



WESTERN ECONOMIC DIVERSIFICATION CANADA: A CATALYST FOR INNOVATION IN WESTERN CANADA

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EXECUTIVE SUMMARY

Innovation is the major driving force in economic development. While innovation did not become a formal strategic pillar until 1999, Western Economic Diversification Canada (WD) has been active in delivering programs and initiatives designed to promote innovation in Western Canada since the inception of the Department in 1988. The purpose of this study is to conduct an outside, objective review of the role of WD with respect to innovation and its effectiveness in that role.

THE ROLE OF WD IN PROMOTING INNOVATION

The major findings arising from our review of WD's role in promoting innovation are as follows:

1. **WD has provided extensive financial support for innovation.**

Given the close relationship between innovation and economic development, virtually all activities undertaken by WD are designed, in some measure, to promote innovation. From 1988 to 1999, WD invested \$445 million in 2,590 innovation projects. Over the past three fiscal years (2001, 2002, and 2003), WD has approved an additional \$200 million more in Grant and Contribution contributions related to innovation priorities not including funding provided through Western Economic Partnership Agreements (WEPAs).

2. **For most projects, WD also provides direct, hands-on assistance.**

While financial assistance may be the most visible type of support, the direct assistance provided by WD staff in formulating partnerships and developing initiatives is often the most critical contribution that the Department makes in promoting innovation. WD's level of involvement varies depending upon the nature of the gaps to be filled and the resources available from other sources. In addition to its direct involvement in projects, WD also works closely with other organizations to identify provincial and pan-Western priorities, facilitate joint planning, and work to strengthen the innovation system in Western Canada.

3. **The role of WD is best characterized as that of a facilitator and catalyst that makes strategic investments.**

The results of our review indicate that:

- **WD funding for innovation represents only a small proportion of total funding for innovation-related activities in Western Canada.** For example, the \$46 million that was approved by WD for innovation activities in fiscal year 2001 represented only 4% of Federal Government expenditures on S&T in Western Canada and only about 1.4% of R&D expenditures in Western Canada. As a result, WD expenditures must be made very strategically and be highly levered if they are to impact the innovation system in Western Canada.
- **Funding from WD has been highly levered with funding from other sources.** In some cases, WD serves as the primary source of funding for a given project. In other cases, funding from WD acts as a catalyst to attract other funding or top up funding from other sources to ensure that the project proceeds in timely fashion and at an appropriate scale. In still other cases, WD may fund the early stage development of a given project which will then attract significant funding from other sources for the implementation of future stages. WD funding has, on average, represented about 28% of the total costs of the projects supported by WD. In other words, approximately \$2.56 has been invested by others for every \$1.00 invested by WD.

- **WD places a high priority on working in partnership with other federal departments and agencies, provincial governments, community based organizations, and other stakeholders involved in innovation.** WD has not provided direct financial support to businesses since 1995. The results of our interviews indicate that most members of the innovation support system in Western Canada have interacted closely with WD with respect to innovation.

4. There is strong support for the high priority placed by WD on innovation.

Overall, 99% of the members of the innovation support system and 98% of the companies who were surveyed indicated that it is appropriate for WD to place a high priority on supporting innovation given its mandate of promoting economic development and diversification. The representatives noted that, by definition, diversification requires some form of innovation and WD's involvement is required given the gaps in the existing innovation system that need to be addressed.

THE EFFECTIVENESS OF WD IN PROMOTING INNOVATION

The major findings of our review regarding the effectiveness of WD in promoting innovation are as follows:

1. WD possesses key characteristics that have enabled the Department to be very effective in promoting innovation.

When asked to rate the effectiveness of WD in promoting innovation (on a scale of 1 to 5, where 1 is not at all effective and 5 is very effective), the average responses ranged from 3.7 among other members of the innovation support system to 4.2 among proponents of systemic projects. The stakeholders attributed the effectiveness to certain characteristics that make the Department uniquely able to fill critical gaps in the innovation system. These key characteristics included:

- The flexibility of its programming, which enables WD to tailor its activities to reflect the specific needs of each province and key clusters as well as to provide a continuum of services.
- Its availability of funding, which is considered crucial in bringing parties together and leveraging resources from other sources.
- The ability of the organization and its employees to respond quickly and make decisions.
- Its ability to match national resources and strategies with regional and provincial needs and issues.
- The presence of staff in the regions who are skilled in developing projects, building partnerships, and assessing opportunities. The experience that staff have gained in economic development, vetting projects, working with various parties, and promoting specific clusters enables the Department to add significant value to this process.
- Its familiarity with the local economy, clusters, and players. While WD may provide funding on a project-by-project basis, one of its major strengths is that the organization focuses on building relationships and establishing development objectives that extend beyond any one project.
- WD is generally perceived as a neutral party that does not have its own agenda apart from promoting innovation, which gives it an advantage when working to establish partnerships.

As a result of these unique characteristics, most members of the innovation support system (84%) indicated that there would be a significant negative impact if WD were to no longer place a high

priority on innovation. Only 9% of those representatives interviewed felt that other organizations could fill at least part of the gaps left by WD while 7% were uncertain what the impact would be.

2. **The initiatives supported by WD are helping to build the foundation necessary for future growth.**

The primary focus of our review is on WD's innovation-related investments and activities that have been implemented since mid-1999. While stakeholders stress that improving innovation performance is a long-term process which will take many years to be realized, our review indicates that the progress made to date can be expected to result in significant future economic benefits. In particular, the assistance provided by WD has been key in:

- **Encouraging additional investments in innovation.** There is only a 24% likelihood that the projects supported by WD would have proceeded without assistance from the Department; those projects that may have proceeded would likely have been delayed or been reduced in scope. The projects have also encouraged organizations to make follow-on investments and have increased access to investment capital.
- **Strengthening research capabilities.** A key constraint to increasing investment in R&D has been the limited number of leading-edge research institutions in Western Canada capable of attracting significant investment from government and industry. WD supported projects have helped to address this constraint by building research infrastructure and human resource capacity, creating linkages and research networks, bringing research into new areas, and leveraging additional research funds.
- **Strengthening linkages between industry, government and the research infrastructure.** In most instances, these linkages have taken the form of collaboration related to research, industry issues, and development opportunities. For example, WD has supported the development of networks related to fields such as new media, genomics, proteomics, fuel cells, functional foods, and climate change. WD is also a founding sponsor of the WestLink Innovation Network, a not-for-profit organization that facilitates communication, collaboration, and technology development and commercialization among 13 Western Canadian Universities, 3 Networks of Centres of Excellence and their affiliated research institutions.
- **Increasing access to skilled workers.** As a result of the support provided by WD, graduate students have been provided with increased research opportunities and training, new programs have been developed, organizations have been able to increase the number of scientific and technical staff they employ, and key organizations have been able to attract high quality international researchers or bring skilled Canadian researchers back to the region. The 66 projects we reviewed directly created approximately 2,000 on-going full-time equivalent (FTE) positions.
- **Bringing attention to the importance of innovation in rural areas.** WD has provided support for studies related to regional innovation, the preparation of regional cluster development strategies, the establishment of regional innovation centres, and research into issues of regional importance.

3. **By helping to build and sustain a critical mass of research, technological, financial and human resources and by forging strong linkages among innovation players, WD has contributed to the formation and development of clusters that will provide the basis for the continued economic growth and prosperity of Western Canada.**

Examples of roles that WD has played in promoting further development of key technology clusters in Western Canada include:

- WD has played a significant role in the development of the fuel cells industry through its early support to Ballard Power Systems and strong support for industry initiatives in recent years.
- WD has been very effective in promoting early stage development of the health care sector in Manitoba through its important association with the St. Boniface General Hospital Research Centre.
- WD has strongly supported the development of a health life science sector in Alberta through support for initiatives such as the Alberta Network for Proteomics Innovation and the Institute of Biomolecular Design.
- WD has facilitated the expansion of research capacity and strengthening of linkages between researchers and industry in agriculture life sciences through initiatives such as its support for the Wine Research Centre, the Richardson Centre for Functional Foods and Nutraceuticals, development of the technology incubator at NRC's Plant Biotechnology Institute, and expansion of the Veterinary Infectious Disease Organization.
- facilitate continued development of information communications and technology, WD has made key strategic investments in key organizations such as TRILabs, the Network for Emerging Wireless Technologies, and NewMIC.
- WD support has enabled the University of Regina to become a leader in climate change research.
- WD played a critical role in enabling the Canadian Light Source (CLS) synchrotron to be constructed in Saskatoon. At a cost of \$173.5 million, CLS will be Canada's largest research and development facility when it becomes operational in 2004.

4. The focus of WD activities is consistent with the targets of Canada's Innovation Strategy.

The *Achieving Excellence* and *Knowledge Matters* documents highlight a number of goals, milestones and targets to be pursued to improve innovation, skills and learning in Canada and help to ensure that Canada becomes one of the most innovative countries in the world. These targets focus on key issues such as investment in R&D, access to venture capital, cluster development, education and access to skilled workers, each of which is reflected in the innovation-related activities of WD.

DEFINITIONS AND ACRONYMS

For the purposes of this report, we have defined key terms related to innovation as follows:

- **Innovation** - is the process through which new economic and social benefits are extracted from knowledge;
- **Commercialization** - is the process of translating an invention, idea, or technology into a saleable product or service;
- **Innovation System** - the set of people, institutions, linkages and interactions, which determine the innovative performance of firms and organizations; and
- **Technology Cluster** - a geographic concentration of interconnected companies and institutions in a particular sector, whose interactions are focused on technological development and innovation for economic growth.

Acronyms which are used in this report include:

AHIA	Alberta Health Industry Alliance
ANPI	Alberta Network for Proteomics Innovation
ARC	Alberta Research Council
ASI	Alberta Synchrotron Institute
BC	British Columbia
BCCA	British Columbia Cancer Agency
CBR	Canadian Bioinformatics Resource
CBSC	Canada Business Service Centre
CED	Community Economic Development
CFDC	Community Futures Development Corporation
CFI	Canada Foundation for Innovation
CFI-SP	Canada Foundation for Innovation Support Program
CHF	Children's Hospital Foundation of Manitoba
CIC	Canada Innovation Centre
CIHR	Canadian Institute of Health Research
CLS	Canadian Light Source
FCC	Fuel Cells Canada
FDI	Foreign direct investment
FJST	First Jobs in Science and Technology
FTE	Full-time Equivalent
GERD	Gross Expenditures on Research and Development
GSC	Genome Sciences Centre
HRDC	Human Resources Development Canada
IBD	Institute of Biomolecular Design
ICA	Inno-Centre Alberta
ICIP	Innovation and Community Investment Program
ILO	Industry Liaison Office
IP	Intellectual property
IPOST	Institute of Pacific Ocean Science and Technology
IRAP	Industrial Research Assistance Program
ITPP	International Trade Personnel Program
LIFP	Loan Investment Fund Program
MRI	Magnetic Resonance Imaging
NAIT	Northern Alberta Institute of Technology
NewMIC	New Media Innovation Centre
NEWT	Network for Emerging Wireless Technologies
NRC	National Research Council
NSERC	National Science & Engineering Research Council

OCCI	Olds College Centre for Innovation
PARC	Prairie Adaptation Research Collaborative
PBI	Plant Biotechnology Institute
PENCE	Protein Engineering Network Centre of Excellence
PET	Positron Emission Tomography
PTRC	Petroleum Technology Research Centre
R&D	Research and Development
REDA	Regional Economic Development Authorities
SFC	Saskatchewan Forest Centre
SI	Strategic Initiatives and Special Projects Program
SME	Small and Medium-sized Enterprises
SOCO	Saskatchewan Opportunities Corporation
SR&ED	Science Research and Experimental Development
SRC	Saskatchewan Research Council
SSI	Saskatchewan Synchrotron Institute
TDO	Technology Development Office
TEAM	Technology Early Action Measures
TPC	Technology Partnerships Program
TTR	Tumour Tissue Repository
UTI	University Technologies International Inc.
VIDO	Veterinary Infectious Disease Organization
VITP	Vancouver Island Technology Park
WCER	Western Centre for Economic Research
WD	Western Economic Diversification Canada
WDP	Western Diversification Program
WEPA	Western Economic Partnership Agreements
WRC	Wine Research Centre

I. INTRODUCTION

A. INNOVATION AND WESTERN ECONOMIC DIVERSIFICATION CANADA

Since the inception of the Department, WD has played a leading role in promoting innovation in Western Canada. For example, from 1988 to 1999, WD invested \$445 million in 2,590 innovation projects.¹ Over the past three fiscal years (2001, 2002, and 2003), WD has approved almost \$200 million more in Grant and Contribution contributions related to innovation priorities with additional funding provided through Western Economic Partnership Agreements (WEPAs).²

Despite these significant resource commitments, relatively few people fully realize the extensive role that WD has played in promoting innovation in Western Canada. Some of the factors that make it difficult for even a knowledgeable observer to become familiar with the broad impact of WD on innovation activities include:

- **Rather than delivering one major program, the activities of WD related to innovation are implemented through a wide variety of programs and initiatives** such as Western Economic Partnership Agreements, the Western Diversification Program, Strategic Initiatives and Special Projects, the First Jobs in Science and Technology Program, the International Trade Personnel Program, the Canada Foundation for Innovation Support Program, the Conferences Sponsorship Program, the Innovation and Community Investment Program, the Loan Investment Fund Program, and the Western Canada Business Service Network.
- **The role of WD goes beyond the financial assistance that is provided.** For example, WD staff members work directly with other organizations to encourage and facilitate the development of projects, initiatives, and industry champions, to enhance the coordination and alignment of innovation priorities between the various government, industry, community and academic players, and to facilitate access to federal science and technology infrastructure programs.
- **Rather than focussing on only one element of the innovation system, the activities of WD are targeted at a full spectrum of innovation drivers** including the R&D infrastructure, partnerships/linkages between the various components of the innovation system, funding for R&D, technology transfer, financing of innovation companies, support for commercialization, skills development, industry research, and community development.
- **The activities have focussed on a wide range of sectors and clusters** (e.g. biotechnology, genomics, proteomics, fuel cells, design engineering, climate change, synchrotron, nanotechnology, geomatics, telehealth, new media, oceans, e-commerce, and value-added manufacturing) as well as SMEs and communities.
- **The activities have been implemented across four provinces and over an extended period of time.**

As a result, while most members of the innovation system are familiar with at least some of the activities of WD, few are in a position to fully appreciate the extent to which WD has promoted innovation in Western Canada.

¹ Western Economic Diversification Canada, Performance Report, For the Period Ending March 31, 2002

² Western Economic Diversification Canada, 2002-2003 Estimates, Part III - Report on Plans and Priorities, pg. 8

B. PURPOSE OF THE STUDY

The purpose of this study is to review WD's activities related to innovation and prepare a document that will inform parties, both within and external to WD, of the roles that the Department plays with respect to promoting innovation in Western Canada, illustrate the types of impacts that result, and identify the characteristics of WD which impact on the organization's ability to effectively fulfill these roles. More specifically, the report is designed to address the following issues:

ISSUES TO BE ADDRESSED

1. Is promoting innovation consistent with WD's mandate of promoting economic development and diversification of Western Canada?
2. What are the characteristics of the innovation systems in Western Canada?
3. What strategies and roles have been pursued by WD with respect to strengthening these innovation systems?
4. What types of impacts have been generated by WD's efforts to strengthen the innovation system?
5. What characteristics of WD affects it ability to fulfill these roles?
6. What would be the impact if WD were no longer active in promoting innovation in Western Canada?

In reviewing the impacts and effects of WD's innovation-related investments and activities in Western Canada, a particular emphasis has been placed on the period from mid-1999 to the present with decreasing emphasis placed on the period from 1996 to mid-1999 and selected emphasis placed on the period from 1987 to 1995.

It should be noted that this study is not a formal evaluation. Rather, the study is designed to build on the results of recent evaluation studies, particularly evaluations of the Western Economic Partnership Agreements and the Western Diversification Program, and recognizes that future evaluations are planned of other programs including the First Jobs in Science and Technology Program, the International Trade Personnel Program, and the Canada Foundation for Innovation Support Program.

C. METHOD OF STUDY

1. We Prepared a Detailed Work Plan in Phase I

We undertook the study in two phases. The purpose of the first phase was to review available information and prepare a detailed work plan which was then implemented in the second phase of the study. The major study steps that were undertaken in the first phase were as follows:

MAJOR STEPS UNDERTAKEN IN PHASE I

- **Conducted an initiation meeting with the Steering Committee.** The members of the Steering Committee are listed in Appendix I.
- **Reviewed background information on the strategies, policy frameworks, and programming that have been implemented by WD** as well as reports, statistics and other literature related to innovation performance and the innovation support system in Western Canada. A partial listing of the many reports and documents that we reviewed is provided in Appendix II.
- **Conducted interviews with 16 representatives of WD.**
- **Developed the detailed work plan.**



2. We Undertook an Extensive Consultation Program in Phase II

The consultation program included interviews with proponents of systemic projects, innovation businesses, and other representatives as summarized below.

MAJOR STEPS UNDERTAKEN IN PHASE II

- **Developed a profile of the innovation system in Western Canada** to establish a context in which to better understand the role of WD.
- **Conducted interviews with 66 representatives involved in systemic projects related to innovation that received funding from WD.** Of the 66 representatives surveyed, 24 are based in BC, 18 in Alberta, 16 in Saskatchewan, and 12 in Manitoba (several organizations have operations in more than one province). The projects support cluster development in a range of areas, the most common of which include information technology (24 projects), life sciences (19 projects) and physical sciences (8 projects).
- **Conducted a survey of a sample of 150 innovation businesses who may be familiar with the innovation-related activities of WD.** The sample was drawn from companies that received funding from WD, companies known to operate in key clusters targeted by WD, and companies identified by project proponents as having been impacted by WD supported projects. Of the 150 representatives, 51 are based in BC, 43 in Alberta, 26 in Saskatchewan, and 30 in Manitoba.
- **Conducted interviews with 70 members of the S&T support system who are able to provide an outside objective opinion of the role and impact of WD.** The sample included representatives of federal, provincial and local government organizations, research institutions and agencies, industry groups, and universities and colleges. Of the 70 interviews, 24 were conducted with representatives in British Columbia, 18 with representatives based in Alberta, 14 with representatives based in Saskatchewan, and 14 with representatives based in Manitoba.
- **Conducted focus groups and obtained structured input from WD representatives involved in developing and assisting innovation-related projects.** We undertook field trips to each of the four western offices.

We then tabulated and analyzed the results to address the key study issues. A more detailed description of the field research, including the characteristics of the organizations surveyed, is provided in Appendix III.

D. STRUCTURE OF THE REPORT

This report is divided into five chapters.

- This chapter has provided a description of the purpose and method of study.
- Chapter II briefly highlights the importance of innovation, the determinants of innovation performance, and the characteristics of innovation systems in Western Canada. A more detailed description of the innovation systems is provided in Appendix IV.
- In Chapter III, we review the roles that WD has fulfilled with respect to innovation including a discussion of the programs and strategies that have been employed in working to strengthen the innovation system in Western Canada. A more detailed description of WD programs that support innovation is provided in Appendix V.

- Chapter IV illustrates the various types of impacts and effects that have been generated and reviews the importance of the assistance provided by WD to the generation of these impacts. A more detailed description of the impacts of selected projects or series of projects is provided in Appendix VI.
- The major findings and conclusions are summarized in Chapter V.

II. INNOVATION AND ECONOMIC DEVELOPMENT

This chapter provides a brief overview of the importance of innovation and then highlights selected characteristics of innovation systems in Western Canada.

A. THE IMPORTANCE OF INNOVATION

The importance of innovation is widely recognized and directly reflected in the strategies of WD as highlighted below.

IMPORTANCE OF INNOVATION
<ul style="list-style-type: none">• It is widely recognized within the Government of Canada and the Provincial Governments within Western Canada that innovation has become the major driving force in economic growth and social development.• Reflecting the importance of innovation, Western Economic Diversification (WD) has established, as one of its three core strategies, providing support for activities and initiatives that promote an innovative and knowledge-driven economy within western Canada.• There is strong support, amongst the representatives surveyed, for the priority that WD places on innovation.

A brief discussion of the importance of innovation is provided in the following paragraphs.

1. Innovation Has Become the Major Driving Force in Economic Development

It has long been recognized that innovation is a major driving force in economic growth and social development. For example, Robert Solow was awarded the Nobel Memorial Prize in Economic Science in 1987 for his work in developing a modern macroeconomic theory of growth. According to the Growth Theory, governments can promote economic development through a variety of means including supporting education and training to develop a more educated work force, stimulating capital investment, stimulating a reallocation of resources from low productivity to higher productivity industries and promoting technological progress and innovation. A major implication of the Growth Theory is that it is this last factor, technological progress and innovation, which is the greatest engine of economic growth.

The correlation between innovation performance and regional economic development has further strengthened over the past 15 years. Recent studies indicate that technological progress is now responsible for up to one-half of the growth of the US economy.³ Because of factors such as globalization, increasing competition, the growing impact of information and communications technology, and the high pace of scientific and technological change, firms must innovate more rapidly than ever before. Surveys suggest that the average R&D cycle of firms has fallen from 18 months in 1993 to less than 10 months today.

³

Wendy H. Schacht, The National Council for Science and the Environment, *Industrial Competitiveness and Technological Advancement: Debate Over Government Policy*, Brief for US Congress, September 2000.

The importance of innovation is reflected in Canada's Innovation Strategy, which was launched on February 12, 2002 with the release of two companion documents: *Achieving Excellence: Investing in People, Knowledge and Opportunity* and *Knowledge Matters: Skills and Learning for Canadians*. In its Innovation Strategy, the Government of Canada notes that a much heavier emphasis is being placed on knowledge than in the past to the point where knowledge is now the main source of competitive advantage.⁴

The *Achieving Excellence* and *Knowledge Matters* documents highlight a number of goals, milestones and targets to be pursued to improve innovation, skills and learning in Canada and help to ensure that Canada becomes one of the most innovative countries in the world. These targets, which are listed in Appendix VII, focus on key issues such as investment in R&D, access to venture capital, cluster development, education and access to skilled workers, each of which has been reflected in the innovation-related activities of WD.

2. Innovation is a Strategic Priority for WD

Recognizing the importance of innovation, Western Economic Diversification (WD) has established, as one of its three core strategies, providing support for activities and initiatives that promote an innovative and knowledge-driven economy within Western Canada. WD's innovation activities focus on both new/emerging knowledge-driven industries as well as traditional resource and manufacturing industries. To achieve the strategic outcome of strengthening the innovation system, WD supports projects and activities that:

- Improve knowledge infrastructure and capacity;
- Enhance technology commercialization;
- Assist rural communities in their transition to become more innovative; and
- Enhance the coordination and alignment of innovation priorities between the various government, industry, community and academic players.

By building and sustaining a critical mass of research, technological, financial and human resources in the West, and by forging strong linkages among innovation players, WD contributes to the formation and development of clusters that will provide the basis for the continued economic growth and prosperity of Western Canada.

3. WD's Emphasis on Innovation is Strongly Supported By Western Representatives

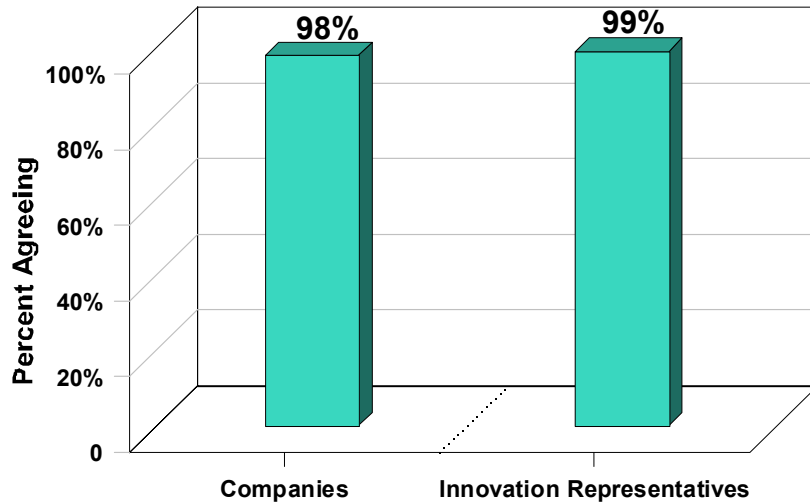
There is strong stakeholder support for the emphasis placed by WD on innovation. As indicated in Table 2.1, 99% of the members of the innovation support system and 98% of the companies who were surveyed agreed that it is appropriate for WD to place a high priority on supporting innovation given the Department's mandate of promoting economic development and diversification.

⁴

Government of Canada, *Canada's Innovation Strategy, Achieving Excellence: Investing in People, Knowledge and Opportunity*, February 2002.

TABLE 2.1

IS WD'S MAJOR EMPHASIS ON INNOVATION APPROPRIATE?



The representatives noted that innovation is the key driver of economic development and, by definition, diversification requires some form of innovation. The representatives also indicated that WD's involvement was required given the importance of innovation and the gaps in the existing innovation system which only government can fill.

B. THE ENVIRONMENT FOR INNOVATION IN WESTERN CANADA

To provide a context for understanding the role of WD in promoting innovation, we conducted a review of the environment for innovation in Western Canada. Innovation performance in any region is a function of:

- The extent to which the Federal and Provincial Governments are able to establish a political, legal and macroeconomic environment that is conducive to innovation. Some of the key issues that affect the willingness and ability of organizations to innovate are the strength of the business environment and a regulatory environment that promotes competition and innovation.
- A microeconomic business environment that both triggers innovation and supports innovation activity. A strong microeconomic business environment features: customers that demand innovation; a highly competitive business environment; ready access to key inputs including technology, R&D infrastructure, human resources, capital, production inputs, physical infrastructure, and commercial information; and clusters of related and supporting industries, suppliers and institutions. Clusters are the building blocks of a productive, innovative economy.
- Company strategies, culture and climate as well as the structure, processes, resource and linkages that have been put in place to promote and support innovation.

A review of the characteristics of the innovation system in Western Canada, with respect to each of these factors, is provided in Appendix IV. The key findings are highlighted in the table below.

These findings are further discussed in the following paragraphs.

THE ENVIRONMENT FOR INNOVATION IN WESTERN CANADA	
<ul style="list-style-type: none"> • The basic foundations of an innovation system have been established in Western Canada. • The macroeconomic environment for innovation has improved over the past ten years. • However, the level of investment in R&D in Western Canada remains significantly lower than the Canadian average. • While the general population of Western Canada tends to be well-educated, there are skill shortages in selected areas. • Access to early-stage patient capital is more restricted in Western Canada than in other jurisdictions. • Stronger linkages need to be developed between the various components of the innovation support system. 	

1. The Basic Foundations of an Innovation System Have Been Established

Key elements of a regional innovation support system include research institutes and organizations, sources of funding for R&D, technology transfer organizations and facilitators, education and training organizations, sources of business capital, and other sources of business assistance as outlined below. Examples of leading players in Western Canada in each of these areas is provided in the following table.

TABLE 2.2

SUMMARY OF THE RESEARCH INFRASTRUCTURE IN WESTERN CANADA

Component	Examples of Leading Players
Research Institutes and Organizations	475 research institutions are based in Western Canada of which 162 are based in BC, 106 in Alberta, 156 in Manitoba, and 103 in Saskatchewan.
Sources of Funding for R&D ⁵	<p>Examples of leading funding programs (the respective percent of national funding that, on average, is awarded to Western Canada is shown in brackets) include:</p> <ul style="list-style-type: none"> • Canada Foundation for Innovation (31%) • Technology Partnerships Canada (15%) • Industrial Research Assistance Program (32%) • National Science & Engineering Research Council (29%) • Canadian Institute of Health Research (23%) • SR&ED tax credit programs in BC, Manitoba, and Saskatchewan and through Revenue Canada. • Provincially funded programs.
Technology Transfer Organizations and Facilitators	There are 6 university industry liaison offices, 3 university owned arms-length companies, and 4 Vice President of Research offices with technology transfer functions.

⁵ Funding percentages are drawn from Table IV.13 in Appendix IV.

Component	Examples of Leading Players
Education and Training	There are 14 universities, 3 university-colleges, and 7 technical institutes in Western Canada with active R&D programs. The universities have annual sponsored research budgets ranging from as high as \$260 million for large universities to as low as \$500,000 for smaller universities. Universities in Western Canada lead or administer 6 of the National Centres of Excellence.
Sources of Business Capital	Sources of business capital include 90 Community Futures Development Corporations, the Business Development Bank of Canada, investment fund programs, chartered banks and credit unions as well as venture capital and investment pool sources and angel investors.
Other Support for Commercialization	Examples of organisations that provide information, advice, and other forms of support to assist in the commercialization of new products include 71 S&T industry or business associations, Canada Business Service Centres, 90 CFDCs, and business incubators located throughout the western provinces.

2. The Macroeconomic Environment for Innovation Has Improved in Recent Years

For example, in recent years:

- There have been significant cuts in Federal and Provincial Government personal, corporate and small business tax rates;
- The after-tax costs of R&D in Western Canada have decreased since 1996 and now compare favourably to other Canadian provinces and internationally. With the exception of Alberta which does not have a provincial SR&ED program, the after-tax R&D costs are lower in Western Canada than in Ontario or Quebec. An analysis by Statistics Canada indicates that Canada’s combined federal-provincial corporate income tax system remains the most attractive of all G7 countries in its treatment of R&D; and
- Interest rates and inflation rates have declined sharply, creating a much more attractive environment for investment.

However, the weak Canadian dollar has been an impediment to innovation. The low dollar both reduces motivation for innovation and makes the cost of acquiring foreign technology more costly. In addition, in spite of the North America Free Trade Agreement, trade barriers continue to impede economic growth.

3. The Relative Level of Investment in R&D in Western Canada Remains Low

Gross Expenditures on Research and Development (GERD) is a statistical term used by OECD Member countries to indicate the total intramural expenditures on research and development in a given territory during a given time period. It includes all the R&D activity undertaken within the territory (e.g. BC or Canada), whether it is funded locally or from outside the region. According to Statistics Canada data, GERD represents 1% of GDP in Western Canada, which is significantly below the national average of 1.7% as indicated in Table 2.3.

TABLE 2.3
GROSS R&D EXPENDITURES (GERD), 2000

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Region	GERD (millions)	GERD as a % of GDP
BC	1,386	1.1%
Alberta	1,188	0.8%
Saskatchewan	321	1.0%
Manitoba	360	1.1%
Western Canada	3,255	1.0%
Canada	18,324	1.7%

These lower rates of investment in R&D are reflected in fewer R&D workers and fewer patents being filed in Western Canada. A key constraint to increasing investment in R&D has been the limited number of leading-edge research institutions in Western Canada capable of attracting significant investment from government and industry.

4. There Are Skill Shortages in Selected Areas

While the general population of Western Canada tends to be well-educated, there are skill shortages in selected areas. For example, Western Canada lags behind other jurisdictions with respect to the number of science and engineering graduates. Out-migration of educated workers is also a key issue, particularly for Saskatchewan and Manitoba.

5. Access to Early-stage Patient Capital Is More Restricted

It often takes seven years or longer to bring a new product to market. As such, the availability of knowledgeable and patient capital to finance and nurture the commercialization of new technologies can be the single most important factor determining the success of businesses.

Statistics indicate that it is more difficult to access venture capital in Western Canada than in other jurisdictions. Although the four provinces account for 30% of the population and 32% of the GDP in Canada, Western Canada:

- Receives only about 14% of the venture capital investments made in Canada; and
- Accounts for about 12% of the venture capital under management in Canada. There is a strong geographic correlation between where venture capital is managed and where it is invested.

Ontario and Quebec, which account for 62% of the population and 55% of the economic output, manage 87% of the venture capital in Canada. In addition, access to angel capital in Western Canada is constrained by the relatively informal structure of the angel investor network. Access to funding for technology demonstration and commercialization activities has also been identified as a constraint to innovation.

6. Stronger Linkages Need to Be Developed Across the Innovation Support System

Although progress has been made, stakeholders note that the innovation system in Western Canada is still characterized by relatively weak linkages and limited collaboration between participants.

7. Regional Clusters Are Evolving but in a Relatively Early Stage of Development

Technology and knowledge based industry clusters are small by national and world standards - all Western Canadian clusters may be considered developing or emerging. There are relatively few world-class technology anchor businesses or research facilities around which other technology firms can cluster. Overall, companies in Western Canada tend to be smaller than those in other regions, there is a greater reliance on the traditional resources industry, and the manufacturing sector is less developed and innovative than in Central Canada.

III. THE ROLE OF WD IN SUPPORTING INNOVATION

WD has undertaken a wide range of activities to support innovation in Western Canada. More specifically, WD has:

- Worked directly with other organizations to encourage and facilitate the development of projects, initiatives, and industry champions, to enhance the coordination and alignment of innovation priorities between the various government, industry, community and academic players, and to facilitate access to federal science and technology infrastructure programs.
- Provided financial support for specific programs, projects and initiatives that have expanded and strengthened the knowledge infrastructure, encouraged and supported technology transfer, commercialization and adoption, increased access to capital, and strengthened human resource capabilities.

This chapter traces the evolution in WD's approach to innovation, provides an overview of WD activities and programs that support innovation, and summarizes the characteristics of specific initiatives and projects that have been supported.

A. EVOLUTION IN THE APPROACH TO INNOVATION

The approach that WD has taken towards promoting innovation in Western Canada has evolved over time and can be segmented into three major time periods: 1988 to 1995, 1996 to mid-1999, and mid-1999 to the present. An overview of the approach in each of these time periods is provided below.

EVOLUTION IN WD's APPROACH TO INNOVATION

- Prior to 1996, the promotion of innovation was not identified as a specific departmental objective. However, WD did deliver a range of programs and services that served, at least in part, to promote innovation in Western Canada.
- From 1996 to mid-1999, WD underwent extensive restructuring. Some of the key elements of this restructuring included the decision to no longer provide direct financial contributions to individual companies, the introduction of a variety of new programs including programs targeted specifically at innovation, the development of the Western Canada Business Service Network, and the definition of WD activities into business lines.
- Since mid-1999, WD has developed a formal Western Innovation Strategy as well as a medium-term strategy and a long-term strategy for economic development in Western Canada that have helped to further define the department's activities. A major implication of this process has been the establishment of innovation as a major strategic pillar within the Department.

A discussion of the evolution in WD's approach to innovation is provided in the following paragraphs.

1. Prior to 1996, Innovation Was Not a Specific Departmental Objective

The Department of Western Economic Diversification was established by the Western Economic Diversification Act (S.C. 1988, c. 17) on June 28, 1988. At that time, a number of existing programs were transferred to WD from the Department of Regional Industrial Expansion.

The mandate of Western Economic Diversification Canada is to promote economic development and diversification of Western Canada and advocate on behalf of western Canadian interests in national decision-making. In its first seven years of existence, the promotion of innovation was not identified as a specific Departmental objective. However, WD did deliver a range of programs and services that served, at least in part, to promote innovation activities in Western Canada. The major activities of WD included:

- Providing financial contributions to businesses and industry groups in Western Canada under the Western Diversification Program (WDP);
- Co-ordinating the economic development activities of the federal government and other stakeholders in Western Canada;
- Administering federal contributions to provincial governments for Canada's Infrastructure Works Program;
- Analyzing economic matters from a Western Canadian perspective, both to manage its own activities and to advocate the West's interests in federal economic policy development;
- Advocating the West's interests in federal procurement of goods and services; and
- Providing, on an ad hoc basis, support of government activities in Western Canada, such as military base closures.

The key characteristic of this period is the provision of direct financing to companies under WDP. Between 1987 and March 31, 1995, WD approved \$901 million in WDP funding. According to the 1995 Report of the Auditor General, 73% of the assistance was repayable (including 89% of the regular contributions). Many of WD's early investments in innovation companies set the stage for the growth of emerging clusters. For example, WD's investments in Ballard Power Systems was a critical driver in the development of the fuel cells industry.

2. From 1996 to mid-1999, WD Underwent Significant Restructuring

As a result of a number of factors including budget reductions, the results of the Auditor General's program review, and a shift in strategies, WD underwent a significant restructuring during this period. Some of the key elements of this restructuring included:

- The decision, in 1995, to move away from providing direct financial contributions to individual businesses. WD has continued to provide direct contributions to other groups such as not-for-profit trade and industry associations.
- The introduction of targeted Loan/Investment Fund Programs. In place of the direct contributions, WD established loan reserve programs in association with private and public sector financial institutions that, in turn, provided financial assistance to businesses in targeted industries.
- The development of the Western Canada Business Service Network. WD assumed full responsibility for the federal share of Canadian Business Service Centres in the West, took over responsibility for Community Futures from Human Resource Development Canada, and funded the establishment of Women's Enterprise Initiatives in each province.

- The introduction of a range of programs that support innovation. Between 1996 and 1999, WD introduced the second term of the Western Economic Partnership Agreements as well as the First Jobs in Science and Technology Program, the International Trade Personnel Program, the Innovation and Community Investment Program, and the Canada Foundation for Innovation Support Program. These programs are described in the next section.
- The redefinition of WD activities into four business lines including Capital Services, Information Services, Targeted Business Services, and Service Partnerships.

3. Since Mid 1999, WD Has Pursued an Innovation Strategy

In mid-1999, WD undertook a further restructuring of its program activities, developed new program elements and expanded its program delivery instruments to establish innovation as a major strategic pillar within the Department. This change reflected the development of a formal Western Innovation Strategy as well as a medium term strategy (published in 1999) and a long term strategy for economic development in Western Canada (published in 2001) that refocused the Department's activities in response to new challenges and priorities.

To implement the strategies, WD programs and services were initially focused into four key areas of activity including Innovation, Partnership and Coordination, Business Development and Entrepreneurship, and Economic Research and Analysis. In 2002, the key areas were redefined into three core strategies including Innovation, Entrepreneurship and Sustainable Communities. The objectives of WD's innovation activities are:

- To improve the rate of new technology development and commercialization and increase growth and job creation in knowledge based sectors of the western Canadian economy.
- To ensure the needs of Western Canadians are taken into account in the design and delivery of national innovation policies and programs.
- To address gaps in national programming in support of innovation.
- To promote western Canadian innovation strengths and capabilities within national and international forums.

WD has identified several priority areas for action to meet the Department's innovation objectives, including:

- Improving western Canadian knowledge infrastructure and capacity;
- Increasing the value and rate of new technologies commercialized in Western Canada;
- Enhancing the capacity of western Canadian firms to develop and adopt new technologies and processes (technology development and adoption); and
- Supporting community innovation.

B. CHARACTERISTICS OF THE SUPPORT PROVIDED BY WD

Since the inception of the Department, WD has played a leading role in supporting innovation-related projects and activities in Western Canada. This section provides an overview of assistance provided by WD related to promoting innovation in Western Canada.

EVOLUTION IN WD's APPROACH TO INNOVATION

- Prior to 1996, the promotion of innovation was not identified as a specific departmental objective. However, WD did deliver a range of programs and services that served, at least in part, to promote

innovation in Western Canada.

- From 1996 to mid-1999, WD underwent extensive restructuring. Some of the key elements of this restructuring included the decision to no longer provide direct financial contributions to individual companies, the introduction of a variety of new programs including programs targeted specifically at innovation, the development of the Western Canada Business Service Network, and the definition of WD activities into business lines.
- Since mid-1999, WD has developed a formal Western Innovation Strategy as well as a medium-term strategy and a long-term strategy for economic development in Western Canada that have helped to further define the department's activities. A major implication of this process has been the establishment of innovation as a major strategic pillar within the Department.

These characteristics are further highlighted below:

1. **WD Has Provided Extensive Financial Support for Innovation**

Table 3.1 summarizes the number of projects and amount of funding approved by WD under various development programs between 1995-96 and 2001-02. Because of the close relationship between innovation and economic development, virtually all of the development activities undertaken by Western Economic Diversification Canada are designed, in some measure, to promote innovation.

TABLE 3.1

FUNDING APPROVED UNDER VARIOUS WESTERN ECONOMIC DIVERSIFICATION CANADA PROGRAMS FROM 1995-96 TO 2001-02

Name of Program	Period	Projects Approved	Funding Approved (\$ million)
Western Economic Partnership Agreements	1998-2002	185	\$74.2
Western Diversification Program	1995-2002	242	\$104.9
Strategic Initiatives and Special Projects	1995-2002	234	\$113.2
First Jobs in Science and Technology	1997-2002	589	\$26.4
International Trade Personnel Program	1995-2002	645	\$24.1
Canada Foundation for Innovation Support Program	1998-2002	102	\$2.0
Conferences Sponsorship Program	1996-2002	641	\$3.1
Innovation and Community Investment Program	2000-2002	47	\$20.7
Total		2,685	\$368.6

As indicated, between 1995 and March 31, 2002, 2,685 projects and \$369 million in funding was approved under these programs. A brief description of these development programs is provided below (a more detailed description is provided in Appendix V):

- **Western Economic Partnership Agreements (WEPAs)** were established in each western province to encourage the economic and regional development of each province using complementary and focused efforts, as well as improved governmental consultations, and to provide mechanisms to achieve greater federal/provincial cooperation and more effective coordination of activities related to economic development in each province. Although the

Agreements are not limited to innovation activities, much of the funding provided under WEPA's went to projects with a strong innovation-related focus.

- Prior to the change in policy in 1995, the **Western Diversification Program (WDP)** provided regular assistance (mainly repayable or conditionally repayable contributions to individual businesses) and industry-wide assistance (or systemic funding) to industry and not-for-profit groups. Since 1995, under WDP, WD has continued to provide direct contributions to groups such as not-for-profit trade and industry associations. These contributions have supported a wide range of systemic projects involving the development of infrastructure, strengthening of linkages between stakeholders in the innovation system, expanding research and development activities, supporting technology commercialization, and facilitating technical skills development.
- The objective of the **Strategic Initiatives and Special Projects** program (SI) is to develop and launch economic development programs and initiatives for Western Canada using partnerships, networks and consortia that involve industry, all orders of government, academic institutions, and research institutions. For most intents and purposes, the Strategic Initiatives and Special Projects Program is not differentiated from the WDP.
- The **First Jobs in Science and Technology** program (FJST), introduced in 1997, provides funding to assist companies, associations and business networks hire recent post-secondary graduates from a recognized science and technology program such as physics, chemistry, biology, engineering, computer science, mathematics or other technology based discipline. The graduates help the companies to implement projects to acquire new technology, identify or implement appropriate technologies, develop an implementation plan, operate or modify technology, train staff to use new technology, and/or develop a new technology.
- WD designed the **International Trade Personnel Program (ITPP)** for growing export-oriented businesses in Western Canada. The program helps small businesses hire recent post secondary graduates to work on international trade projects. Graduates can be hired to identify international markets and characteristics, plan and implement export market strategies, prepare export promotional materials or their translation, modify packaging to meet specific market demands, or direct product promotion to export markets.
- The Canada Foundation for Innovation (CFI) is a Crown Corporation established in 1997 to invest in research infrastructure projects. The goal of CFI is to strengthen the capability of Canadian universities, colleges, research hospitals, and other not-for-profit institutions to carry out world-class research and technology development. WD's **Canada Foundation for Innovation Support Program (CFI-SP)** provides contributions of up to \$20,000 to assist western institutions in developing applications to CFI. The \$2 million in CFI-SP funding provided by WD represents about 0.5% of the funding awarded under CFI in Western Canada.
- WD has provided over \$3 million in funding for activities related to a wide variety of **conferences** such as including technology trade fairs, fuel cell symposiums, angel forums, aerospace conferences, agriculture biotech conferences, e-business forums and other events. The amount of funding contributed by WD varies, with most events receiving less than \$5,000.
- The **Innovation and Community Investment Program (ICIP)**, WD's primary mechanism for addressing rural innovation issues, is designed to help diversify the economies in the four western provinces by supporting the development of innovative technologies and facilitating the creation of innovation clusters and innovation at the community level. ICIP has supported activities related to technology transfer and commercialization, applied research and development, connectivity, E-commerce promotion, skills development, planning studies, linkages/synergies between communities and research/educational institutions, and community innovation strategies.

In addition to these programs, WD has also delivered other programming that impacts on innovation-related activities. These programs include:

- Under the **Loan Investment Fund Program (LIFP)**, WD has established loan fund programs with a number of financial institutions across Western Canada to increase the amount of capital available to businesses in sectors that are typically considered a high risk such as advanced technologies, information technology and telecommunications, and agricultural value-added processing.
- WD delivers a range of programs and services to SMEs through its **Western Canada Business Service Network**. The Network incorporates over 100 points of service including CFDCs, Women's Enterprise Initiative offices, Canada Business Service Centres, Francophone Economic Development Organizations and WD offices located throughout rural and urban Western Canada.
- **Technology Assessment Services**, designed to assist SMEs assess whether to develop a technology for commercialization, are offered through a joint effort of WD and the Canadian Innovation Centre.

2. **WD is a Catalyst Working in Partnership With Other Organizations**

Although WD has provided significant amounts of funding for innovation-related activities, the role of the organization is best characterized as that of a catalyst which makes strategic investments. The results of our review indicate that:

- **WD funding for innovation accounts for only a relatively small proportion of funding on technology related activities in Western Canada.**

For example, the \$46 million spent by WD on innovation activities in the fiscal year ending March 31, 2001, would represent only 4% of the Federal Government expenditures on S&T in Western Canada and only about 1.4% of R&D expenditures in Western Canada.⁶ As a result, WD expenditures must be made very strategically and be highly levered if they are to impact on the innovation system in Western Canada.

- **Most of the activities supported by WD also received funding from other sources.**

In some cases, WD serves as the primary source of funding for a given project. In other cases, the funding from WD acts as a catalyst to attract other funding or tops up funding from other sources to ensure that the project proceeds in timely fashion and at an appropriate scale. In still other cases, WD may fund the early stage development of a given project which will then attract significant funding from other sources for the implementation of future stages.

Overall, WD funding has, on average, represented about 28% of the total costs of the projects supported by WD. In other words, approximately \$2.56 has been invested by others for every \$1.00 invested by WD. The reliance on WD funding ranges from about 20% of total project costs for the conference sponsorship projects to 74% of the costs associated with developing proposals for CFI as indicated below.

6

A summary of Federal Government expenditures on Science & Technology, by province is provided in Table IV.11 in Appendix IV

TABLE 3.2

AVERAGE LEVERAGE BY WD FUNDING PROGRAM

Name of Program	WD Funding (\$ millions)	Total Costs (\$ millions)	Percent Funded By WD
Western Economic Partnership Agreements	\$74.2	\$339.0	22%
Western Diversification Program	\$104.9	\$249.5	42%
Strategic Initiatives and Special Projects	\$113.2	\$480.5	24%
First Jobs in Science and Technology	\$26.4	\$73.9	36%
International Trade Personnel Program	\$24.1	\$73.0	33%
Canada Foundation for Innovation Support Program	\$2.0	\$2.7	74%
Conferences Sponsorship Program	\$3.1	\$15.7	20%
Innovation and Community Investment Program	\$20.6	\$76.0	27%
Total		\$1,310.2	28%

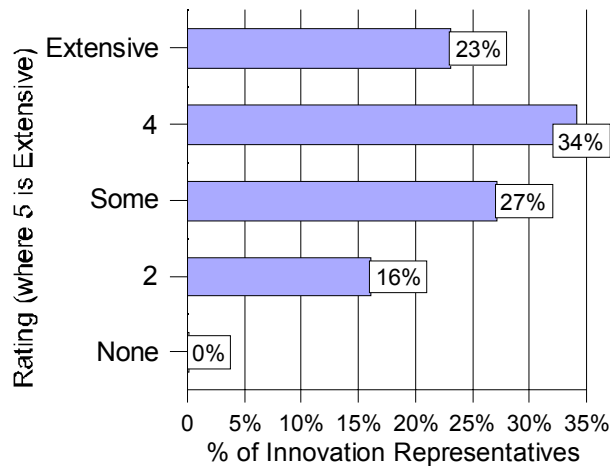
- **WD places a high priority on working in partnership with other federal departments and agencies, provincial governments, community-based organizations, and other stakeholders involved in innovation.**

Since 1995, it has been WD’s policy not to offer direct assistance to businesses except in circumstances where it has been authorized by WD’s Executive Committee and is determined to be the more cost-effective delivery mechanism for providing assistance to WD’s target clientele. Rather than direct financial support to businesses, WD innovation activities and investments place a high priority on fostering public-private-research institution partnerships and consortia.

The results of our interviews illustrate the breadth of involvement that WD has had with other members of the innovation support system in Western Canada. Of the 70 representatives of the innovation support system we surveyed, all indicated at least some involvement with WD on innovation-related projects or issues. On average, the representatives rated the level of their interaction with WD as a 3.6 on a scale of 1 to 5 where 1 is no interaction at all, 3 is some interaction and 5 is extensive interaction.

TABLE 3.3

HOW MUCH INTERACTION RELATED TO INNOVATION HAVE YOU HAD WITH WD?



When asked to provide examples of programs, projects, initiatives or forums in which they participated with WD:

- 50 respondents identified one or more specific projects;
- 23 respondents identified joint planning, strategy and coordination sessions; and
- 10 respondents identified trade shows, conferences or other forums.

3. WD Provides Hands-on Assistance in Addition to Funding

While the financial assistance is often the most visible type of support provided by WD, the role of WD staff in bringing together groups, formulating partnerships, nurturing champions, and assisting in the design of projects and initiatives can be the most critical contribution that WD makes in the promoting the development of a given cluster. WD Project Officers often characterized the role of the Department as helping to fill the gaps that may exist in the innovation system for a given cluster, noting that their level of involvement varies depending upon the nature of the gaps to be filled and the resources available from other sources. In some circumstances, WD may even provide hands-on assistance in areas such as path finding or advocating on behalf of projects or clusters but provide no funding.

To illustrate the types of roles played by WD, we asked the 66 proponents of systemic projects whether WD played an important role in the design, development or implementation of their projects in addition to providing funding. Of the 66 representatives, 40 (61%) indicated that WD played an important additional role (the percentage is 69% if the proponents who received funding under CFI-SP are excluded). Examples of the roles that were identified as being played by WD included:

- Participated as a key member of the steering committee or group;
- Assisted in designing the project and reviewing the proposal;
- Played a lead role in bringing the various partners together;
- Assisted in obtaining funding from other sources;
- Provided strong strategic advice related to the project;
- Served as a champion for the project within government; and
- Conducted extensive due diligence related to the project.

It was noted that WD's involvement can help to give a project credibility.

The nature of involvement can vary by region. For example, in Manitoba and Saskatchewan, where fewer resources are available and capabilities are less developed, WD staff may take more of a leadership role and spend more time working with others in developing projects. In Alberta and BC, where infrastructure capabilities are more developed, WD staff may spend more time responding to requests for assistance.

Apart from its direct involvement in projects, WD has also worked closely with other organizations to identify provincial and pan-Western priorities, to facilitate joint planning, to work to strengthen innovation programs and services, and to address the "innovation gaps" that exist in the West as a result of a lack of investment in research and development in key sectors. This priority is reflected in WD's participation in various forums such as the Western Forum of Senior Innovation Officials, WEPAs, and the Industry Portfolio. In particular, it was noted that WD has developed strong relationships with the Provincial Governments.

4. WD is Increasingly Focused on Clusters

The underlying objective for improving innovation performance is to facilitate the further development of industrial clusters in Western Canada. Recent economic theory uses the cluster model to describe the development of concentrations of firms. Members of an industrial cluster are not limited to one industrial sector but rather include a series of manufacturers, suppliers and service providers along the value-chain from basic to final products. The appeal of the cluster theory is that it views firms and sectors in the context of a larger industrial system. The firms and sectors may be linked through, for example, their dependence on similar labour skills, use of similar technologies, or focus on common or similar groups of goods and services. The cluster is supported by an innovation system which may include universities and colleges, research institutes, financing institutions, incubators, business services and advanced communications/transportation systems.

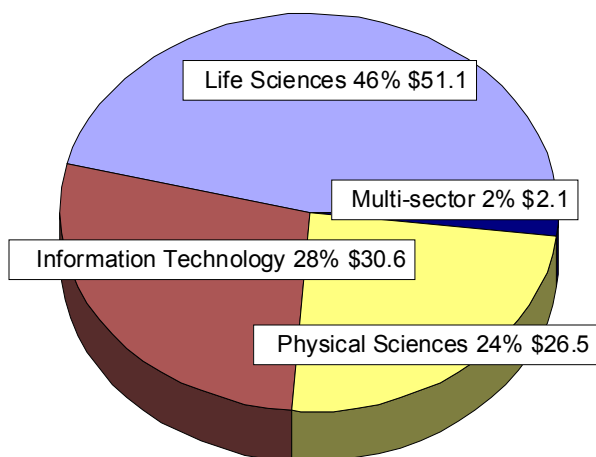
WD investments related to innovation have become increasingly proactive and strategic in nature in order to capitalize on existing and emerging strengths and comparative advantages within Western Canada. Reflecting the results of research and consultations undertaken in developing their innovation strategy, WD gives priority to promoting the growth of key knowledge-based clusters including:

- Life Sciences, which includes clusters such as biotechnology, proteomics, and health technologies;
- Information Technology, which includes clusters in areas such as new media, telehealth, and geomatics;
- Physical Sciences, which includes clusters such as fuel cells, design engineering, climate change technologies, synchrotron and micro-technologies; and
- Multi-sector projects.

The distribution of the \$110 million in WD funding provided for innovation-related projects by cluster group in Fiscal Years 2001 and 2002 (excluding the funding provided to innovation-related projects under WEPA) is illustrated in Table 3.4. A more detailed discussion of the role of WD in promoting the development of selected clusters is provided in Chapter IV.

TABLE 3.4

**INNOVATION FUNDING BY KNOWLEDGE-BASED
CLUSTERS FROM APRIL 2000 TO MARCH 2002**
(Funding in \$ Millions)



5. WD Support Can Be Targeted At Any Element and Stage in the Innovation System

WD supports a wide range of initiatives to enhance innovation performance in Western Canada. For example, various programs and initiatives seek to strengthen the strategic infrastructure, encourage investment in research & development, support new technology adoption and commercialization, improve manufacturing productivity, facilitate specialized skill development, and increase investment in value-added production. WD investments are made to strengthen both the individual elements of the western innovation system and the linkages between the elements.

The following table summarizes some of the ways in which WD has worked to improve various elements of the innovation system in Western Canada.

TABLE 3.5

EXAMPLES OF SUPPORT PROVIDED BY WD

Elements of the Innovation System	Examples of Activities Undertaken By WD
Political, legal and macroeconomic environment	<ul style="list-style-type: none"> • Advocating the interests of the West in federal economic policy • Identification of gaps and coordination of development initiatives, programs and projects with Provincial Government organizations and other Federal Government organizations through mechanisms such as the WEPA programs and the Senior Officials Forum on Innovation • Preparation of regional cluster competitiveness and development strategies
Demand conditions	<ul style="list-style-type: none"> • Support for export and marketing initiatives • Advocating in government procurement • Promoting the strengths and capabilities of Western Canadian companies within national and international forums
R&D/Technology Infrastructure	<ul style="list-style-type: none"> • Support for investments in physical infrastructure (e.g. buildings, equipment, and labs) • Support for proposal development aimed at increasing participation in CFI, which provides support for the development of research infrastructure • Support for ILOs, innovation centres, technical support services, and pre-competitive research that helps facilitate

Elements of the Innovation System	Examples of Activities Undertaken By WD
	<ul style="list-style-type: none"> technology transfer and commercialization Support for pilot tests of new technologies
Linkages	<ul style="list-style-type: none"> Focus on partnerships involving public sector organizations, industry, and research institutions in its projects Assistance in developing and increasing the capacity of cluster champions and coordinating bodies Support for conferences that bring together parties active in the innovation process
Human Resources	<ul style="list-style-type: none"> Support for the establishment of education and training programs Support to help companies hire recent S&T grads and interns to assist in technology development, commercialization and adoption projects
Capital	<ul style="list-style-type: none"> Increased access to capital through loan reserve programs, Community Futures and other programs Provision of direct assistance to businesses (prior to 1995)
Commercial Information	<ul style="list-style-type: none"> Economic research and analysis Market information obtained through opportunity identification, planning, strategies, and cluster studies Technology assessment services
Company Operations and Strategies	<ul style="list-style-type: none"> Support for conferences related to technology and innovation Support for E-business initiatives Support targeted at improving business mgmt capabilities

Initiatives related to innovation can also be viewed in terms of their position on a continuum which stretches from initial or basic research through to the development process which can involve technology transfer, applied research, and commercialization of new products and process. Within its mandate of promoting economic development and diversification of Western Canada, a major focus of Western Economic Diversification Canada has been on development (i.e. technology transfer, applied research, and commercialization). However, this has not precluded WD from supporting activities related to earlier stage research (primarily in the form of investments in infrastructure) where it was demonstrated that:

- The cluster holds significant potential to diversify and further develop the economy of Western Canada;
- Capabilities related to early stage research are the initial constraint to further development of the cluster. Support for latter-stage commercialization activities is not warranted if the technological knowledge base on which the cluster will be built is not yet in place.
- No other organizations are in a position to provide the assistance needed by the emerging cluster.

For the past two years (2000-01 and 2001-02), WD has categorized its expenditures related to innovation (excluding funding provided through the WEPAs) into 5 key areas including infrastructure, linkages, research and development, technology development, and technical skill development. A brief description of each of these categories is provided below:

- **Infrastructure.** WD has taken a multi-faceted approach to improving knowledge infrastructure and capacity by investing in research infrastructure as well as in cluster planning studies and in facilitating access to federal science and technology infrastructure programs. Examples of infrastructure projects include support for the construction of six hydrogen safe laboratories at the

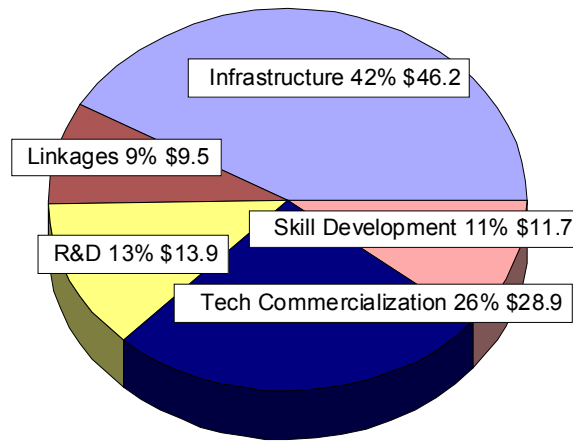
Fuel Cell Technology Centre, equipment for the Genome Sequence Centre, development of the St. Boniface Clinical Research Institute, development of the Canadian Light Source facility, and construction of the Greenhouse Gas Technology Centre.

- **Linkages.** WD places a priority on encouraging collaboration on innovation initiatives by working various networks, industry associations, and groups on initiatives or events designed to build synergies among the players of the innovation system. For example, WD is a founding sponsor of the WestLink Innovation Network, a not-for-profit organization that facilitates communication, collaboration, and technology development and commercialization among 13 Western Canadian Universities and 3 Networks of Centres of Excellence and their affiliated research institutions. WD has also supported other initiatives such as the Alberta Synchrotron Institute, the Proteomics Consortium, the Canada West Health Innovation Council, New Media BC and the Vancouver Island Advanced Technology Park.
- **Research and Development.** Examples of recent R & D projects include the Agricultural Greenhouse Gas Reduction Project, funding provided to the Alberta Research Council (ARC) to finance six research projects, and contributions to set up the first node of the Canadian Bioinformatics Resource (CBR) in Alberta.
- **Technology Commercialization.** Many of WD's investments promote the commercialization of technology. For example, support has been provided to organizations that directly commercialize technology such as the Technology Commercialization Offices at Alberta's major universities. WD also supports InnoCentre Alberta and other Innovation Centres that foster technological innovation and stimulate the commercialization of technology among small and medium sized technology enterprises. Technology commercialization activities also include the First Jobs in Science and Technology projects and other projects that introduce or demonstrate new or existing technologies into the marketplace.
- **Technical Skills Development.** Technical Skills Development activities include initiatives that contribute to building skills and or training. Examples of recent skills development projects include support for the New Biotechnology University Graduate Program, the Aerospace/Aviation Training Centre, the Technology Entrepreneurship Programs, and the Technology Commercialization Internship Program.

A more detailed description of projects in each of these areas is provided in Appendix VI. Of the \$110 million in funding approved for innovation projects from April 1, 2000 to March 31, 2002 (excluding innovation related funding approved under the WEPAs), infrastructure projects received the largest share of funding as indicated in Table 3.6. However, it should be noted that many of the projects relate to more than one activity and the allocation of funding by activities is, in some cases, quite arbitrary.

TABLE 3.6

**TOTAL FUNDING BY TYPE OF INNOVATION
ACTIVITY FROM APRIL 2000 TO MARCH 2002**
(Funding in \$ Millions)



C. THE PERCEIVED ROLE, EFFECTIVENESS, AND VISIBILITY OF WD

Members of the innovation support system, proponents of systemic projects, and innovation company representatives were asked to provide their observations regarding the role of WD, its effectiveness in promoting innovation, and the profile of the Department. The major findings are highlighted below.

PERCEIVED ROLE, EFFECTIVENESS AND VISIBILITY OF WD

- The role of WD is most commonly characterized as that of a facilitator and catalyst for innovation.
- According to the stakeholders, WD has been effective in supporting innovation.
- The flexibility of its programs, its ability to respond quickly, the capabilities of its staff, and its familiarity with the local economy, clusters, and players are major factors contributing to the effectiveness of WD. Funding limitations is the primary factor constraining WD from having an even more significant impact.
- The most common recommendations for improvement are for WD to develop and pursue more specific innovation strategies in association with other members of the innovation system, become more pro-active in the delivery of its programs, and increase its overall level of funding.
- Gaps in the innovation system, that could potentially be targeted by WD, include limited access to investment capital (particularly early-stage seed funding), under-developed linkages between key players in the innovation system, and the limited assistance available for technology demonstration and commercialization activities.
- The role of WD in supporting innovation is well recognized by organizations that are potential targets for funding but much less so by the broader business community and particularly by the general public. activities.

The feedback obtained from the members of the innovation support system, proponents of systemic projects, and innovation companies is highlighted below. A more detailed summary of the responses to survey questions is provided in Appendix VII.

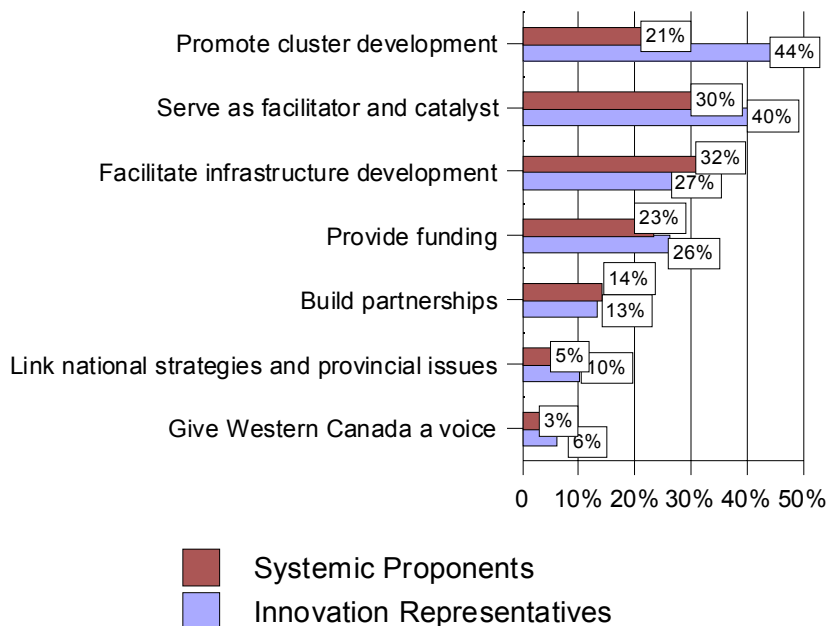
1. WD is Perceived as a Facilitator and a Catalyst

The role of WD with respect to innovation is most commonly characterized by the respondents as that of a facilitator and catalyst for innovation, which promotes the development of leading edge clusters through

providing leadership, sharing risk, making strategic investments, assisting in the development of infrastructure, building partnerships, and linking Ottawa and Western Canada.

TABLE 3.7

WHAT DO YOU PERCEIVE TO BE THE ROLE OF WD WITH RESPECT TO INNOVATION?



As representatives of other organizations active in innovation related activities, the members of the innovation support system noted that the activities of WD complement those of their organization by:

- Filling in gaps, particularly with respect to funding (25 respondents);
- Enabling their organization to develop, expand and accelerate projects and initiatives (19 respondents);
- Supporting the development of partnerships and networks and increasing access to other sources of funding (17 respondents);
- Creating greater awareness of the importance of innovation and working to strengthen the innovation support systems in Western Canada (9 respondents);
- Strengthening the infrastructure for innovation (8 respondents);
- Delivering programs and other support services (5 respondents); and
- Assisting in the commercialization of new technologies (4 respondents).

Of the 70 innovation members surveyed, 89% indicated that there was no duplication or overlap in the services of their organization and those of WD. Areas where some duplication was identified by the remaining respondents included the potential for overlap between Community Futures and provincially funded regional development organizations, some overlap in the area of international trade, and some duplication in employment-related programs targeted at recent graduates. However, none of the respondents indicated that any overlap, which may exist, detracts from the impact of WD in promoting innovation.

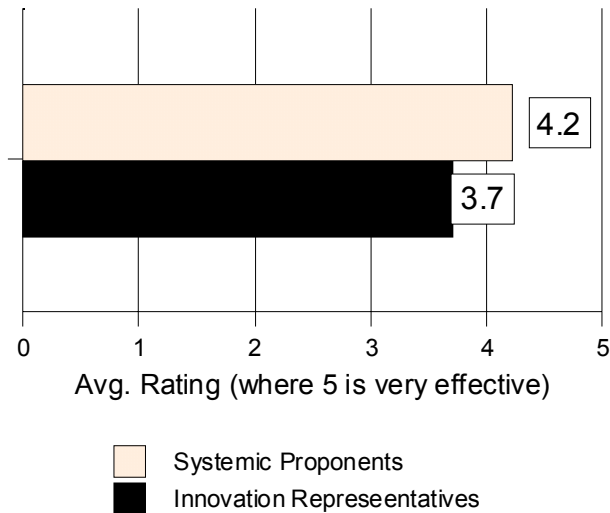
2. WD is Effective in Promoting Innovation

The average rating of WD's effectiveness in promoting innovation ranged from 3.7 amongst members of the innovation support system to 4.2 amongst the proponents of systemic projects (on a scale of 1 to 5, where 1 is not at all effective and 5 is very effective). Of those respondents who expressed an opinion, 84% of the

innovation representatives and 98% of the proponents rated WD as at least somewhat effective in supporting innovation. In particular, WD was praised for helping to strengthen the infrastructure and to create a positive environment that has established the foundation for future innovation.

TABLE 3.8

HOW EFFECTIVE HAS WD BEEN IN SUPPORTING INNOVATION?

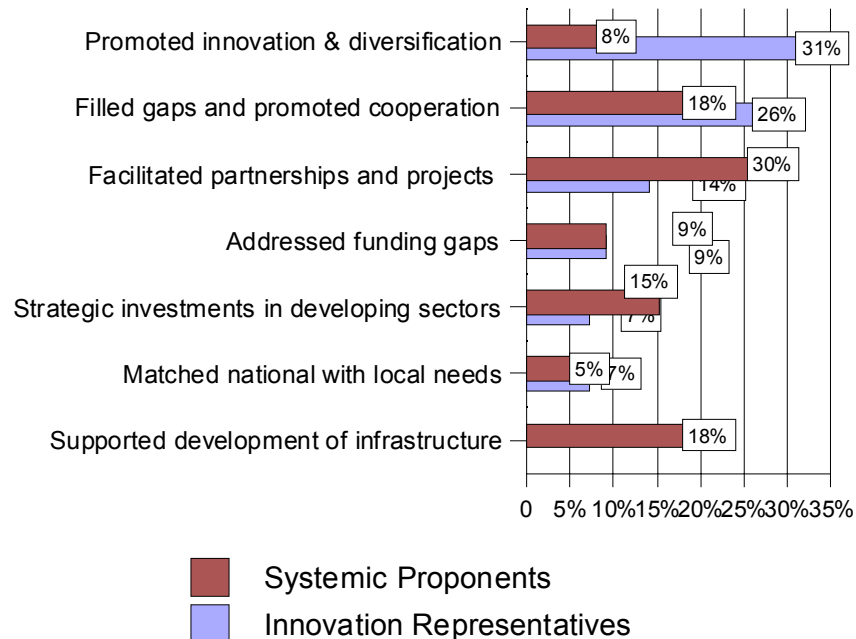


When asked to identify specific areas and ways in which WD has been successful, the most common responses were that WD has:

- Helped to fill gaps and to facilitate the development of important partnerships and projects that have helped to promote innovation and diversification;
- The support provided by WD has facilitated the development of important partnerships and projects that have helped to promote innovation and diversification;
- WD has worked to address key funding gaps; and
- WD has made strategic investments in new and developing sectors.

TABLE 3.9

IN WHAT WAYS HAS WD BEEN SUCCESSFUL IN PROMOTING INNOVATION?



The members of the innovation support system and proponents of systemic projects were also asked whether there are areas where WD had been less effective than they would have expected. The results reflect some of the uncertainty and confusion caused by changes in WD’s innovation-related mandate and strategies over time. The results also indicate that certain areas identified as strengths, such as its flexibility, breadth of involvement, and speed in decision-making, can also be perceived as weaknesses or areas of concern. The most common responses provided by the members of the innovation system included:

- WD has struggled in clearly defining its mandate with respect to innovation and/or in balancing mixed mandates (11 respondents). Several respondents noted that establishing clearer objectives and target outcomes would be useful in defining the role of the organization and providing a basis for evaluating progress. In addition, the preparation of additional cluster studies and technology roadmaps would also be beneficial in defining overall directions, the role of WD, and its relationship to other organizations;
- There appears to be a lack of an overall direction, focus or strategy with respect to WD’s innovation efforts (10 respondents). Several respondents noted WD may be diluting its impact by supporting too wide a range of projects. While some respondents criticized WD for being too reactive, others viewed this as a strength because it means that the organization is market-driven in responding to requests from potential proponents;
- Awareness of its programs and activities is low (9 respondents);
- More interaction and collaboration with other members of the innovation system would be beneficial (8 respondents); and
- WD has not been successful in increasing the funding it has available for innovation activities (5 respondents).

Nevertheless, despite these concerns, 59 of the 70 members of the innovation support system indicated that there would be a significant negative impact if WD were to no longer place a high priority on innovation. Six respondents felt that other organizations could fill at least part of the gaps left by WD while 5 were not sure what the impact would be.

When asked to identify areas where WD had been less effective or successful, the proponents of systemic projects tended to focus more directly on the availability of funding and reporting requirements as indicated by the responses summarized below:

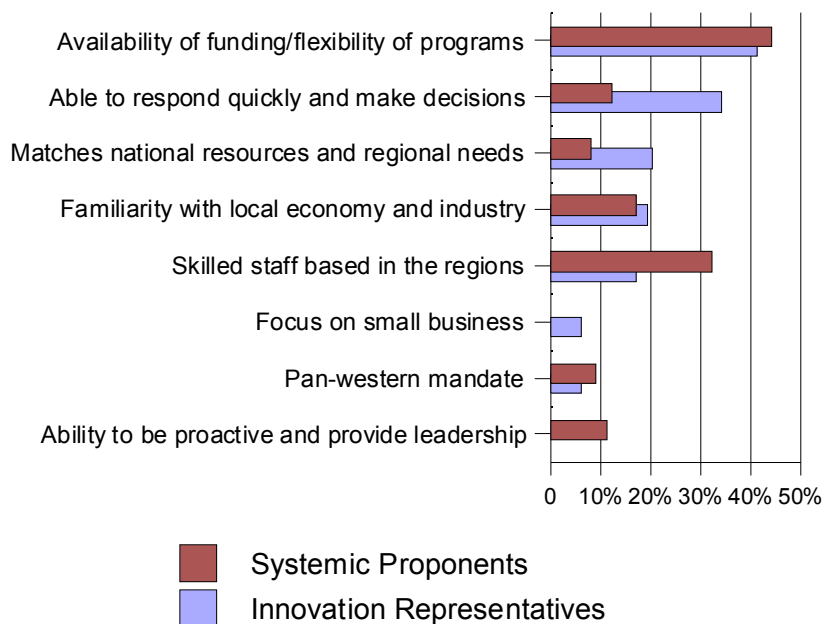
- Resource constraints, particularly funding, have limited the magnitude of the impacts generated by WD (8 respondents);
- Because of its funding constraints, WD has not been able to make longer-term funding commitments (7 respondents);
- Awareness of WD’s programs and activities is low and more work needs to be done to raise its public profile (7 respondents); and
- The organization is too bureaucratic and accountability requirements are too stringent (6 respondents).

3. WD’s Effectiveness is Attributable to Certain Key, Unique Characteristics

A key issue in reviewing their role in the innovation system is identifying whether there are certain characteristics associated with the Department that may enable WD to be effective or to provide assistance where other organizations may not be able to. Of the 70 innovation representatives, 50 (71%) indicated that WD does have characteristics which make it uniquely able to fill certain gaps in the innovation system (10 did not perceive WD as having unique characteristics and 10 were not sure). Similarly, of the 65 proponents of systemic projects, 51 (79%) indicated that WD does have characteristics which make it uniquely able to fill certain gaps in the innovation system (3 did not perceive WD as having unique characteristics and 11 were not sure).

TABLE 3.10

WHAT CHARACTERISTICS ENABLE WD TO BE EFFECTIVE OR PROVIDE ASSISTANCE WHERE OTHERS MAY NOT BE ABLE TO?



The most significant ways in which WD is perceived as differentiated from other organizations are the flexibility of its programs, its ability to respond quickly, the capabilities of its staff, and its familiarity with the local economy, clusters, and players as indicated in Table 3.10.

In particular, the flexibility of its programming is considered critical in that it enables WD to tailor its activities to reflect the specific needs of each province and key clusters as well as to provide a continuum of services. The availability of funding is considered crucial in bringing parties together and leveraging resources from other sources. Another advantage that WD has in establishing partnerships is that it is generally perceived as a neutral party which does not have its own agenda apart from promoting innovation.

While WD may provide funding on a project-by-project basis, one of its strengths is that the organization tends to focus on building relationships and establishing development objectives which extend beyond any one project. The experience that it has gained in economic development, vetting projects, working with various parties, and promoting specific clusters also enables the Department to add value to this process. It was also noted that WD often gets involved early in the process and helps to bring attention to specific initiatives or clusters and, in some cases, to provide a foundation on which to attract future funding. A notable example that was cited was WD's early involvement in nanotechnology in Alberta, which eventually helped lead to the establishment of the Nanotechnology Institute there.

The factors that were identified as constraining WD from having had an even more significant impact in terms of promoting innovation included:

- Funding constraints, particularly for multi-year programs and initiatives (identified by 32 representatives of the innovation support system and 18 proponents);
- Systemic issues related to government bureaucracy and/or political considerations (identified by 7 innovation representatives and 7 proponents);
- A constantly changing mandate and focus (identified by 7 innovation representatives and 5 proponents);
- Human resource constraints, such as competing demands for staff time or the availability of technical expertise (identified by 6 innovation representatives and 5 proponents); and
- Not enough communication and interaction with other organizations related to the development or selection of projects (identified by 6 innovation representatives). However, most respondents identified the effectiveness of WD in obtaining input from a wide variety of organizations as one of its strengths.

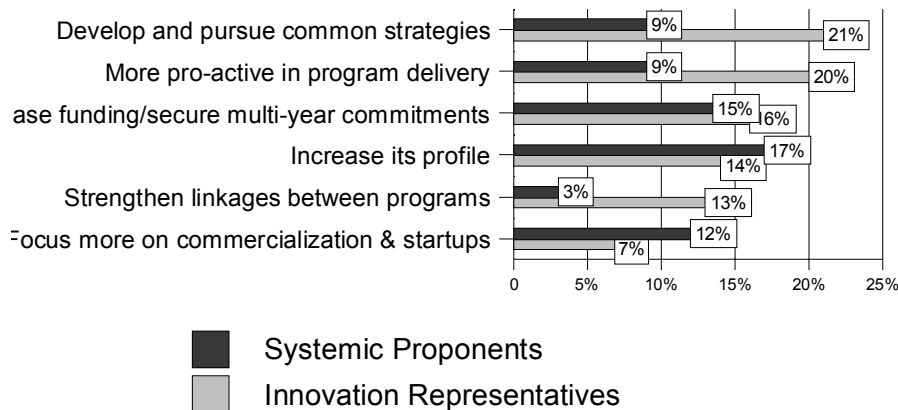
4. The Stakeholders Provided a Wide Range of Recommendations for WD

When innovation representatives and systemic proponents were given an opportunity to provide recommendations regarding how WD could enhance their innovation-related activities, the most common responses were to:

- Develop and pursue specific innovation strategies in association with other members of the innovation system;
- Become more pro-active in the delivery of its programs;
- Increase its overall level of funding and secure a multi-year commitment for that funding; and
- Increase awareness of its programs, initiatives and successes.

TABLE 3.11

HOW COULD WD ENHANCE THEIR INNOVATION RELATED ACTIVITIES?



Most of the members of the innovation support system (57 of the 70 representatives surveyed) also expressed interest in strengthening the relationship between their organization and WD. It was noted that strengthening the relationship between the two organizations would help to:

- Enable both organizations to be more productive and proactive in promoting innovation in the cluster and/or region (31 respondents);
- Develop and implement initiatives and strategies in a more timely and/or cost effective manner (21 respondents); and
- Improve the level of coordination, particularly with respect to long-term planning and the selection of projects (15 respondents).

To strengthen the relationship between WD and their organization, the innovation representatives recommended improving the level of communication and interaction between senior representatives in each organization, placing a higher priority on shared planning and collaboration, and more clearly defining the roles and priorities of WD with respect to innovation and communicating those priorities to other groups.

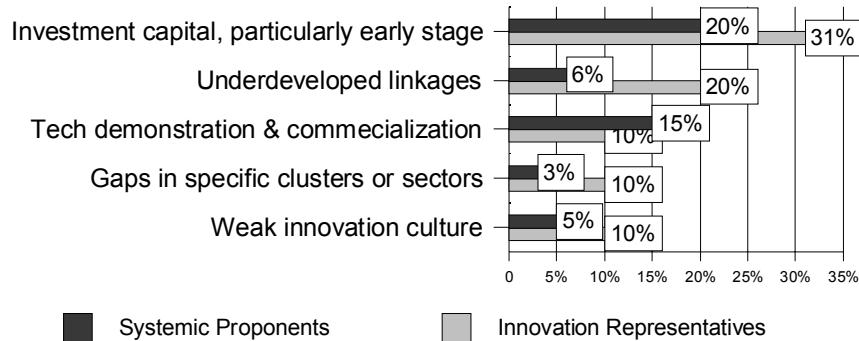
In contrast to the recommendations of innovation representatives and systemic proponents, which focussed on broader strategic issues, the recommendations of the innovation companies tended to be more narrowly focussed. More specifically, the company representatives recommended that WD continue to provide, and possibly increase, the amount of funding provided, place a greater emphasis on start-up/early-stage companies, broaden the eligibility requirements for graduates under FJST, focus more specifically on the cluster or sector in which the company is involved, provide greater technical assistance in the form of business support and counselling, and promote stronger linkages between educational institutions and private sector.

5. There are Additional Gaps In the Innovation System That Could Be Filled By WD

While the activities of WD have helped to strengthen the innovation system in Western Canada, most stakeholders identified other gaps in the innovation system that could be targeted by the Department. These gaps closely reflect the weaknesses in the innovation system in Western Canada, which were discussed in Chapter II. In particular, members of the innovation support system and proponents of systemic projects highlighted the limited availability of investment capital (particularly early-stage seed funding), the under-developed linkages that exist between the key players in the innovation system, and the limited amount of assistance available for technology demonstration and commercialization activities.

TABLE 3.12

**WHAT ADDITIONAL GAPS RELATED TO INNOVATION
COULD BE FILLED BY WD?**



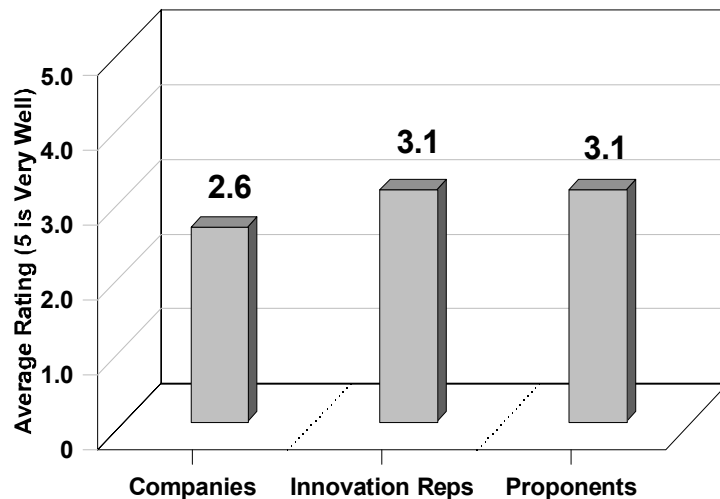
The representatives of innovation companies also identified a range of specific activities for which further support is needed including marketing and product development (identified by 20 of the 150 respondents), R&D (10 respondents), technology transfer and commercialization (10 respondents), and technical assistance and/or business support services (7 respondents). Other comments received from the innovation companies included that WD should place a greater emphasis on start-up/early stage companies (10 respondents) or more specifically on their sector or cluster (10 respondents).

6. Outside of Key Stakeholders, WD has a Low Profile

When the stakeholders were asked to rate the how well recognized WD is for the role that they play with respect to encouraging innovation in Western Canada, the average ratings ranged from only 2.6 to 3.1 across the three survey groups (on a scale of 1 to 5, where 1 is not at all well and 5 is very well recognized). Many of the representatives noted that WD is well recognized by their organization and other organizations that are potential targets for funding but often not at all recognized by the general public and to only a limited degree by the business community. The conference sponsorships, in particular, were identified as a useful mechanism through which WD had been able to interact more directly with members of industry clusters and foster relationships with other organizations.

TABLE 3.13

HOW WELL RECOGNIZED IS WD IS FOR ITS ROLE IN ENCOURAGING INNOVATION?



Many respondents questioned the need to significantly increase the visibility of WD given that the Department already has strong relationships with the other key players in the provincial innovation systems and, with the exception of FJST and ITPP, its innovation activities are not targeted at individual businesses and it has no innovation programs targeted at the general public. The key, according to these respondents, is to ensure that WD continues to build on these strong relationships and is also recognized within the Federal Government for the critical role that it plays with respect to innovation in Western Canada.

Assuming that increasing the profile of WD becomes a priority for the Department, the action that was most commonly recommended by the innovation representatives and systemic proponents was to become more proactive and aggressive in promoting media coverage of projects and overall activities. Other suggestions were to expand programming, require clients to implement a formal communication strategy, increase the level of interaction with the local business community, develop and communicate formal strategies and plans, and advertise the highly visible projects and other success stories. It was also suggested that WD could become more strategic in terms of its communication messages; for example, instead of focusing on announcements on a project-by-project basis, the messages could highlight the role of various projects and initiatives in promoting cluster development.

Of the three groups, the innovation companies were the least aware of WD's innovation activities. Their most common recommendation for increasing the visibility of WD was for staff to get out into the business community more often through mechanisms such as attending events, networking with key industry associations, and direct interaction with companies.

IV. IMPACTS AND EFFECTS

This chapter illustrates the types of impacts and effects that are generated by the innovation related activities of WD. The chapter first discusses the intended impacts and then summarizes impacts reported by the proponents of systemic projects as well as the impacts reported by innovation companies. Lastly, we provide examples of broader impacts that WD has had in promoting the development of selected clusters.

A. INTENDED IMPACTS AND EFFECTS

The intended impacts of WD's innovation activities can be divided into immediate outcomes, intermediate outcomes, and final outcomes as outlined below:

WDP Immediate Outcomes:

- Improved political, legal and macroeconomic environment for innovation
- Increased demand for innovation technologies, products and services
- Enhanced R&D and technology infrastructure including increased investment in R&D
- Strengthened linkages and coordination in activities between participants in the innovation system
- Increased access to capital
- Increased access to skilled workers
- Increased access to commercial information
- Enhanced corporate operations and strategies related to innovation

WDP Intermediate Outcomes

- Commercialization of new technologies
- Further development of technology clusters in Western Canada

Final Outcomes:

- A strengthened Western Canadian innovation system
- Economic development and diversification in Western Canada
- Increased western Canadian participation in the development and implementation of national policy, programs and projects

A program model illustrating the interrelationships between the activities, outputs, and intended impacts is provided below.

TABLE 4.1

PROGRAM MODEL FOR SERVICES PROVIDED TO INDIVIDUAL BUSINESSES

Activities	<ul style="list-style-type: none">• Work directly with other organizations involved in innovation including representatives from industry, academia, research institutions, the Provincial Governments and other Federal Government departments and agencies to provide financial support for specific programs, projects and initiatives• Projects that have expanded and strengthened the knowledge infrastructure, encouraged and supported technology transfer, commercialization and adoption, increased access to capital, and strengthened human resource capabilities.
Outputs	Projects, strategies and initiatives that seek to expand and strengthen the knowledge infrastructure, encourage and support technology transfer, commercialization and adoption, increase access to capital, strengthen human resource capabilities, and improve the environment for innovation in Western Canada.

Immediate Outcomes	<ul style="list-style-type: none"> • Improved political, legal and macroeconomic environment for innovation • Increased demand for innovation technologies, products and services • Enhanced R&D and technology infrastructure including increased investment in R&D • Strengthened linkages and coordination of activities between participants in the innovation system • Increased access to capital • Increased access to skilled workers
Intermediate Outcomes	<ul style="list-style-type: none"> • Commercialization of new technologies • Further development of technology clusters in Western Canada
Final Outcomes	<ul style="list-style-type: none"> • A strengthened Western Canadian innovation system; • Economic development and diversification in Western Canada; and • Increased western Canadian participation in the development and implementation of national policy, programs and projects

In reviewing the results of our interviews regarding the impacts that WD has had with respect to supporting innovation in Western Canada, it is important to keep in mind that:

- The primary focus of this study is on WD’s innovation-related investments and activities that have been implemented since mid-1999.
- The impacts of these investments and activities will take many years to be realized. As noted in Chapter III, members of the innovation system stressed that improving innovation performance is a long-term process which, while critical to the future competitiveness of Western Canada, will take many years to be realized. This is particularly true of the types of projects supported by WD which, by their nature, generally require an extensive period to be implemented (many are only becoming operational now while others are not yet completed) and generate impacts which can be assessed only over the medium to longer-term. For example, it will take many years to determine how successful the expanded research infrastructure that has been supported by WD will be in facilitating the development and commercialization of new technology in Western Canada.
- The nature of the impacts varies significantly by project, which makes it difficult to meaningfully aggregate the results. For example, some projects are designed to strengthen R&D capabilities while others are targeted at supporting the transfer of existing technology or addressing human resources issues in a given sector.

As a result, we have sought to highlight the types of impacts that can be generated from WD’s investment and activities as well as to provide examples of progress that has been made to date. However, only over the medium to long-term will it be possible to assess the actual impact of WD’s innovation-related activities.

B. IMPACTS OF SYSTEMIC PROJECTS

We conducted interviews with 66 proponents of systemic projects that received funding from WD, many of whom received funding for multiple projects. Of the 66 systemic proponents, 34 are university-based research centres, 13 are network organizations that represent a specific cluster or sector, 9 are health related agencies, 4 are Federal or Provincial Government research institutes, 3 are local government organizations, and the remaining 3 are other types of non-profit organizations. Of the 34 university-based centres, 22 were interviewed regarding one or more larger-scale project while 12 were surveyed regarding their proposals that had been supported under the Canada Foundation for Innovation Support Program (CFI-SP). With the exception of the university-based proponents funded under CFI-SP, the sample of proponents was biased towards larger scale projects.

In our survey, the proponents were asked a series of questions regarding the status of their projects, the role of the projects and their effectiveness to date in promoting development of the cluster, examples of the impacts that have been generated, and the likelihood that the projects would have proceeded without assistance from WD. The major findings are highlighted below:

IMPACTS OF THE SYSTEMIC PROJECTS

- The primary focus of our review is on projects approved since mid-1999. Of the 66 proponents surveyed, 56% were associated with systemic projects that have been completed and are fully operational. The remaining systemic projects are in various stages of development.
- Given the lengthy time horizon associated with the development of emerging clusters, the innovation-related projects have generally not yet resulted in significant long-term economic benefits. However, the proponents indicated that the projects are helping to build the foundation necessary for future growth. When asked to rate the effectiveness of the projects to date in promoting further development, where 1 is not at all effective and 5 is very effective, the average rating was 4.3 and 75% of proponents rated the projects as being effective or very effective in promoting further development.
- The systemic projects have had a major impact in terms of strengthening research capabilities in Western Canada (proponents provided an average rating of 4.4 on a scale of 1 to 5, where 1 is no impact at all and 5 is a major impact). The projects have built both human resource and physical infrastructure capacity, created linkages and research networks, brought research into new areas and increased capacity with respect to leveraging additional research funds.
- The projects have also had a major impact in strengthening linkages between industry, government and/or the research infrastructure (average rating of 4.4). In most instances, these linkages took the form of collaboration related to research, industry issues, or development opportunities.
- The projects have also had a significant impact in terms of increasing access to skilled workers (average rating of 4.1), increasing investment in R&D (4.0), and raising the profile of the cluster, sector or region (4.0). Given their focus and the early stage of development, the systemic projects have had less of an impact to date in facilitating technology transfer (3.3), facilitating technology commercialization (3.1), or increasing access to investment capital (3.0).
- To date, the 66 projects themselves have created approximately 2,000 on-going full-time equivalent (FTE) positions.
- WD support has been very instrumental in ensuring that systemic projects proceed. On average, there is only a 24% likelihood that the projects would have proceeded without assistance from WD. The 26 projects that may have proceeded without assistance from WD would likely not have proceeded in the same time frame and with the same scope.

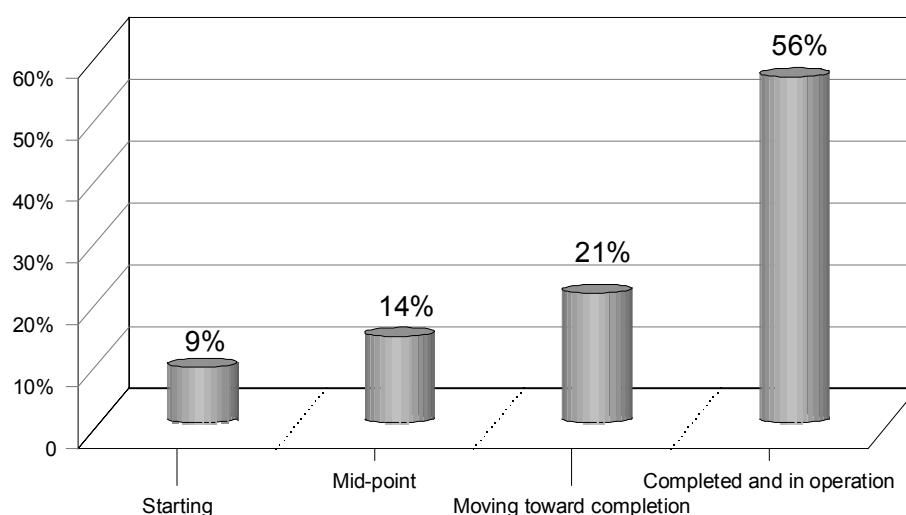
A summary of the survey results is provided in the following paragraphs (a more detailed discussion of the responses to survey questions is provided in Appendix VII).

1. Most Projects are Not Yet Completed or Only Recently Completed

The primary focus of our review is on projects approved since mid-1999. Of the 66 proponents surveyed, 56% were associated with systemic projects that have been completed and are fully operational. For these projects, all project funds have been expended, equipment has been purchased, renovations have been completed and the facilities are being used by industry and/or the research community.

TABLE 4.2

WHAT IS THE STATUS OF THE SYSTEMIC PROJECTS?



The remaining systemic projects are in various stages of development, with 9% in the initial or beginning stages, 14% mid-way through implementation and 21% moving towards completion as indicated in the Table 4.2.

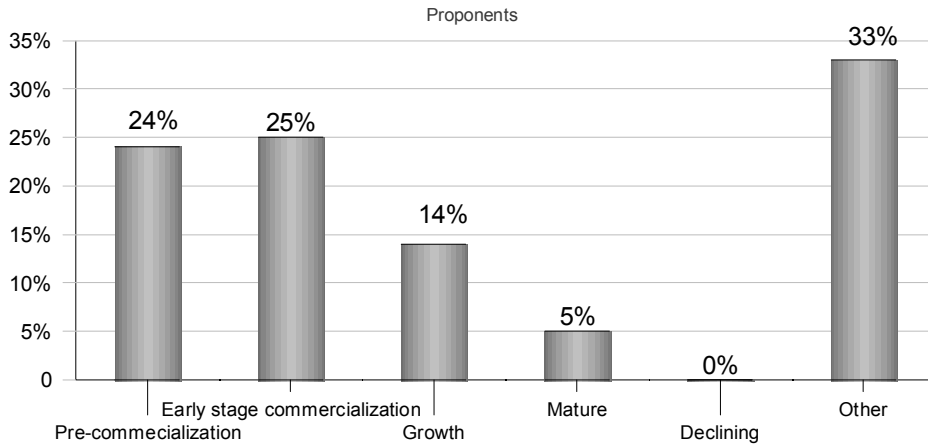
2. Most Projects Target Developing Clusters

The underlying objective of the innovation-related support provided by WD is to promote the development of industry clusters. At the time funding for the initial project was provided, most of the clusters that were the focus of support were in an early stage of development.

As indicated in Table 4.3, of the 66 proponents, 24% identified their cluster as being at the pre-commercialization stage, 24% at the early commercialization stage, and 14% at the growth stage. Only 5% identified the cluster as being mature in terms of the industry life cycle.

TABLE 4.3

AT WHAT STAGE OF DEVELOPMENT IS THE CLUSTER TARGETED BY THE PROJECT?

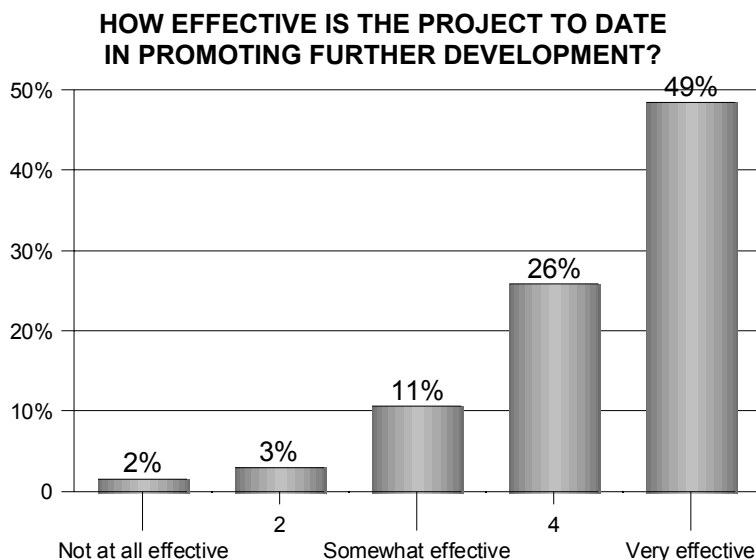


According to the proponents, innovation-related projects funded by WD may fulfill a wide range of roles with respect to promoting development of a given cluster or region. Some of the roles commonly identified by the proponents included encouraging and/or facilitating greater collaboration and networking in the industry, expanding research and development infrastructure and capacity, assisting in the development of new products or technologies, working to address key industry issues that are constraining development, increasing the availability of skilled labour and facilitating the commercialization of new products and technologies.

3. Systemic Projects are Building the Foundation for Future Economic Growth

Given the lengthy time horizon associated with the development of emerging clusters, the innovation-related projects have generally not yet resulted in significant long-term economic benefits. However, the proponents indicated that the projects are helping to build the foundation necessary for future growth. When asked to rate the effectiveness of the projects to date in promoting further development, where 1 is not at all effective and 5 is very effective, the average rating was 4.3 and 75% of proponents rated the projects as being effective or very effective in promoting further development.

TABLE 4.4



When asked to provide reasons for their rating, proponents commented that the projects were effective with respect to leveraging funds from private investors and research granting agencies, positioning facilities and their staff as world leaders, increasing research and training opportunities for staff and graduate students, stimulating economic development, developing needed infrastructure and increasing the commercialization of R&D. Several proponents commented that it was still too early to comment on the effectiveness of the project, given its early stage of development, and one respondent commented that the project's effectiveness had been limited due to some growing pains.

4. The Projects Have Generated a Wide Range of Impacts

The proponents were then asked, using a scale of 1 to 5 where 1 is no impact at all and 5 is a major impact, to rate the extent to which the projects have generated (either directly or indirectly) impacts in a variety of areas including:

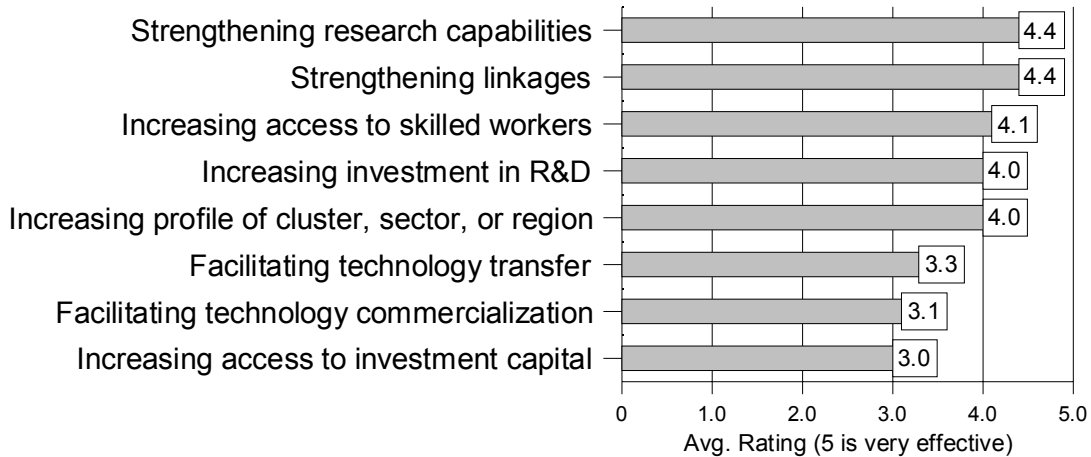
- Strengthening research capabilities
- Increasing investment in R&D
- Strengthening linkages between industry, government and/or the research infrastructure
- Increasing access to skilled workers
- Increasing access to investment capital
- Facilitating technology transfer and commercialization, and
- Increasing the profile of the region, cluster or sector.

It should be noted that the average responses to these questions tends to be lower than the average rating given by the respondents with respect to the overall effectiveness of the projects because each project tends to be targeted at only a subset of these impacts. A higher average rating indicates that the impact is a common objective among the projects and that success has been achieved. A lower rating indicates that the impact is not a common or major objective of the projects, at least in the short-term.

The average ratings ranged from 3.0 with respect to increasing access to investment capital to 4.4 with respect to strengthening research capabilities and strengthening linkages between industry, government and/or the research infrastructure. A notable percentage of the respondents answered not applicable (n/a) to certain questions due to the type of project (this was particularly true for respondents who received funds provided under the CFI-SP program) or because of the projects early stage of development.

TABLE 4.5

**TO WHAT EXTENT HAVE THE SYSTEMIC PROJECTS
GENERATED SPECIFIC TYPES OF IMPACTS?**



A discussion of the impacts of systemic projects is provided below:

a. Strengthening Research Capabilities

The systemic projects have had a major impact in terms of strengthening research capabilities in Western Canada. The average rating among those expressing an opinion was 4.4 and 50% of proponents rated the projects as having a major impact in terms of strengthening research capabilities. When asked to explain how the projects had strengthened research capabilities, the most common responses given by proponents included that the projects had built both human resource and physical infrastructure capacity, created linkages and research networks, brought research into new areas and increased capacity with respect to leveraging additional research funds.

A few specific examples of the many impacts reported by proponents with respect to strengthening research capabilities include:

- The Petroleum Research Centre has become the leading research centre for the study of heavy oil in the world.
- The investment in the Institute for Biomolecular Design (IBD) led to the purchase of millions of dollars of new state of the art equipment suitable for discovery and development in the proteomics field;
- The activity to create Canadian Light Source (CLS) has precipitated the formation of the Alberta Synchrotron Institute(ASI), the Saskatchewan Synchrotron Institute (SSI), the BC Synchrotron Institute and has galvanized the research community to embrace the use of synchrotron light in their studies. The ASI investment has attracted other funds and established an infrastructure and connectivity to CLS which, in turn, has induced a world class researcher to stay at the University of Alberta and has attracted other high quality personnel to the province.
- Through a clinical trials network, the Canada West Health Innovation Council has increased the capacity of the health research community across the four Western provinces and brought innovation and best practices into healthcare.

Although most of the research is still in the early stages, some projects have already led to records of invention or patents being filed. For example, there have been 8 patents filed relating to intellectual property from research undertaken at the St. Boniface Research Centre and two patents filed the Institute of Biomolecular Design. While no patents have been filed at the MRI research and demonstration site for veterinary medicine, over 30 research papers have been published.

b. Strengthening Linkages

The systemic projects have had a significant impact in terms of strengthening linkages between industry, government and/or the research infrastructure. The average rating among proponents who expressed an opinion was 4.4 and 44% of proponents rated the projects as having a major impact. In most instances, these linkages took the form of collaboration related to research, industry issues, or development opportunities. A few specific examples of impacts reported by proponents with respect to strengthening linkages include:

- The research activities at Olds College have enabled the college to create linkages with Alberta Innovation and Science, the Federal and Provincial Departments of Agriculture and Canada's tri-councils for research grants - NSERC, MRC and SSHRC.
- NewMIC's collaborative model enables academic researchers to work directly with industry to develop commercial products faster and more efficiently. This model is helping to position British Columbia and Canada as world leaders in new media innovation.
- The Alberta Cord Blood Bank actively supplies stem cells to a variety of research teams across Canada and has galvanized interest in stem cell research and stem cell-based treatments.

c. Increasing Access to Skilled Workers

The systemic projects have had a significant impact in terms of increasing access to skilled workers. The average rating among proponents who expressed an opinion was 4.1 and 60% of proponents rated the projects as having more than somewhat of an impact. As a result of the support provided by WD, graduate students have been provided with increased research opportunities and training, organizations have been able to increase its number of scientific and technical staff they employ, and key organizations have been able to attract high quality international researchers or bring skilled Canadian researchers back to the region. A few specific examples of the impact of projects on increasing access to skilled workers include:

- At VIDO, the staff complement will grow from 50 to 140 people. There are currently 70 staff, including 39 PhD's.
- At Genome Prairie, there are now 250 researchers employed on 6 projects.
- The development and construction of CLS has required thousands of person years of employment and CLS Inc. currently has a staff of more than 60 people, including 24 scientists.
- Staff at the St. Boniface Research Centre will grow from 150 to 600 when completed. Currently, the Research Centre has over 250 employees, including 30 research scientists and 26 support staff. A total of over 1,100 scientific publications have emerged from the scientists in the Research Centre.

d. Increasing Investment in R&D

With respect to increasing investment in R&D, the proponents gave an average rating of 4.0 and 36% rated the projects as having a major impact. A few specific examples of projects which have contributed to increased investment in R&D include:

- Of the 12 CFI-SP projects, 9 were successful in receiving CFI funding which increased their capacity to carry out world class research and technology development.
- In 2000/2001, the St Boniface Research Centre attracted over \$20 million dollars in external funding for research, with \$3 million coming from industry or corporate support. Access to external funding is expected to continue to increase.
- The presence of IBD has precipitated a second \$14 million project, partially supported by CFI, the province of Alberta, IBM and other in-kind support.
- The WD funds enabled Genome Prairie to win \$60 million (including matched funds) for increased research.
- The basic budget for research at the Petroleum Research Centre has increased from \$1.45 million a year to \$2.5 million a year, with \$750,000 coming from industry. In addition, PRTC has raised \$21 million for the next 4 years for a CO² storage project in Weyburn, Saskatchewan.
- The Industry Partnership wing at PBI has attracted the attention of the investment community and enabled PBI to leverage approximately \$15 million in additional funding.
- The BC Cancer Agency has attracted an additional \$15 million in investment from industrial partners and research granting agencies. Over the next three years, it is projected that the BC Cancer Agency will attract \$50 million in increased investment and file 15 to 20 new patents.
- The BC Cancer Foundation has leveraged an additional \$79 million in competitive research funding as a result of the initial \$15 million investment.

e. Increasing the profile of the cluster, sector or region

Systemic projects have worked to increase the profile of clusters, sectors and regions in Western Canada by attracting international recognition, advancing the cluster, and establishing world-class competencies and facilities. Specific examples of the projects which enhanced the profile of Western Canada include:

- Combining the experience of world-renowned scientists, the Genome Science Centre is poised to play a major role in the field of bioinformatics and various genome projects around the world. Experimental genomics is carried out on the latest sequencing and fingerprinting equipment, such as the MegaBace machines from Molecular Dynamics and the ABI 3700 DNA Sequencers from Applied Biosystems, with data collected and analyzed on one of the most innovative and flexible bioinformatics computing facilities in the world.
- The ice spray-wind tunnel facility at the University of Manitoba has enabled researchers to study the important phenomenon of ice formation on structures and equipment such as helicopter blades and power lines.

- Fuel Cells Canada (FCC) has helped to advance the development of Canada's world-leading fuel cell industry.
- Through close collaborative efforts with public sector organizations and industry, NRC-PBI has contributed to the emergence of Saskatoon as one of the foremost agricultural biotechnology clusters in North America.

f. Facilitating technology transfer

Approximately one-third (32%) of proponents rated the systemic projects as having more than somewhat of an impact in terms of facilitating technology transfer. The average rating among proponents was 3.3. Some specific examples of the impact the projects had on facilitating technology transfer include:

- SMART Park has enhanced and facilitated research partnerships between the university and industry and has transferred new technologies into the marketplace.
- WestTest has facilitated the transfer of the automotive design technology developed in Detroit and brought its application to Winnipeg.
- Over the past two years, the research centre at St. Boniface Hospital has built 6 biotech start-up companies and that number is expected to double in two years. The Research Centre supports technology transfer from the lab bench to commercialization, by providing guidance, advice, and infrastructure for small Manitoban companies.
- The mandate of the Vancouver Island Technology Park is to nurture the development of spin-off companies from university-based research.
- The Plant Biotechnology Institute (PBI) assists with transferring research to product development and commercialization and is a training centre for plant biotechnology scientists.

g. Facilitating technology commercialization

The systemic projects have had somewhat of an impact in terms of facilitating technology commercialization. The average rating among proponents who expressed an opinion was 3.1 and 21% of proponents rated the projects as having more than somewhat of an impact. Specific examples of the impact the projects had on facilitating technology commercialization include:

- Client companies often send their R&D staff to work at VIDO to extend proof of principle work to further advance the scale-up and commercialization of technology.
- BC Cancer Agency's Technology Development Office (TDO) nurtures the entrepreneurial spirit of the scientists and research clinicians and encourages and assists them to actively participate in the spin-off companies that emerge.
- The demonstration site at the Calgary Foothills Hospital within the Seamans Family MRI Centre facilitated the commercialization of a moving magnet MRI suite.
- Research at NewMIC is conducted as part of its strategic plan, which aims to impact commercialization within an 18 to 36 month horizon, depending on the project.
- By developing managed networks, the Canada West Health Innovation Council is linking expertise between provinces to help achieve a critical mass in commercialization and the competition for national and global funding.

- SMART Park provides a high quality, attractive environment to foster interaction between the university and industry, to support research and education programs in the priority areas necessary for the commercialization process.
- Genome BC provides expertise to facilitate commercialization and spin-off of valuable intellectual property resulting from research activities in major industries; and
- The Industry partnership wing at the Plant Biotechnology Institute is a unique incubation facility for agricultural biotechnology in Canada. The Partnership Wing provides essential integrated services for incubating companies who need to work closely with researchers at PBI. In 5 to 10 years, it is expected that the technologies and companies that have graduated from the PBI incubator will generate from \$250 to \$500 million in economic activity in the Canadian agricultural economy.

h. Increasing access to investment capital

The systemic projects have had somewhat of an impact in terms of increasing access to investment capital. The average rating among proponents who expressed an opinion was 3.0 and 17% of proponents rated the projects as having more than somewhat of an impact. Some specific examples of the impact the projects had on increasing access to investment capital include:

- The Yotta Yotta project resulted in an investment of \$1 million in-kind and almost \$1 million in cash from Capital Health, \$2.1 million in kind and almost \$300,000 in cash from Yotta Yotta.
- Incubator companies at PBI have attracted \$15 million in investment capital.
- At the St. Boniface Research Centre, a \$90 million venture capital fund has been assembled.
- The BC Cancer Agency has attracted \$25 million in private sector business capital.
- The Tumour Tissue Repository attracted \$1.5 million in investment capital from its private sector partner.
- The University of Lethbridge Technology Transfer office has attracted \$1 million in investment capital.

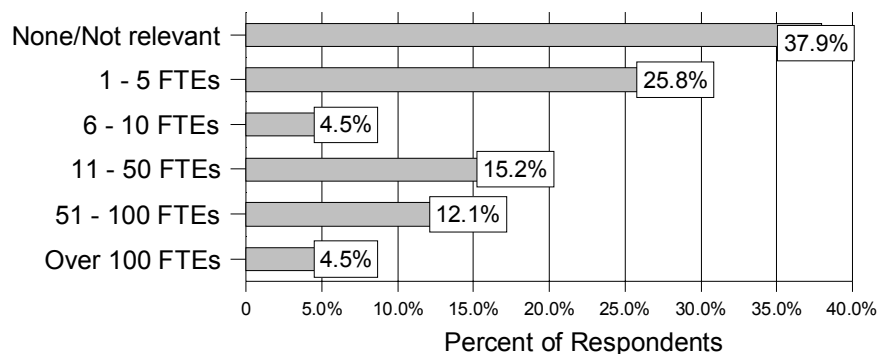
In several of the projects, relationships with venture capitalists have been established.

i. Project Employment

To date, the projects themselves have created approximately 2,000 on-going full-time equivalent (FTE) positions. As outlined in Table 4.6, nearly one-third of the projects have created 11 or more FTE positions.

TABLE 4.6

HOW MANY FTE POSITIONS HAVE BEEN CREATED BY THE PROJECT?



j. Other Impacts

The proponents of systemic projects were asked if other notable impacts had been generated to date. The most common responses were that the projects increased awareness of specific opportunities, issues, capabilities or clusters in the community, built critical mass research capacity, stimulated faculty, led to improved education and training programs, and enhanced the organization's capacity to leverage and/or attract investment. Examples of the various types of other impacts that were identified include:

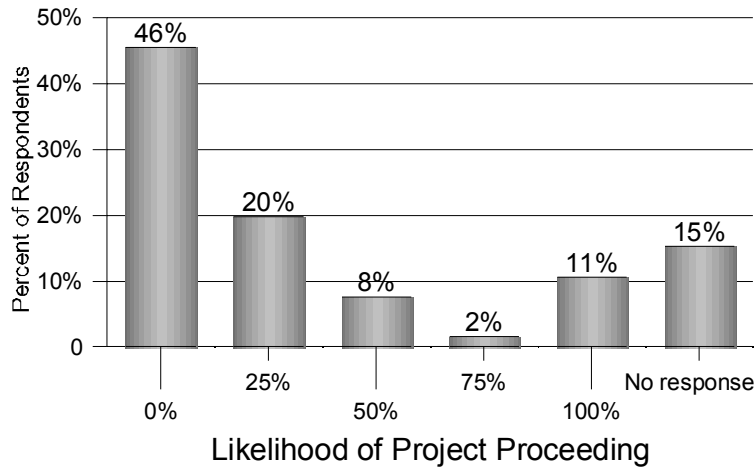
- The OCCI has demonstrated the role that colleges can play in Canada's innovation system.
- The experience of Westlink has encouraged Canada's tri-granting councils to create a funding envelope of \$1.6 million to support internship training programs such as that pioneered by Westlink.
- ASI promoted opportunities to participate in the construction of CLS to Alberta companies. For example, UMA Engineering in Calgary and PCL Construction in Edmonton had major roles in the construction of the facility.
- The C-Prosperity initiative has encouraged many community leaders to become actively involved in promoting cluster development.

5. WD Assistance was Key in Enabling Projects to Proceed

WD support has been very instrumental in ensuring that systemic projects proceed. When asked how likely it was that their project would have gone ahead, even without assistance from WD, 30 of the 66 proponents (45%) indicated that without WD assistance their project would definitely not have proceeded. Only 7 proponents (11%) indicated that there was a 100% likelihood that their project would have proceeded even in the absence of WD support. On average, there is only a 24% likelihood that the projects would have proceeded with assistance from WD. Systemic proponents noted that the WD funding helped build confidence, establish credibility, and attract funding from other sources for the projects and that alternative sources of funding were not available.

TABLE 4.7

**HOW LIKELY IS IT THAT THE PROJECTS WOULD
HAVE PROCEEDED WITHOUT ASSISTANCE FROM WD?**



Even those 26 projects that may have proceeded without assistance from WD would likely not have proceeded in the same time frame and with the same scope. Respondents commented that:

- The project would have been delayed by one or two years (11 respondents);
- Only parts of the project would have proceeded (10 respondents);
- The facilities would not have been as well equipped (6 respondents); and
- The scale of the project would have been reduced (4 respondents).

C. IMPACTS ON INNOVATION COMPANIES

As part of this review, we conducted interviews with a sample of 150 innovation companies who were asked to comment on the impact of WD funded innovation-related projects on their organization. The sample was drawn from companies that received funding from WD, companies known to operate in key clusters targeted by WD, and companies identified by project proponents as having been impacted by WD supported projects.

Of the 150 companies, 116 had received funding at some time from WD including 75 companies that had received funding under FJST, 54 companies that had received funding under ITPP, and 17 companies that had received funding under WDP prior to 1995. The major findings are summarized below:

IMPACTS ON INNOVATION COMPANIES

- WD funded projects have impacted on the innovation companies, with representatives rating the impact of any innovation-projects for which their company had received funding, as well as any systemic projects undertaken by others, as a 3.7 on a scale of 1 to 5, where 1 is no impact at all and 5 is a major impact.
- In particular, WD supported projects were viewed as impacting on company research capabilities (an average rating of 3.4) and encouraging them to increase their investment in R&D (3.1). Respondents noted that projects helped to improve the effectiveness and magnitude of their technology or product development activities, facilitated a new investment in equipment or other technology, enabled them to hire staff or students to work on research projects, and otherwise expanded their capabilities or resources available for research. The projects also assisted in the commercialization of new technology (3.1), primarily as a result of the ITPP program, and adoption of new technology (3.1).

A summary of the survey results is provided in the following paragraphs (a more detailed description of the survey results is provided in Appendix VII).

1. Innovation Companies are a Later Stage in the Industry Life Cycle than the Systemic Projects

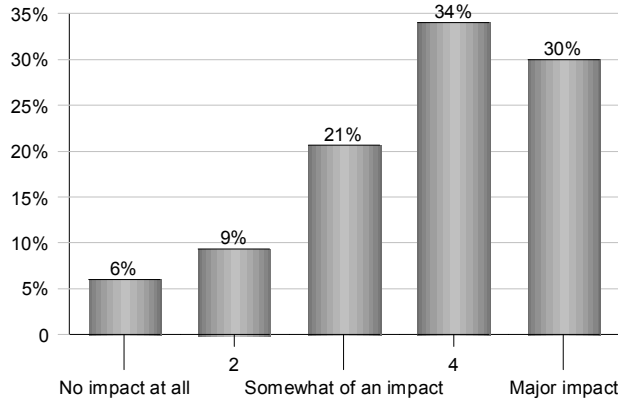
The majority of the companies (76%) are in the pre-commercialization, early stage commercialization, or growth phases of the industry life cycle. Whereas only 5% of the systemic projects were targeted at industries characterized as mature, 23% of the innovation companies identified their industry as being in the mature or declining stage of the product life cycle. This reflects that the programs which have funded systemic projects generally target emerging clusters while the ITPP and FJST are accessible to a wide range of industries.

2. WD Funded Projects Have Impacted Innovation Companies in Western Canada

The representatives were first asked to identify any innovation-projects for which their company had received funding as well as any systemic projects, undertaken by others, which have had an impact on their organization. They were then asked to rate how much of an impact that the project(s) have had on their organization on a scale of 1 to 5, where 1 is no impact at all and 5 is a major impact. The average rating was 3.7 indicating that the project(s) had a relatively significant impact.

TABLE 4.8

HOW MUCH OF AN IMPACT HAVE WD FUNDED PROJECTS HAD ON THE COMPANY?



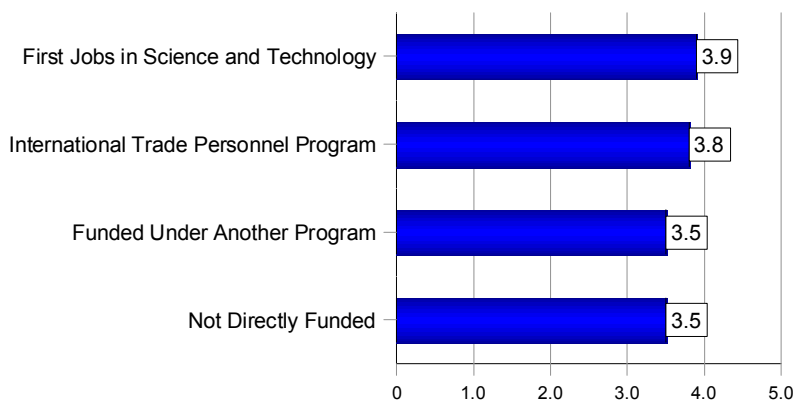
When asked to provide a rationale for the rating, the most common responses were that the project:

- Added to the resources available to the firm;
- Contributed to the growth and/or survival of the firm;
- Enabled or greatly assisted in the start-up of the business;
- Assisted in the development of a new technology or product;
- Enhanced the companies sales and marketing capabilities; and
- Resulted in costs savings.

The average rating varied somewhat depending upon the WD program under which the company received funding. As indicated in Table 4.8, the ratings ranged from a high of 3.9 for organizations that had received funding under FJST to 3.5 for companies that had received funding from a WD program other than FJST or ITPP. Representatives whose company had not directly received funding but were aware of systemic projects also provided an average rating of 3.5.

TABLE 4.9

HOW DO THE IMPACT RATINGS VARY BY PROGRAM?



3. A Wide Range of Impacts Have Been Generated

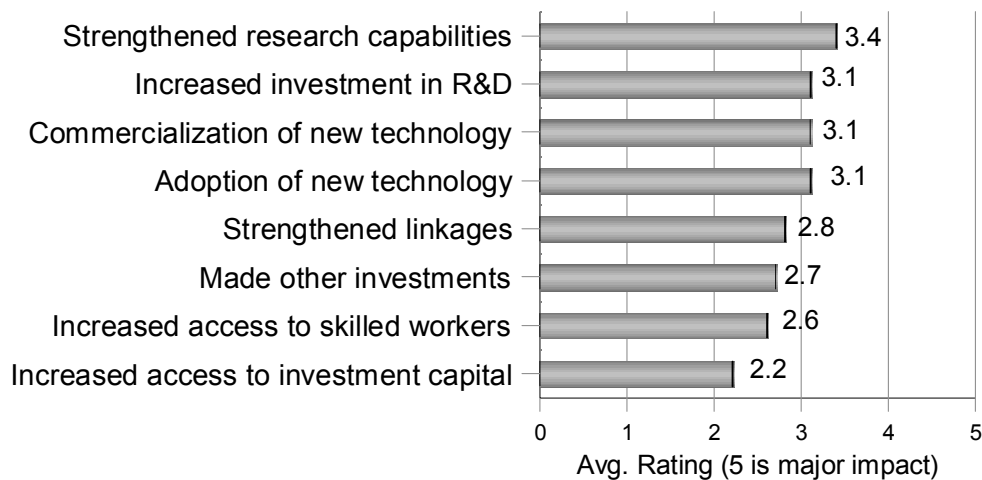
The proponents were then asked, using the same scale of 1 to 5 where 1 is no impact at all and 5 is a major impact, to rate the extent to which the project(s) had generated certain specific impacts on their organization including:

- Strengthening research capabilities;
- Increasing investment in R&D;
- Encouraging other investments;
- Strengthening linkages between industry, government and/or the research infrastructure;
- Increasing access to skilled workers;
- Increasing access to investment capital;
- Facilitating adoption of new technology; and
- Assisting in the commercialization of new technology.

The average response to these questions is lower than the average rating given by the respondents with respect to the overall impact of the projects because each project tends to be targeted at only a small number of these impacts. For example, a FJST project may be targeted at increasing access to skilled workers and strengthening research capabilities but not impact access to investment capital or industry linkages. A higher average rating indicates that the impact is a more common objective among the projects and that some success has been achieved. A lower rating indicates that the impact is not a common objective amongst the projects. As indicated in Table 4.10, the average ratings ranged from 2.2 with respect to increasing access to investment capital to 3.4 with respect to strengthening research capabilities.

TABLE 4.10

TO WHAT EXTENT HAVE INNOVATION COMPANIES EXPERIENCED SPECIFIC TYPES OF IMPACTS?



A discussion of the reported impacts is provided below:

a. Impact on Research Capabilities

Of the 150 companies surveyed, 80 rated the impact of the project(s) on their research capabilities as a 4 or 5. When asked how the project(s) strengthened their research capabilities, the most common responses were that it helped to improve the effectiveness of their technology or product development activities (26 respondents), enabled them to hire one or more students to work on research projects (26 respondents), and expanded their capabilities or resources available for research (16 respondents).

b. Increased Investment in R&D

Of the 150 companies surveyed, 68 rated the impact of the project(s) on their investment in research as a 4 or 5. The most common responses were that it led to, or facilitated, a new investment in equipment or other technology (24 responses) and they increased their investment in new product or technology development projects (20 respondents).

c. Assisting the commercialization of new technology

Of the 150 companies surveyed, 70 rated the impact of the project(s) in assisting in the commercialization of their investment in research as a 4 or 5. Approximately 60% of these respondents attributed the impacts to the assistance that the ITPP program provided in helping them to develop international markets for their products. Others indicated that the project enabled them to develop new products which are now being commercialized or to develop Canadian markets for their products.

d. Facilitating the adoption of new technology

Of the 150 companies surveyed, 68 rated the impact of the project(s) in facilitating the adoption of new technology as a 4 or 5. Of these 68 companies, 40 indicated that they had hired students under the FJST program who had helped in the adoption of new technology such as technical equipment, testing equipment, industrial machinery, robotics, and computers. Others indicated that the project had helped in adapting technology to their business environment or developing new software, equipment or processes.

e. Strengthening the linkages between their organization and other organizations.

Of the 150 companies surveyed, 68 rated the impact of the project(s) in strengthening their organization's linkages with other organizations as a 4 or 5. The types of organizations with which linkages most commonly were strengthened were the broader network of companies and other organizations in the cluster (22 respondents) and specific representatives in one or more other companies (8 respondents).

f. Encouraging them to make other investments.

Of the 150 companies surveyed, 52 rated the impact of the project(s) in encouraging them to make other investments as a 4 or 5. Estimates of the amounts invested ranged from \$100,000 to \$700,000, with the exception of one company funded under WDP which indicated that the support received eventually led to the further investment of \$90 million. The types of assets in which investments were made included new technology, equipment, production processes, new products and people.

g. Increasing access to skilled workers.

Of the 150 companies surveyed, 49 rated the impact of the project(s) in increasing their access to skilled workers as a 4 or 5. Of these respondents, 19 had participated in the ITPP program and 30 in the FJST program.

h. Increasing access to investment capital.

Of the 150 companies surveyed, only 30 rated the impact of the project(s) in increasing their access to investment capital as a 4 or 5. Respondents noted that the results of the projects had assisted them in going public (1 respondent), accessing venture capital or angel investment (11 respondents), obtaining loans or increasing their line of credit (9 respondents), or accessing other government funding (3 respondents).

D. THE PROMOTION OF TECHNOLOGY CLUSTERS

While it is premature to assess the ultimate impact that WD will have in promoting the development of technology clusters in Western Canada, this section provides examples that illustrate the role of the organization and its projects. More specifically, this section provides a brief overview of some of the actions taken by WD in promoting the development of fuel cells, life sciences related to health and agriculture, ICT, the climate change cluster; and synchrotron-related activities. The results are highlighted below:

THE PROMOTION OF TECHNOLOGY CLUSTERS

Examples of the roles played by WD in promoting key technology clusters in Western Canada include:

- WD has played a significant role in the development of the fuel cells industry through its early support to Ballard Power Systems and strong support for Fuel Cells Canada in recent years. British Columbia, in particular, has the potential to become a global centre for commercial fuel-cell application and development.
- WD has been very effective in promoting early stage development of the health care sector through its important association with the St. Boniface General Hospital Research Centre and its role in the development of the Alberta Network for Proteomics Innovation, Genome BC and Genome Prairie as well as other projects.
- WD has facilitated the expansion of research capacity and strengthening of linkages between researchers and industry in agriculture life sciences through initiatives such as its support for the Wine Research Centre, the Richardson Centre for Functional Foods and Nutraceuticals, development of the technology incubator at NRC's Plant Biotechnology Institute, and expansion of the Veterinary Infectious Disease Organization.
- To facilitate continued development of ICT, WD has made strategic investments in a number of key organizations such as NewMIC, TRILabs, and NEWT to expand capabilities and to strengthen linkages between companies and with the shared research infrastructure. Wireless and new media offer significant opportunities for further economic development.
- WD support has enabled the University of Regina to become a leader in climate change research through the new Greenhouse Gas Technology Centre, the International Test Centre for Carbon Dioxide Capture, the Prairie Adaptation Research Collaborative (PARC) and the associated work of the Petroleum Technology Research Centre. Climate change has become a high priority for the Federal and Provincial Governments, particularly with the ratification of the Kyoto Accord.
- WD played a critical role in enabling the Canadian Light Source (CLS) synchrotron to be constructed in Saskatoon. When it becomes operational in 2004, CLS will be Canada's largest research and development facility. CLS, in association with the Alberta Synchrotron Institute and the Saskatchewan Synchrotron Institute have positioned Western Canada to develop a substantial core competence related to the use of synchrotron science in the fields of proteomics, nanotechnology and a variety of molecular biology and physics disciplines.

WD has also worked to support the development of clusters and linkages by promoted and described in more detail in the following paragraphs (more detailed descriptions of individual projects is provided in Appendix VI).

1. Fuel Cells

WD played a critical role in the initial development of the fuel cell industry through the support it provided to Ballard Power Systems in the late 1980s as well as the support that it provided to Global Thermoelectric (although the company was not yet involved in fuel cells). Beginning in 1999, the Department placed a renewed emphasis on fuel cells with the identification of the cluster as a high priority in its Medium Term Strategy.

Under the Canada/BC WEPA, \$13 million in funding was invested in the fuel cell industry. Of this amount, \$12.02 million was made available for demonstration projects and \$980,000 was dedicated to establishing Fuel Cells Canada, a national non-profit organization to assist industry, academia and government in

capitalizing on the opportunities in this rapidly growing sector. The purpose of Fuel Cells Canada (FCC) is to collaborate with all levels of government, the private sector and educational institutions and encourage economic spin-offs in the supply of parts and subsystems as well as engineering, design, testing, training and research services to the industry. FCC was also responsible for identifying, coordinating and presenting fuel-cell systems demonstration projects for funding considerations. Support for market focused demonstration projects utilizing fuel cells or fuel cell related technologies are critical to prove the potential uses and benefits of the technologies, establish performance, and prove reliability, durability and efficiency.

The \$13 million contribution by the federal and provincial governments included funding to test and evaluate the next generation of fuel cell bus engines. It enabled BC Transit to buy three fuel cell bus engines from XCELLSIS Fuel Cell Engines - a joint venture by DaimlerChrysler AG, Ballard Power Systems and the Ford Motor Company. XCELLSIS tested the engines and monitored their performance, maintenance requirements and durability. In June, 2002, an additional six fuel cell demonstration projects received funding including projects to demonstrate the use of fuel-cell power units in powered industrial trucks, build a small-scale hydrogen generator unit, demonstrate the refuelling process and procedure for powered industrial trucks, develop a sustainable, integrated fuel-cell-based system to generate electricity, demonstrate the viability of a hydrogen fuelling station for vehicles, and demonstrate and test a 1.2-kilowatt utility standby fuel-cell system.

These projects provide a venue to showcase and prove the potential uses and benefits of fuel cells and related technologies as well as serve to attract investors, developers, suppliers and potential purchasers to the region. Demonstration projects will also show the safety of the fuel cells and related technologies and advance the development of codes and standards.

WD also contributed \$1 million to Fuel Cells Canada (FCC) and the National Research Council (NRC) toward the construction of six additional code-compliant, hydrogen safe laboratories at the Vancouver-based Fuel Cell Technology Centre. On completion of laboratory construction, client companies will be able to set-up testing and demonstration projects in fully hydrogen-safe laboratories. The laboratories will serve as incubator facilities for new companies to carry out required testing and development of new parts and subsystems, and allow existing technology developers that do not have the required facilities to pursue test and research activities necessary for the commercialization of their products.

WD plays a broader role than simply providing funding. It also acts as a catalyst and facilitator by serving as an advocate to governments on behalf of the industry and by participating on the FCC Board, on the NRC Innovation Centre Advisory Board, in the Fuel Cell Commercialization Road Map process, and in the development of the Fuel Cells for Everyone course. In addition, WD supported an industry study (Fuel Cells: The Opportunity for Canada) which represented the first ever study of Canadian fuel cell industry, its potential, and recommendations for action. While BC is the lead region with respect to fuel cells, WD in Alberta has also been active in supporting conferences and in the development of a proposal that would make the Northern Alberta Institute of Technology (NAIT) a leader in the implementation and optimization of fuel cell technology for stationary power generation.

Tremendous growth in the industry has occurred since the initial support was provided to Ballard Power Systems almost fifteen years ago. Ballard Power Systems has emerged as a world leader in PEM fuel cell technology and is now complemented by a strong and emerging cluster of fuel cell developers, users, system integrators, and component and service suppliers. The local industry now employs over 1,500 people.

The potential for further growth is very significant. Fuel cells possess vast potential as an energy source in the 21st century and over the next 20 years. Fuel cells convert natural gas, methanol, petroleum and hydrogen fuel into electricity. Heat and pure water are the only by products when fuel cells are supplied directly with hydrogen. This technology provides an environmentally friendly source of energy, a solution to greenhouse gas emissions that cause global warming, and an opportunity for significant economic development. British Columbia could become the global centre for commercial fuel-cell application and development. Industry forecasts for fuel cells predict exponential growth in world markets from \$4 billion US in 2003 to \$46 billion US in 2011. By 2020, it is projected that the potential market for fuel cells could be \$145 billion worldwide, creating 15,000 jobs for every billion dollars in demand.

2. Life Sciences - Health

WD has been very active in promoting the development of the life sciences cluster in Western Canada. As an illustration, the Department has:

- Provided leadership in raising awareness of the economic diversification opportunities of the health sector. For example, in Alberta, WD provided assistance for a review of the life sciences sector and facilitated discussions with other Federal and Provincial Government departments and agencies to lever financial support and link the proposal with the other stakeholder activities on a pan western basis.
- Established targeted loan fund programs for the health industry and biotechnology sector.
- Used the CFI Support Program to help the research community prepare applications to lever significant research infrastructure investment in BC.
- Worked with various organizations to help address human resource skills requirements in the cluster.

In addition, WD has also provided support for a wide range of research projects related to life sciences. In Manitoba, a key driver of the life sciences cluster is the St. Boniface General Hospital Research Centre. The 110,000 square foot Research Centre is currently home to dozens of major world-class research programs, including those in cardiovascular sciences, oncology and health research on aging. The Centre has received WD funding for a series of projects including \$1.25 million for a filmless radiology network, \$4.5 million for a demonstration site of MRI technology used for neurological research, \$2.1 million to establish a Centre of Health Research for the Elderly, and \$3 million for a clinical cardiology research initiative.

More recently, St. Boniface received \$5 million in WD support to establish the \$25 million I.H. Asper Clinical Research Institute, which is currently under construction adjacent to the St. Boniface General Hospital Research Centre. The new research facility will help further cardiovascular care through the bridging of research and patient care, and will provide the clinical resources necessary for the improvement of cardiovascular medicines and treatments. It will also help Manitoba further develop its reputation as a leader in vascular and cardiology science/health research in Canada - Manitoba will have one of only three facilities across Canada that can support Phase 1 to Phase 3 clinical trials for new drugs and medical devices. The facility will make it easier for companies and entrepreneurs to test their products in preparation for commercialization.

The impacts of the St. Boniface General Hospital Research Centre to date have been significant. For examples, 8 patents have been filed relating to intellectual property from research undertaken at the Centre, over 1,100 scientific publications have been prepared, 6 biotech companies have been started, the Research Centre now has over 250 employees, (including 30 research scientists and 26 support staff), and a \$90 million venture capital fund has been assembled. The new Clinical Research Institute is projected to have aggregate research revenues of \$50 million.

WD has also provided significant support for projects in other areas. Two examples are projects related to proteomics and genomics and, which are highlighted below.

- In Alberta, WD worked closely with the University of Alberta, the University of Calgary, the University of Lethbridge, and the Government of Alberta to develop the Alberta Network for Proteomics Innovation (ANPI), a major proteomics research centre in Alberta. ANPI draws on the capabilities of the three universities as well as provincial and federal laboratories in chemistry, structural biology, bioinformatics, and other disciplines that underlie proteomics to create an integrated base of competence. WD played an important role at the early stages, by helping to bring all of the stakeholders to the table and providing significant funding for the establishment of the initiative including:
 - \$60,000 to the University of Calgary for costs incurred by the three Alberta universities towards the development costs for establishment of the centre.

- \$1 million to the University of Calgary, \$1 million to the University of Alberta and \$150,000 to the University of Lethbridge to assist with research equipment purchases to help the universities develop their capacity in proteomics research.
- \$2 million over 5 years to the University of Alberta, University of Calgary and University of Lethbridge for the start-up and operating costs of ANPI. The funding enables the three universities to focus in the area of proteomics research, provide core services (i.e. gene sequencing, genotyping and gene-chip reading technologies), provide a central repository for genomics data, provide an ethical regime for genomics activities, and ensure appropriate linkages to industry.
- \$2 million to acquire research equipment necessary for ANPI activities.

Overall, WD funding to ANPI has resulted in matching funds from other public and private partners totalling \$50 million. ANPI has established a unique position as a provider of life sciences research infrastructure in Alberta. The availability of new platform technologies is key to Alberta's ability to compete globally in the "post genomics era" of life sciences research. ANPI funding has been crucial to the establishment of the Institute of Biomolecular Design (IBD) at the University of Alberta as well as the Sun Center of Excellence for Visual Genomics at the University of Calgary and the Biostructural Centre at the University of Lethbridge.

The development of IBD reflects the increasingly important role played by computers in nearly every aspect of drug discovery and development. They have helped discover and develop new treatments for many diseases including AIDS, cancer, high blood pressure, obesity and arthritis. Computer aided drug design has grown so fast that there is now a critical shortage of skilled individuals to perform these tasks. In response to this shortage, the University of Alberta, created the Institute for Biomolecular Design (IBD), a \$25 million on-campus institute with state-of-the-art computer and graphics facilities that brings together researchers from a variety of faculties into a multi-disciplinary research environment for new drug development. The IBD houses 25 different principal investigators plus another 75 students, postdocs, technicians and support staff. IBD's scientists come from all corners of the University campus with representatives from biochemistry, chemistry, biology and pharmaceutical. The presence of IBD has precipitated a second \$14 million project. IBD expects to be a significant incubator for commercialization in the field of proteomics and create spinoff companies, licensable technology and world class research results. In the longer term, IBD expects to have a team of more than 50 researchers and occupy more than 45,000 square feet of office and lab facility.

The close proximity of ANPI and IBD to the Protein Engineering Network Centre of Excellence (PENCE), the National High Field NMR Facility (NANUC), the Agriculture Canada research stations in Lacombe and Lethbridge, and NRC's Plant Biotechnology Institute, AgWest Biotech and the synchrotron facility in Saskatoon is helping to create a cluster of internationally recognized excellence in Western Canada in related research fields, significantly enhancing the collective scientific value of these research centres. It will enable Alberta to keep and attract top research scientists, a critical prerequisite for the development of these industrial clusters in the province. Moreover, the focus of ANPI on collaboration and building an integrated base of competence among the three major universities, provincial and federal research laboratories and federally funded Networks of Centres of Excellence is critical in establishing an organization with credible research strength in order to compete with major research organizations nationally and internationally.

- WD provided \$1 million to the BC Cancer Agency to acquire equipment for its affiliated Genome Sciences Centre (GSC). WD also prepared the Treasury Board Submission and

acted as the conduit for the federal transfer of \$10 million to the GSC. The priority of GSC is to find innovative means to automate the DNA sequencing and fingerprinting process, develop cost-effective measures that will make such research financially viable and utilize state of the art computing facilities to collect, mine, analyze and disperse data collected at this and other genome facilities. By fully understanding genes, the GSC will be able to improve the diagnosis of disease, develop new medicines and apply genomics knowledge to other areas important to BC's economy.

WD provided also funding to help Genome BC develop a research-funding proposal to Genome Canada. Established in 2000, Genome BC is one of five Genome Canada genomics research centres across the country. The purpose of the Centre is to provide a coordinated and strategic approach to genomics in British Columbia and enable BC to become a world leader in this field. By creating an infrastructure, encouraging investment and technology transfer and establishing partnerships with researchers and research facilities, Genome BC is creating a virtual institute for genomics research. BC boasts the highest per capita investment by Genome Canada in the country, with approved projects and platforms worth over \$100 million.

- Genome Prairie is a not-for-profit corporation recently established by Genome Canada to coordinate and undertake genomics research across the three Prairie provinces. WD provided \$500,000 over two years for start-up operating costs to enable the organization to staff key positions, develop its programs, build linkages to industrial partners, ensure awareness of the proposed programs within all levels of government, and develop research proposals. There are now 250 researchers employed on 6 projects.

In part because of the impact of the WD supported activities, the life sciences sector (including biotechnology and genomics cluster) has experienced phenomenal growth in Western Canada. For example, in BC, the industry now employs more than 3,000 people and consists of over 90 private biotech firms and several public research institutions in BC. It has been estimated that over 70% of the biotechnology companies have been borne out of local research.

In Alberta, the close proximity of the Protein Engineering Network Centre of Excellence (PENCE), the National High Field NMR Facility (NANUC), the Institute of Biomolecular Design in Edmonton, the Agriculture Canada research stations in Lacombe and Lethbridge, and NRC's Plant Biotechnology Institute, AgWest Biotech and the National Synchrotron Facility in Saskatoon is helping to create a cluster of internationally recognized excellence in Western Canada in related research fields, significantly enhancing the collective scientific value of these research centres. It will enable Alberta to keep and attract top research scientists, a critical prerequisite for the development of these industrial clusters in the province. Moreover, the focus of ANPI on collaboration and building an integrated base of competence among the three major universities, provincial and federal research laboratories and federally funded Networks of Centres of Excellence is critical in establishing an organization with credible research strength in order to compete with major research organizations nationally and internationally.

3. Life Sciences - Agriculture

In support of the life sciences cluster related to agriculture, WD has provided funding for a range of projects including projects targeted at:

- The functional food and nutraceutical industry. Functional foods and nutraceuticals are products that are demonstrated to have physiological (health) benefits and/or reduce the risk of chronic disease beyond their basic nutritional functions. The world market for functional foods and nutraceuticals is estimated to be over \$50 billion US and the value of the industry is expected to reach \$500 billion US worldwide by 2010. Many of the commodities produced in Western Canada have the potential to be grown and processed into functional foods and nutraceuticals for domestic and international markets.

To facilitate industry growth, increased research efforts are needed across a broad spectrum of scientific, clinical and engineering areas to support health claims and encourage the development and commercialization of products. To help promote the industry, WD has provided assistance towards the development of a \$25 million state-of-the-art integrated research and development centre that will be built at the University of Manitoba. The Richardson Centre for Functional Foods and Nutraceuticals will promote collaboration among researchers from different disciplines to identify, enhance, economically extract and test bioactives. In Alberta, WD support was important in the development of the Alberta Health Industry Alliance (AHIA). AHIA has proposed development of a Functional Foods and Nutraceuticals Test Centre in Alberta.

- The wine industry. WD first provided \$490,000 to UBC's Wine Research Centre (WRC) for new equipment to carry out research on the sciences, including genomics, of grape cultivation and wine making and then provided \$500,000 to upgrade labs to carry out wine research. WRC's mission is to conduct pioneering research in enology and viticulture and to develop highly qualified human resources with relevant scientific expertise and enterprise who will promote the technological advancement of the wine industry in Canada.
- Commercializing plant biotechnology. The National Research Council's Plant Biotechnology Institute (PBI) in Saskatoon received funding under WEPA for a multi-million dollar expansion to develop a technology incubator facility. Five tenants have committed to the facility and there is additional space for two more companies. The incubator companies at PBI have attracted \$15 million in investment capital.
- Infectious diseases in animals. WD has provided funding, in two stages, for expansion of the Veterinary Infectious Disease Organization (VIDO) at the University of Saskatchewan. Researchers will explore the genetics of bacteria to see which genes are responsible for causing disease, as well as the genes that marshal the body's defence against these organisms. The work is expected to lead to the development of new medicines and vaccines to combat infectious diseases in both humans and animals. As a result of the two projects, the staff complement will grow from 50 to 140 people.

4. Information, Communications and Technology

ICT has long been recognized by the Federal Government as a key driver of economic development and, as a result, WD has been very actively involved in promoting development of the industry as well as the use of ICT through its e-business initiatives and other initiatives. The software industry has been a key component of the economy since the 1980s. Other segments, such as new media and wireless, continue to experience high rates of industry growth.

To facilitate continued development of ICT, WD has made strategic investments in a number of key organizations to expand capabilities and to strengthen linkages between companies and with the shared research infrastructure. Examples of these investments include:

- WD is the Federal Government partner in TRILabs, Canada's largest not-for-profit applied telecommunications research consortium, with laboratories in Edmonton, Calgary, Regina, Saskatoon and Winnipeg. These labs provide a unique opportunity for more than 200 researchers, professionals seconded from industry, professors, graduate and undergraduate students and support staff to develop knowledge and expertise on technologies with commercialization potential. WD has contributed \$10 million over four years to help TRILabs to develop new technology applications, advance knowledge in formation technologies and telecommunications, and train university students for productive roles in Canadian industry. In its 15 year existence, TRILabs has trained nearly 700 highly skilled university graduates, created 250 technologies adapted for use by companies and generated 43 patented inventions.
- WD recently supported the development of the Network for Emerging Wireless Technologies (NEWT) at the Alastair Ross Technology Centre in the Calgary Research Park. NEWT is

currently one of the most developed wireless testbeds in Canada and is becoming a model for other wireless testbeds that are underdevelopment. Investments in NEWT totalled \$3.5 million including \$1.5 million from [http://www.westerndevelopment.ca](#) and \$400,000 from Alberta Innovation and Science with the remaining \$1.6 million to be generated from industry user fees and memberships.

- WD supported the development of the New Media Innovation Centre (NewMIC) in BC. NewMIC is a unique collaboration between industry, academia and government that focuses on the research, development and commercialization of new media technologies and applications. NewMIC has attracted investment and developed partnerships with multinational corporations including Electronic Arts, IBM, Nortel Networks, Sierra Wireless, Sony and Telus. The result is that academic researchers are able to work directly with industry to develop commercial products faster and more efficiently. NewMIC received \$4 million from WD over 5 years (including \$2.8 million under WEPA) for initial operating costs, \$1.8 million to establish the Immersive Media Lab, and \$0.75 million to establish a human computer interface laboratory to study and assess the human interaction with, and response to, technology.

5. Climate Change

Climate change has become a high priority for the Federal and Provincial Governments, particularly with the ratification of the Kyoto Accord. WD's early involvement with climate change technologies was motivated, in part, by a desire to ensure that Western Canada received a reasonable share of funding under the Technology Early Action Measures (TEAM) program.

WD has been particularly active in assisting the University of Regina in becoming a leader in climate change research through the new Greenhouse Gas Technology Centre, the International Test Centre for Carbon Dioxide Capture, the Prairie Adaptation Research Collaborative (PARC) and the associated work of the Petroleum Technology Research Centre. The Greenhouse Gas Technology Centre received a \$2.8 million contribution from WD to create a new facility for leading-edge research on reducing greenhouse gas emissions, especially emissions produced by the energy industry. Research conducted at the Centre will help Canada respond to its international environmental commitments on climate change, while pioneering the global reduction of greenhouse gas emissions over the long term. The new Centre builds on the December 1999 funding announcement for the \$8.5 million International Test Centre for Carbon Dioxide Capture. The International Test Centre consists of a pre-commercial scale technology demonstration plant at SaskPower's Boundary Dam Power Station near Estevan and a pilot plant at the university for greenhouse gas technology development and screening. Research on capture techniques will help decrease the amount of carbon dioxide released into the atmosphere and pave the way for new storage and disposal methods and new industrial uses for the gas.

In Alberta, WD has provided funding for a range of projects focussed on the suitability and economics of disposing of CO² in the Western Canadian sedimentary basin, the development technology for displacing methane trapped in coal beds with carbon dioxide, acid gas re-injection, clean hydrocarbons, the removal and reduction of agriculture-related greenhouse gases, and energy efficiency audits of gas plants.

6. The Synchrotron

The Canadian Light Source (CLS), at \$173.5 million, will be Canada's largest research and development facility. The project has pulled together 14 government, university and industry capital funding partners, five major operating and research partners, 19 Canadian university user-partners and six support groups. WD, the lead Federal Government department for the project, has contributed approximately \$25 million to the capital costs of the project and other related initiatives.

CLS is a national synchrotron light source capable of generating a wide spectrum electromagnetic beam with a brightness equal to one million times greater than natural sunlight. The CLS will have a unique focus among synchrotron facilities, with a strong commitment to private-public partnerships and serving industrial users, along with the traditional focus on innovative academic research. The CLS will focus on research in four key areas: biotechnology, bio-pharmaceuticals and medicine; mining, natural resources and the environment;

\$805,000 to the College for research in July 2000 and, in January 2002, a \$3.3 million value-added processing project received approval from CFI.

- To enable WESTEST, an industry-owned research and technology laboratory that provides equipment manufacturers with advanced physical testing services, to expand and upgrade its Force and Vibration Simulation Laboratory in Portage La Prairie. The facility tests component parts, new product designs, prototypes, and machinery for the agricultural, transportation, construction, mining equipment, and product packaging manufacturing sectors. WESTEST projects that the upgraded laboratory will generate some \$2.9 million in additional fees and about \$192 million in spin-off industry sales of new products over the next 10 years.
- To assist hog producers in Alberta and Saskatchewan address environmental issues through environmentally friendly technology. The demonstration projects will assess the impact of manure treatment technologies on odour, greenhouse gas (ghg) emissions, and soil and water quality. The results from the project will help hog producers determine which technology is appropriate for their operations. Within ten years, it is projected that these technologies could reduce ghg emissions by an estimated 320 kilotonnes per year as their use becomes more widespread in Canada.
- To Economic Development Brandon for the development of an Economic Development Cluster Strategy for the community. The 20-year Strategic Plan identifies strengths and niche marketing opportunities, takes advantage of existing relationships between the city and the adjacent municipalities, creates a targeted development strategy, and assesses existing and potential opportunities.
- Towards establishment of a technology transfer program at the University of Lethbridge. The program will complement the growing level of scientific research taking place at the university, create significant opportunities in the area of technology development and commercialization and help Alberta to retain and recruit top researchers and graduate students.
- To the Sask Forest Centre in Prince Albert to help bring new methods, ideas and technologies to the Saskatchewan forestry industry, fill applied research gaps through focussed development fund investment, and develop knowledge and data infrastructure. The Saskatchewan Forest Centre brings together the best training, market research and private sector involvement from across Saskatchewan and Canada. A Forest Development Fund has been established to support sector-wide projects that develop applied technologies, conduct research, identify market opportunities and encourage expansion of the forestry industry.
- For a series of projects, delivered through IPOST, designed to promote development of the oceans industries. The oceans have long been considered a significant development opportunity for British Columbia. IPOST, formed through the consolidation of three ocean sector industry associations, focused on coastal issues such as seafood sustainability, seabed resources and phenomena, climate change, clean seas and coasts, and marine technology applications. The Institute completed initiatives in the areas of alternate species aquaculture, mariculture, aqua-feeds and information systems and provided logistical support for NEPTUNE Canada, a proposed undersea monitoring system to improve scientific understanding of the ocean system and plate tectonics.

V. SUMMARY OF FINDINGS AND CONCLUSIONS

This chapter provides a summary of our findings regarding innovation in Western Canada, the role and effectiveness of WD in promoting innovation, and the impacts generated to date.

A. INNOVATION IN WESTERN CANADA

The major findings of our review regarding innovation in Western Canada are as follows:

1. Innovation is widely recognized as the major driving force in economic growth and social development.

The Government of Canada explicitly recognizes the importance of innovation in its new Innovation Strategy, which notes that knowledge is now the main source of competitive advantage. The Innovation Strategy provides leadership, establishes targets, and will help to chart the future directions of the innovation system in Western Canada.

2. Innovation performance is a function of political, legal and macroeconomic environment, the microbusiness environment, and company operations and strategy.

More specifically, innovation performance in any region is a function of:

- The extent to which the Federal and Provincial Governments are able to establish a political, legal and macroeconomic environment that is conducive to innovation.
- A microeconomic business environment that both triggers innovation and supports innovation activity. A strong microeconomic business environment features customers that demand innovation, a highly competitive business environment, ready access to key inputs (including technology, R&D infrastructure, human resources, capital, production inputs, physical infrastructure, and commercial information) and clusters of related and supporting industries, suppliers and institutions. Clusters are the building blocks of a productive, innovative economy.
- Corporate strategies, culture, climate and structures.

3. The basic foundation of an innovation system is in place in Western Canada.

Key elements of the innovation system in Western Canada include 475 research institutes and organizations, a range of Federal and Provincial Government programs that provide funding for R&D, 14 universities, 3 university-colleges, and 7 technical institutes, technology transfer organizations located at universities in each province, and a variety of sources of business capital and other types of business assistance.

4. Further work is required to build upon this initial foundation to establish an innovation system that will enable the existing and emerging regional clusters to realize their potential for development.

Examples of notable gaps and opportunities for improvement in the existing innovation system include:

- **Total investment in research and development in Western Canada averages only about 1.0% of GDP, significantly below the Canadian average of 1.7%.** Historically, a key constraint to increasing investment in R&D has been the limited number of leading-edge research institutions in Western Canada capable of attracting significant investment from government and industry. As a result, a major focus of WD efforts to date have been on expanding the research infrastructure.

- **There are skill shortages in selected areas.** For example, Western Canada lags behind other jurisdictions with respect to the number of science and engineering graduates and size of the research workforce. Out-migration of educated workers is a key issue, particularly for Saskatchewan and Manitoba.
- **Access to early-stage patient capital is more restricted in Western Canada than in other jurisdictions.** Ontario and Quebec, which account for 62% of the population and 55% of the economic output, manage 87% of the venture capital in Canada. The angel investor network tends to be very informally structured in Western Canada. Access to funding for technology demonstration and commercialization activities has also been identified as a constraint.
- **Stronger linkages need to be developed between the various components of the innovation support system.** Although progress has been made, stakeholders noted that the innovation system in Western Canada is still characterized by relatively weak linkages and limited collaboration between participants.
- **Regional clusters are evolving but still in a relatively early stage of development.** In Western Canada, companies tend to be smaller than those in other regions, there is a greater reliance on the traditional resources industry, and the manufacturing sector is less developed and innovative.

B. THE ROLE OF WD IN PROMOTING INNOVATION

The major findings of our review regarding the role of WD in promoting innovation are as follows:

1. WD's approach to innovation has evolved over time.

The approach that WD has taken towards promoting innovation can be segmented into three major time periods: 1988 to 1995, 1996 to mid-1999, and mid-1999 to the present as outlined below:

- Prior to 1996, the promotion of innovation was not identified as a specific Departmental objective. However, WD did deliver a range of programs and services that served, at least in part, to promote innovation in Western Canada. A major focus of WD during this period involved the provision of direct financing to individual companies.
- From 1996 to mid-1999, WD underwent extensive restructuring. Some of the key elements of this restructuring included the decision to no longer provide direct financial contributions to individual companies, the introduction of a variety of new programs including programs targeted specifically at innovation, the development of the Western Canada Business Service Network, and the definition of WD activities into business lines.
- Since mid-1999, WD has developed a formal Western Innovation Strategy as well as a medium-term strategy and a long-term strategy for economic development in Western Canada that have helped to further define the Department's activities. A major implication of this process has been the establishment of innovation as a major strategic pillar within the Department.

2. There is strong support for the priority placed by WD on innovation.

Overall, 99% of the members of the innovation support system and 98% of the companies who were surveyed agreed that it was appropriate for WD to place a high priority on supporting innovation given its mandate of promoting economic development and diversification. The representatives noted that innovation is the key driver of economic development and, by definition, diversification requires some

form of innovation. The representatives also indicated that WD's involvement is required given the importance of innovation and the gaps in the existing innovation system which need to be addressed.

3. In recent years, WD has provided extensive financial support for innovation.

Given the close relationship between innovation and economic development, virtually all activities undertaken by WD are designed, in some measure, to promote innovation. As such, the activities of WD related to innovation have been delivered through a variety of programs including the Western Economic Partnership Agreements, Western Diversification Program, Strategic Initiatives and Special Projects, First Jobs in Science and Technology Program, International Trade Personnel Program, Canada Foundation for innovation Support Program, Conferences Sponsorship Program, and Innovation and Community Investment Program. Over the past 6 years, almost 2,700 projects totalling almost \$370 million have been approved under these programs. In addition, Loan Investment Fund Programs have been established for selected technology clusters and other assistance has been available through the Western Canada Business Service Network.

4. Although WD has provided significant amounts of funding, the role of the organization is best characterized as that of a catalyst which makes strategic investments.

The results of our review indicate that:

- **WD funding for innovation accounts for only a relatively small proportion of funding on innovation-related activities in Western Canada.** For example, the \$46 million spent by WD on innovation activities in the fiscal year ending March 31, 2001, would represent only 4% of the Federal Government expenditures on S&T in Western Canada and only about 1.4% of R&D expenditures in Western Canada. As a result, WD expenditures must be made very strategically and be highly levered if they are to impact the innovation system in Western Canada.
- **Funding from WD has been highly levered with funding from other sources.** In some cases, WD serves as the primary source of funding for a given project. In other cases, the funding from WD acts as a catalyst to attract other funding or top up funding from other sources to ensure that the project proceeds in timely fashion and at an appropriate scale. In still other cases, WD may fund the early stage development of a given project which will then attract significant funding from other sources for the implementation of future stages. WD funding has, on average, represented about 28% of the total costs of the projects supported by WD. In other words, approximately \$2.56 has been invested by others for every \$1.00 invested by WD.
- **WD places a high priority on working in partnership with other federal departments and agencies, provincial governments, community-based organizations, and other stakeholders involved in innovation.** Rather than direct financial support to businesses, WD innovation activities and investments place a high priority on fostering public-private-research institution partnerships and consortia. The results of our interviews indicate that most members of the innovation support system in Western Canada have had considerable interaction with WD with respect to innovation.

5. While the financial assistance provided by WD is often the most visible type of support provided by WD, the role of WD staff in bringing together groups, formulating partnerships, nurturing champions, and assisting in the design of projects and initiatives can be the most critical contribution that WD makes in promoting the development of a given cluster.

The majority of proponents indicated that WD provided hand-on assistance in addition to the funding that was provided. The role of the Department is often characterized as helping to fill the gaps that

may exist in the innovation system for a given cluster. WD's level of involvement varies depending upon the nature of the gaps to be filled and the resources available from other sources.

As such, the nature of involvement can vary by province. For example, in Manitoba and Saskatchewan, where fewer resources are available and capabilities are less developed, WD staff may take more of a leadership role and spend more time working with others in developing projects. In Alberta and BC, where infrastructure capabilities are more developed, WD staff may spend more time responding to requests for assistance.

Apart from its direct involvement in projects, WD has also worked closely with other organizations to identify provincial and pan-Western priorities, to facilitate joint planning, to work to strengthen innovation programs and services, and to address the "innovation gaps" that exist in the West as a result of a lack of investment in research and development in key sectors. This priority is reflected in the leadership role that WD plays in various forums such as the Western Forum of Senior Innovation Officials, Western Economic Development Deputies Forum, Western Economic Partnership Agreements, and the Industry Portfolio. In particular, it was noted that WD has developed strong relationships with the Provincial Governments.

6. The assistance provided by WD can be targeted at any element of the innovation system.

For example, programs and initiatives work to address various elements in the innovation system by strengthening the strategic infrastructure, encouraging investment in research & development, supporting new technology adoption and commercialization, facilitating specialized skill development, and increasing access to capital. WD investments are made to strengthen both the individual elements of the western innovation system and the linkages between the elements.

7. The innovation-related activities of WD have become increasingly focussed on cluster development.

The underlying objective for improving innovation performance is to facilitate the further development of industrial clusters in Western Canada. Reflecting the results of research and consultations undertaken in developing their innovation strategy, WD gives priority to promoting the growth of key knowledge-based clusters related to life sciences (which includes clusters such as biotechnology, proteomics, and health technologies), information technology (which includes clusters in areas such as new media, telehealth, and geomatics), and physical sciences (which includes clusters such as fuel cells, design engineering, climate change technologies, synchrotron and micro-technologies). The targeting of clusters has enabled WD to become more proactive in identifying and developing potential projects.

C. THE EFFECTIVENESS OF WD IN PROMOTING INNOVATION

The major findings of our review regarding the effectiveness of WD in promoting innovation are as follows:

1. According to key stakeholders, WD has been very effective in supporting innovation.

The role of WD is most commonly characterized by the stakeholders as that of a facilitator and catalyst for innovation, particularly through the provision of funding, through assistance for the development of supporting infrastructure, and through assistance targeted at leading-edge clusters. When asked to rate the effectiveness of WD on a scale of 1 to 5, where 1 is not at all effective and 5 is very effective, the average responses ranged from 3.7 amongst members of the innovation support system to 4.2 amongst the proponents of systemic projects.

2. WD possesses a number of unique characteristics which enables the organization to effectively support innovation in ways that other organizations are not able to.

Approximately three-quarters of the members of the innovation support system and proponents of systemic projects who were surveyed indicated that WD has certain characteristics that make it uniquely able to fill certain gaps in the innovation system. These key characteristics included:

- The flexibility of its programming, which enables WD to tailor its activities to reflect the specific needs of each province and key clusters as well as to provide a continuum of services.
- Its availability of funding, which is considered crucial in bringing parties together and leveraging resources from other sources.
- The ability of the organization and its employees to respond quickly and make decisions.
- Its ability to match national resources and strategies with regional and provincial needs and issues.
- The presence of staff in the regions who are skilled in developing projects, building partnerships, and assessing opportunities. The experience that staff have gained in economic development, vetting projects, working with various parties, and promoting specific clusters enables the Department to add value to this process.
- Its familiarity with the local economy, clusters, and players are major contributing factors to the effectiveness of WD. While WD may provide funding on a project-by-project basis, one of its strengths is that the organization tends to focus on building relationships and establishing development objectives which extend beyond any one project.
- WD is generally perceived as a neutral party that does not have its own agenda apart from promoting innovation, which gives it an advantage when working to establish partnerships.

The stakeholders indicated that there would be a significant negative impact if WD were to no longer place a high priority on innovation. Funding limitations was the factor most commonly identified as constraining WD from having an even greater impact. Some stakeholders criticized WD for being too reactive and supporting too wide a range of activities; however, others viewed this as a strength because it indicates that the organization is market-driven in responding to opportunities presented by potential proponents.

3. Where available, WD and other members of the innovation system benefit from clearly defined strategies for the development of specific clusters and regions.

Development strategies and roadmaps have been prepared for certain clusters and regions and both WD and other stakeholders supporting innovation would benefit from the further development of such strategies. According to stakeholders, broadly agreed upon strategies for development enable WD and other organizations to become more pro-active in promoting the development of specific clusters and/or regions and help in defining future directions and roles. In the past, the absence of clearly defined and communicated strategies, coupled with the evolving mandate of WD, has created some confusion and uncertainty with respect to the role of WD and its relationship to other organizations. Establishing clear objectives and target outcomes would also be useful in defining the future role of the organization and providing a basis for evaluating progress.

4. The role of WD in supporting innovation is well recognized by organizations that are potential targets for funding but often not at all recognized by the general public and to only a limited degree by the business community.

When the members of the innovation support system, proponents of systemic projects, and representatives of innovation companies were asked to rate how well recognized WD is for the role that they play with respect to encouraging innovation in Western Canada (on a scale of 1 to 5, where 1 is not at all well and 5 is very well recognized), the average ratings ranged from 2.6 amongst the corporate respondents to 3.1 amongst both the innovation representatives and the project proponents as indicated below. However, many of the stakeholders questioned the need to significantly increase the visibility of WD given that the Department already has strong relationships with the other key players in the provincial innovation systems. The key, according to these respondents, is to ensure that WD continues to build on these relationships and is also recognized within the Federal Government for the critical role that it plays with respect to innovation in Western Canada.

D. ILLUSTRATION OF THE IMPACTS TO DATE

The primary focus of our review is on WD's innovation-related investments and activities that have been implemented since mid-1999. Stakeholders stress that improving innovation performance is a long-term process which, while critical to the future competitiveness of Western Canada, will take many years to be realized. This is particularly true of the major systemic projects supported by WD which, by their nature, generally require an extensive period to be implemented (of the 66 proponents of systemic projects surveyed, only 56% were associated projects that have been completed and are fully operational) and will generate economic impacts over the medium to longer-term. For example, the expanded research infrastructure is creating pipelines that will generate economic activity five, ten and fifteen years out from today.

In the report, we have sought to highlight the types of impacts that can be generated from WD's investment and activities as well as to provide examples of progress that has been made to date, recognizing that, only over the medium to long-term, will it be possible to assess the actual impact of WD's innovation-related activities. The major findings of our review of impacts of WD innovation-related activities to date are as follows:

1. The systemic projects are helping to build the foundation necessary for future growth.

When asked to rate the effectiveness of the projects to date in promoting further development, where 1 is not at all effective and 5 is very effective, the average rating was 4.3 and 75% of proponents rated the projects as being effective or very effective in promoting further development. More specifically, the systemic projects have had a major impact to date in terms of:

- Strengthening research capabilities in Western Canada (average rating of 4.4). The projects have built both human resource and physical infrastructure capacity, created linkages and research networks, brought research into new areas and significantly increased capacity with respect to leveraging additional research funds; and
- Strengthening linkages between industry, government and/or the research infrastructure (average rating of 4.4). In most instances, these linkages took the form of collaboration related to research, industry issues, or development opportunities.

The projects have also had a significant impact in terms of increasing access to skilled workers, increasing investment in R&D, and raising the profile of the cluster, sector or region. The 66 projects themselves have created approximately 2,000 on-going full-time equivalent (FTE) positions.

2. WD support was generally instrumental in ensuring that systemic projects proceeded.

On average, there is only a 24% likelihood that the projects would have proceeded without assistance from WD. The 26 projects, that may have proceeded without assistance from WD, would likely not have proceeded in the same time frame and with the same scope.

3. WD funded projects have assisted innovation companies in strengthening their research capabilities, increasing their investment in R&D, and commercializing new technology.

A sample of 150 innovation companies was interviewed regarding the impact of WD funded innovation-related projects on their organization. The sample was drawn from companies that received funding from WD, companies known to operate in key clusters targeted by WD, and companies identified by project proponents as having been impacted by WD supported projects. On average, the representatives rated the impact of any innovation-projects for which their company had received funding, as well as any systemic projects undertaken by others, as a 3.7 on a scale of 1 to 5, where 1 is no impact at all and 5 is a major impact.

The average rating varied somewhat depending upon the WD program(s) under which the company received funding, ranging from 3.9 for organizations that received funding under FJST to 3.8 for organizations that received funding under ITPP and 3.5 for companies that received funding from other WD programs. Representatives whose company had not directly received funding but were aware of systemic projects also provided an average rating of 3.5.

The WD supported projects were most commonly identified as impacting the company's research capabilities (an average rating of 3.4). The innovation companies noted that the projects helped to improve the effectiveness and extent of their technology or product development activities, facilitated a new investment in equipment or other technology, enabled them to hire staff or students to work on research projects, and otherwise expanded their capabilities or resources available for research.

The projects also assisted in the commercialization of new technology (3.1), primarily as a result of the ITPP program which assisted in developing international markets, and the adoption of new technology (3.1). Students hired under the FJST program helped in the adoption of new technology such as technical equipment, testing equipment, industrial machinery, robotics, and computers. WD funded projects also helped companies in adapting technology to their business environment or developing new software, equipment or processes.

4. By helping to build and sustain a critical mass of research, technological, financial and human resources and by forging strong linkages among innovation players, WD has contributed to the formation and development of clusters that will provide the basis for the continued economic growth and prosperity of Western Canada.

Examples of roles that WD has played in promoting further development of key technology clusters in Western Canada include:

- WD has played a significant role in the development of the fuel cells industry through its early support to Ballard Power Systems and strong support for industry initiatives in recent years.
- WD has been very effective in promoting early stage development of the health care sector in Manitoba through its important association with the St. Boniface General Hospital Research Centre.
- WD has strongly supported the development of a health life science sector in Alberta through support for initiatives such as the Alberta Network for Proteomics Innovation and the Institute of Biomolecular Design.
- WD has facilitated the expansion of research capacity and strengthening of linkages between researchers and industry in agriculture life sciences through initiatives such as its support for the Wine Research Centre, the Richardson Centre for Functional Foods and Nutraceuticals, development of the technology incubator at NRC's Plant Biotechnology Institute, and expansion of the Veterinary Infectious Disease Organization.
- To facilitate continued development of information communications and technology, WD has made key strategic investments in a number of key organizations such as TRILabs, the Network for Emerging Wireless Technologies, and NewMIC to expand

capabilities and to strengthen linkages between companies and with the shared research infrastructure.

- WD support has enabled the University of Regina to become a leader in climate change research.
- WD played a critical role in enabling the Canadian Light Source (CLS) synchrotron to be constructed in Saskatoon. At a cost of \$173.5 million, CLS will be Canada's largest research and development facility when it becomes operational in 2004.

5. WD has strengthened linkages between organizations through initiatives such as its support for the WestLink Innovation Network.

WD is a founding sponsor of the WestLink Innovation Network, a not-for-profit organization that facilitates communication, collaboration, and technology development and commercialization among 13 Western Canadian Universities, 3 Networks of Centres of Excellence and their affiliated research institutions.

6. WD is supporting the development of clusters in both regional and urban centres.

WD has supported a wide range of initiatives designed to enhance regional innovation performance. For example, WD has provided support:

- For a major study to review innovation activity occurring in the rural areas of BC, assess the infrastructure and systems that have been established to support regional innovation, and identify potential actions that could be taken to improve innovation performance.
- For the establishment of the Olds College Centre for Innovation (OCCI), with a mandate to encourage innovation and diversification within Alberta's agricultural community by assisting in product, business and human resource development.
- To enable WESTEST, an industry-owned research and technology laboratory that provides equipment manufacturers with advanced physical testing services, to expand and upgrade its Force and Vibration Simulation Laboratory in Portage La Prairie.
- To assist hog producers in Alberta and Saskatchewan address environmental issues through environmentally friendly technology.
- To Economic Development Brandon for the development of an Economic Development Cluster Strategy for the community.
- Towards establishment of a technology transfer program at the University of Lethbridge.
- To the Sask Forest Centre in Prince Albert to help bring new methods, ideas and technologies to the Saskatchewan forestry industry, fill applied research gaps through focussed development fund investment, and develop knowledge and data infrastructure.
- For a series of projects, delivered through IPOST, designed to promote development of the oceans industries.