiency and effectiveness of the project review groups have been criticized. Industry has complained that the reviews have not been purposeful or well coordinated. (This may be due in some cases to turnover in departmental personnel, a problem which affects many phases of project processing.)

The destruction of systems for collecting project monitoring and evaluation data, which occurred as a result of ISB re-organizations and decisions, has brought about a serious decline in the monitoring and control function. The Department and the DIPP Committee in particular cannot know how projects and the program are performing in the absence of such data, and total program budgetary control has been seriously eroded.

#### Reporting

The directive and branch management require reporting, and a considerable amount of reporting is being carried out at the project level. The quality of reporting impinges directly on the quality of management decisions. We found that DIPP reporting in general lacks coordination, completeness, and consistency. Financial reports are deficient in timeliness and accuracy, which has severely impeded the DIPP Office in seeking to ascertain ongoing funding requirements.

Project sales reports have not been available since March, 1975, despite DIPP Office protests to its management.

Post-project data are not collected or reported in an obligatory, systematic, or regular basis.



Final Evaluation and Post-project monitoring

This was found to be the weakest stage in the project delivery system.

Reports to the DIPP Committee do not cover all the projects completed. The program directive does not require an analysis of downstream project success or failure.

The ISB system (now defunct) and the FSB system for collecting DIPP sales benefit data were found to vary by as much as a factor of 13 for identical companies in the same year. Not all of the variances could be accounted for.

The weaknesses of the final evaluation stage amplify the weaknesses noted in ongoing monitoring project monitoring. Together, they render the final stage of the DIPP delivery system almost useless for management or evaluation purposes. These shortcomings preclude management from using concrete, historical data as a means of targeting future development.

Program Data Base

The main program data base (FSB computer file GC - 154) is in very poor condition. Projects are missing; the data on file are often inaccurate and incomplete; files are identified poorly and inconsistently; and completed projects are not so identified. As many as 60 of 63 projects put into effect between November, 1978, and November, 1979, had not been recorded in the computer file at the time of our examination.

The file's present condition prevents users from carrying out their work effectively and efficiently. If its condition is not improved, the changes recommended in this study will be extremely difficult to implement. With improvements, the file could become a powerful instrument for effective management.

#### File Documentation

The quality of file documentation is seriously deficient. Important documents such as the contract agreement and the final management report are missing from many files. Other documents are haphazardly represented. At present there is no system for systematically recording and summarizing project information.

#### DIPP Committee

According to the directive, the DIPP Committee is responsible for reviewing proposals and recommending to the Deputy Minister or Treasury Board on their appropriateness, viability, and terms and conditions. Their functions include monitoring the overall performance of DIPP, reviewing progress of projects, and making decisions on necessary changes.

In practice, the Committee has acted primarily as a project approval mechanism for small to medium-size projects. Large projects and major policy issues have been dealt with elsewhere. Project status reports and project final reports have received little attention.

As many as three persons have covered each membership position in the space of one year. The rank of attendees has declined. The original concept of the Committee's role has been weakened by a diffusion of responsibilities and by the weakening of its accountability for the program. The focus of the Committee has been on projects rather than on the program.

Our recommendations for the Committee are described in a later section of this report. They take into account the original concept of the committee's role and draw on earlier structural arrangements, with modifications.

#### CURRENT OPERATIONAL PHILOSOPHY AND CHARACTERISTICS

Why does the DIPP delivery system have the attributes just described? Basically, the reason is that although there has long been some concern regarding the benefits from the program, it has operated as an "eligibility" program: if a project qualified (met the directive requirements) it was supported. The program emphatically has not operated with priorities and only informally in support of strategies. The program has tended to operate as a collection of projects rather than as a managed program. Given the criterion of simple eligibility, as long as there were sufficient funds to meet the demands, DIPP problems were subordinated to the other urgent matters with which the Department had to deal.

The recent flood of applications, the emphasis on "value for money", and the increased attention to sector strategies have changed the operational environment to focus attention on these problems.

A question could be raised as to whether the system could not have adapted itself gradually to the changed conditions. The response which this study would give is that:

- It is difficult to establish responsibility and commensurate program authority within DIPP; consequently, there has not been a focus of control;
- Even if certain changes had been desired, the lack of reliable complete program data would have proved a major barrier to their development and implementation.

#### SOME GENERAL PROBLEMS IN PROGRAM DELIVERY

Certain general problems have been detected in the current system:

- There is a lack of clarity in the goals of the program; in particular, there are significant differences among the perceptions of those operating the program with regard to the relative importance of the economic, defence, and technological objectives.
- The program directives have not required the setting of priorities. The program has operated (quite properly in accordance with those directives) on the basis of "eligibility" and subsequent "formula support". In the absence of qualitative criteria, no interproject selection has been undertaken.
- The system tends to make the ISB officers advocates of projects once the initial, informal discussion phase is over. This is certainly not universal, but the tendency exists. At present the underlying incentive system for these officers influences them to "support" their sector by attaining approval of what they quite naturally view as good projects, i.e., projects which meet the program criteria.

- The sales/grant ratio of 10:1 - 15:1, which is the current economic eligibility criterion, is of dubious validity. It is far too low for incremental projects; more fundamentally, it is not in itself a good yardstick.
- The processing time for projects is far too long, due in part to cumbersome procedures subsequent to DIP Committee approval.
- The partial matrix system under which DIPP operates makes it difficult to identify a focal point for accountability and responsibility. This characteristic manifests itself most dramatically in the budgetary squeeze/project queue which has recently emerged.

#### MODIFIED SYSTEM

This section of the covering report describes changes which we recommend be made to the current delivery system.

Major objectives of the modified system design are to:

- Yield more effective projects under conditions where projects would compete on their own merits;
- Clarify accountability, responsibility, and authority;
- Provide improved program and project control;
- Reduce the project processing time.

The system we recommend is basically similar to the current one, but with the following differences:

- A modified program directive to ensure that the system is "cost-effective" and, in accordance with this aim, would define roles and responsibilities.

- The use of a comprehensive set of illustrated guidelines for company and departmental use to the end that everyone would know what information would ensure smooth and speedy handling - not necessarily approval. In drawing up these guidelines, the standards used by venture capital and/or financial institutions appropriate to each instrument (loans or grants) could be used as a guide to the detail required.
- The adoption of the project management team concept for the handling of submissions. An ISB officer, designated by the responsible divisional chief, would be the leader of a team composed of the current advisors i.e., machinery, marketing, financial and economic\*, but also including technology. This team would follow a formally submitted project all the way through to its completion. Accountability for the integrated judgement would be primarily located with the divisional chief, who provides continuity, mature judgement, and knowledge. In addition, the independent views of all advisors would be clearly identified and recorded throughout the process.
- The use of a project scoring system to guide (not mechanistically determine) project assessment, by giving due weight to the characteristics associated with high pay-off projects. The system would "filter" first on NPV "winners" and then on incrementality. This would be done in the one overall assessment but with the sequence just noted; it would not be time-consuming. It should be reiterated that this process would not

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\* In a perfect world, all of the factors would feed into a comprehensive economic analysis. We do not believe that this is practical, due to limitations on time, personnel and information; the program will very probably have to operate with rudimentary analyses which will have to be integrated but in which the individual views would be apparent.

select only those projects which were civil, mature technology and low risk; these characteristics would receive greater weight but not absolute preference. The resulting group of projects could be thought of as a risk portfolio, in the sense that some would fail, but the indication for each would be that the expected economic benefit was positive. It would not, therefore, be a portfolio in which projects would be deliberately chosen to attain a pre-determined distribution of risk and expected pay-off; such a distribution would result but the selection would be on the basis of the expected economic benefit of each individual project. Moreover, weight could be given also to sector strategy priorities as determined by ITC management. An additional feature of the system would be a frequent updating of the required parameter values to help to ensure that resources were not over- or under-expended. (One result, of course, could be that some good projects would be rejected, or held over, unless supplementary funds could be obtained.)

- The improvement of the Statement of Work by the incorporation of a planning instrument similar to a PERT or GANTT chart. This would help to make project monitoring and control effective and efficient, for example, by concentrating only on "exceptions/deviations" from stated performance indicators and would also to facilitate accountability during project execution.
- A two-tiered committee system composed of:
  - a DIPP Program Committee - comprising three ADM's, and responsible for policy, overall program management (with the chairman having particular responsibility), establishing priorities, and overseeing the negotiation and execution of large projects;

- . DIPP Project Committee - at the DG level, responsible for approving projects in accordance with the assessments and priorities, periodically review the results of monitoring and control.

This committee structure would achieve the following:

- As a committee system, permit the integration of a number of perspectives;
- As a two-tier committee, it permits the questions appropriate to each level to be addressed to that level;
- The Project Committee, in particular, would not supersede the judgements of the staff regarding project characteristics but would, rather, ensure that the staff assessments were well and consistently done; and would ensure that additional sector, or other priorities, were fairly represented;
- The Head of the Committee Secretariat could serve as the focal point for program management with regard to tracking expenditures and ensuring that the selection parameter values were adjusted to keep the program within budget. This individual could perhaps be designated the DIP Program Manager.

Within this system, different groups of projects should follow different paths, as shown in Exhibit 9, opposite:



EXHIBIT 9

POSSIBLE FLOW OF DIPP PROJECTS

"Normal Projects"

From Project Assessment

Scoring:

Incremental  
Satisfactory  
Score

(quick reaction)

Non-Incremental  
but Satisfactory  
Score\*

Loan

R&D Repayable  
Grant (50:50)

CA: Loan/Repayable Grant (50:50)

SE: Repayable grants

Large Projects

Support to be  
Negotiated

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\*This score would be higher than for Incremental Projects

- Large (above \$10 million) projects should be treated differently, as in practice presently happens. Such projects, which should number 0-3 per year, should take the following route:
  - . Preliminary, but rapid, assessment at the ISB level;
  - . Reference to the DIPP Program Committee;
  - . Appointment by that Committee of a special team, drawn from across the Department, and taking direction from the DIPP Program Committee;
  - . Preliminary negotiation by that team, leading to a Cabinet Memorandum through the DIPP Program Committee and ITC management;
  - . Negotiation of the project terms by the team, under Committee supervision, on the basis of the Cabinet directive.
- In addition, if at all possible, such large projects should be separately funded, at the departmental or at the government level. If large projects are not separately funded the DIP Program itself will be thrown off balance, and an environment of instability will be recreated.
- The use of successively speedier processes as between grants, interest-free loans, and interest-bearing loans; this would give industry the opportunity to trade-off between fast response and degree of support.

It is critically important that the information/data base system for DIPP be greatly improved to support the more sophisticated decision-making envisaged. To a much higher degree than in the past, the program will suffer if its data base remains inadequate.

VERTICAL SECTOR OR HORIZONTAL PROGRAM

Any system with the foregoing major characteristics would be capable of effectively delivering DIPP. Before selecting any one particular system, however, a fundamental decision should be made as to the relative emphasis between the vertical sector strategy and the horizontal program strategy. If DIPP is to be operated essentially as a group of associated but basically independent programs, each supporting a sector, then clearly the delivery system will have different features from one which supports an integrated single program.

ADDITIONAL MEASURES

Parallel Contract Processing

This study accepts, in the absence of evidence to the contrary, the creation of an ITC contract cell within the DSS organization in order to reduce delays in processing contracts. If this recommendation is not adopted, attention should be directed to the parallel processing of the contract with the submission. At present over 80% of formal submissions result in signed contracts; there would not be a great deal of "wheel spinning" if all submissions were immediately started on the contract route, particularly if check points were also included in the design of the parallel routes.

Loan Board

Too many simultaneous changes to the delivery system could be indigestible. The Department might wish to consider at a later stage, the handling of loan items under the following arrangement:

- A Loan Board composed of private sector businessmen not employed by the DIPP firms;
- Votes accorded to individual firms corresponding to a 5-year moving average of participation but with any one firm limited to 5% of the votes;
- The Board to administer a Revolving Fund which receives injections only to allow for inflation and an agreed percentage of "bad loans".
- This Board would be motivated, as representatives of the DIPP community, to process loans quickly but would also know that if too many loans "turn bad", no more funds will be forthcoming.

We believe that further comments are in order on two particularly sensitive aspects of program design.

#### INCENTIVE/RESPONSIBILITY/ACCOUNTABILITY

- In our view the modified system would satisfactorily meet these three requirements.
- The current system runs reasonably well on current incentives. The modified system would enhance these by increasing the identification of individuals with projects whose economic performance would be measured.
- We have identified the divisional chief as a particular focus of responsibility. It should be noted that if this accountability is imposed, then commensurate rewards (perhaps additional merit pay) should be available. Accountability should be associated with rewards as well as penalties.

- Clear responsibilities have been identified:
  - . ISB Officers and Division Chief - Project Assessment;
  - . Project Committee - Assessment Quality and Consistency;
  - . Program Committee - Priorities, Large Projects, Overall Effectiveness of System;
  - . Secretariat - Program Performance within Budget.

#### MATRIX ASPECT

An associated report by the Bureau of Management Consultants lays more stress than the present study on the need to have a full matrix organization and, specifically, a Program Manager. In our view, this is an arguable proposition. We find it difficult to identify aspects of the program, other than budget control, with which it would be practical to charge this position.

#### INCREASED RESOURCES

The changes suggested for the delivery system would not be cost-free. As a rough estimate, we judge that the changes, if fully implemented, would cost in the order of \$1 million annually. With this program, however, it can clearly be shown that the increased expenditure would yield cost-effective results in the form of higher economic pay-off from projects. It would be worthwhile, therefore, to secure more administrative funds to increase resources, even at the cost of program funds.

IX - INTERPRETIVE DISCUSSION

REALITY OF DIPP ASSUMPTIONS

The burden of investing in defence equipment can be made more acceptable if that money is at least spent at home. DIPP originated from a (then) new approach to that goal by concentrating on the production for export of sub-systems and components and effectively this trading off against the production by our allies of major systems. A major implicit presumption was that the overall Western defence market was a lucrative one.

A second assumption was that all Canadian defence firms required support to match the aid given to their domestic firms by foreign governments.

A third assumption for DIPP was that defence industries, almost by definition, formed the cutting edge of technological development and that these developments would have long term economic pay-offs.

A fourth, though lower-keyed, assumption was that an industrial base was required in Canada for defence purposes.

This study casts some doubt on each of these assumptions:

- . The defence market is not a commercially lucrative one - and, in fact, in its volatility creates distinctive problems;
- . Canadian firms in the current circumstances, do not require universal matching subsidies;

- . To the extent measurable in this evaluation, the economic benefits derived from the spin-offs from the DIPP projects do not appear significant; but, more fundamentally, we would judge that DIPP does not create a disproportionately large number of spin-offs compared to support programs in other areas;
- . With regard to the fourth assumption, that an industrial base is required in Canada for defence purposes, it does seem that the importance of this factor as a component of the DIPP decision making process has become eroded.

The risk dimension in these project decisions has, of course, also been a theme and one which the study supports.

#### FEATURES OF A RE-ORIENTED PROGRAM

In view of the current emphasis on economic benefits, the study indicates that although DIPP has not had a positive pay-off relative to the 10% norm, changes in program philosophy and design could yield a higher economic return.

The measures to bring this about have been identified:

- . A broader program for high technology industry as a whole - in which defence industries would be included;
- . Much more emphasis on the use of mature technology: more commercial benefits, less technical "glamour";
- . A program design in which support is given in a manner which minimizes the distortion in normal business decision-making: do not entice firms into projects; rather, make it possible for them to make their own way.

To these measures should be added an underlying theme: emphasize and support marketing. Clearly, there must be a balance between technical capability and marketing capability. At present, the technical side is too heavily weighted.

#### AN INTEGRATING PERSPECTIVE

At the risk of being repetitious, it may be helpful to draw certain of the findings of this study together by noting that the study could be interpreted as supporting the use of a "Japanese" strategy for industrial growth adapted to Canada.

- It is not necessary to start with basic R&D; the efficient production and exploitation of mature technology can be highly profitable;
- Concentrate on civil industries and possibly within these industries on those segments for which other countries are not providing high levels of support or for which Canada has a natural advantage;
- Avoid a decision-making apparatus which creates the distortions which can result from "free money";\*
- Give proper emphasis to the identification, development, and satisfaction of market demands and marketing requirements.

It is noteworthy that the Canadian aerospace industry - whose DIPP projects were generally economically worthwhile - has evolved a strategy not dissimilar to that advocated here; there is emphasis on civil projects, the technology is reasonably well proven, and there is considerable attention to marketing.

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\*These points are elucidated in Appendix F to this covering report.



TECHNOLOGICAL SPIN-OFFS

The question of the technological spin-offs from DIPP and the economic value of these spin-offs is worth additional comment:

- It must be acknowledged that such spin-offs are difficult to track; certainly the firms found it so, although they expressed an almost intuitively-held belief that "there was something there". This difficulty of identification is, in a sense, negative evidence but not overwhelmingly so;
- The evidence from the technical experts was that a residue of knowledge and capability did result from DIPP projects;
- From the evaluation perspective, however, we could identify only an estimated \$18 million ('69\$) as an additional economic return; a sum which would not substantially alter the thrust of the findings;
- Our survey of the literature showed that no program design has been found which is an efficient source of spin-offs. The evidence is, rather, that the almost random nature of spin-offs means that a wide variety of programs with a certain level of activity/funding will have the same expected yield;
- Overall, then, the technological rationale for DIPP as a particular type of program is not well founded but it is likely that any technological industry support program will result in bonus technological developments over and above the immediate project payoffs.
- Beyond these points, there should be little doubt that there have been DIPP investments whose prime objective was to support a technological capability - the maintaining of the de Havilland design team may be a

case in point. These investments were often successful in these terms. The pursuit of this goal cannot be criticized given the diversity of views on the goals of the Program and given the directive requirements.

OTHER "SPIN-OFF" EFFECTS

The argument could be made that the corporate funds "freed up" by DIPP funds in the non-incremental projects have not been sufficient allowance for in the economic analysis.

The evaluation has treated this point in the following manner:

- The alternative use of funds has been credited with the 10% average return for the economy as whole, since it is reasonable to assume that these funds are likely to be put to use somewhere in the economy as a whole.
- If it is judged that this assumption is too "coarse", then the next appropriate level of usage would be the high-technology segment of industry. Here, both the general evidence and the evidence from a study of Pratt & Whitney indicate that the return is below 10%.

Beyond the methodological approach stated above, in practice the unit of analysis (project, division, or corporation) was chosen so that each boundary enclosed the very large bulk of the flow of DIPP funds, i.e., the unit was, to the maximum extent possible, coherent and self-contained. It is of interest that three of the major cases - Pratt & Whitney, Microsystems International, and Canadian Marconi - the unit was either the entire corporation or a complete division.

A final point regarding the accuracy of the ROI level as an overall representation of economic performance is that there are balancing factors in both an upward and a downward direction. As noted in the report, some spin-offs may not have been fully captured. In contrast, certain economic assumptions were generous. In our Firm's opinion, a reasonable balance has been struck at the 7 ½% level.

### GOALS

It should be reiterated that, in line with the remarks regarding the technological objective and those in the Program Delivery annex, the views held by program officers regarding program goals were honestly and openly held. Their views should not be criticized on the basis of divergence from the program directive. Our evaluation of the program indicates that the current program directive permits a fair range of interpretation as to program aims.

### TRANSITION PROBLEMS

We recognize that any re-orientation of DIPP - and specifically from defence to a broader mix - will cause transition problems for the current group of DIPP firms since, on the average, their support will be diluted. Nevertheless, we would also note that:

- the pace of transition is subject to determination by the Department;
- if such a transition is to be made, the currently higher demand from the U.S. market makes the present an auspicious time to do it.

Related to this last point, we must acknowledge also that there is a strong school of thought which holds that the recent increase in U.S. DOD procurements will be long-lasting; to the point that this market - contrary to our historically based observations - has now become attractive. This may be true; we have reservations regarding the continuation of a markedly higher procurement level, but the final judgement on this topic must come from the Department.

#### RELATIONSHIP TO INDUSTRIAL SECTORS

The findings of the statistical analysis and of the marketing study regarding a broader program are mutually reinforcing. Many of the problems now faced by the Canadian DIPP firms in the defence area, e.g., the need to rely on exports, the existence of only a small number of customers with highly volatile demands, the absolute exclusion from certain markets, and the need to rely on the experience and requirements of non-Canadian entities, would not exist for high technology firms serving Canadian civilian customers, particularly those in the resource areas. If it is accepted that import replacement is equivalent, if not preferable, to exports, then the support of such high technology firms offers the prospects of economic benefits both absolutely and in terms of the export/import dimension as well.

In the cost-benefit analysis, additional benefits have, of course, been ascribed to foreign sales for the reasons discussed in the cost-benefit methodology (CAE Case, Annex IA). Import replacement would, however, yield the same additional (foreign exchange) benefits as export sales.

Whatever changes are made to DIPP, we believe that a carefully planned communication campaign should be undertaken to make it clear to potentially interested firms just what the thrust of the program is. The "Corporate Factors" section records current views of DIPP. Even with an unchanged program, we believe that some of these criticisms and misconceptions should be met. For a modified program, this communication exercise would be even more important. It should encompass program officers as well as the clientele so that everyone operates from a common base of knowledge and understanding.

#### A Renewed Research Program

It has been observed that:

- knowledge of the residual industrial research element in DIPP is minimal;
- practically no research is done within DIPP projects;
- research projects may not be economically worthwhile in any immediate sense.

Nevertheless, downstream benefits from focused research is a real possibility. (This matter was touched on in the discussion of spin-offs.)

The Department might wish to consider, therefore, establishing and/or coordinating a program of activities:

- |                        |   |
|------------------------|---|
| IRAP (NRC)             | - perhaps somewhat modified to form a basic industrial research program;                  |
| Industrial Development | - a new program to bridge the research-to-production gap (including feasibility studies); |

DIPP/EDP (Innovation) - programs designed to support commercially viable production with an unambiguous economic aim.

The point could fairly be made that a broader DIPP would simply duplicate the EDP (Innovation) activity. It may very well be that there is a case for amalgamating the two. Our view, however, is that while these two activities - a broader DIPP and EDP(I) - would overlap, they would not be identical. DIPP should continue to be a program which supports projects at a higher risk level than EDP. We have emphasized in this study low risk endeavours as having more potential payoff; but we have also emphasized that risk is just one factor in a project assessment. The challenge to a program like DIPP is to tread the narrow path between being absolutely safe and taking unwarranted risks. We believe this is possible and that in this role DIPP could be complementary to a more conservative EDP. In any case, a penchant for bureaucratic tidiness should not dominate these decisions.

It may be worthwhile, therefore, to consider a modest (\$5 million/year) industrial research support and development program which would, if nothing else, relieve the pressure from projects which are basically intended to yield new knowledge and which might serve as catalysts for development within vertical strategies.

#### RELATION OF FINDINGS TO OTHER STUDIES

It has already been noted that the participation in DIPP is a form of self-selection which makes its clientele an unusual group of firms. Our

observations, particularly as they relate to R&D performance, export performance, or subsidiary relationships, are not, therefore, directly applicable to Canadian firms in general.

Other studies may, on the other hand, have some bearing on our recommendations. Specifically, in a broadened DIPP the possible reluctance of subsidiaries to export in competition with parent firms may become a factor which would have to be neutralized.

#### WORTH OF HIGH TECHNOLOGY

It will be apparent that in this evaluation, the study team has accepted the worth of supporting high technology industry. We have assured ourselves that the changes recommended would yield an economically worthwhile program. We have not tried to establish whether a more radical change, for example, to support medium technology industry, would be even more worthwhile. Our study of the available evidence and literature did not, however, cause us to challenge the high technology assumption.

It should be underlined, nonetheless, that it has been "normal" industrial R&D growth which the literature indicates as leading economic growth, not government-led R&D. We have tried to ensure that this "normal" industrial activity occurs within DIPP through the recommendations that the decision-making processes in the firms remain as undistorted by government support as possible.

CAPITAL ASSISTANCE

CA projects have performed relatively well and with new criteria should perform better. There is, nevertheless, some lack of clarity as to the precise operational aim of this component. Is it to supply the most advanced equipment? Is it to supply equipment which will simply yield higher productivity? Is it to supply equipment which though not advanced may be optimal commercially? The study has identified these various themes but has not been able to determine statistically the relative merits of the individual rationales. This is a topic which should be addressed and for which ITC is likely to be the most appropriate judge.

RELATION TO HOWE-MCFETTRIDGE FINDINGS

The Howe-McFettridge (HM) study is a major and oft-quoted study of DIPP. It is worthwhile relating its findings to those of this study.

Briefly stated, they are in accord. The HM study concluded that every dollar invested in DIPP yielded more than one dollar in R&D funds. Our finding was similar in that the R&D funds were, on the average, increased by more than the DIPP grant.

STABILITY OF FUNDING AND LARGE PROJECTS

The study has commented on the attraction which environmental stability has for commercial firms. This is particularly true of funding; quite understandably, they like to be assured that funds will be forthcoming. One



means of doing this is to define projects in terms which encompass a series of related projects rather than considering each one independently in succession. On the other hand, such an approach raises the question of the point at which the (underlying) sequence of projects becomes non-incremental.

We do not believe that there is any simple way of deciding what the extent of a project should be.

- This aspect may very well be a feature of the large projects and, as such, a suitable topic for negotiation;
- Even for projects below \$10 million, this may be one area which is properly subject to negotiation;
- The test in our view should be a firm's ability to demonstrate the national advantages of designing a large scope project. These advantages may very well exist (for example, in the early acquisition of larger-scale facilities than an initiation project might justify, but the onus should be on the firm to establish this; however,
- Turning the question around, each DIPP project should be commercially viable in itself and not undertaken as a support for another activity.

In defining projects in this way, the question of the incremental/non-incremental "breakpoint" must be considered and allowed for so that unnecessary support is not continued. This would involve identification of the point at which the project is no longer incremental. The breakpoint would be a matter to be determined in the negotiations.

This topic also affects the whole question of Large Grants/Adequate Funding. Many of the projects which have been studied have certain characteristics in

common. These are:

- a continuing series of projects;
- large grants;
- a large firm;
- location motivations for foreign firms.

Due to this overlap in characteristics, it is not possible with these data to definitively differentiate between some of the potential causal factors leading to economic benefits. We have judged "Adequate Funding" as providing the best interpretation, but it is only an interpretation and not a robust one.

The whole topic of how to define and handle large projects (which may consist of what were formerly sequences of projects) so as to attain maximum economic benefits in an efficient manner is one to which the Department must devote particular study and attention. We recommend that it be given high priority.

SUMMARY OF MAJOR FINDINGS

- The program has contributed to an agreed defence objective; this objective requires clarification and restatement to reflect present day circumstances.
- The program has contributed to the maintenance of technological capability; this evaluation has not, however, fully measured how this capability translated itself into substantial economic benefits.
- Overall DIPP has yielded an NPV of \$61.1 million ('69\$), for an ROI of 10 3/4%.
- Considering only the incremental projects, DIPP has yielded an NPV of \$-96.6 million ('69\$) for an ROI of 7 1/2%.
- The economic benefits tend to be depressed by projects which were defence oriented, entailed high (commercial) risk, and embodied the "leading edge" of technology.
- DIPP can be modified to positively support the economic rationale by giving greater weight to projects which are civil-oriented, embody mature technology and entail lower (commercial) risk.
- The current DIPP delivery system can be modified to support a cost-effective program.

X - RECOMMENDATIONS

MAJOR RECOMMENDATIONS

- Broaden the program to make it a "Technology Industry Productivity Program", with an emphasis on commercially viable projects.
- Based on the evidence of the past, maintain the overall "steady state" funding at at least the current level (for a broadened program) but transfer 20% of the funds from grants to loans; support large projects from other funds; re-examine the funding level in the light of the experience with a broadened program.
- Based on the assumption of the continuation of the "steady state", maintain the CA/SE funds at current levels.
- Use a two-step selection process, with the first stage looking for high NPV and the second stage looking for incrementality.
- Develop the proposed project scoring models for use in the process; these models would give particular weight to civil and mature technology projects which are well funded and in which particular attention is paid to market analysis.
- Examine the creation of a family of technology industry support programs.
- Be wary of projects in which government has to push industry to participate.

EXHIBIT 10

ROBUSTNESS OF RECOMMENDATIONS

<u>RECOMMENDATION</u>	<u>ROBUSTNESS</u>	
BROADEN PROGRAM	HIGH	
LEAVE FUNDING	HIGH	
LEAVE CA/SE FUNDING	LOW	
DECISION PROCESS & SCORING MODELS	MEDIUM	Process is highly robust but parameter values less so.*
INCREASE MARKET RESEARCH	HIGH	
MODIFY DELIVERY SYSTEM	MEDIUM	

\* Amongst causal factors Risk, Mature Technology and Civil are highly robust; adequate funding is low.

- Increase government-supported market research to decrease risk and improve economic performance.
- Modify the program delivery system in line with the new approach and, in particular, formulate a program directive which clarifies the program goals.

### CONFIDENCE LIMITS

At various points in this report, we have given the statistical evidence that supports certain of the findings; in others we have indicated where we were bringing judgement to bear to support a finding. Exhibit 10, opposite, links these indications with judgements on the sensitivity of associated recommendations to yield estimates of the robustness of the recommendation. Thus, even if a finding has only relatively low confidence associated with it, if the recommendation is insensitive - i.e., carries little chance of an adverse result even if the finding were incorrect - the recommendation could be viewed as robust.

Note that the sensitivity and adversity have been judged on the basis of economic and political consequences alone.

The recommendations which have been made are based on our best estimates of the facts regarding the program. They could be made more robust with more work, but, in our judgement, additional work would not radically change the major thrust of our recommendations, even for those with low robustness.

# DUE DATE

APR 10 1987		
JUN 04 2010		
NOV 25 1988		
MAY 05 1989		
JUN 5 1989		
JUL 17 1989		
JAN 17 1990		
APR 17 1990		
NOV 21 1991		
AUG 26 1998		
	201-6503	Printed in USA

INDUSTRY CANADA/INDUSTRIE CANADA



69726



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