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INNOVATION ELEMENT EVALUATION

VOLUME I

SUMMARY OF FINDINGS AND RECOMMENDATIONS

**Program
Evaluation
Branch**

**Direction
de l'évaluation
des programmes**



Government
of Canada

Regional Industrial
Expansion

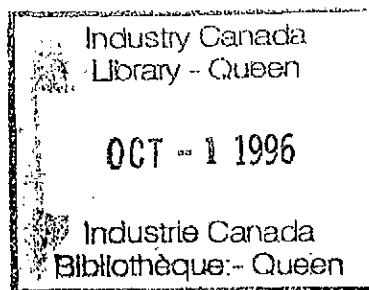
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Prepared by:

Program Evaluation Branch

DRIE

September 1983

INNOVATION ELEMENT EVALUATION

EXECUTIVE SUMMARY

The departmental Senior Management Committee approved in January, 1983 that an evaluation-oriented, focussed study be conducted on selected innovation assistance programs. While utilizing program evaluation approaches, this study was not to be considered as a formal evaluation of these programs. This report contains the findings of that study and is intended to provide information on the experience of previous ITC/DREE innovation assistance programs from 1977-82 which will be useful to the continuing design, implementation, strategic and operational planning of the new Industrial and Regional Development Program (IRDP).

Due to the senior management requirements imposed on this evaluation in terms of the changing innovation program structure and time constraints, four specific issues were selected from within the basic program evaluation issues of program rationale, results, improvement and delivery/efficiency. The specific study issues included:

- ° regional suitability of innovation programs;
- ° effects of regional skewing (contribution level richness);
- ° innovation investment and its incrementality; and
- ° employment creation.

The majority of the study's findings are derived from interviews and through project file review of 110 Enterprise Development Program (EDP) projects. These findings are complemented by expert and project officer interviews and by data obtained from other studies.

Volume I of this report presents the major findings and recommendations as they relate to program design and implementation. Volume II presents more detail on the study issue findings. The study's major findings are summarized here in terms of the basic program evaluation concerns, the specific study issues and lastly, functional conclusions and recommendations relating to IRDP design, delivery and results planning.

1.0 Basic Program Evaluation Concerns

1.1 Objectives Achievement

Following the theme of assessing past program experience in light of the proposed activities of the new department, the study considered the extent to which EDP-type programming would likely contribute to DRIE's mandate and IRDP objectives.

DRIE's mandate has been expressed in the Minister's press release as being "to increase the economic prosperity of Canadians by promoting productive investments to achieve industrial development and renewal in all regions, thereby contributing to job creation, exports, improved competitiveness and non-inflationary economic development." The IRDP innovation element objective, as stated in the same press release, is "to encourage investment to develop new products and services ... and enhance the competitiveness of Canadian industries."

This study has shown that the EDP program has had, and by inference that the IRDP innovation element will have, a positive effect in promoting incremental investments in new product development which in turn have resulted in products exhibiting at least the typical industry success rate (50%). The companies utilizing EDP have also exhibited an improved growth rate and competitiveness, and generated new jobs and exports as a result of commercializing new products.

EDP, however, did not contribute equally to all regions as firm take-up was dependent upon an existing manufacturing base. Although improvements in eligible costs and financial skewing may enhance the attractiveness of innovation programming in disparate regions, it is not expected that the innovation element of IRDP in isolation will be effective in significantly reducing regional economic imbalances.

1.2 Program Usage

Innovation is defined as the process of converting an idea into a commercially successful new and improved product or process. Differences in sector and innovation practices at the firm level and the design of EDP have largely determined the pattern of previous program usage. Sectors most dependant on innovation, such as electrical-based industries, used the program more than others. Product developments which had a high proportion of current (i.e. expensed) versus capital costs (i.e. 80-20) were favoured by the EDP eligible cost structure and tended to be assisted more often than capital intensive projects. The typical firms which used the program tended to be small to medium sized, product development oriented, and generally were in a weaker than average position to finance their project. It is this category of firms which the EDP was designed to assist.

Past design ensured that the program reacted to the innovation assistance demand of firms while delivery criteria generally ensured financial need and an ability to carry out the project existed. The number of firms utilizing EDP as percentage of the population of manufacturing firms averaged 2.4% and did not vary significantly across provinces. (Vol. I s 2.2)

1.3 Results

Incrementality

Projects were generally found to be incremental at the firm level. 54% of firms stated that they would not have proceeded without project funding and 94% stated that they either would not have proceeded or that the project would have been reduced or delayed without assistance.

Investment in Product Development

Firm R&D investment in absolute dollars rose slightly during and after project performance. R&D intensity (R&D/sales), however, did not change significantly as shown in the time series analysis in Volume II.

On an incremental basis, for every \$1.00 of EDP contributions, firms invested at least \$1.20.

A significant proportion of investment levered was in the form of facilities expansion. 46% of companies surveyed reported that new or expanded production facilities were built.

Employment

Incremental employment impacts were between three and eight jobs created or maintained per project at a cost of between \$10,000 and \$22,000 per job.

Job creation was not related to firm or grant size but was related to the degree of project commercial success.

Production workers accounted for 70% of jobs created as a result of product development projects.

Other Benefits

Product sales varied significantly among projects and averaged \$700,000 - \$1,000,000 per project when discounted to the time of EDP funding. After five years, EDP product sales amounted to 25% of firm sales. Exports amounted to 30% of EDP product sales. Indirect benefits included increased growth potential, improved technological capability and spin-off products.

2.0 Issue Considerations

2.1 Regional Suitability

EDP was perceived as being useful by program users although many would favour expanded eligible costs and an easier application process. EDP was more suitable to certain industrial sectors and thus to certain regions, (as shown in Vol. I section 2.0) dependant upon the existence of those sectors in their industrial base. For regions with an

established manufacturing base, EDP has been suitable. For those regions with a predominantly processing industrial base which are attempting to increase their manufacturing base, EDP and the IRDP innovation element will not be as suitable unless used in conjunction with other IRDP elements such as Development Climate and Establishment.

2.2 Regional Skewing

The proposed skewing of contribution levels of the IRDP innovation element for disparate regions will likely have a negligible impact in disparate regions and a negative impact on Tier I regions. Survey results have shown that increased product development funding alone will not induce new firms into innovation in disparate regions without first remedying infrastructure problems such as skills availability and market - supplier proximity. In Tier I regions, small firms (which have the greatest need for cashflow assistance) indicated a high degree of sensitivity to the contribution level reductions which will exist under the proposed system. Based upon past usage, a greater number of firms will experience a reduced level of funding than those which will qualify for increased funding.

While all of the effects of the increased eligibility of innovation costs are not known, the study results indicate that skewing of contribution level by firm size would more logically meet the innovation financing needs of business than skewing by region.

3.0 Functional Conclusions and Recommendations

With regard to the IRDP innovation element, the following major conclusions and recommendations are made.

IRDP Design

- 1) The narrow definition of EDP eligible costs was a constraint to the usage and effectiveness of EDP in certain sectors and thus regions. IRDP Innovation element alone will not provide for important innovation costs such as manufacturing start-up (tooling, plant layout, facilities expansion) and marketing start-up (distribution arrangements, promotion). This may be remedied by either including these types of costs as eligible within the innovation element or by ensuring that these costs can be covered by other program elements. (Vol I s 2.3, s 3.1)

Manufacturing start-up and marketing start-up costs should be eligible under the IRDP program. The relative merits and practicality of expanding the innovation element or modifying and utilizing other IRDP elements should be the subject of further study.

- 2) Sector, product and firm characteristics were more important than location in determining innovation program usage and effectiveness. Regional skewing of contribution level will likely not increase innovation activity in disparate regions for existing firms and have a minimal impact on relocation of firms. Moreover, financial burden, and therefore the need for assistance in innovation, is generally greater for small firms than for larger firms in all regions. Proposed IRDP contribution level skewing which reduces assistance to small business in Tier I regions will likely reduce the national effectiveness of the innovation element. (Vol I, s 3.2)

Maximum funding levels for the innovation element should be adjusted within the tier system in order to reflect differences in the financial burden of innovation between large and small firms. Further study should be undertaken to identify a means of accomodating enriched contribution levels for small business innovation in all regions.

IRDP Delivery

- 3) The market assessment stage of product development projects was found to be a critical success factor. (Vol. I, s 2.4.2)

Market assessment activities should be stressed in the delivery of innovation projects. A study into the conduct of market assessments as part of innovation projects should be made in order to arrive at cost-effective methods of performing this critical function.

- 4) Past program delivery was slow and uncertain from a user perspective, requiring sectoral expertise on the part of the department for the most effective results. (Vol I s 4.2, 4.3)

The IRDP delivery should emphasize:

- i) speeding up funding turnaround time,**
 - ii) increasing user knowledge regarding application information requirements before the application process begins, and**
 - iii) ensuring that sectoral expertise is available in all stages of project management.**
- 5) Inadequate promotion of the program was considered by DRIE officials to be an important element in the narrow use of the program. (Vol I s 4.1)

A marketing plan should be established and resources committed to educate a broader base of firms about product development and the role which IRDP can play in conjunction with other forms of support in facilitating innovation.

- 6) There are many innovation / product development assistance programs administered by other federal departments, provincial governments, research councils and innovation centres. IRDP innovation could realize significant benefits by sharing program and client information on a formal basis with many of these other programs in order to eliminate possible duplications and/or missed areas of complementarity. (Vol I s 4.5)

Further study should be made to investigate ways of sharing program usage and strategic information with other federal, and possibly provincial and research council/innovation centre, product development assistance program administrators. Confidentiality of information must be a consideration of this study.

IRDP Results Planning

- 7) In terms of results planning and resource targetting, the following conclusions are made. Incrementality is an important consideration in determining program impacts. Objective measures of financial burden were found to be related to project incrementality. Private benefits indicators, including sales, jobs, exports, and other financial ratios, are useful in determining project success. Less tangible benefits, such as increased innovation capability, technology, and other social benefits to Canada are also important but much more difficult to measure. Project implementation and realized benefits were found to occur significantly later than originally expected. (Vol. I s 4.4, s 5.1, s 5.2, s 5.3, s 5.4)

Ongoing results and effectiveness data collection and assessment should take into consideration the following:

- i) IRDP planners, analysts and project officers should define and use objective measures of financial burden to assist in the determination of firm level incrementality. Incrementality definitions and guidelines for assessment should be established in order to implement the IRDP general program criteria on incrementality.**

- ii) Private benefits and costs should be monitored on every project, and collected in such a way that a minimum of initiative is required by assisted firms to respond to information requests.

- iii) Intangible and social benefits, as well as detailed consideration of incrementality, should be investigated on a periodic basis by studying samples of assisted projects.

- iv) A time delay factor in results achievement should be considered in program planning, budgeting, and results measurement.

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1.0 INTRODUCTION

1.1 Innovation Programming in ITC/DREE

Prior to January 1982, the departments of ITC and DREE had a number of funded programs which assisted companies in selected aspects of their innovation activities, i.e. converting technology or ideas into commercially accepted products. These programs included EDP, whose objective was the development of technologically advanced products, DIPP, which developed products primarily for military export markets, STEP which supported productivity improvements via micro-electronic process and product development, IERD, an energy saving program, and MSA, whose objective was the industrial development of a specific region.

Subsequent to the amalgamation of the two departments in January 1982, effort has been devoted to rationalizing previous program structures, i.e. removing overlaps, filling in gaps and establishing common administrative procedures. The resultant program structure will have as its core a new program called IRDP which will provide support to companies based upon the corporate development cycle. One of the elements of this program will relate to innovation and will subsume much of previous innovation programming.

In addition, the new department will assume several new operating imperatives relating to meeting regional needs, targetting support where government involvement is likely to have the greatest impact and economic benefit, and undertaking a more pro-active approach while facilitating private sector initiatives.

1.2 Purpose and Mandate of Study

The purpose of this study is to provide timely data useful in IRDP program design and implementation and to assist senior management in the targetting of resources and planning of results. Based upon the experience of previous ITC/DREE innovation programs, information is provided on how proposed innovation programming designed on a national basis can be implemented in a number of regions of possibly differing industrial development and innovation needs.

The mandate for this study arose from a meeting of the Senior Management Practices Steering Committee in December, 1982 which considered how program evaluation techniques could be applied in the short term (6-8 months) to assist in decision making relating to program design, implementation and strategic/operational planning.

After considering issues relating to the basic program evaluation concerns of program rationale, program results, program improvements and program delivery/efficiency, the Committee approved the following four issues for study:

- . Regional suitability of innovation programs
- . Effect of regional skewing (program richness)
- . Innovation investment by companies and its incrementality
- . Employment creation

Focus of the study would be primarily on the Enterprise Development Program (EDP) which most closely resembles the innovation programming in the proposed IRDP, although some consideration would be given to the other innovation programs such as DIPP, STEP, IERD and MSA.

The study would be limited to addressing the issues proposed as being relevant to near-term decisions and not be considered as a full evaluation of innovation programming. Information collected would include perceptive data augmented by quantitative data where possible.

1.3 Methodology and Data Quality

With respect to all four issues, 110 previous users of EDP were interviewed (90 by telephone and 20 by personal contact) and an additional 12 personal interviews were conducted with companies having used DIPP, STEP, IERD and MSA. Additional data on each company interviewed was obtained from file reviews of EDP composite submissions to the EDP Boards.

The sample of 110 EDP users was drawn from a population of approximately 800 firms which had utilised EDP for product development and design commencing in 1978 and having completed projects prior to March 1982. Upon the direction of the Steering Committee, the sample provided equal coverage by project on a provincial basis, chose an 80%-20% small-large company representation (based on a company size cut-off of \$2 million in annual sales) and median-sized projects from within these firms, and concentrated on the four major industrial sectors of EDP utilization in each province.

EXHIBIT 1

Distribution of EDP Firms Surveyed

Province	Nfld.	N.S.	N.B.	P.E.I.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
	6	11	5	8	10	29	11	6	11	13
Sector	Chemical		Electrical		Mach. & Transp.		Metal Fab.	Wood		Other
	28		27		31		4	6		14

With respect to the regional suitability and skewing issues, the general study approach emphasized the elicitation of opinions and the analytical abilities of private and public sector experts in R&D policy, regional development and program delivery. The experts, including 15 from the private sector and provincial governments, and 25 from DRIE regional offices involved in policy and program delivery, were interviewed using open-ended questions to obtain their comments, perceptions and analyses. This was augmented by objective, quantitative data from other databases such as the EDP information system, Statistics Canada, Dun and Bradstreet, and the results of other related R&D studies such as those done by the Economic Council of Canada.

In terms of data quality, the sample design of the firm survey does not allow the presentation of statistically - valid, ie definitive findings from a national perspective. This arises for two reasons: (i) the absolute sample size and resources available for the study had tight limits, and (ii) the deliberate choice to design the sample coverage on the basis of equal regional participation rather than a random allocation of the sample (which would have more closely reflected the heavy utilization of EDP in Central Canada at the expense of broader regional coverage). Nevertheless, strong indicative findings for the target population of EDP were obtained and substantiated by both quantitative and qualitative evidence. Credence is attached to the study results by reason of the relatively large number of firms contacted compared to other relevant innovation studies, the apparent face validity of the manner in which the firms responded, and finally, by the way in which the several data sources corroborated the findings.

1.4 Structure of This Report

This volume, a summary of findings and recommendations, is presented to provide easy access to the major findings of the study.

At the suggestion of the Steering Committee, and to further facilitate the utilization of this report within the department, the study's findings are presented in this Volume I under the functional headings to which they most logically pertain, ie. innovation policy, program design and results planning.

Readers who are interested in the findings of the study presented on the basis of the four study issues and further detail of study methodology, analysis and results will find these in the study report Volume II, Technical Report, and in its Appendices. Section number references to Volume II are shown throughout this report. Definition of terms used in this report are shown in Appendix D.

The following sections of this volume present the study findings and recommendations as they pertain to innovation policy, IRDP design, IRDP implementation and results planning/resource targetting.

2.0 INNOVATION POLICY

2.1 Introduction

This section is intended to describe the past usage of the Enterprise Development Program, and to profile EDP users against a conceptual model of the innovation process. Section 2.2 describes past EDP usage. Section 2.3 describes the innovation process model used for analysis. Section 2.4 profiles the innovation characteristics of user firms against the model and Section 2.5 briefly reviews investment and employment impacts and effects.

2.2 Usage of the Enterprise Development Program

Observations

Usage has been less than 5% of all manufacturing firms in all provinces except PEI over the period 1977-1982. PEI exhibited a higher usage rate due to the extremely small industrial population.

Usage has varied more significantly by firm sector than by province.

Supporting Data (Vol II s4.3, exhibit 4-1)

EXHIBIT 2
EDP Approved Projects/Firm Population

	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.
EDP Approved Projects	8	18	18	11	253	267	53	38	50	82
Dun and Bradstreet * Firm Population	295	105	795	596	7,697	13,004	1,413	1,452	3,330	4,192
Provincial Usage (%)	2.7	17	2.2	1.8	3.2	2	3.7	2.6	1.5	1.9

	Chem.	Wood	Metal	Mach.	Elec.	Other
EDP Approved Projects	110	48	74	229	237	100
Dun and Bradstreet Firm Population	872	642	3,293	4,863	848	22,355
Sector Usage (%)	12.6	7.4	2.2	4.7	27.9	0.4

Conclusion

The factors which have tended to most influence program usage have been sectoral differences in the innovation environment, product development process and firm characteristics, rather than differences in provincial program delivery.

* An estimate of firm population which most closely represents the sectors and types of firms which utilized EDP.

2.3 Innovation Cost Model

In order to analyze the differences in the process of innovation between sectors and companies, a model of the innovation process was assumed. The model suggested below is generally accepted within the business community and was outlined in the DRIE internal discussion paper released in April '83 entitled A Strategic Approach to Promoting Innovation and Productivity.

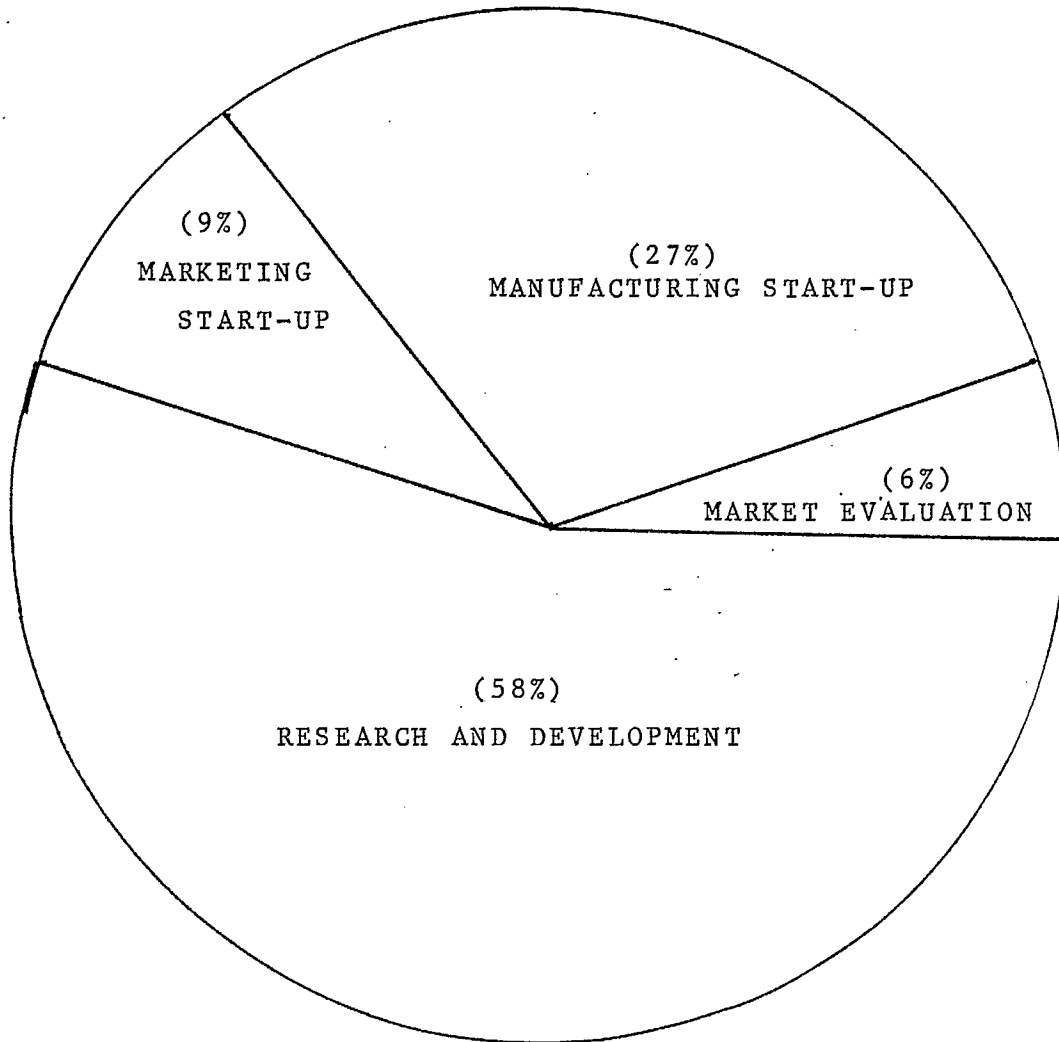
The departmental definition of innovation is that it entails the "... entire process leading to the commercial success of new and improved products and production methods. This definition leads to two critically important points. First, innovation is market-driven ... second, innovation is an on-going process undertaken by firms in the course of doing business."

From this definition the innovation process can be viewed as beginning with the identification of a market opportunity and culminating in the use of a new production process and/or sale of a new product.

Innovation assistance has been targetted in the past at specific segments of the innovation process. Generally, EDP funding was targetted at research and development activities, however, other activities are included in the innovation or product development process. For simplicity these other activities may be classified as market evaluation (market assessment, feasibility, etc.); marketing start-up (distribution activities, advertising, etc); and manufacturing start-up (tooling, adjustment of plant layout, expansion of facilities etc.).

Exhibit 3. indicates the breakdown in terms of cost of the various product development activities for EDP assisted firm. (The model generally conforms to models developed by Statistics Canada and the Economic Council of Canada).

Exhibit 3
Relative Proportion of Innovation Costs for EDP Firms
(Vol II, s 4.5.5)



While theoretically only research and development activities have been eligible for EDP product development funding, in a significant number of cases some market evaluation and manufacturing start-up activities have actually been funded.

Conclusion

Two major conclusions can be drawn from the analysis of innovation assistance against an innovation process model. Firstly, development activities remain the most important cost factor in product development and EDP has properly focussed on this element. Secondly, there are significant product development cost factors outside of the EDP eligible costs and project officers have sometimes found it necessary to bend the rules to provide adequate product development assistance. (There is no evidence that bending the rules had any negative impacts on project results).

2.3.1 Innovation Process Model and EDP Usage

Observations

From analysis of the preceding model, the following observation is made with regard to the types of firms which used EDP assistance: EDP was more attractive to firms having significant research and development costs as a proportion of total product development rather than firms with high manufacturing start-up (including capital) or other costs.

Supporting Evidence (Vol II s4.3, s4.4, s4.5)

EDP was most heavily used by manufacturing firms rather than processing firms. As indicated by other studies, processing industries which may have large R&D costs tend to have higher production start-up costs than do manufacturing industries.

EDP usage was most heavy in electronics industries where manufacturing start-up tends to be low, and least heavy in metal fabrication and other industries which tend to exhibit higher manufacturing start-up and capital costs.

Conclusion

The favouring of direct costs over capital costs in innovation assistance tends to encourage program use by specific types of firms over others. A typical EDP firm produces high quality, low volume products requiring high labour costs in the development stage but relatively low capital costs for manufacturing start-up.

2.4 Innovation Characteristics of EDP Firms

2.4.1 A Profile of Innovation Assistance Users

Observations

EDP program users have had distinctive characteristics in terms of firm size, R&D and labour intensity, motivations for innovation, markets, risk areas, financial status, and funding sources.

Supporting Data (Vol II s4.3, s4.5)

a) Firm Size

EDP users have tended to be medium to small in both sales and in terms of employees as per the department's small business definition. Nevertheless they tend to be in the upper range of Canadian manufacturers.

b) R&D and Labour Intensity

EDP users tend to have higher R&D intensities than the general population of manufacturers.

(Median R&D/Sales = 2.2% for EDP firms versus less than 1% for Canadian manufacturers as a whole.)

The EDP assisted firms are also more labour intensive than the general population of manufacturers.

(Sales/Employees averaged \$40,000/employee for EDP versus \$90,000/employee for the general population for the years 1977 to 1982.)

c) Motivation for Innovation

The most prevalent motivation for innovation amongst EDP users was found to be the perception of new market gaps. Other reasons mentioned were to take advantage of new technological advances, improve the quality of a product, response to foreign competition and interactions with customers. In terms of EDP assisted projects being 'market pull' (product filling a market need) v.s. 'technology push' (technology pushing the new product), the breakdown favours market pull. This is in line with findings in other innovation studies.

d) Sources of Technology

Most firms claimed that their major source of technology or idea for the innovation was from within the firm. This was more true for small firms than for large firms. Firms from the maritime provinces tended to claim that the innovation sources came from outside the firm more than firms in the rest of Canada.

e) Markets

Product development activities and marketing strategies are closely related to the type of markets which EDP assisted firms are serving. The products developed with EDP assistance tend to be industrial 'high ticket' items. As pointed out in recent work on the subject, such markets are subject to different risks and require different strategies than consumer markets.

f) Areas of Risk

While risk perceived by the firms was generally in the medium range, there were differences amongst sectors in terms of estimates of high risk. Electrical firms considered marketing the highest risk, chemical firms considered technical risk to be the greatest, and other firms generally considered financial risk to be of greatest importance.

g) Financial Burden

Financial burden was often significant. Total innovation costs for EDP supported projects averaged almost 90% of firm assets at the start of the project.

h) Financial Position of EDP Firms & Sources of Innovation Funding

EDP assisted firms tend to be cash strained at the time of application, with limited assets and high current debt as compared to the average manufacturing firm. This leads to the conclusion that many EDP firms would have difficulty attracting capital from private financial sources.

i) Nationality of Ownership

Almost all of the firms surveyed were Canadian owned (in spite of a sample selection process which had no explicit consideration of ownership).

In terms of sources of innovation finance, the study findings confirm the hypotheses that EDP firms would have trouble obtaining private financing. Virtually all product development financing, aside from that provided by EDP, is done from internal funds. This would seem to be due more to the fact that private funding was not available rather than individual preference since firms were often using outside sources to finance other activities (i.e. general operations).

Conclusion

In summary, the EDP user firm has generally been a medium-small sized firm producing a high quality industrial product requiring high development costs for which the firm generally was in a worse than average position to finance. Generally speaking, the program has therefore served the clientele for which it was designed.

Short of a rigorous cost/benefit analysis from the private and public viewpoint, there appears to be convincing evidence that government contribution support was appropriate in the assistance of innovation for most EDP assisted firms.

EDP catered to a clientele which preferred cash grants over other forms of assistance. This tends to support the contention that grants have a legitimate role in supporting innovation.

2.4.2 The Role of Marketing

Observation

Study results highlight the crucial role of the market place in determining the final success of innovation projects.

Supporting Data (Vol II s4.5)

40% of firms surveyed considered their critical success factor for their project to be marketing.

The consensus of experts and government administrators was that market evaluation was a critical factor to innovation project success.

Conclusion

IRDP is appropriate in its support of innovation in the private sector whose principal strength is knowledge of the market place. In addition, the added flexibility in funding of IRDP over EDP enables more direct support of market evaluation activities before product development and should enhance program effectiveness.

2.5 Investment and Employment Impacts

2.5.1 Investment

Observation

While EDP projects tended to influence the undertaking and the quality of short term product development activities, the evidence does not suggest that long term R&D investment has been increased.

However, EDP projects did increase establishment and expansion of manufacturing facilities particularly in small firms.

Supporting Data (Vol II s6.4)

Firm management generally felt that they learned something about product development decision making during the process of application and the quality of their R&D investment was improved.

Engineering personnel hired for the projects tended to continue with firms and the firms' investments in R&D increased; however no increase in the net R&D/Sales ratio was generally found. Also firms did not rate contribution to innovation capacity as a high spin-off benefit. Experts generally argued that infrastructure support such as Innovation Centres, CAD/CAM and technology transfer was needed to increase innovation capability.

Conclusion

Improvement of the innovation level of Canadian firms cannot rest entirely with contribution programs such as EDP. In effect, a variety of instruments are required and should be aimed at both direct specific product development financing needs and at general infrastructure support needs.

2.5.2 Employment Impacts

Observation

Jobs created and maintained at the firm level as a result of EDP contributions showed high variance from project to project. Employment tended to be correlated with commercial success and was not correlated with firm size or contribution level. The largest impacts were found for production worker employment. The incremental cost per job is estimated at \$22,000.

Supporting Data (Vol II s7.3)

1) Average jobs created per project = 9

Standard deviation amongst projects = 21.9

Valid cases = 95

2) Job breakdown 70% Production
 15% Research
 15% Management

3) Incremental cost per job was determined by including as incremental jobs employment created in firms who responded that they would have a very small chance of doing the project without funding. The ratio of these jobs divided by total EDP contributions in the sample produced the cost per job estimate of \$22,000. This estimate is conservative since jobs were likely created in partially incremental projects. (ie. firms performing projects sooner, more quickly or with a broader scope as a result of funding.) One factor not recognized in the analysis is the impact of firm bankruptcies.

Conclusion

EDP tended to create production related jobs as a result of project commercialization, rather than research jobs as a result of enhanced innovation capability. In this way EDP acted as a growth assistance program.

Given the preceding analysis of past usage, firm innovation characteristics, and program impacts and effects, the relevant questions to pose with regard to the new IRDP are how will design and implementation changes impact on effectiveness, and what are the implications for results planning and resource allocation? The following sections address these concerns.

3.0 PROGRAM DESIGN

3.1 Eligible Costs

Observation

EDP funded product development to the prototype stage but did not fund applied research, nor manufacturing and marketing start-up costs. IRDP, by utilizing all elements, will apply to a broader scope of the corporate cycle and innovation process. Within the innovation element, eligible activities include feasibility studies, development of new products and processes, technological capability, and design, demonstration and engineering. These eligible cost changes will very likely increase program effectiveness. However, major innovation costs such as marketing start-up and manufacturing start-up remain ineligible.

Supporting Data (Vol II s4.5.8, s4.5.9, s4.5.10)

Under IRDP, Innovation cost eligibility cast against the innovation model considered previously is as follows:

Innovation Cost	EDP	IRDP Innovation Element	Other IRDP Elements
1. Market Evaluation	yes	yes	
2. R and D			
. Research	no	yes	
. Development	yes	yes	
3. Manufacturing Start-up			
. tool design, production specs.	yes	yes	
. equipment, tooling, plant alteration	no	no	Yes (Expansion with \$250K minimum in Tier I)
4. Market Start-Up			
. plans, advertising, promotion	no	no	
. demonstration	no	yes	

Although many activities associated with an innovation project can be supported under IRDP by moving from one element to another, ie. from R&D/Innovation to Expansion, marketing start-up within the Marketing Element only applies to Tourism.

By itself, the Innovation element will not address the complete process of introducing new products into the market place.

One of the charges often made by users of EDP was that the program did not go far enough in recognizing and funding the crucial elements of the innovation process, especially market development.

The concept of innovation as an activity carried out in the normal course of business is viewed by the department (Strategic Overview, p. 6) as encompassing the full range of activities from idea through to commercial exploitation. IRDP has broadened somewhat the range of innovation activities eligible for assistance by supporting innovation in its early phase, that of developing technological capability particularly in areas of strategic importance to the firm and industrial development priorities of the region. Missing in the assistance offered by IRDP Innovation is support to the later stage of the process when the leap is made from prototype to commercial product. In this stage, the burden of financing tooling, production equipment and marketing is left to the firm and so too, the risk that successful technical development will not be translated to commercial success in the marketplace. The study results indicate that the extent of this burden varies from sector to sector and particularly between the manufacturing and processing groups.

EDP funding, in general, was 40% of total product development costs. The figure varied with industry sector from a low of less than 30% for chemical-based industries to just over 40% for machinery, and electrical-based industries. This corresponds to what would be predicted given the innovation model outlined in section 2.3 (i.e. Chemical-based firms have the highest manufacturing start-up costs, which were ineligible costs under EDP, and hence the lowest EDP funding ratio).

Conclusion

EDP had a systematic bias in favour of firms with high R&D costs and low manufacturing start-up as opposed to firms with high manufacturing start-up with low R&D. It is likely that broadening the activities eligible for funding under IRDP will induce new firms to undertake some form of product innovation/development. This broadening can be achieved in at least two ways:

- i) All costs could be included in the innovation element. The potential benefits of this approach are that full recognition of innovation costs would be included in the innovation element and that business product development cycle budgeting would be more accurately reflected than under the current system. The potential shortcomings of this approach are that there is the possibility of assistance overlaps with other elements such as plant expansion etc., also there is the potential for diversion of innovation element funding for non-innovation related activities (e.g. The use of innovation funding to expand manufacturing capability).

- ii) Costs could be split amongst IRDP elements for the same project. The potential benefits of this approach would be that there would be no "leakage" of funding designated for one activity into another (e.g. plant expansion funding leaking into innovation etc.). Such a system would also fit the current IRDP design. The potential problems with such a system include gaps in the current design for items such as marketing start-up, possible difficulties in coordinating element funding, ambiguities in attributing benefits, and the possible restrictions which each element imposes in terms of tier threshold limits, types of funding etc. (i.e. plant expansion must be at least \$250K in tier I, but what if the expansion part of an innovation project is only \$100K?). The problem of firm uncertainty as to what multi-element assistance would be available

could perhaps be overcome by provision of conditional approval of the total package via some form of "Innovation Agreement".

Recommendation

Manufacturing and marketing start-up costs should be eligible under the IRDP program. The relative merits and practicality of expanding the innovation element or utilizing other IRDP elements should be the subject of further study.

3.2 Contribution Level Skewing

Observation

The EDP survey and expert interviews indicate that regional financial skewing of program contribution levels will not have a significant impact on the performance of regional product development.

In addition, since the product development costs for a given innovation tend to be fixed, the financial burden of product development for small business is significantly greater than for large firms.

Supporting Data (Vol II s4.5.12, s4.7.2, s5.2)

Under EDP, firms with sales of less than \$10 million were eligible for the maximum contribution of 75% of shared costs compared with 50% for firms with sales of over \$10 million. This in effect skewed the program on a regional basis since most of the firms in the disparate areas, being small firms, qualified for the maximum contribution of 75%. For these firms, IRDP offers no increased support.

Large firms in disparate regions will now qualify for 75% of eligible costs, an increase of 25%. The "losers" will be primarily small firms in advantaged regions dropping from 75% to 50%. Small companies claimed in the firm survey that the effect of such a cut back would be that 66% would abandon their innovation project.

The average financial burden as measured by total product development costs/firm assets at project initiation is 100% for small firms (sales less than two million dollars) and 50% for large firms.

In order for regional skewing to be effective, location must be a factor in the process of innovation. Most of the firms surveyed indicated that location played a very minor role in the undertaking of their original innovation and that they would not consider shifting locations for the marginal funding increases incorporated in the IRDP. Experts held the same view.

Conclusion

Regional skewing will likely not increase the innovation activity of existing firms in disparate regions. The potential for regional skewing to induce firms to relocate their innovation capability to disparate regions is minimal.

Moreover, the financial burden, and therefore the need for assistance in product development, is generally greater for small firms than for large firms in all regions.

Recommendation

The tier system should permit the maximum contribution for innovation to be linked to firms' size regardless of location.

Funding levels should be adjusted in order to reflect differences in financial burden. An analysis should be undertaken to identify the appropriate firm size criteria and funding levels for IRDP innovation assistance.

4.0 IRDP IMPLEMENTATION

4.1 Promotion

Observation

The Enterprise Development Program has very likely not been promoted to the extent necessary to ensure optimal usage.

Supporting Data (Vol II s4.3.6, s4.8)

The general perception of many delivery personnel was that EDP may have been under promoted. The firm survey revealed that EDP was not well understood by user firms.

The nature of EDP users provides another clue as to the effectiveness of promotion in the past. Most firms seemed to be product development oriented before getting EDP assistance indicating that EDP may have been reaching firms which were already well educated in the benefits of product development and innovation.

Conclusion

More active promotion of innovation in general, and specifically product development assistance, would significantly increase program usage.

Recommendation

A marketing plan should be established and resources should be committed to educate firms about product development and the role which (possibly in conjunction with other forms of support) IRDP can play in facilitating innovation. The marketing plan should define the roles of Headquarters, Regional Offices and other organizations such as the FBDB.

4.2 Business Interface in Project Delivery (Gov't - Business Communications)

Observation

EDP firms claimed that sector knowledge was a very important factor in the delivery of projects. The continuing involvement of such an informed project officer was also deemed to be important.

The 'management' of product development, often learned through the EDP submission process and contacts with a knowledgeable project officer, was an important side benefit to project delivery.

Supporting Data (Vol II s6.5)

While quantified data is not available or relevant to this point, qualitative data in the form of expert and firm comments stressed the need for sectoral expertise in project officers and the 'management benefits' accruing to the performer of EDP assisted product development. Some of the comments expressed by businesses interviewed are as follows.

Need for Sectoral Expertise

- a) "To facilitate communications, you should send a representative who possesses a sound technical knowledge of the industry (Comptroller of a small wood-based firm).

"Impractical standards should be reduced. More technical experts are needed to deliver the program". (Secretary - Treasurer of a small manufacturing company).

Management Benefits

- b) "The submission process imposed some discipline onto an otherwise undisciplined firm. This helped the management of the project". (President of small electronics firm).

Conclusion

Sector knowledge and general management assistance are critical success factors to effective innovation assistance delivery.

Recommendation

Efforts should be made to make sectoral/general innovation management expertise readily available to firms during the program application and performance stages of innovation projects. Departmental delivery work plans should ensure that a dedicated project officer is actively involved at every stage of the product development process, particularly in the case of small firms.

4.3 Delivery Expectations

Observation

EDP firms were generally unprepared for the paper work, time delays and uncertainty which they faced upon originally applying for assistance. Having gone through the process, the vast majority of firms would re-apply for assistance under similar conditions.

Small firms tended to express more dissatisfaction with paper burden and time delays than did large firms.

Supporting Data (Vol II s4.7)

Two quotes supporting this point are as follows:

"I found the documentation difficult; it is hard to suit both corporate and program needs" (President, small manufacturing firm).

"Red tape should be reduced. With respect to time and paperwork, ITC requires the same work for a \$100,000 project as they do for a \$10,000 project. This is not realistic". (President - small manufacturing firm).

The comprehensive audit findings of 1980 showed the actual delivery time from submission to receipt of assistance to average almost nine months. This is generally slower than other financing programs.

Conclusions

Firm expectations are often not met with regard to assistance paperwork and timing, however, once knowledge about delivery procedures is acquired, the delivery process becomes much less cumbersome.

Small firms tend to have greater difficulties with the application process.

Recommendations

Current IRDP regulations which include new delegation of authority will likely decrease turnaround time. In addition, efforts should be made to reduce the paperwork for small firms.

A uniform thrust to create the correct expectations about paperwork requirements and turnaround times in firms first applying for assistance should be emphasized. Efforts should be directed at decreasing, as much as possible, the uncertainties about the timing and level of funding for projects which are likely to be approved.

4.4 Incrementality

Observation

The survey of EDP firms produced strong evidence that EDP projects have generally been incremental.

Supporting Data (Vol II s6.2, s4.5.12)

Over 50% of respondents said that they would have terminated their project without assistance. A substantial additional proportion would have modified the project so that an overall percentage of 94% responded that they would have terminated or modified their project without EDP support.

Incrementality tended to be slightly lower in electrical-based industries than in others. This finding appears to be consistent with the hypothesis that the more innovation dependant sectors tend to show less project incrementality.

Objective data also supports the hypothesis that EDP projects were incremental. Total project costs made up a significant proportion of assets for most firms (see 3.3) while success rates were in the 50-60% range. The indication is that EDP projects tended to be risky investments from a firm stand point, and this, combined with the below average financial strength of many EDP firms, indicates that many projects would likely not have been done without government assistance.

Conclusion

Incrementality consideration was present in past EDP program delivery. IRDP delivery stands a good chance of being incremental if delivered in a similar fashion to EDP.

Recommendation

The new program should not radically change the innovation - product development delivery process in terms of consideration of incrementality.

4.5 Exchange of Program Information

EDP assistance is one program amongst many discretionary grant, tax incentive, and direct services programs run by other Federal departments and Provincial Governments to assist the innovation-product development process in firms. There is no evidence that any attempt at coordination has taken place amongst these programs in a systematic way. Current information systems do not formally coordinate the exchange of interdepartmental or intergovernmental program information on a consistent national basis.

Supporting Data (Vol II s4.6.6)

There are over 50 direct and indirect government assistance programs which are potentially relevant to the product development - innovation process in Canadian firms.

Some examples of potentially complementary programs include the Industrial Research Assistance Program which tends to focus on applied research assistance grants; the Product Development Management Program which deals with the general management process of innovation; several provincial programs dealing with product development in small firms; and provincial research institutes and innovation centres which have tended to focus on technology transfer services.

In conducting the EDP file review and examining current in-house information systems, no data collection on other government grants (federal or provincial) was found other than that supplied by companies during the project submission process.

While federal and provincial government administrators stated that some limited information sharing with ITC/DREE existed, such sharing could generally be described as ad hoc, discretionary, and informal. Many of these informal communications have been built up to deal with the perceived complementarity of other federal and provincial programs with EDP.

Conclusion

There appears to be a high likelihood that efforts have been duplicated and/or complementary services have been missed amongst other government and research council programs and current DRIE innovation assistance programs. The potential exists for incomplete or innaccurate information on previous assistance provided to firms and the past performance of firms with that assistance.

Recommendation

Further study should be made to investigate the feasibility of sharing of program usage and strategic information with other federal, and possibly provincial, product development and innovation assistance program administrators. Included in this study should be Provincial Research Councils and Innovation Centres since the services provided by these institutions may serve as direct complements to IRDP assistance. Impact on confidentiality should be considered.

5.0 RESULTS PLANNING AND RESOURCE TARGETING

5.1 Ex-Ante Indicators of Incrementality

Observation

Estimates of project financial burden were found to be related to firm self-assessments of project incrementality. The relationship was more significant for small firms than for large firms.

The new IRDP uses as one of its major assessment criteria the concept of incrementality. While ex-ante assessment of firm incrementality (whether or not a firm would perform a project without assistance) has tended to rely on the subjective judgement of project officers and EDP boards in the past, there has been some question as to what role objective measures, such as tests of financial burden, should play in the determination of incrementality. Critics have argued that while such measures may indicate firm financial risk, that they have no reference to technical risk or to financial return, and therefore are inadequate as tests of incrementality. These weaknesses notwithstanding, if financial risks tend to be an important decision criterion for firms in deciding whether or not to go ahead with a project, then financial burden indicators should be related to firm assessments of incrementality, assuming that project risk and return estimates vary randomly.

Supporting Data (Vol II s6.3.3)

Three tests of financial burden were considered. These tests were i) project costs plus implementation costs divided by tangible net worth (a former EDP significant burden ratio); ii) project costs plus implementation costs divided by total

assets; and iii) project costs plus implementation costs divided by working capital. Each of these variables was calculated for EDP surveyed firms and correlation statistics were generated between the financial burden ratios and firm self assessments of incrementality.

When the entire EDP sample was tested a moderately significant relationship was found between "project cost plus implementation costs/assets" and incrementality. No relationship was found for the other tests when all firms were included, however the following correlation statistics were found for small firms (sales less than two million dollars) using the incrementality survey response as the dependant variable and the three financial burden ratios as the independant variables:

EXHIBIT 4

Financial Burden and Incrementality In Small EDP Firms

	<u>Correlation</u>	<u>Cases</u>	<u>Certainty</u>
Project Cost + Implementation/Tangible Net Worth	.18	72	80%
Project Cost + Implementation/Total Assets	.30	82	99%
Project Cost + Implementation/Working Capital	.20	72	90%

Conclusion

Financial burden statistics appear to be of use in determining project incrementality for small firms. While such ratios show some indication of incrementality, other factors such as the project risk-return relationship and other project, firm, and sector specific factors would appear to explain most incrementality considerations, especially for larger firms.

Recommendation

Acting in a complementary role to project officer judgement, financial burden ratios should be calculated in ex-ante assessment of project incrementality. Financial burden ratios should play a more significant role in assisting officers to determine incrementality for small firms than for large firms.

5.1.1 Incrementality - Effects on Results

Observation

Incrementality considerations affect program impacts by generally reducing them by 1/4 - 1/2.

Supporting Data

- 1)i) Cost per job before consideration of incrementality = \$17,500
- ii) Cost per job after consideration of incrementality = \$22,000

- 2) Investment levered before consideration of incrementality = 2.5:1

- Investment levered after consideration of incrementality = 1.2:1

Conclusion

Incremental impacts are significantly lower than average impacts.

Recommendation

Incrementality should be considered in all future estimates of program impacts and effects. As a minimum, periodic detailed estimates of incrementality based on in-depth analysis should be performed in addition to on-going assessments.

5.2 Monitoring of Results

Observation

Project monitoring for benefits has not been performed systematically in the past.

The devotion of resources to project monitoring and results information collection are necessary, firstly to assist in project control, and secondly, to provide impacts and results estimates for planning purposes.

Supporting Data (Vol II s4.8)

As indicated by the EDP Evaluation Assessment and Comprehensive Audit performed in 1980 and by the file review performed for the current study, results are generally not being measured and recorded systematically by management information systems.

The measurement of project results at a firm specific level appears to be at once the most easily accessible information and the most relevant in terms of program management since grants are given out on a firm specific basis. (See Relevant Measures 5.3)

In general, a monitoring system which would rely on a high level of firm initiative would seem to be unrealistic since firms have nothing more to gain once all contributions are received, and the program paperburden is already often considered excessive. For this reason, the initiative will need to be taken by DRIE staff to follow-up on project results.

Conclusion

Current plans for IRDP incorporate procedures for the systematic collection of results information in the form of a Project Benefit Report. While this report is well founded in principle, a delivery technique requiring firm initiative in sending in benefit reports would seem to leave open a significant risk that information will be incomplete.

Recommendation

The proposed Project Benefit Report under IRDP should have a designated responsible monitoring group which should follow up projects results with firms by phone over a designated time period.

5.3 Relevant Measures of Economic Impact

Observation

Private economic benefits (appropriable by firms or individuals) and costs can be more easily quantified than social benefits (not strictly appropriable by one group at the expense of others). The inclusion of assessments of social benefits on an on going project basis for small innovation projects would not seem to be practical given project delivery requirements.

Supporting Data (Vol II s6)

Assessments of private benefits currently incur significant effort in the form of projected product costs, timing, sales and cashflows, as well as job impacts. These projections often vary significantly from actual results. In general our study found that the less ambiguous the measure, the lower the level of net benefits found. For example, if we judge project success by jobs created, more projects are successful than if we judge success by net present value or benefit/cost criteria. This would seem to be due to the fact that respondents will tend to exaggerate benefits slightly because they perceive that this is what the government wants to hear.

In some cases respondents may exaggerate indirect benefits to compensate for a lack of tangible benefits. For example our survey found that often projects which reported few tangible benefits (product sales or jobs) tended to report high nontangible benefits such as "the project increased the technological base of the region".

Conclusion

In summary our findings suggest that while assessments of social impacts and non-private benefits are relevant to innovation assistance programing, such assessments are best done in a detailed systematic way such as on a periodic sampling basis rather than in the course of on-going program monitoring.

Recommendations

IRDP should continue with plans to collect information on product sales, firm sales, exports, research and development expenditures, other project costs, jobs created and maintained. In measuring all impacts, consideration of incrementality should be taken into account. Measures of social benefits should not be attempted on an ongoing basis for small innovation projects but rather should be studied intensively on a periodic basis. Assessment of social benefits should be made on large projects.

5.4 Time Factors in Results Planning

Observation

Both project performance and project results tended to occur significantly later than planned.

Supporting Data (Vol II s6)

The average project was estimated for about a one year duration but was not completed for a year and a half.

Project sales for commercialized product developments have tended to begin about two years after project initiation, this is often a year later than planned.

Conclusion

Project planned schedules are significantly more optimistic than actual project performance.

Recommendations

Program planners should recognize the significant time delays which often occur in product development projects and budget accordingly. A detailed trend analysis should be conducted on past projects to develop budget forecasts of actual to committed expenditures for innovation product development projects.

Results measurements should be taken for at least three years after project completion in order to most fully capture impacts.

