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TECH CENTRE RESOURCE REVIEW

TECHNICAL REPORT

AUGUST 19, 1985

Canada

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SUMMARY VOLUME

(VOLUME I)

AUGUST 13, 1985

TECH CENTRE RESOURCE REVIEW

SUMMARY VOLUME

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EXECUTIVE SUMMARY

MANDATE

MOSST has directed that a study be undertaken in order to meet the following objectives:

i) Determine the nature and level of the current federal investment in technology centres; and

ii) Analyse existing centres to determine whether there has been:

a) undue overlap or duplication;

b) proliferation/fragmentation;

c) lack of coordination;

d) strains on the availability of skilled human resources; and

e) significant barriers to the achievement of self-sufficiency which could hinder the future implementation of such a policy.

This report presents findings pursuant to these objectives.

DEFINITION OF A CENTRE

A key step was defining what is and what is not a technology centre for the purposes of this study. A technology centre was defined to be an organization, or separately identifiable unit of an organization, which provides assistance to industry in adopting new technology. Excluded from this definition are organizations that are engaged predominantly in post-secondary degree granting, mission oriented government labs[1], or those working on a proprietary basis for profit.

PROCESS

Despite the short time frame, the scope of the study was set to include all technology centres in Canada in order to fully address the important proliferation and overlap/duplication questions. The operational definition of a technology centre was applied to existing DRIE and Statistics Canada databases through a systematic multi-stage review and vetting process that resulted in a list of candidate technology centres numbering close to 300. A full census of this group was undertaken for the purposes of data collection, the first time that an information collection exercise of this scale and level of detail had ever been conducted on technology centres in Canada.

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1. This exclusion was applied to university faculties of engineering, science, etc., however it was not applied to centres that are affiliated with universities but which provide a significant amount of direct services to industry. Government labs were analysed for their technology centre components only, and are treated as special cases for the purposes of this study. (see section 2).

FINDINGS

i) The Nature and Level of the Federal Investment in Technology Centres

Several important characteristics about the population of technology centres emerged from profile information.

- There are 124 institutions which devote over 20% of their time and effort to the provision of direct technological service to industry in Canada, representing a total Canadian expenditure of $280 million in 1984.
- The Federal Government's share of this $280 million was $145 million.
- Less than $40 million of federal funding went to external (non-federally managed) centres in 1984.
- The overwhelming preponderance of current federal funding is directed towards organizations which spend less than 20% of their time and effort on activities aimed at the provision of direct services to industry (i.e. the promotion of technological change in industry). On the other hand such programs provide services in the national interest, many of them used extensively by industry and many of them support research in universities and government laboratories.

ii) Analysis of Major Questions

a) Undue Overlap/Duplication

Overlap and duplication was not found to be a significant problem in terms of the direct services provided by centres to industry. (No pronouncements can be made regarding research activities.) If centre's activities are represented by a two-dimensional matrix of technology fields and industry sectors being served, only 35 cells out of a potential total of 171 are found to contain simultaneous activity by more than one centre. Each of the 35 potential overlap situations was investigated and, through the application of additional criteria including type of service, field specialization, mandate, and regional limitations, found to be fully differentiated in all but one case.

b) Proliferation/Fragmentation

The study found the majority of centre efforts in technological services to be fragmented or under-funded in the sense that they provided service below a critical minimum ($100 K or 1 PY) level commonly accepted by the scientific/technical community.

c) Lack of Coordination

Networking and coordination were considered extremely important by most technology centre management, however a suboptimal level of networking activities was found, compounding the effect of, and perhaps caused by, fragmentation.

d) Strains on the Availability of Skilled Human Resources

From interview responses to questions regarding the hiring and retention of skilled human resources, it is apparent that technology centres do not view competition with industry for skilled resources as a problem. (However, no evidence was obtained from private industry regarding this claim.) Many centres in fact see their role as including the practical training of university graduates for technical positions in industry. In terms of addressing a generally-acknowledged scarcity of practically-trained skilled human resources, technology centres therefore may be part of the potential solution rather than part of the current problem.

e) Financial Self-Sufficiency

The goal of financial self-sufficiency does not appear viable as a general policy objective for technology centres. Fewer than 15% of the centres studied earned over half their income from industry sources in 1984. Of those that were nearly self-sufficient in terms of industry incomes, the nature of their services and client sizes varied significantly from those that were less dependent on industry revenues. The implication is that the imposition of absolute financial self-sufficiency would either eliminate a great many centres or drastically change their services to industry, i.e. away from technical outreach and dissemination activities to small business, and towards routine testing and contract research to solve short-term problems in medium - large business. This would essentially defeat the objective of having created centres in the first place.

RECOMMENDATIONS

From an analysis of the study findings the following recommendations are made:

1. The data base of technology centres generated for this study should be maintained, updated, and possibly enlarged so as to provide a valid and comprehensive source of continuing information on the nature of the federal investment in technology centres, as well as for use as an aid in the evaluation of future government science and technology policy options.

2. The Federal Government should undertake a major investigation into technology centre effectiveness. Without such an investigation no fully supportable conclusions on centre service or operational effectiveness can be drawn. The study should focus on three important issues:

   i) The relationship of critical centre size to service effectiveness should be examined;

   ii) The manpower training potential of centres should be examined with respect to the addressing of current shortages of skilled human resources; and

   iii) Centre services should be examined with a view to identifying industrial client needs, service awareness, usage characteristics and current effectiveness.

3. The federal government should undertake policy initiatives to stimulate, enhance, and coordinate networking among technology centres, and between technology centres and government, as a means of improving coordination of their activities, strengthing the technical linkages among them, and reducing the effect of fragmentation.

4. Absolute financial self-sufficiency should not be imposed as a funding policy objective for federally sponsored technology centres.

SUMMARY VOLUME

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SUMMARY

1. INTRODUCTION

1.1 Background (Vol II s 1.1)

Cabinet directed in May 1985 that MOSST undertake a study on ways and means to rationalize the federal government's investment in technology centres. Duplication of services was identified as one of the key problems with federal support for those centres, and self-sufficiency was recognized as a desirable component of future federal involvement. As a result, MOSST was directed to bring forward, by August 19, 1985:

a) A plan for a national system of technology centres; and

b) a strategy to redeploy existing resources that will rationalize and consolidate the existing centres.

1.2 Mandate (Vol II s 1.1.5)

A Technology Centre Review Team was struck by MOSST to fulfill its obligations in this regard. The sub-group responsible for preparing this report was mandated to gather and report background information on currently-existing technology centres in order to provide a factual base in support of the above requirements.

1.3 Approach (Vol II s 1.2)

1.3.1 Questions

The study approach was driven by the following two sets of questions:

i) What is the level and nature of federal investment in technology centers; and

ii) with regard to technology centers is/are there:

a) undue overlap or duplication;

b) proliferation/fragmentation;

c) lack of coordination;

d) strains on the availability of skilled human resources; and

e) obstacles to financial self-sufficiency

1.3.2 Definition of Tech Centre (Vol II s 1.2.1, s 1.2.2)

The first step in understanding the questions raised about technology centres was to define the entity to be studied.

At a meeting of the Technology Centres Advisory Group comprised of representatives from MOSST, NRC, NSERC, Statistics Canada, and DRIE, the following was agreed to as a definition of technology centres for the purposes of the study at hand:

> "Organizations sustained (through grants contribution or contracts) or operated by the federal government and which were designed or now function predominantly in support of industry needs for new technology or specific technical skills."

This definition excluded most departmental laboratories which operate primarily as performers of mission-oriented R&D, (e.g., DND laboratories), while including those with direct industry support objectives. Where it was unclear whether an internal (federally managed) institution's activity should be included or not, an opinion was solicited from the responsible department. External organizations were identified by examining lists and data from many sources and by determining through extensive follow-up if they met the definition. Over 600 organizations were studied in this way, and in the end almost 300 were identified. This group formed the study's "operational universe".

1.3.3 Selection and Interview Process (Vol II s 1.2.2, 1.2.3)

Based on a combination of objective criteria and expert knowledge, the operational universe was split into two groups for follow-on data collection purposes. Approximately half the universe, consisting of the larger, more diversified institutions which were most likely to perform technology centre functions, was designated for surveying by in-depth personal and telephone interviews, while the other half of the universe (the smaller and less-likely centres) was designated to be contacted for profile information.

The in-depth interview process generated quantitative information on each centre's organizational characteristics, human and financial resources, clients, and services, as well as qualitative information on the centre's services and human resources, the role of its funding agencies, and its interaction with other centres. The centres contacted for profile information provided data on services, clients, and human and financial resources.

Changes to the database were made as a result of information collected during the interview process, so that after a 93% response rate to the census of organizations within the operational universe, the study team was able to exclude nearly 100 which did not meet the technology centre definition. This left a maximum of 200 organizations which fit the technology centre definition. This group was further refined as will be described in section 2.

1.4 Analysis and Reporting (Vol II s 1.2.4)

The analysis for this report was divided into two parts. First, profile data on all centres was processed and interpreted to address the various questions relating to the nature of technology centres in Canada and to the federal investment in those centers. This analysis is covered in section 2 of this volume. Second, information pertinent to the major study questions about overlap, duplication, proliferation, coordination, skilled human resources, and funding/self-sufficiency was produced and analysed by question. This analysis is covered in section 3 of this volume.

2. PROFILE OF TECHNOLOGY CENTRES

2.1 Categories of Technology Centres

Technology centres may be described by using several different criteria such as size, region, or sponsor type (e.g., federally-sponsored, provincially- sponsored, university-sponsored, DRIE-sponsored, industry-sponsored, or other). The shortcoming in each of these methods of categorization is that they distinguish centres by their physical characteristics, or by who runs them, rather than by the nature of their activities. The most useful categorization method for the purposes of this study was found to be one which categorized centres by the degree to which they undertake technology centre activities of the type described in the previously-determined definition. (see s 1.3.2.).

2.2 The Special Case of Federal Laboratories (Vol II s 2.2, Appendix C)

Most federally operated laboratories are not considered technology centres for the purposes of this study. Several provide technical support more or less exclusively for their own departments' mission. Others devote a considerable amount of time to providing technical support for other departments without laboratories or to maintaining standards of measurements (e.g. time, length and mass). Many are also mandated to devote a significant part of their resources to high risk, medium- to long-term research of potential benefit to Canadian industry. Much of the technology transfer and diffusion resulting from this work occurs intra- or interdepartmentally, or between scientists at government laboratories and their counterparts in high-technology industries, without need for engaging in the kind of activities or services commonly associated with technology centres. Separate studies were being conducted in several departments, which were complementary to the present one and, in many cases, more detailed.

As a result of these factors, basic data on all likely federal technology centres was collected. Of the 110 laboratories examined, 27 indicated that they spent greater than 20% of their time/effort on direct service to industry and therefore fit the study definition. (see s 2.3)

IRAP/PILP

These are two federal programs that engage in significant technology transfer activities, but do not match the definition of technology centres used in this study. These programs assist and partially fund companies in the translation of R&D results into processes and products of good commercial potential. Some of the IRAP/PILP funds provided to industry for further development work may end up being spent by the recipient at a technology centre -- more often they are spent on intramural development work -- but such funds arrive only indirectly at the technology centre, and so are not accounted for in this study as part of the direct federal grants and contributions to technology centres.

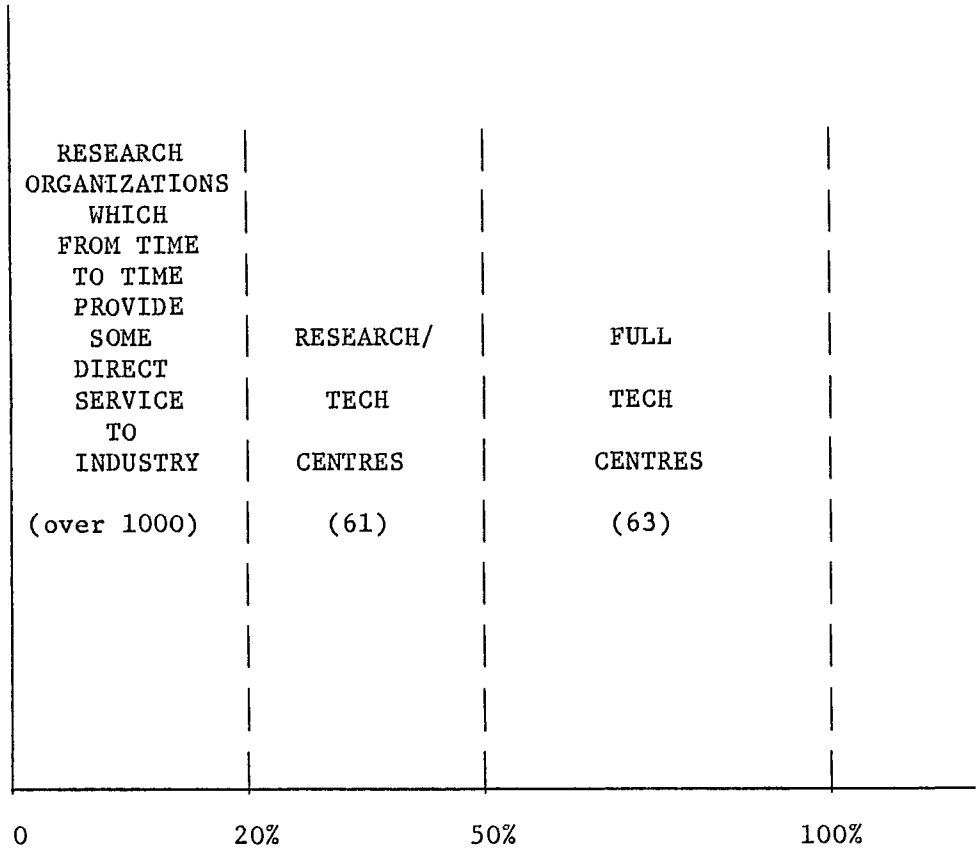
2.3 Definition of Direct Service to Industry

In order to categorize organizations by the degree to which they fit the definition of technology centres (i.e., the degree to which they provide direct, hands-on services to industry) it was necessary to derive a direct service to industry (DSI) index, based on technology centre responses to questions regarding the percentage of time and effort they devoted to direct technology support services to industry. "Technology support" in this context refers to the interaction that takes place between a centre and its client during those times when the centre is physically engaged in making the client aware of, and familiar with, a new technology, and is assisting the client with the adoption process.

The DSI index is used only to separate centres into various groups that have largely different mandates. As a purely descriptive variable the DSI index does not measure the industrial relevance of a centre's work, nor its responsiveness to industrial needs, nor its effectiveness in fulfilling its mandate, nor the importance to Canada of the centre pursuing such a mandate.

Figure 1.

CATEGORIZATION OF ORGANIZATIONS BY PERCENTAGE DIRECT SERVICE TO INDUSTRY



The DSI index merely reflects the degree to which an organization is involved in outreach activities, for example, of the kind that tend to be needed in supporting Canada's large population of low technology companies. By contrast, centres involved in supporting Canada's high technology companies (who do not need a great deal of technical awareness-building and hand-holding, but who do benefit from short bursts of high-level coupling) tend to have a low DSI index because of the need for undertaking considerable background research. Two examples taken from the data base illustrate the meaning and limitations of the DSI index:

- o A provincial CAD/CAM centre devotes nearly seven-eights of its time to training and educating its clients in the application and use of CAD/CAM systems and equipment. Its primary clients are manufacturers of machinery and equipment, auto parts, and miscellaneous electrical equipment, all of them medium to low technology sectors. Because of the high proportion of time spent in direct contact with clients which is in fulfilment of the centre's mandate, its DSI index is fairly high at 82%. It clearly is a technology centre.

- o A federal materials and structures laboratory devotes three-quarters of its time to research and development, primarily in developing generic information about the performance properties of advanced metals, metal alloys, and composites under the design and service conditions prevalent in aircraft and space applications. Nearly 80 per cent of its industrial clients are manufacturers of aircraft and aircraft parts, an exceptionnaly high technology sector. Because most of the technology exchange with clients is in the form of brief, high-level information exchanges, only a small proportion of the centre's time is spent in direct contact with clients. Nevertheless the clients depend on the information received, and on the centre's fulfilling its mandate to conduct the necessary background research needed to generate this information. The centre's DSI index is (appropriately) low at 20%. It clearly is a research organization with associated support activities.

FIGURE 2 PROFILE FINANCIAL DATA

i) ORGANIZATIONS WITH DSI INDEX > 20%

Group	Count	SOURCES OF FUNDING ($000) Federal Contracts	Federal Other	Other Contracts	Other Funding	Total
Federal	27	0	113,239	1,940	204	115,383
DRIE	13	2,780	3,047	5,921	4,126	15,874
Industry	13	3,145	4,116	4,170	21,853	33,284
Provincial	21	6,612	1,714	28,334	44,401	81,061
Other	50	2,886	11,175	8,930	11,742	34,733
TOTAL	124	15,423	133,291	49,294	82,327	280,335

ii) ORGANIZATIONS WITH DSI LESS THAN 20%

Group	Count	SOURCES OF FUNDING ($000) Federal Contracts	Federal Other	Other Contracts	Other Funding	Total
Federal	82	-	324,978	209	-	325,187
DRIE	1	274	200	91	-	563
Industry	-	-	-	-	-	-
Provincial	5	552	275	8,312	9,045	18,183
Other	30	2,478	9,854	2,198	10,700	25,230
TOTAL (OF THE ORGANIZATIONS STUDIED)*	118	3,302	335,307	10,810	19,745	369,163

* NOTE: Institutes in this second set (DSI $\leq$ 20%) represent only a small sample of the organizations in the Canadian population which would fall into this category.

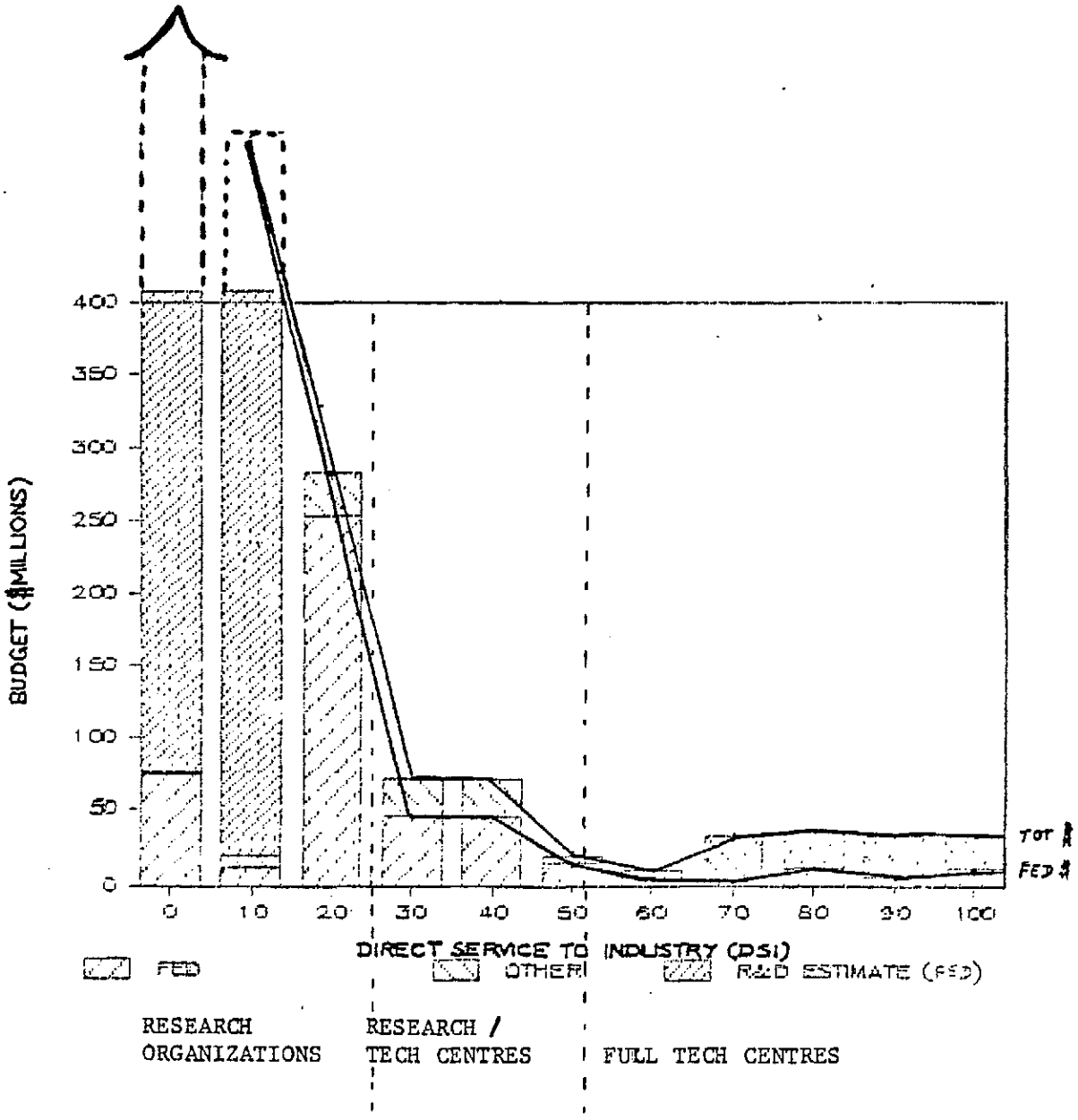
As shown in Figure 1, important distinctions can be made between centres which (a) spend over 50% of their time and effort in direct, hands-on service to industry clients (these centres are termed "full technology centres" or High DSI); (b) spend between 20% - 50% of their time and effort in the direct service of industry clients (referred to as "research/technology centres" or Low DSI); and (c) spend less than 20% of their time and effort on direct service to industry clients ("research organizations" which may do some work for industry or be involved with non-industry clients and objectives as mentioned). In this way the DSI index was used to distinguish technology centres from other centres. While some federal research organizations had been originally nominated as part of the study scope, further investigation revealed that they did not in fact fall into the technology centre category as reflected by the DSI categorization. (see Figure 2). A further discussion of federal laboratories is provided in Volume II section 2.1.1.

2.4 Technology Centre Characteristics

2.4.1 Groups

Industry-sponsored centres and DRIE centres are heavily represented in the full technology centre (high direct service to industry - HDSI) category. PRO and other centres show mixed classifications, and federal laboratories tend to be found in the low direct service to industry (20-50% DSI) category, or indeed are not technology centres at all.

FIGURE 3
TOTAL AND FEDERAL CANADIAN EXPENDITURES
ACROSS DIRECT SERVICE TO INDUSTRY CENTRE CATEGORIES
(1984)



2.4.2 Resources

As shown in Figure 3, funding decreases as direct service to industry increases, both in terms of total Canadian expenditures and, particularly, in terms of federal funding.

Of particular significance is the fact that there are only 63 full technology centres -- those with a DSI index of greater than 50% -- and a total of only 124 centres in the combined groups of full technology centres and research/technology centres, i.e., all those with a DSI index greater than 20%. The total Canadian investment in these 124 centres totals about $276 million annually, of which the total federal portion totals less than $150 million (only $37 million of which goes to centres spending over 50% of their time in direct service to industry). These expenditures contrast sharply with the federal investment in research organizations that spend less than 20% of their effort in direct service to industry.

In terms of human resources, technology centres tend to be small. The majority of technology centres retain fewer than 20 scientific/technical staff members, with the central tendency ranging between 5 and 25 scientific/technical staff members per centre. This tendency holds true for both high and low DSI groups.

2.4.3 Clients and Services

The size distribution of technology centre clients varies significantly from one centre to another. In general, while small firms (1 - 49 employees) tend to make up the majority of tech centre clients overall, very large firms (over 500 employees) are significantly over-represented compared to the

Canadian industrial population of firms. Also, while the central tendency for all categories of centre was to provide service predominantly to small firms, the full technology centres tended to service a greater number of medium sized clients than did the other centres.

In terms of serving their overall client base, centres attributed to industry a general lack of awareness of centre services, a lack of client technical sophistication, and a lack of industry funds as the most significant barriers to achieving greater outreach or market penetration.

2.4.4 Conclusions

There is no simple definition to separate technology centres from non-technology centres. In recognition of this shortcoming, an operational definition based on centre activities (not to be confused with value or relevance) had to be developed for the purposes of this study. Further investigation would likely enhance future efforts at categorization.

In terms of centres which spend most of their time and effort in the direct, hands-on service of industry clients, the number of full technology centres is small. Similarly, the federal investment in grants and contributions to these centres is small (less than $40 million annually). DRIE-sponsored centres represent an exception to the rule that the overwhelming majority of federal investment is tied up in the research rather than the diffusion end of the innovation and technological development spectrum.

2.4.5 Recommendation

The database generated for this study should be maintained, updated, and possibly enlarged so as to provide a valid and comprehensive source of continuing information on the nature of the federal investment in technology centres, as well as for use as an aid in the evaluation of future government science and technology policy options.

3.1 OVERLAP/DUPLICATION

Issue/Description

MOSST had been given to understand that over 300 technology centres had been established by the separate activities of 11 government departments and agencies, and so the concern was expressed was that overlap and duplication among technology centres was a serious prospect and therefore was one of the "key issues or problems with current federal support." The issue for this portion of the study has been whether overlap and duplication, as anticipated, really exists to any significant extent, and if so where does it occur and is it indeed a problem.

Findings (Vol II s 3.1)

From a conceptual review of this issue, it has become clear that once the true level of federal investment in technology centres is recognized (i.e., 124 centres spending over 20% of their time/effort on direct service to industry, with federal support totalling less than $150 million annually), the likelihood of overlap and/or duplication is significantly reduced, compared to what was originally anticipated. Furthermore, given the small national investment in technological diffusion activities ($276 million annually for institutions spending over 20% time/effort on direct services to industry), and the immense range of areas in which centres can specialize, there is a high probability of gaps existing rather than overlaps. There is also a probability of significant fragmentation of resources.

From a systematic review of technology centre activities, covering technology field, industry sector, and services provided, it is clear that the the actual presence of overlap and duplication, even in the most frequently-serviced fields (e.g., microelectronics, biotechnology, and CAD/CAM), is negligible and immaterial.

Moreover fully 52% of centre respondents interviewed during the study reported no effect from the provision of a comparable service by another organization. In fact 30% of respondents perceived an actual increase in business, while only 10% reported a business decrease. Of the 10% reporting a decrease, over two-thirds also contended that at least one aspect of their resources, usually their personnel, was utilized to the full and in some cases the staff was working a considerable amount of overtime. The complaint about a decrease in business at those centres thus appears spurious. For the remaining one-third, the primary cause of these centres' decrease in business in all but one case could be linked at least equally strongly to other factors such as the recent cutting back by the federal government of its funding for certain technology areas (such as renewable energy), or the elimination by the centre's sponsoring organization of all core funding.

Conclusion

There is not a serious problem in terms of overlap and duplication of direct services to industry among Canadian technology centres.

3.2. PROLIFERATION

Issue/Description

Recent reports have identified excessive proliferation as a problem among Canadian technology centres. Proliferation is reputed to have provoked a fragmentation of effort by centres in general.

Findings (Vol II s 3.2)

Based on an in-depth review of the profile data collected by this study, it appears likely that a significant proportion of efforts in Canadian technology centers may be fragmented or under-funded in the sense that many centers operate with efforts in certain technologies which are below a minimum critical size needed to maintain a viable effort. For example, while there are over 100 centers providing services to industry in 12 technology fields in Canada, over 50% of their efforts in these fields amount to less than $100,000 per year, which is equivalent to roughly one scientific or technical staff person year devoted to providing that service. What is significant here is that more than half of the centres providing less than the threshold level of service receive some federal funding. It would appear that federal funding has not significantly contributed to preventing fragmentation, and may in fact have encouraged it.

The vast majority of centre officials interviewed stated that their centres were fully or over utilized, thereby showing at least circumstantial evidence of usefulness to their client community. In addition, both the

interviews and the objective data analysis have revealed significant gaps in technology services provided, indicating the existence of ample room for more (albeit differently directed) investment in technology centres.

Conclusion

There is no evidence of undue proliferation of technology centres. However, there appears to be significant fragmentation or at least under-funding of service efforts among many Canadian technology centres. Federal funding has not prevented, and may have contributed to, this fragmentation.

Recommendation

The federal government should undertake to investigate the relationship between the effectiveness of technology diffusion and critical size, among other effectiveness factors, with a view to consolidating tech centre investment in some of the more fragmented service areas. It should be emphasized that without such further investigation, no supportable conclusions can be drawn about technology centres' effectiveness.

In light of the fact that the federal government controls only a limited number of these fragmented centres, close consultation with provincial governments, industries associations, and university administrations is recommended.

3.3 COORDINATION & NETWORKING

Issue/Description

Among the factors believed to be contributing to overlap, duplication and fragmented effort by technology centres, was a lack of coordination among centres as well as between centres and the federal government. The issue for this portion of the study has been whether a lack of adequate coordination exists.

Findings

An analysis of interview findings showed that a very wide range of coordinating mechanisms exists and that many of them are being employed among technology centres as well as between centres and their clients, but that the depth of their application in many cases was limited.

Networking was identified as an exceptionally useful and effective coordinating mechanism and several outstanding examples emerged. Among these was the intensive networking among microelectronics centres, and the formal network between the IRAP program and provincial research organizations (PRO's). Apart from this latter case, networking between technology centres and the federal government was found to be generally poor.

Conclusions

Despite indications that networking and other mechanisms for coordination are useful for the better management of technology centres, it is reasonably clear that insufficient use is made of these mechanisms, particularly in light of the fact that centres in general display an apparently high degree of fragmentation.

Recommendation

The federal government should undertake policy initiatives to stimulate, enhance, and coordinate networking among technology centres as a means of improving the coordination of their activities, strengthening the technical linkages among them, and reducing the effects of fragmentation.

3.4 SKILLED HUMAN RESOURCES

Issue/Description

Concern has been expressed that government-sponsored technology centers have acted as a drain on skilled human resources in the private sector.

Findings (Vol II s 3.4)

While a number of centres reported that they had experienced difficulty with recruiting and maintaining skilled staff, their main problem concerned the quality of available people, not the quantity. Competition with industry was not viewed as a significant problem.

Many centres viewed the training of university graduates as an integral part of their operations so that the only mention of technology centre human resource problems vis-à-vis industry was that caused by a high turnover rate whereby trained staff left the centres to join private firms.

Conclusion

Rather than being a drain on skilled human resources, technology centres appear to function as a source of practically-trained scientific and technical staff for industry. In terms of addressing an acknowledged shortage of high quality trained scientific/technical staff, technology centres may in fact be part of the solution rather than part of the problem. Due to the fact that no effectiveness review of the impact of technology centres on the availability of skilled human resources to the private sector has been conducted, further investigation into this issue is required before any firm pronouncements can be made.

Recommendations

Further study should be undertaken to investigate ways in which technology centres can be used to increase the pool of high quality and practically-trained scientific and technical staff required to diffuse technology into Canadian industry.

3.5 FINANCING/SELF-SUFFICIENCY

Issue/Description

MOSST has been directed by Cabinet to employ a strategy which would emphasize the early attainment of financial self-sufficiency for technology centers.

Findings (Vol II s 3.5)

Of those centre officials surveyed, none was in favour of self-sufficiency. Analysis of the data revealed that while most centre representatives believe that a significant portion of their income should be derived from industry contract work, even the centres closest to achieving self-sufficiency were unsupportive of self-sufficiency as a goal for other centres as well as for themselves.

A review of the available data on sources of income for technology centres revealed that fewer than 15% of all centres interviewed earn over half of their income from industry revenues. (The percentage is higher for the HDSI centres, but nevertheless relatively low at only about 30%). In addition, the data show that in cases where a centre maintains a high proportion of industry income, the more proactive aspects of technology transfer and diffusion (both direct and indirect, e.g., training) decrease in intensity, while the more reactive aspects (e.g. supplying test facilities or testing services) increase in intensity. The increase in testing-related activities reflects the fact that the private sector is already willing to pay for this type of activity.

Furthermore, over 50% of the respondents who believed technology centres should fill a number of existing technological gaps explained this view on the basis that individual firms would not be able or willing to pay for, or carry out, the work required to fill the gap. This reflects the reason why the

federal government in the past became involved in the area of technology centres, namely the apparent inability or unwillingness of industry to pursue the requisite technological development and diffusion activities.

Therefore, if a federal initiative is necessary to stimulate technology diffusion due to a perceived failure of the private market to invest adequately in these activities, then requiring the agents of diffusion (technology centres) to become totally dependent on private sources of income would cause them to concentrate on those services for which the private sector is already willing to pay. This would have the effect of reducing the services which are at once the raison d'être of these technology organizations and the policy objective of the federal government vis-à-vis encouraging technology diffusion.

Conclusion

While some of the services provided by technology centres may be legitimately self-financing, the goal of total centre self-sufficiency runs counter to the conceptual purpose of technology centres as agents of diffusion. In addition, such a policy would be practically difficult to implement given the heavy current reliance of most centres on public funding.

Recommendation

The federal government, while seeking to promote the industrial relevance of technology centres, should not impose an eventual goal of absolute financial self-sufficiency on those which it currently funds.

4 REVIEW OF SELECTED PROJECTS (SUCCESSES AND BENEFITS)

4.1 INTRODUCTION/MANDATE

A review of selected technology centre projects was conducted in order to characterize products/projects performed by technology centres for clients in industry with an emphasis on successful outputs and benefits accrued to client firms.

4.2 TASKS

The major tasks involved in undertaking the review were:

- organization and classification of the "universe" of projects and tech centres (TCs);
- selection of a sample of TCs and projects to be used in a telephone interview survey;
- undertaking the telephone interview survey;
- producing a synthesis of the results of the survey.

4.3 LIMITATIONS OF THE SURVEY

It should be emphasized that this survey is based on a selection of projects which have been deemed "successes" by the technology centres (TCs). The survey cannot, therefore, provide conclusions on the overall effectiveness of TCs because it does not include representation from the "failures", nor does it estimate the total costs involved in delivering technology centre services.

4.4 SYNTHESIS OF SURVEY RESULTS

As a result of the information collected, a synthesis of survey results can be organized into the following broad categories:

1. Timing and length of projects
2. Method of project initiation
3. Work involved in project preparation
4. The sources of funding
5. The cost of projects
6. Use of resources (non-dollar) on the projects
7. The benefits that ensued from the projects
8. The opinions of TC clients on the success of the projects and factors contributing to that success
9. The views of clients on TCs
10. Discrepancies in information provided by TCs and clients

4.4.1 Timing and Length of Projects

The majority of projects (approximately 90%) which were surveyed had been executed by the TC during the last five years. For approximately half of the projects the duration of the involvement of the TC had been less than one year.

4.4.2 Method of Project Initiation

In almost 50% of the projects, the TC was involved in initiating the project either on its own or jointly with the client; in the other cases the client approached the TC with a request for its services. This implies that in about half of the cases, the TC acted pro-actively in developing a project and not simply as a reactive organization.

4.4.3 Work Involved in Project Preparation

The most common activities involved in project preparation were:

- o discussions between TC and client;
- o drafting of proposal by TC;
- o investigation of funding sources by the TC and/or client;
- o drafting of a contract or agreement;
- o preliminary literature review and information gathering between the TC and client.

Other types of preparatory work mentioned were preliminary market research, preliminary design work, development of testing facilities and laboratory work.

4.4.4 The Sources of Funding

The clients were involved, in some measure, in the funding of a high proportion (more than 90%) of projects; in about 40% of cases, however, funding was provided jointly by the client and a federal government and/or provincial program.

There were indications in some of the joint client/government funding projects that the project might not have been executed without the government financial support. In about 20% of the projects the TC itself was involved in providing funding.

4.4.5 The Cost of Projects

A distribution of the projects for which a dollar value of costs incurred by the TC and/or client is available is shown in the following:

$000	% of Total Projects
Less than 50	53
50 - 100	18
100 - 500	18
500 - 1,000	10
More than 1,000	1

There was therefore, a wide range of size of projects undertaken by the TCs. Although more than half of the projects were less than $50,000 approximately 30% were more than $100,000 and 11% were more than $500,000.

4.4.6 Use of Resources (Non-Dollar) on the Project

The majority of the projects (56%) were executed jointly by the client and TC with contributions of human resources from both parties; in the rest of the projects the TC acted alone in providing non-dollar resources.

4.4.7 The Benefits that Ensued from the Projects

Two-thirds of the projects surveyed had already realized benefits to the clients in terms of one or more of the following:

- o increased product sales;
- o increased productivity;
- o greater expertise within the organization.

In the balance of the projects the benefits were still unrealized; in many of these, however, there were indications of significant potential benefits in the near future usually through the introduction of a new product or improved production process.

In addition, 20% of the projects identified spin-off benefits resulting from the original project.

4.4.8 The Opinions of TC Clients

The factors which were most often mentioned by the TC clients as contributing to the success of the projects were:

- o the knowledge and expertise that resides within the TC - this was the single most frequently mentioned success factor;
- o the co-operation during the execution of the project between the client and the TC;
- o clear objectives for the project and a well defined terms of reference;
- o where a new product was involved, the "fit" of the product to market requirements;
- o the commitment of the TC to the project;
- o the proximity of the TC to the client;
- o the availability of external funding to the client;
- o the specialized facilities and equipment provided by the TC.

4.4.9 The Views of Clients on TCs

In general, clients responded very favourably to their association(s) with TCs. They felt that the TCs had made a very positive contribution to the success of the project and any of the clients did not know of alternative sources of similar expertise. The TCs ability to provide specialized facilities and expertise which was not generally available and to act as a focus for new ideas put TCs in a favourable light in the minds of many clients. There were may comments and criticisms of TCs, however, form the clients some of which are recorded below:

- o they are often slow, cumbersome, and bureaucratic to deal with;
- o their services were more expensive than expected;
- o they should be more business/market oriented rather than just centres of research and theoretical ideas;
- o there is a need for more communication and information about TCs services and capabilities;
- o clients in Quebec stressed the importance of being able to obtain TC services in French;
- o the TCs were often bad at project management and projects took longer than expected to complete;
- o smaller firms relied on external funding to make use of TC services;
- o the scientific research staff of TCs often did not fit well within an industrial setting;

- o smaller companies stressed the importance of the technical support provided by the TC as a factor in the companies' continued survival;

- o TCs should remain as advisors and providers of research capabilities and not usurp the role of industry;

- o insufficient "focussed" dissemination of information by TCs.

4.4.10 Discrepancies in Information

In general, there were no large discrepancies in the information on projects provided by the TCs and the clients. Those discrepancies which did occur were often due to a lack of readily available information or to individuals working from memory. Most of the TCs were aware of the successful nature of a project although they were often unaware of the degree of that success. Only one of the projects had, subsequent to the work performed by the TC, proved to be unsuccessful.

ANNEX A

TECH CENTRE RESOURCE REVIEW TEAM

Study Participants

Status	Name	Organization
Team Leader	Ed Hahn	DRIE
Project Manager	Steve Montague	DRIE
Professional Staff	Bob McDonald	DRIE
	Yvon Bédard	DRIE
Professional Secondments	John Coleman	NRC
	Yuri Daschko	MOSST
	Luc Lalonde	MOSST
	Paul Latour	NSERC
	Bert van den Berg	NRC
Principal Consultant	Verne Chant	J.F. Hickling
Consultants	Jim Cousens	J.F. Hickling
	Mark Rosenberg	J.F. Hickling
Interviewer/Secondment	Roland Lussier	DRIE
	Guy Gallant	DRIE
	Louise Williamson	DRIE
	Marie-Josée Thivierge	DRIE
Technical Support	Bruce Stewart	COSEP
	Kim Barton	Systemhouse
	Luc Van Baaren	J.F. Hickling
	Thérèse Gagnon	Barbara Personnel

In addition to the above-mentioned team members, valuable contributions were also made by Tom Hopwood of DRIE, Roger Heath of MOSST, and Humphrey Stead, Bert Plaus, Mary Lynn Redmond, and Doug Rombough of Statistics Canada.