

The Growth of the Digital Economy in Western Canada: Opportunities for Western Economic
Diversification to Support the Digital Economy

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Executive Summary

Innovations in the digital economy are important to overall economic growth. The digital economy mainly consists of the Information and Communication Technology (ICT) and the Interactive Digital Media (IDM) sectors. Innovations from the digital economy are adaptable to functions and productions in other sectors which contribute to increased production efficiency. The digital economy is an emerging industry that plays an increasingly important role in Canada. The Government of Canada has recognized the need to expand the digital economy to increase the country's global competitiveness and expand its digital media advantage.

As a regional development agency, Western Economic Diversification (WD) is interested in supporting the growth of the digital economy as it acknowledges the importance of the industry and aligns its priorities with the government. WD plays a role in improving the region's competitiveness which is one of the department's priorities by encouraging business productivity and increasing innovation capacity. As the federal government works towards a national digital economy strategy, WD is interested in identifying challenges in innovations from the digital economy in Western Canada. Therefore, the report will examine the importance of innovations in the digital economy, Western Canada's digital economy and WD's current contribution, other jurisdictions' strategies to promote innovation in the digital economy. Drawing from the analysis, recommendations will be provided to WD on how it can expand its involvement in the industry. In doing so, the report will identify the financial barriers of Western Canada's digital economy to determine how WD can expand its support to the industry to align WD's priorities with the federal government's digital economy strategy and to encourage innovation growth in the emerging industry.

Methodology

Academic, private and public resources were used throughout the report to provide a detailed analysis of the digital economy in Western Canada. A definitions section based on academic and public sources clarified the meaning of key terms that were used throughout this report. Using academic and public resources, the background section examined the importance of innovations in digital economy to the economy and why governments are interested in supporting the sector. In addition to sources examined in the background, other academic sources were used to create the literature review section to examine the importance of innovation, the innovation process and government rationale for intervention. A conceptual framework was developed from the literature review to examine the roles of various actors in Western Canada's digital economy and identify shortfalls in the innovation process. Using government websites, the cross-jurisdictional Scan section examined programs from the rest of Canada, South Australia and Germany to review different strategies that support the digital economy. The information and analysis from the sections were then used to provide WD with evidence-based recommendations.

Research Findings

The conceptual framework developed from the literature review and analysis of Western Canada's digital economy revealed that while there is funding to support the innovation process, there is a lack of funding to support start-up firms that commercialize innovation. While there is sufficient direct public funding that support higher education and research organization for the research and development of innovation, both the federal and provincial government do not offer sufficient direct funding to businesses involved in innovation. Therefore, businesses in Western

Canada have mostly depended on private sources to fund the commercialization of innovation. However, it is difficult for new start-up firms to secure enough capital for innovation. Thus, the insufficient funding for start-up firms in the innovation process hinders them from participating in innovation.

The cross-jurisdictional scan examined programs from the Atlantic Canada Opportunities Agency (ACOA), Ontario provincial government, South Australia and Germany. Based on findings from the jurisdictions, there is an emphasis on supporting the commercialization process of innovation. In particular, the Ontario and South Australian programs offer specific assistance to start-up firms in the digital economy. ACOA takes a broader approach with funding for both commercial projects and non-commercial projects in the sector. Germany took a broad-based approach to strengthen horizontal cooperation in the innovation process. The examples from the jurisdictions and findings from the conceptual framework were applied to form recommendations for WD.

Canada does not have a comprehensive approach in supporting innovations in the industry. This affects WD's role in the digital economy as it does not have a specific mandate to encourage innovation in the digital economy. In the South Australian example, the state government places an emphasis on supporting the start-up and growth of new businesses in the digital economy. Germany takes a different approach, as the ICT2020 strategy also promotes horizontal cooperation to encourage innovations in the digital economy. Compared with the German approach, the South Australian program is more narrowly focused on firm-based innovation. Their programs also take into the consideration of other actors in the innovation system, as well as the challenges start-up firms tend to face.

Recommendations

From the findings of the report, it reveals that there is a lack of government support to start-up firms in the digital economy. WD can adopt the following actions:

1. To create a Digital Economy Team to prepare and address the federal digital economy strategy, and to oversee WD's strategies for the promotion of the digital economy.
2. To establish a specific funding program to support start-up firms in the digital economy.

The findings of the report will provide WD with information to address shortfalls in the region's digital economy and prepare for the upcoming federal digital economy strategy. It will also be a reference point for future research on the topic.

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1. Introduction

Innovation in the digital economy is important to the growth of the economy. Innovations from the digital economy are adaptable to functions and productions in other sectors which contribute to increased production efficiency (Colecchia & Schreyer, 2002, p. 409). According to the Government of Canada (2010), Canada needs to expand the digital economy if it wishes to become more globally competitive (p. 20) and expand its digital media advantage (p. 25). As a regional development agency (RDA), Western Economic Diversification is interested in supporting the growth of the digital economy as it acknowledges the importance of the industry and aligns its priorities with the government.

Western Economic Diversification Canada (WD) was created by the federal government in 1987 to diversify and improve the long-term competitiveness of Western Canada's economy (Western Economic Diversification [WD], 2010b, para. 2). To promote economic development in the region, WD provides financial support to activities in innovation, business development and community economic development (WD, 2010b, para. 3). Therefore, one of WD's priorities is to encourage innovation, which is a process that transforms knowledge into new products, processes, or services to generate new economic benefits (WD, 2010a). WD promotes innovation activities by providing strategic funding to projects in the digital economy, life science, clean technology and other enabling technology industries (WD, 2010a).

The digital economy, which consists of the information and communication technology (ICT) and the interactive digital media (IDM) sectors, is identified by WD as a key industry focus (Government of Canada, 2010). Between Fiscal Year (FY) 2005-2006 and 2009-2010, WD contributed \$24.0 million to projects in the digital economy (approximately 9 percent of total \$287 million funding to innovation projects) (WD, 2010, Internal Document [Microsoft Excel], "Multi-Year"). The funding supported projects in new media, wireless technology, telehealth, and geomatics (WD, 2010a). The FY 2011-2012 Corporate Business Plan reemphasizes WD's commitment to promoting the growth and development of the digital economy (WD, n.d., p. 20) to achieve the department's objectives to encourage innovation in Western Canada and to align its priorities with the federal government (WD, 2010a).

In May 2010, the federal government launched an online public consultation to create a federal digital economy strategy (Government of Canada, 2010, p. 9). The Canadian government is interested in pursuing a digital economy strategy as it recognizes the importance of innovations from the digital economy "to create jobs, foster growth and create new opportunities for Canadians" (Government of Canada, 2010, p. 11). Acknowledging that Canadian firms are consistently investing less than other G7 countries in terms of ICT innovations, the Canadian government also links the underinvestment in ICT as a contribution to the country's weak productivity growth in the recent decade (Government of Canada, 2010, p.13). Through the consultation and the development of a nation-wide strategy, the government aims to review its current programs and policies to align their support for ICT innovations with existing business strategies and ensure global competitiveness (Government of Canada, 2010, p. 13). The government's commitment to building a federal digital economy strategy is reemphasized in the 2011 Budget (Ministry of Finance, 2011, p.150).

The report will identify the shortfalls of Western Canada's digital economy to determine how WD can expand its support to the industry to align WD's priorities with the federal government's upcoming digital economy strategy and to encourage innovation growth in the emerging industry. WD's Corporate Policy division is interested in gaining a better understanding of how innovation fits into the digital economy, what role has WD been playing in supporting the sector and where WD can fill the gaps to support the digital economy. Thus, the intended outcome for the research project is to provide WD with: an analysis of Western Canada's digital economy; relevant information to prepare for a national digital economy strategy; and recommendations to expand its role as a supporter of the digital economy in Western Canada. Specifically, the report will examine information from WD, public sector resources, academic discourse and grey-literature to provide:

- An overview of the digital economy in Western Canada;
- A definition of innovation with examinations of the theories and the components of innovation;
- An explanation of market failures in innovation and the purpose of public intervention;
- An analysis of the innovation process in the digital economy;
- A summary of public and private support to the innovations in the digital economy in Western Canada; and
- An analysis of WD's funding to digital economy innovation from FY2005-2006 to 2009-2010.

Using the information gathered, the report will then identify the potential funding shortfalls in the innovation process of Western Canada's digital economy and where WD fits in the current framework. The report will then examine how other jurisdictions address the gaps in the process to provide WD with recommendations on how WD can address funding challenges faced by Western Canada's digital economy.

The rest of the management report will be presented as follows. The Definitions section will clarify the meaning of key terms that will be used throughout this report. The Background section will examine the importance of innovations in digital economy to the economy and why governments are interested in supporting the sector. The Literature Review section will review the academic position on innovation, why governments support innovation and how regional innovation systems are important to the development of the digital economy. The section following the Literature Review will examine the roles of various actors in the region's digital economy. It will identify the shortfalls in the regional innovation system of the digital economy in Western Canada and where WD can potentially play a role in supporting the sector. This is followed by a Cross-Jurisdictional Scan, which will examine the rest of Canada, South Australia and Germany's programs that support innovation in the digital economy. A Discussion and Recommendations section will review the information to provide recommendations on how WD can better support innovations in the digital economy. A conclusion will summarize the findings and recommendations of this report.

2. Definitions

It is important to define innovation for the purpose of this report. Various actors of innovation, such as government agencies, universities, firms and other industrial organizations ascribe different meanings to the word innovation.

2.1. Innovation

WD defines innovation as a process that turns knowledge into new products to generate new economic benefits (WD, 2010a, para. 1). Products of innovation can include physical products, processes or services (WD, 2010a, para. 1). The OECD defines the term based on four types of innovation: product innovation, process innovation, marketing innovation and organizational innovation (Organisation for Economic Cooperation and Development [OECD], n.d., para. 2). Product innovation refers to goods or services that are new or improved, while process innovation is where there is “a new or significantly improved production or delivery method” (OECD, n.d., para. 3-4). Marketing innovation and organizational innovation involve new marketing or organizational methods (OECD, n.d.). Based on these definitions, “innovation process” refers to innovation as a process, while “innovation” will refer to the result of such process.

2.1.1. Research and Development

The term “research and development” (R&D) is closely related to innovation. In the innovation process, research and development refers to the three early stages of innovation—“basic research, applied research and experimental development” (OECD, 2001, para. 1). Basic research refers to research that result in “new knowledge of the underlying foundations of phenomena and observable facts” without application of the knowledge (OECD, 2003b, para. 1). Applied research is the research undertaken to specifically gain new knowledge to achieve a particular goal (OECD, 2003a, para. 1). Experimental development moves the research stage towards commercialization as it applies research to new innovation (OECD, 2003c, para. 1).

2.1.2. Commercialization

“Commercialization” of innovation is usually conducted by the industry, where the innovation is introduced as a new product or service to the market (Canada Business, 2011, para. 2). This is considered the second to final stage of the innovation process. Therefore, the process of innovation begins with research and development which leads to the commercialization of the innovation.

2.2. Summary

Innovation is a complex term that is used differently by various groups. Overall, innovation generally refers to a new or improved product, service or process. The innovation process refers the stages of development that start from an idea that leads to research and development and finally to commercialization.

The background section will examine the definition of the digital economy and how various actors interact in the innovation process to determine gaps that hinder the success of innovation. This would enable WD to have a better understanding on how to fill these gaps to encourage innovation in the digital economy.

3. Background

This section examines the definition of the digital economy and provides an overview of the industry in Western Canada. The digital economy is mainly comprised of the information and communication technology (ICT) and interactive digital media (IDM) sectors and they will be examined individually to assess the current state of the digital economy in Western Canada. This enables the reader to better understand the context of the report and allows WD to better assess its position in supporting the growth of the sector in Western Canada.

Sources from this section are gathered from online databases such as JSTOR, Elsevier, Science Direct and Google Scholar. Government websites were also used to gather data and information on Canada's digital economy.

3.1. Definition of the Digital Economy

According to the Government of Canada, the digital economy refers to

“the network of suppliers and users of digital content and technologies that enable everyday life. Digital content and technologies are ubiquitous and critical to almost every activity in our economy and society. These applications enable businesses to be innovative and productive; help governments to provide services; and allow citizens to interact, to transmit and to share information and knowledge” (Government of Canada, 2010, p.8).

The ICT and IDM sectors make up the digital economy. The focus of this report is on innovation from the ICT and IDM sectors. Johansson, Karlsson and Stough (2006) define the digital economy as the “recent and still largely unrealized transformation of all sectors of the economy by the general spread of ICTs” (p. 3). The digital economy emerges from the development and diffusion of contemporary ICT innovations (Johansson, Karlsson & Stough, 2006, p. 3). While literature suggests that the digital economy mainly consists of innovations from the ICT sector, the federal government includes the IDM sector as part of the digital economy (Government of Canada, 2010). It identifies the IDM sector as an emerging sector important to expanding the economic potential of Canada's creative industries (Government of Canada, 2010). As well, WD supports innovation projects in both sectors of the digital economy.

In *Improving Canada's Digital Advantage*, the Government of Canada (2010) describes innovations from the ICT sector as digital products and services that change the way people live, such as the Blackberry, global positioning system (GPS) and iPad (p.9). The IDM sector, as defined by the Canadian Interactive Alliance, is composed of digital content and environments via the Internet, mobile networks or gaming devices that facilitate interactive participation between users for entertainment or education purposes (Canadian interactive Alliance [CIAIC], 2010, p.20).

3.2. The ICT Sector

The OECD (2002) defines the ICT sector as a “combination of manufacturing and services industries that capture, transmit and display data and information electronically” (p. 81). The ICT sector in Canada plays an increasingly important role in encouraging overall productivity.

According to the National Research Council (NRC), the ICT sector is an enabler to other sectors¹ through software development, photonics, microelectronics and wireless (National Research Council Canada [NRC], 2010). ICT innovations, as argued by Lucas, Sands and Wolfe (2009), facilitate the transformation of traditional “mechanical, electric and electro-mechanical systems” (p. 189) to electronic systems. This creates a trend of “miniaturization of components” (Lucas, Sands & Wolfe, 2009, p. 189) to enable quicker adoption and transmission of these new components. The sector is also highlighted by a quick turnover of new innovations and acceleration of productivity (Lucas, Sands & Wolfe, 2009). An example is the physical size of hard drives. The diameters of disk drives have reduced from 14 inches and 8 inches to 5.25 inches and 3.5 inches within a decade (McKendrick, 2001, p. 313). Thus, the growth of the ICT sector is also instrumental in promoting overall economic competitiveness.

In Canada, the ICT sector is an emerging sector important to the growth of the country’s economy. Across the country, ICT output continues to be on the rise, reaching 1.4 percent of real Gross Domestic Product (GDP) in the third quarter of 2010 (Industry Canada [IC], 2011a, p. 3). The country’s ICT sector is largely comprised of small companies, where 80 percent of the 32,000 ICT firms in 2005 employed approximately one to nine people (Lucas, Sands & Wolfe, 2009, p. 191). According to Industry Canada, the ICT sector contributed approximately 4.8 percent of GDP to Canada in 2008, with revenue of \$59.2 billion (IC, 2009, para. 6). As well, the ICT sector contributed to approximately \$5.7 billion of R&D spending in 2006, accounting for 39 percent of total private sector R&D (Lucas, Sands & Wolfe, 2009, p. 191). While Ontario and Quebec continue to lead in the ICT sector, Western Canada’s ICT sector is becoming increasingly competitive (IC, 2010a).

Western Canada’s ICT sector is emerging as a leader in the country. Across Canada, two out of eight ICT clusters are located in Western Canada—Calgary and Vancouver (Lucas, Sands & Wolfe, 2009, p. 191). According to Michael Porter (2000), “clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions...in a particular field that compete but also cooperate” (p. 15). Western Canada currently produces approximately 25 percent of Canada’s total output in the ICT sector: \$59.5 billion in 2008 (IC, 2010a, p. 1). As well, Alberta and British Columbia are leading in terms of sector growth as a proportion of GDP (*Figure 1*). Between 2002 and 2008, Alberta’s ICT sector GDP growth was 6.9 percent and British Columbia was 5.4 percent (*Figure 1*). This is compared to Ontario, which is the leading ICT region, with 4.3 percent growth between 2002 and 2008 (*Figure 1*). Manitoba and Saskatchewan also experienced 3.9 percent increase between 2002 and 2008 (*Figure 1*). Western Canada’s digital economy has competitive advantages in various activities, such as wireless technologies, and geomatics (WD, 2010c, p. 41). In particular, innovations in the ICT sector in Western Canada support other sectors by adding to their value-chains in computer engineering, medical robotics, nanodevices and nanofabrication, enterprise software solutions and Global Positioning System products (WD, 2010c, p. 41). The sector also specializes in remote sensing, wireless broadband, e-health, security, e-learning, e-training, Smart Grid and special effects production (WD, 2010c, p. 41).

¹ Sectors include health technology, environmental technology and aerospace development (National Research Council of Canada, 2010).

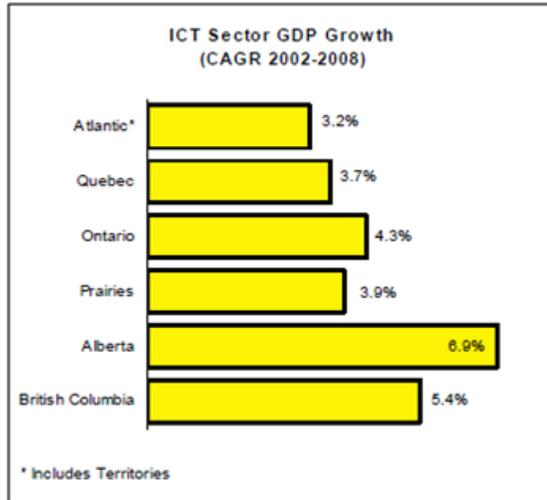


Figure 1. ICT sector GDP growth (2002 to 2008).

Adapted from *ICT sector GDP* by Industry Canada (May 2010). Retrieved November 10, 2010 from [http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0107912eng.pdf/\\$FILE/0107912eng.pdf](http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0107912eng.pdf/$FILE/0107912eng.pdf)

3.3. The IDM Sector

Canada's IDM sector focuses on digital content and environments where users engage in the participation of various purposes, such as entertainment, information or education through electronic or digital medium like the Internet, mobile networks, gaming consoles or media storage devices (CIAIC, 2010, p. 3). The IDM sector is considered by the federal government to be a fast growing sector within the digital economy. To promote the growth of the sector, the federal government announced in its 2011 Budget to support the "creation of convergent digital content across multiple platforms, including television and leading-edge applications for the Internet, wireless and other emerging platforms" (Ministry of Finance, 2011, p. 151).

Commitment from the government and investments from international firms will encourage the expansion of the IDM sector.

The IDM sector has strong growth opportunities in Canada. In 2009, Canada is ranked third as the world's leading sector for video games content creation, signifying the sector's global competitiveness and importance to the Canadian economy (Canadian Interactive Alliance [CIAIC], 2010, p. 4). This is highlighted by the games sub-sector in Canada's IDM sector, which attracted investments from global companies such as Activision, Disney, Electronic Arts (EA), Eidos, Koei, Microsoft Games, THQ and Ubisoft (Invest in Canada, 2011, p. 4). Canada's IDM sector is becoming increasingly important to the growth of the country's digital economy. In 2008, the sector's revenue was approximately \$3.8 billion (Invest in Canada, 2011, p. 3). Between 2006 and 2008, the sector posted a 50.9 percent increase in annual revenue (CIAIC, 2010, p. 52). As well, approximately 3000 companies employ more than 52,000 full-time employees in the sector (Invest in Canada, 2011, p. 3).

The IDM sector in Western Canada is younger and smaller compared to other regions in Canada, but it has competitive advantage against other Canadian regions. Compared to the IDM sector in Canada, where IDM firms average around 9 years old, firms in BC and the Prairies are relatively younger with an average age of 8.3 years old (CIAIC, 2010, p. 58). The IDM sector in Western

Canada produces digital content and environments (a created world within a computer or a group of computers) (CIAIC, 2009, p. 20) in the areas of e-learning, video gaming and social media. The sector also consists of activities such as “software development, digital compression technologies, internet applications and interactive television” (Ontario Media Development Corporation, 2009, p. 2). IDM firms in Western Canada specialize in gaming, digital entertainment, animation and digital film (WD, 2010c, p. 41). Internationally recognized video game development corporations such as EA, BioWare and Ubisoft are present in the western provinces (CIAIC, 2009, p. 22). IDM firms in Western Canada also specialize in web design and development (CIAIC, 2009, p. 22).

3.4. Discussion

The digital economy has increased the productivity of other sectors, as innovation from the industry resulted in the creation of a multifaceted relationship-based model comprising of various actors² in the innovation process (Clarke, 2001, p. 190). The digital economy allows firms to promote inter-firm interaction and to rely on external affiliates and networks to complement their work (Clarke, 2001, p. 118). The interaction between the actors in the innovation processes of the digital economy improves the efficiency of attaining knowledge and the effectiveness of sharing knowledge. There has been a general acceleration of time from 5-7 years to 3-5 years or less to complete the innovation process as a result of innovations from the digital economy (Amara, 1990, p. 146). For example, Apple’s iPhone was first released in 2007 and Apple released its fourth generation of iPhone in 2010 (Samra, 2010, para. 1). Therefore, innovations from the digital economy enabled the overall economy to be more competitive with accelerated innovation cycles.

As well, innovations in the digital economy succeeded previous world changing technologies that have greatly affected the way the economy works (Freeman, 2001, p. 118). Through the integration of innovations from the digital economy into the functions and productions of other sectors, such as introducing semiconductors in assembly lines, firms are able to increase production efficiency (Colecchia & Schreyer, 2002, p. 409). This highlights the importance of innovations in the digital economy as an “intermediate input to capital goods production” (Colecchia & Schreyer, 2002, p. 409). As innovations from the sector enable the ability to transfer knowledge digitally, new information or products can be marketed more quickly to allow quicker adoption and application by other actors. This would encourage growth in other sectors.

Western Canada’s digital economy is a growing industry that can stimulate growth in other areas of the economy. Both the ICT and IDM sectors are growing industries in the region and are gaining competitiveness against other Canadian regions. As strengthening the innovation capacity in Western Canada is a WD priority, it is important to further examine the importance of innovation to economic growth and how innovations in the digital economy will enhance that. As well, it is important to understand the role of government intervention and other actors that help promote innovation in the digital economy.

² Actors in the innovation system firms, governments, higher education institutions, research centers, industry associations, etc. (Cooke, 2001).

4. Literature Review

It is important to understand why governments are interested in supporting innovations in the digital economy. The Literature Review begins with an overview of Schumpeter's innovation theory, which has been widely used to innovation. This section examines the importance of innovation in the digital economy to the economy and the rationale for government intervention. The section also reviews common policy instruments governments use to address market failure in innovation. As well, it will examine the innovation process in a regional innovation system to identify the shortfalls in innovation.

The Literature Review provides an academic examination on why governments are interested in promoting innovation in the digital economy. The section is written with evidence gathered from academic literature, grey literature and government resources. Scholarly journals were researched online using databases such as JSTOR, Science Direct, Elsevier and Google Scholar.

4.1. Schumpeter's Innovation Theory

Schumpeter's innovation theory is widely used to discuss the importance of innovation. Innovation is a driver of the economic process (Schumpeter, 1912/2002) as it applies productive resources to untried practices and withdraws resources from their previous applications (Schumpeter, 1928, p. 378). The "Schumpeter hypothesis" focuses on market structure, firm size and innovation, and the different roles of small and large firms (Hagedoorn, 1996, p. 883). According to Schumpeter, innovation is a driver of the economic process (Schumpeter, 1912/2002), where the new innovation would lead to several more innovations to be created (Bauer, 1997, p. 559).

Schumpeter highlights the importance of the entrepreneur and the availability of capital to the success of innovation (Hagedoorn, 1996). An entrepreneur³ is an individual who has the ability to produce new things or do things in a new way (Schumpeter, 1947, p. 151). The entrepreneur serves as the main lever of economic growth by underselling and withdrawing existing practices (Schumpeter, 1928, p. 384). Entrepreneurs, in Schumpeter's definition, are embedded in new firms (Schumpeter, 1928). Although Schumpeter credits the entrepreneur as the driver of innovation, who brings new ideas into society, Schumpeter equally stresses the importance of the availability of investment in innovation. New firms need to invest large sums of capital before it could generate revenue (Schumpeter, 1928, p. 381). Entrepreneurs attract external investments by showing their innovation can increase profit margins through lower cost production or greater profits (Schumpeter, 1928). Without external investments, Schumpeter argues a new small firm cannot create innovation since it has little market power and capital (Schumpeter, 1928). Schumpeter believes that ultimately, innovation occurs in large companies where innovation is carried out per advice from specialists (Schumpeter, 1928, pp. 384-385).

Some economic theorists criticize Schumpeter's theory for being too broad and not supported by empirical evidence. A central theme in the critiques concerns Schumpeter's argument on market structure and firm size. Symeonidis (1996) found little empirical support that suggests "large firm size or high concentration are factors" (p. 59) associated with high innovation activity (p. 59). In a study conducted by Acs and Audretsch, they found firm size is unlikely a factor of

³ For the purpose of the report, the term "entrepreneur" refers to the person conducting and developing innovation. As well, it is important to note that the term is used interchangeably with "firm".

innovation, as firms with less than 500 employees had higher innovation output than larger firms which contradict Schumpeter's theory (Symeonidis, 1996, p. 59). Cohen and Levin also found little empirical support that the concentration of firms and firm size have an impact on innovation (Scherer, 1992, p. 1425). Neoclassical economics theorists believe innovation or technological changes occur in competitive markets consisting of small firms, thus challenging Schumpeter's hypothesis regarding the role of entrepreneurs and large firms (Acs & Audretsch, 1986, p. 109). While there are challenges to Schumpeter's innovation theory, it remains a widely accepted theory.

In Schumpeter's theory of innovation, he focuses on the role of the entrepreneur and the role of the investor as determinants for successful innovation. Figure 2 reveals the linear relationship based on Schumpeter's innovation theory. The process highlights the importance of financial investments (*Figure 2*). Although entrepreneurs or firms are at the centre of innovation, other actors contribute to the innovation process that leads to the development and commercialization of innovation.

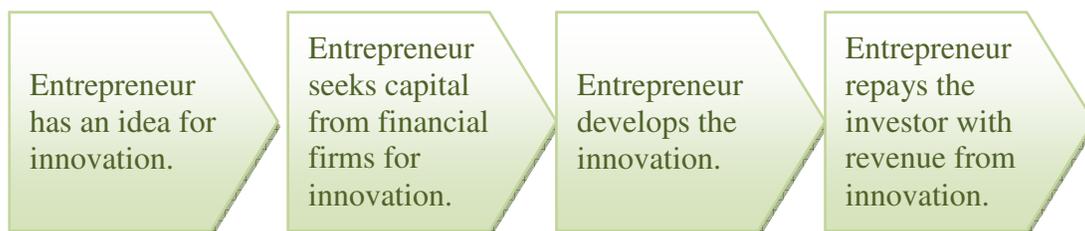


Figure 2. Schumpeter's innovation theory.

4.2. The Importance of Innovation

Despite contesting views on innovation, it is generally accepted that innovation has important impact on economic growth. Innovation allows firms (entrepreneurs) to gain temporary competitive advantage because the introduction of a new innovation lowers production cost (Schumpeter, 1928, p.378). Once a new product or service is created, the firm can benefit from temporary market dominance as the diffusion process of innovation reveals that innovation is slowly adopted by some until it the bandwagon effect occurs and innovation is adopted by multiple actors at a rapid speed (Robertson, 1967, p. 16). Competitive advantage lasts longer for firms that create innovation, as the knowledge to build such innovations is not easily transferrable (Amara, 1990, p. 145). Wanting to profit from market opportunities, firms would enter the market, resulting in an acceleration of the turnover rate of innovation (Amara, 1990, p. 150).

Innovation enables firms to escape from perfect competition through the acquisition of temporary market power to increase productivity and competitiveness (Foray & Hargreaves, 2002, p.4). Through innovation, firms are driven to compete for market dominance, thus driving economic growth. The importance of innovation goes beyond increasing market competitiveness. As current economic trends are moving away from resource dependent economies to knowledge-based economies, innovation is an important component to economic development (Council of Canadian Academies, 2009).

Given the importance of innovation to the economy, governments are interested in promoting innovation. As the innovation process consists of various actors that interact on multiple levels, it is important to examine the innovation process to determine how governments can best intervene to support innovation.

4.3. The Innovation Process

The innovation process, where an idea is researched and developed for commercialization and adoption, is made up of various actors that facilitate the process. In the innovation process, the entrepreneur is embedded in firms where commercialization occurs. *Figure 3* reveals the transition from Schumpeter’s innovation theory to the innovation process, which incorporates other actors. *Figure 3* also highlights the innovation process presented in a multi-player environment of an innovation system, which includes the interaction between three key actors in innovation: higher education institutions (universities, colleges and technical institutions), industry and government (Etzkowitz & Leydesdorff, 2000). While firms remain a key component of innovation, higher education institutions and research organizations are responsible for the initial stages of innovation, leaving firms with the role to commercialize innovation (*Figure 3*). The government plays a role in facilitating the transfer of technology⁴ from higher education institutions to firm and to provide incentives for innovation, which will be examined in the next section. Therefore, it is accepted that higher education institutions and other research organizations conduct innovation and firms commercialize innovation (*Figure 3*). *Figure 3* examines the innovation process based on applied research, as curiosity based research is not reviewed in the report.

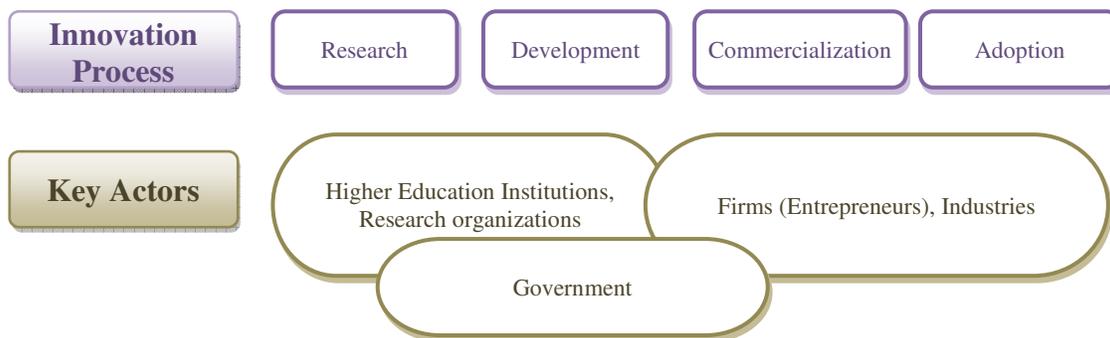


Figure 3. Basic concept of the innovation process.

Note: Adapted from *Why do companies do R&D?* by H. Douglas Barber (2010) for the 9th Annual Re\$earch Money Conference. Retrieved May 25, 2011 from <http://www.researchmoneyinc.com/conferences/201003/pdf/Why%20Companies%20Do%20R&D-Barber.pdf>

The concept of a regional innovation system results from increased global competition and shortcomings of traditional models and policies and the emergence of clusters (Doloreux & Parto, 2004, p. 7). It is an aggregate of various sector-based innovation systems that interact with regional governance and innovation infrastructure within the region (Cooke, Uranga & Etxebarria, 1997, p. 476). A region is a physical or geographically-defined area administered by

⁴ Technology transfer is the process in which intellectual property resulting from academic research and development is licensed or bought for usage by a firm to be commercialized (Friedman & Sliberman, 2003, p. 18).

networks and institutions to promote innovation (Doloreux & Parto, 2007, p. 22). A regional innovation system promotes economic coordination by encouraging “inter-firm coordination, socio-cultural structures and institutional environment” (Asheim & Isaksen, p. 78) to stimulate innovation.

Regional innovation system focuses on enhancing the competitiveness of local firms and improving the business environment (Doloreux & Parto, 2007, p. 10). The system involves the interaction of private and public organizations, institutions and other actors to generate and disperse innovation (Doloreux & Parto, 2007, p. 9). Firms play an important role in driving their own competitive advantage to promote innovation activity (Cooke, 2001, p. 951). Firms in the digital economy can benefit from regional innovation systems, as they rely on public funding for the development stages of the innovation process and then secure venture capital investments and other sources of funding for technology commercialization (Cooke, 2001, p. 962). A regional innovation system is also supported by higher education institutions (Welfens, 2005, p. 344).

Higher education institutions provide competitive advantages to innovation beyond fostering a talent pool and developing innovation for the digital economy. A talent pool is important to the digital economy because it is highly dependent on skilled labour that has academic knowledge in the subject (Etzkowitz, 2003). There is also an increasing emphasis on the promotion of technology transfer through transferring intellectual property (IP) rights from universities to firms (Verspagen, 2006, p. 608). IP is “the legal rights that result from intellectual activity in the industrial, scientific, literary and artistic fields,” (Canadian Intellectual Property Office, 2011, para. 1). For example, University of Manitoba’s Smartpark’s Incubator aims to promote entrepreneurship for Manitoban residents who have a “technology-related business opportunity, product, intellectual property idea or enterprise” (University of Manitoba, n.d., para. 3) in sectors including the ICT sector. IP developed at higher education institutions is becoming more commonly commercialized at institutions with incubator facilities and where spin-off companies are being established to facilitate the technology transfer.

Governments in a regional innovation system stimulate the market through building infrastructure, providing education and supporting companies with incentives to innovate (Cooke, 2001, p. 958). *Figure 3* reveals the role of the government who acts as a bridge between the two key actors of innovation to support the transition from research to commercialization.

Governments play a role in the regional innovation system by offering incentives, such as providing modern facilities for companies as an incentive to keep their operations in the region (Welfens, 2005, p. 344). Governments can offer tax incentives for venture capital (VC) firms to operate in the area and fund innovations in the sectors (Welfens, 2005, p. 344). By being close to large urban hubs, the digital economy can rely on the regional infrastructure support to allow technology transfer and opportunities for “tacit-knowledge exchange and other untraded interdependencies” (Cooke, 2001, p. 963).

Regional innovation systems enable coordination between actors to encourage firm innovation. The Silicon Valley is a notable example of a digital economy within a regional innovation system. The community in the Silicon Valley functions on shared norms of “co-operation, trustful interaction and ‘untraded interdependencies’” (Cooke, 2001, p. 960) allows firms from

the Silicon Valley to enjoy long-term innovation performance. By using the Internet and a variety of software and web programs, firms in the regional innovation system are able to interact quickly, responding to questions and concerns and making timely decisions (Carlsson, 2004, p. 255). Success of the ICT and IDM sectors come from the “common proximity to as well as some presence in large cities” (Cooke, 2001, p. 962), because firms are dependent on the availability of institutions and infrastructure (Cooke, 1001, p. 962). This allows firms in the industry to take advantage of establishments such as higher education institutions, research centers and government agencies (Cooke, 2001, p. 962).

Besides infrastructure, the availability of funding is important to the growth of the digital economy. The quick development of the digital economy is the result of financial support from private VC companies and stock markets that are attracted by the valuations of telecommunications, infrastructure and Internet-related innovations (Britton & McGonegal, 2007, p. 109). VC investments are one of the primary funding sources that fuel the growth of the ICT and IDM sectors (Britton & McGonegal, 2007, p. 110), as they are important to the commercialization of new technologies or innovations (Salmenkaita & Salo, 2002, p. 186). In the United States, VC investments largely went to support the growth of the digital economy, making up more than half of total VC investments (\$25.5 billion in 2006) (Britton & McGonegal, 2007, p. 111). However, VC investments often come in the later stages of innovation, since it predominantly supports the commercialization stages of innovation (Britton & McGonegal, 2007). Thus, start-up firms will require capital to pay for input costs of innovation (Pohjola, 2004). This is presented by the problem known as the valley of death (*Figure 4*). Between the government funding for R&D conducted by universities and research organizations and private funding to industry for commercialization, there is a lack of funding to facilitate the transition (*Figure 4*). This is where start-up firms may encounter financial constraints, which is marked by lack of interest from VC firms and other private investors to provide financial support to uncertain outcomes (Salmenkaita & Salo, 2002).

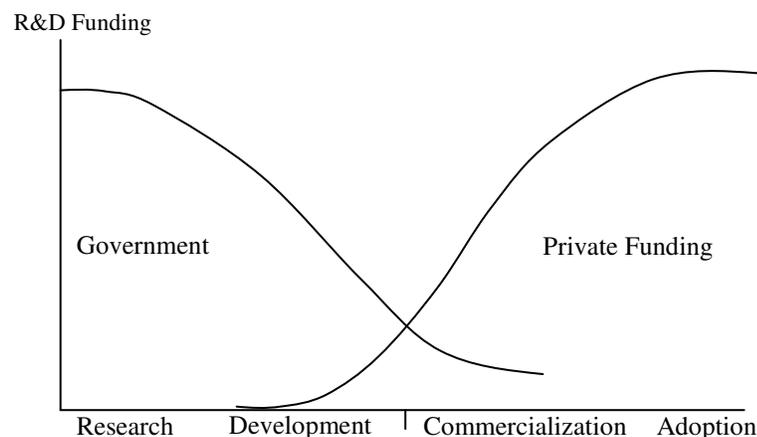


Figure 4. The valley of death.

Note: Adapted from *Bridging the valley of death: public support for commercialization of eco-innovation*, by the European Commission – Directorate General Environment, 2009. Retrieved August 21, 2011 from

http://ec.europa.eu/environment/enveco/innovation_technology/pdf/bridging_valley_report.pdf

Based on interactions between the actors of the regional innovation system, a schematic of the innovation process can be drawn (Figure 5). As higher education institutions play a role in building skills necessary for the basic and applied research to develop innovations, they are the promoters of new ideas for innovation. Other research institutions and government research centers are also at the same stage of the innovation process. Following research and development, firms commercialize innovation transferred from the institutions. Ultimately, the innovation is marketed and adopted by society. Public funding typically presides over the initial stages of innovation, while private funding supports the latter stages of innovation. Overlooking the innovation process, governments play a role in facilitating the technology transfer from university to industry by intervention to encourage innovation. The rationale for government intervention will be further examined in the subsequent section.

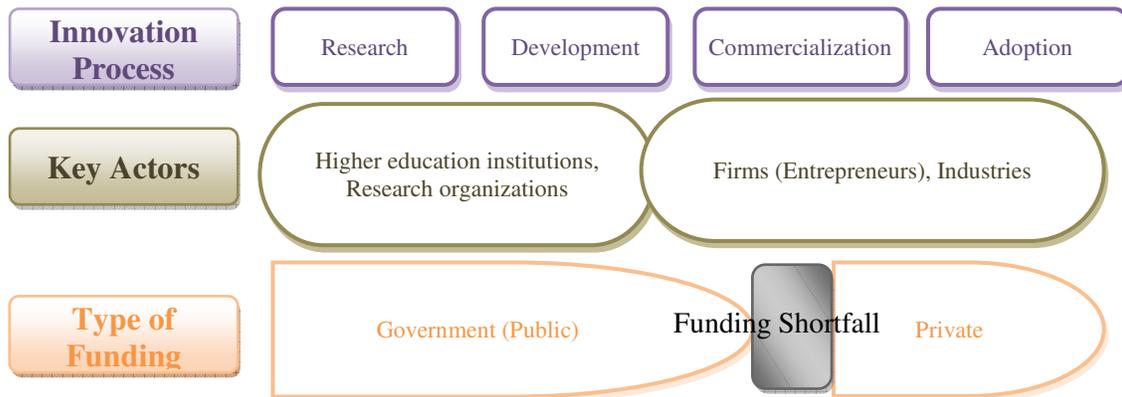


Figure 5. Conceptual framework of the innovation process of the digital economy in Western Canada

4.4. The Rationale for Government Intervention

Although firms are naturally driven to innovation because of its potential benefits, governments are involved in the innovation process to promote innovation for economic growth. This section examines why governments intervene. Market failures involving social optimality, asymmetric information and moral hazard that deter firms from innovation will be reviewed in this section.

Firms do not invest in innovations at the socially optimal level as a result of market failures. A market is considered to be producing the socially optimal level when marginal revenue of firms meets the marginal social demand (Marglin, 1963). Therefore, the amount of innovation produced by firms will not reach the socially desired level unless firms' marginal benefit equal social benefit (Figure 6). Firms will invest in innovation up until where the marginal cost equals the marginal revenue. Underinvestment as a result of market failure reduces the amount of innovation. This is because there is an uncertainty to returns of innovation, and therefore if firms are not driven by incentives, the amount of innovation created by firms will not meet the social demand. Since private firms cannot account for the entire social benefit of innovations (Loury, 1979, p. 405), governments provides incentives to firms to invest in innovations beyond their marginal revenue (Figure 6).

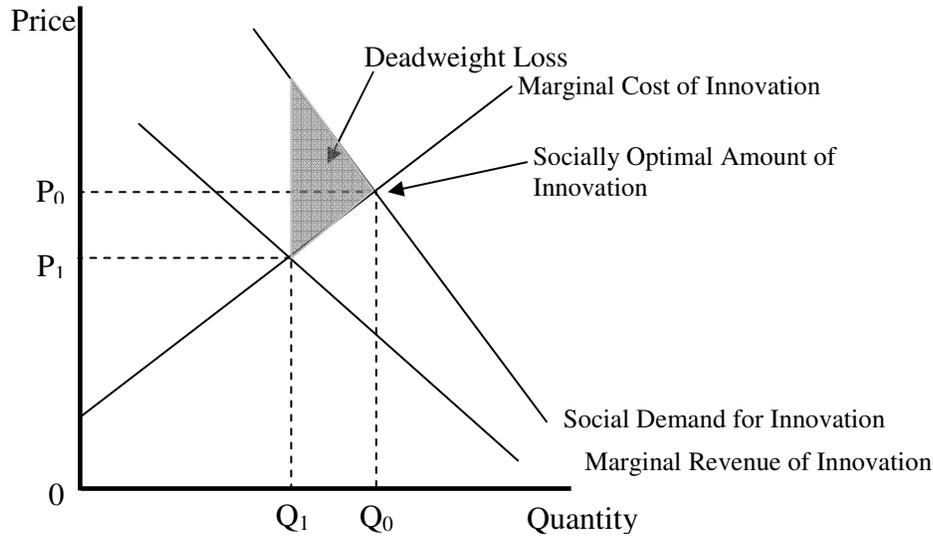


Figure 6. Socially optimal amount of innovation.

One of the market failures happens when the amount of innovation does not meet social optimality (Hauknes & Nordgren, 1999, p. 1). Hauknes and Nordgren (1999) suggest that there are three basic reasons preventing private and for-profit firms from achieving the social optimum: outcomes of innovations are uncertain; knowledge is considered a public good; and indivisibility exists in the process of knowledge generation (p. 1). Arrow and Nelson argue that knowledge spillovers discourage firms from innovation, as they undermine the appropriability of returns from innovation (Cohen & Levinthal, 1989, p. 575). However, Cohen and Levinthal (1989) argue that there is “an offsetting incentive with spillovers, because only through its R&D may a firm exploit the knowledge generated by its competitors” (p. 575). Since the social rate of return for innovation is normally higher than that of private returns, firms do not invest in innovation to the level of social returns (Hauknes & Nordgren, 1999, p. 3).

Another market failure is the problem of asymmetric information, which is when one side has more information than the other in a transaction process (Rosen, Wen, Snodden, Dahlby & Smith, 2008, p. 37). It occurs when firms try to secure external investments for innovation. Firms normally require external finances to cover the input costs of the innovation. As firms are the developers of innovation, they have more information on the innovation than the investors. Therefore, when seeking investments from financial investors, firms may withhold information from the creditor or exaggerate the expected outcome (Hall, 2002). With investors knowing less than firms, investors would be more cautious when committing funding to the innovation (Hall, 2002). This would lead to an underinvestment of the innovation, as investors’ willingness to invest in the innovation is lower than the social optimal level (Arrow, 1962, p. 616). This creates a deadweight loss (grey-shaded area in Figure 6) where the loss is suffered by society as a result of investors’ reluctance to invest. As a result, some innovations may not be created and commercialized.

Moral hazard is another market failure in innovation when there is a separation of ownership and management of the innovation (Hall & Lerner, 2009, p. 10). According to Rosen, et.al (2008), moral hazard occurs when a person has the power to influence the chances or magnitude of a loss by undertaking certain actions (p. 479). Moral hazard is a principal-agent issue where the

principal is the investor and the agent is the firm conducting innovation (Rosen, et. al, 2008). Moral hazard occurs as a result of the separation between ownership and management (Hall, 2002, p. 38). The separation leads to a conflict between the firm or person conducting innovation and the investor resulting in a failure to maximize share-value of the innovation (Hall, 2002, p. 39). Hall (2002) proposes two potential scenarios that co-exist in the case of moral hazard. First, investors would likely invest in activities that would benefit them and second, the risk averse nature of investors would deter them from investing in uncertain projects (Hall, 2002, p. 39). One potential solution is to provide long term incentives for investors to invest in innovation (Hall, 2002, p. 39). Since investors tend to be more risk averse, they are more reluctant to invest in innovation projects that would increase the firm’s risks (Hall, 2002, p. 39). Thus, because investors are the ones in control of finances, they may not invest in innovations unless success is a guarantee and their opportunity cost in innovation is low (Hall 2009, p. 11). Governments can play a role in sharing the risks by providing investments to innovation projects.

Given the disincentives for firms to invest in innovation, governments provide financial incentives to encourage firms to continue to develop innovation for society (Figure 7). Figure 7 reveals that there is a shortfall of funding between R&D and the commercialization of innovation. Therefore, governments are interested in supporting innovation because it drives productivity and economic growth. If the market is left uninfluenced by the government, there is an assumption that the market will under invest in innovation (Hauknes & Nordgren, 1999, p. 10). Thus, the policy implication for governments to enter the market is to minimize the impact of market failure to allow innovations to reach the socially optimal amount (Hauknes & Nordgren, 1999, p. 10). By providing incentives to firms, governments can encourage firms to engage in innovation activities to meet the socially optimal level. Neoclassical theorists have argued that the economy can effectively invest in the market provided that governments have set up the basic infrastructure for market mechanisms and related public goods (Mahmood & Rufin, 2005, p. 344). In order to achieve optimal allocation for innovation, government intervention is important to provide financial support to innovation (Arrow, 1962, p. 623).

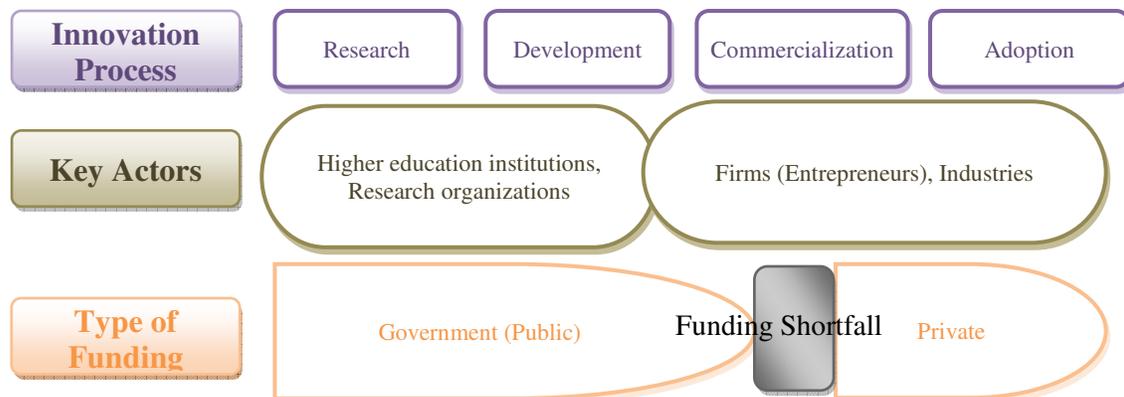


Figure 7. Conceptual framework of the innovation process of the digital economy in Western Canada.

4.5. Common Policy Instruments

Approaches from governments to support innovation are normally in the form of direct or indirect policies (Denniss, Yuan & Withers, 2009, p. 149). Governments adopt different policy instruments to promote investment in innovation (Martin & Scott, 2000, p. 438). Instruments

such as competition policy, tax policy, subsidies and public-funded research have widely been used by governments to promote innovation (Martin & Scott, 2000, p. 438). These policy instruments mitigate the adverse effects of the market imperfections caused by market failure (Stiglitz, 1989, p. 202). They can minimize the risks faced by entrepreneurs to promote productivity and attract more investments (Stiglitz, 1989, p. 202). Because there are various actors at the different levels of innovation, public support to innovation is distributed across various innovation activities.

A common policy approach is to support higher education R&D, based on the assumption that university reforms would increase commercialization as a result of publicly funded research (Rasmussen, 2008, p. 506). This is exemplified by *Figure 7*, which indicates that government funding mainly goes towards the research and development stages of innovation. University reforms include changes in the academic system and changes in existing policies for innovation (Rasmussen, 2008, p. 506). Resources are allocated to promote the commercialization of R&D at the higher education level through creation of university spin-offs (Rasmussen, 2008, p. 506). The importance of spin-off companies is highlighted by the amount of spin-off companies in Canada. By 2003, there were approximately 876 spin-off companies from Canadian universities (Rasmussen, 2008, p. 506). Governments play a role in facilitating technology transfer to encourage commercialization at the university level (Rasmussen, 2008, p. 506). This can be done through intervention at various stages of innovation, including establishing public incubators, facilitating technology transfer and encouraging inter-industry activities (OECD, 1997, p. 21). This would encourage higher education institutions to work with industry to increase the output of innovation. Although there is support for higher education innovation, firms remain the centre of the innovation process. Governments acknowledge this by providing incentives to encourage business-led innovation by providing some funding to the commercialization of innovation(*Figure 7*).).

To encourage firm innovation and mitigate problems from market failure, governments may provide subsidies to achieve the socially optimal level (Almus & Czarnitzki, 2002, p. 1). Direct subsidies from governments lower the cost of innovation for the firm or entrepreneur, thus allowing innovation to be carried out (Almus & Czarnitzki, 2002, p. 1). Subsidy programs provide a form of guarantee to investors who are unsure about their investments. It reduces the asymmetric information issue faced by investors, as the screening process of a government's subsidy program would verify the innovation as a potential success (Takalo & Tanayama, 2009, p. 18). However, there is a question of financial sustainability of the screening process for government subsidy programs, as it can be costly and time consuming for governments to conduct full screenings on all the applications (Takalo & Tanayama, 2009, p. 36). Firms have strong incentives to apply for various public subsidies as they are constantly looking for funding to support their innovation (Almus & Czarnitzki, 2002, p. 1). This can burden the system if the government does not impose regulations or standards for application. Despite potential offsets, subsidies to promote innovation minimize financial challenges faced by firms, especially start-up firms that are seeking for capital investments, as the subsidies reduce the cost of external capital and provide a guarantee to private investors (Takalo & Tanayama, 2009, p. 37).

Tax incentives are indirect measures that governments apply to encourage business-led innovation. Many governments have tax incentive programs to reduce the gap between the cost

of capital and innovation investments (Hall, 2002, p. 45). Canada's Scientific Research and Experimental Development (SR&ED) program is a federal tax credit program administered by the Canadian Revenue Agency to encourage business-led innovation (Canada Revenue Agency [CRA], 2010, para. 1). The program is designed to provide incentives for firms of all sizes to undertake innovation, including work that involves experimental development, applied and basic research and support work for innovation (CRA, 2009, para. 1). Parson and Phillips (2007) found that per dollar of financial assistance provided through the SR&ED program, there is a net economic benefit of \$0.11 (p.24). The indirect support from the SR&ED program stimulates business innovation activity (Bérubé & Mohnen, 2009, p. 207). The SR&ED program is an indirect funding program that allows a greater variety of firms to access the program. However, because tax credits are not full refunds of investments, firms may not have sufficient funds from the credit to make up for their investments on innovation (Hall & van Reenen, 2000, p. 449). Caps on tax credits that limit the maximum claim amount and the base amount will affect the innovation decision of a firm (Hall & van Reenen, 2000, p. 449). As well, it is noted that approximately one-third of the tax credit is wasted or abused as there is limited government auditing resources (McKenna, 2011, para. 3 and 4). Despite the limitation, Hall and van Reenen (2002) maintain that the lenient and broad based nature of tax credits makes governments more likely to provide tax incentives than direct grants (p. 466). Research by Dagenais et al. (1997) revealed that a one percent increase in the SR&ED program would lead to an average of \$0.98 additional private R&D expenditure forgone per dollar of tax revenue (Czarnitzki, Hanel & Rosa, 2004, p. 3). As well, the SR&ED credit has, with each dollar of tax revenue forgone, generated additional \$1.38 R&D expenditure in Canada (Czarnitzki, Hanel & Rosa, 2004, p. 3). Thus, tax incentives provide some support to business-led innovation.

4.6. Summary

Innovation is a complex process that requires more than an entrepreneur to successfully develop, produce and market the product or system. Since innovation is an important component of economic growth, governments are interested in supporting innovation to achieve the socially optimal amount. Various policy instruments are applied to support innovation in both a national and regional context. As innovation continues to be an important aspect of the economy, especially, as the digital economy emerges, more actors are involved. Innovation systems are created to understand how firms work independently and collaboratively with other actors in innovation to maintain or to increase their competitiveness. To better understand the complexities of the digital economy in Western Canada and how WD can play a role in supporting the emerging sector, it is important to examine the current realities of the digital economy within the region and WD's current involvement in the sector. This will be examined in the next section, as it applies the conceptual framework to Western Canada's digital economy to examine the shortfalls in the industry and WD's current contribution to the industry.

5. Key Actors in Western Canada’s Digital Economy

This section of the report applies *Figure 8* to the Western Canada context to determine the gaps in Western Canada’s digital economy. The conceptual framework (*Figure 8*) is applied to examine the current innovation process in the digital economy to outline potential solutions on how WD can address the shortfall of funding in innovation. Innovations in Western Canada’s digital economy are becoming more relevant to the growth of the economy; therefore, it is important to examine the key actors and the linkages in the region’s digital economy. In Western Canada, there are several key actors, such as industry associations, who create linkages between the various actors of innovation in the digital economy. Thus, relationships between these key actors are examined to identify the gaps where public intervention may be necessary. This section begins with a review of WD’s involvement in the sector by examining WD’s financial support to the digital economy. The time frame measured for this analysis is from fiscal year 2005-2006 to fiscal year 2009-2010. Subsequently, it will examine the various key actors in Western Canada’s digital economy in Western Canada to analyze their involvement in the innovation process. Sources from this section are mostly from websites of governments, private policy and research organizations and industry associations. Data is gathered using CANSIM, Statistics Canada and other government websites.

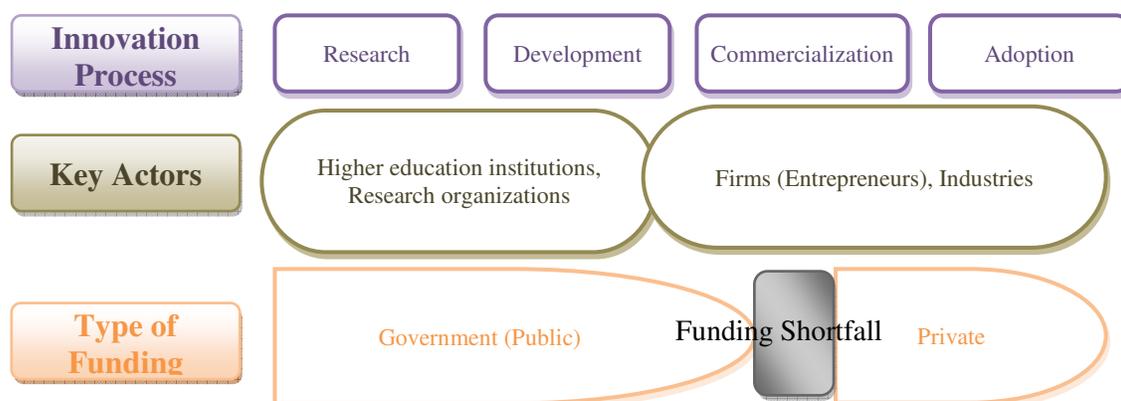


Figure 8. Conceptual framework of the innovation process of the digital economy in Western Canada.

5.1. The Role of Firms in Western Canada’s Digital Economy

Firms are crucial to the commercialization of innovation projects in Western Canada’s digital economy (*Figure 8*). According to Industry Canada, the ICT sector in Western Canada employs approximately 160,000 workers, with British Columbia leading in employment growth (IC, 2010b, [Figure 1] *Distribution of ICT employment by region, 2005*). The sector in Western Canada also generated approximately 25 percent or \$21.6 billion of total Canadian ICT revenue in 2005 (IC, 2010c, [Figure 1] *Distribution of ICT revenue by region, 2005*). The IDM sector in British Columbia is supported by approximately 850-950 IDM firms that employ approximately 15,600 people to generate approximately \$1.2-\$1.4 billion in gross annual revenue (CIAIC, 2010, p. 68). Collectively, Alberta, Saskatchewan and Manitoba have approximately 450-550 firms, employing about 5000 people to generate approximately \$500-700 million gross annual revenue (CIAIC, 2010, p. 83). The growing number of firms in the region will drive the expansion of the sector, as they are important to the commercialization and diffusion of innovation (*Figure 8*). Large multinational companies have established a presence in the region, such as Electronic Arts, Ubisoft, Microsoft and Pixar, etc. (WD, 2010c). Some multinational companies have invested in

and taken over local businesses, such as Electronic Arts' acquisition of Black Box Games in Vancouver (Gerstmann, 2002, para. 1). Western Canada also leads in the number of internally developed intellectual property, an indication that the region is perhaps more dedicated to innovation as opposed to services (CIAIC, 2009, p. 66).

5.2. The Role of Higher Education Institutions in Western Canada's Digital Economy

In Western Canada, higher education institutions provide highly qualified personnel for the digital economy. The importance of creating a strong talent pool for the digital economy is signified by the federal government's commitment in the 2011 Budget to provide \$60 million over three years to promote student enrolment in higher education studies in key subjects related to the digital economy (Ministry of Finance, 2011, p. 145). Overall, there was an increase in the number of undergraduate and graduate degree recipients in fields of study related to the digital economy in Western Canada between 2000 and 2008 (Table 1 and Table 2). The ratio of undergraduates in Western Canada to Canada as a whole increased by 1.6 percent from 2000 to 2008 (Table 1 and Table 2). The availability of a skilled and knowledgeable talent pool is crucial to R&D in the digital economy (*Figure 8*).

Table 1

Undergraduate Degrees in Fields of Studies Related to the Digital Economy (2000-2008)

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008
Alberta	1725	2004	2076	2277	2562	2571	2655	2739	2640
British Columbia	2538	2439	2472	2829	2934	3084	3459	3297	3600
Manitoba	909	780	435	453	651	606	657	555	564
Saskatchewan	663	648	654	624	633	390	390	390	405
Western Canada	5835	5871	5637	6183	6780	6651	7161	6981	7209
Canada	23712	24435	24408	25782	27018	26739	27570	29037	28125

Note: Data drawn from *CANSIM II*; Table 477-0014. Fields of study include: Physical and Life Sciences and Technologies, Visual and Performing Arts and Communications Technologies and Mathematics, Computer and Information Sciences. Statistics Canada, 2010, Ottawa: Statistics Canada.

Table 2

Graduate Degrees in Fields of Studies Related to the Digital Economy (2000-2008)

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008
Alberta	378	387	438	501	501	480	654	639	660
British Columbia	519	552	597	624	690	666	726	795	801
Manitoba	105	75	111	96	117	129	135	129	108
Saskatchewan	108	93	108	99	108	72	72	72	96
Western Canada	1110	1107	1254	1320	1416	1347	1587	1635	1665
Canada	4839	5166	5601	6039	6609	6768	7086	7233	7509

Note: Data drawn from *CANSIM II*; Table 477-0014. Fields of study include: Physical and Life Sciences and Technologies, Visual and Performing Arts and Communications Technologies and Mathematics, Computer and Information Sciences. Statistics Canada, 2010, Ottawa: Statistics Canada.

Higher education institutions are instrumental in creating intellectual property, as the higher education sector in 2008 generated an income of \$53.2 million from intellectual property and employed 321 full-time equivalents managing intellectual property (Statistics Canada [StatsCan], 2010a, *Intellectual property in the higher education sector* [Table]). In 2008, 34 Western Canadian institutions have a combined income of \$16 million from higher education IP or approximately 30 percent of the total Canadian income (\$53 million) (StatsCan, 2010b, *Regional differences in intellectual property* [Table 19-1], *part 1 - 2008*, p. 28). From those institutions, a total of 141 patents were issued and 307 inventions were protected in 2008 (StatsCan, 2010b, *Regional differences in intellectual property, part 2 – 2008* [Table 20-1], p. 29). IP at the higher education level is important to the research and development in the digital economy. Universities in the region's digital economy are instrumental in applying their talents to R&D of the innovation process. Therefore, local universities within the region are crucial to providing firms with new ideas or intellectual property that would ultimately promote innovation (Lucas, Sands & Wolfe, 2007, p. 199).

Higher education institutions also provide infrastructure that support the innovation and commercialization capacity of the digital economy (*Figure 9*). Technology transfer from university to firm normally occurs through the creation of spin-off companies. In *Figure 9*, spin-off companies will appear where firms overlap with universities, marking the transition from the development of innovation to the commercialization of innovation. An example of a Western Canadian spin-off firm is Kanata Health Solutions, a spin-off company from the University of Alberta focused on commercializing a wireless patient monitor patent into a marketable product (Kanata Health Solutions Inc., 2009). However, federal funding agencies have not invested as much in higher education research in the digital economy as it had to the life sciences sector (Clayman & Holbrook, 2011, p. 11). This is because larger firms in the sector may have their own research facility and the cost to create innovations in the digital economy may be lower than innovations in the life science sector (Clayman & Holbrook, 2011, p. 11). As the role of higher education institutions in innovation continues to expand, higher education institutions remain crucial to supporting other actors, especially firms, in the innovation system.

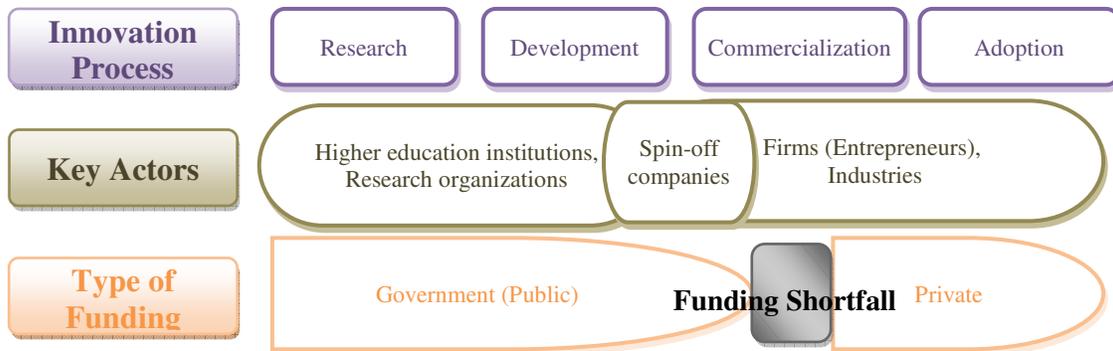


Figure 9. The role of higher education institutions in the innovation process of the digital economy in Western Canada.

5.3. The Role of Private Funding in Western Canada’s Digital Economy

Besides support from higher education institutions, firms also require sufficient finances for innovation. Venture capital, angel investments, personal assets and government funding are potential resources to support innovation. Private funding is crucial to the commercialization and adoption process of innovation in the digital economy (Figure 10). Figure 10 reveals the private funding pattern in terms of the innovation process. VC firms in Canada are one of the main sources of capital, mostly supporting innovations from the digital economy, pharmaceuticals and life sciences and energy and environmental technology industries (Canada’s Venture Capital and Private Equity Association, 2010, p. 21). Specifically, VC firms invested approximately \$489 million into the digital economy in 2009 (Canada’s Venture Capital and Private Equity Association, 2010, p. 21). Between April 2005 and December 2010, Western Canada’s digital economy industry received approximately \$499.1 million from VC funds (Figure 11). Ontario continues to be the region that captures the most VC investments in the digital economy, while Western Canada has overtaken Quebec to place second in receiving VC investments for innovations in the digital economy (Figure 11). In 2007, the digital economy received the most VC investments amounting for approximately \$780 million (Figure 11). As well, Western Canada experienced a sharper increase between 2009 and 2010 relative to other regions in Canada (Figure 11).

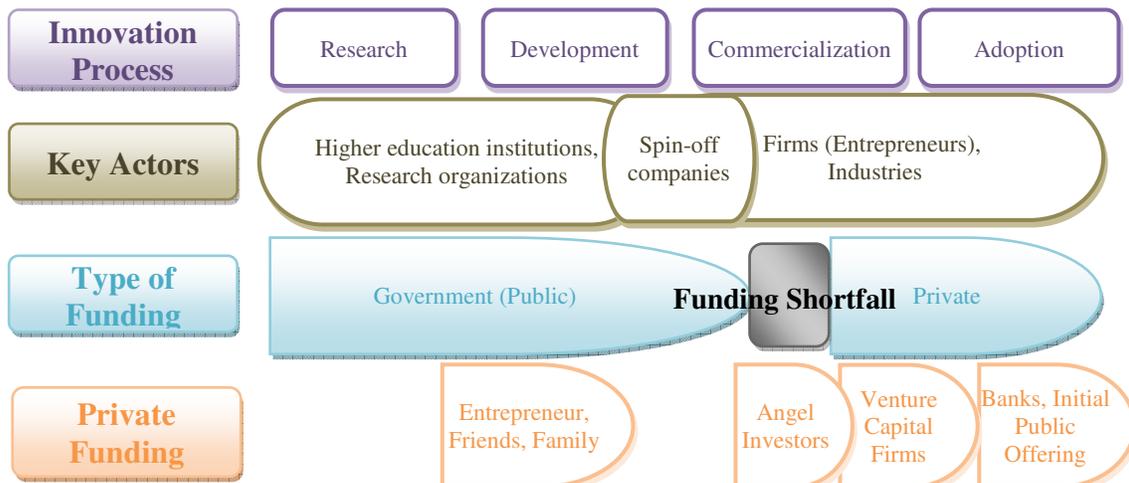


Figure 10. The role of private funding in the innovation process of the digital economy in Western Canada.

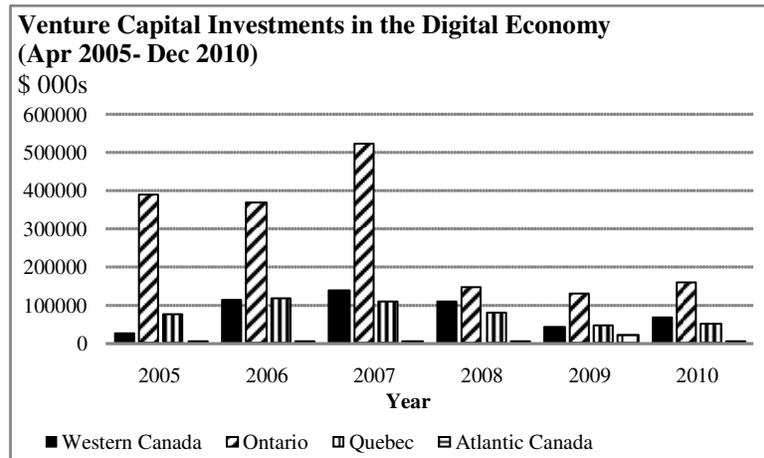


Figure 11. Venture Capital investments by Canadian region in the digital economy from April 2005 to December 2010.

Note: From Thomson Financial VC Reporter [Database]. Thomson Financial, 2010. Data retrieved from <http://www.canadavc.com/marketing.aspx?page=aboutvcr>

It is difficult for new firms to secure venture capital investments and other sources of funding due to barriers of entry in a new market. Angel investors are typically those who invest their own funds to a small set of companies for early stage development (Denis, 2004, p. 308; Figure 10). In Canada, angel investors provided approximately \$3 billion to various firms (Angel Investment Network, n.d., para. 2). According to Henderson from Research Money, angel investors in Canada are investing more in innovations in the digital economy than venture capitalists (Marshall, 2010, para. 23). While angel investments are beneficial to start-up firms in the digital economy, in the long run, VC investments are necessary to provide funding to the commercialization process of innovation (Marshall, 2010, para. 26). However, venture capital firms in Canada tend to be more risk averse than the United States and not having fully recovered from the loss incurred in the early 2000s information technology bubble burst, they may be less willing to invest in risky innovations (Marshall, 2010, para. 24). Beyond using personal and private capital, another important source of funding comes from the government.

5.4. The Role of Public Funding in Western Canada’s Digital Economy

Provincial governments have programs that provide both direct and indirect support innovation in Western Canada’s digital economy (Figure 12). Figure 12 reveals that the provincial funds mostly support the initial stages of innovation. Each province has a tax credit program that matches the federal SR&ED program. The BC provincial government has funding programs dedicated to promote innovation. For example, the BC Knowledge Development Fund is geared towards innovation at the basic and applied research level (Ministry of Advanced Education, n.d., p. 8). Another form of provincial indirect funding is directed at the interactive digital media sector. The BC New Media Tax Credit provides venture capital firms incentives to invest in innovations in the IDM sector (Ministry of Economic Development, n.d., p. 25). For Alberta, the Alberta Ingenuity Fund is an \$800 million program that supports science and engineer research and innovation (Alberta Innovates – Technology Futures, n.d. a, para. 2). Alberta has a Commercialization Associates funding program to promote the commercialization of industrial

innovation (Alberta Innovates – Technology Futures, n.d. b, para. 1). For Saskatchewan, the Innovation and Science Fund is a matching funding program for the Canada Foundation for Innovation that supports innovation from universities, colleges and research institutes (Government of Saskatchewan, n.d.). Besides having a general direct funding program for innovation, Manitoba also provides an Interactive Digital Media Tax Credit (Ministry of Innovation, Energy and Mines, n.d.) and a joint provincial and federal funding program for the commercialization of intelligent systems (Government of Manitoba, n.d.).

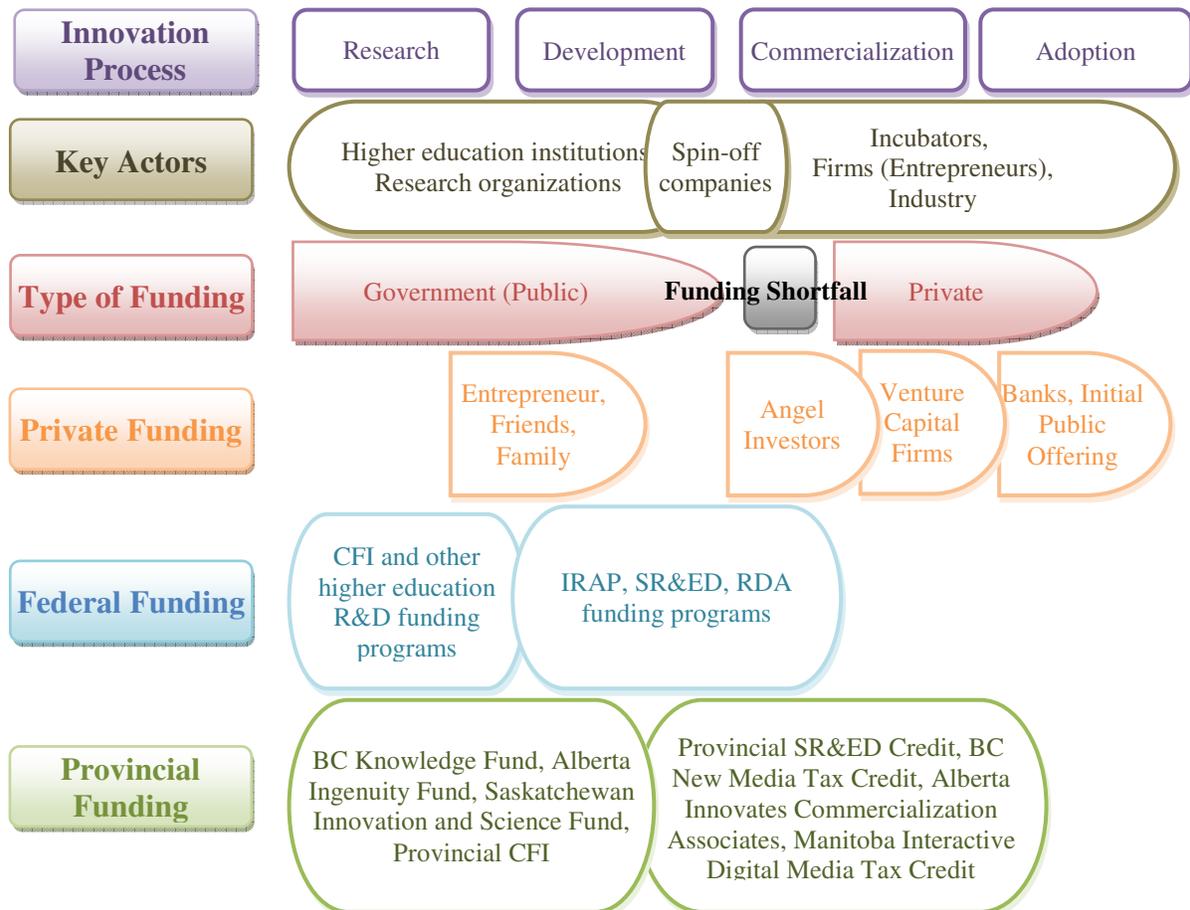


Figure 12. The role of public funding in the innovation process of the digital economy in Western Canada

There are federal funding programs that support innovation in the digital economy (Figure 12). Figure 12 reveals that federal funding to the digital economy is mostly directed to the initial stages of innovation with some programs that support commercialization. In the 2011 Budget, the federal government announced its commitment to increasing the digital advantage of Canada. The Canada Foundation for Innovation (CFI) is one of the primary funders of innovation projects across Canada, providing up to 40 percent of project infrastructure costs to research institutes, higher education institutions and not-for-profit organizations (Canada Foundation for Innovation [CFI], 2010, para. 2). CFI projects in Western Canada accumulate approximately 20 percent of total CFI funding up until January 2011 (CFI, 2011). There were 80 projects out of a total of 1992 projects funded to institutions in Western Canada that are related to the digital economy, making up approximately \$18 million (1.7 percent of Western Canada CFI funding) of CFI

funding up until January 2011 (CFI, 2011). NRC's Industrial Research and Assistance Program (IRAP) provides direct support to firm-based innovation (NRC, 2011, para. 1). Budget 2011 committed an additional \$80 million over three years to the IRAP program to support small and medium businesses through collaboration with higher education institutes to adopt ICT technologies crucial to their businesses (Ministry of Finance, 2011, p. 17). The SR&ED tax credit is the largest federal R&D program that provides incentives for businesses to innovate (CRA, 2010), accounting for approximately \$4.7 billion of indirect funding to businesses in 2011 (McKenna, 2011, para. 3). The indirect subsidy program accounts for the majority of federal financial assistance to innovation.

Governments provide funding to various actors in the innovation system. *Figure 13* describes the flow of Canada's public and private funding to the various performers of innovation in 2009. The figure reveals that the federal government provided approximately \$2.6 billion to federal innovation, \$2.8 billion to higher education innovation and \$281 million to business innovation (*Figure 13*). Similarly, the provincial government provided approximately \$1.1 billion to higher education R&D and \$304 million to provincial R&D (*Figure 13*). Both levels of governments have placed an emphasis on supporting higher education R&D over other actors in the innovation process. This is exemplified by the types of programs available to support innovation. Although the SR&ED tax credit provides indirect support to businesses for innovation, there remains a lack of direct funding to business from the governments in Canada. Business innovation has been stressed by policy experts such as the Council of Canadian Academies (CCA) (2009) to be important to commercializing innovation, thus capturing market advantage as a result. Canada's innovation weakness is potentially signalled by the low business expenditure on R&D (BERD), which declined by 20 percent between 2001 and 2007 and has been consistently below the OECD average (CCA, 2009, p. 2).

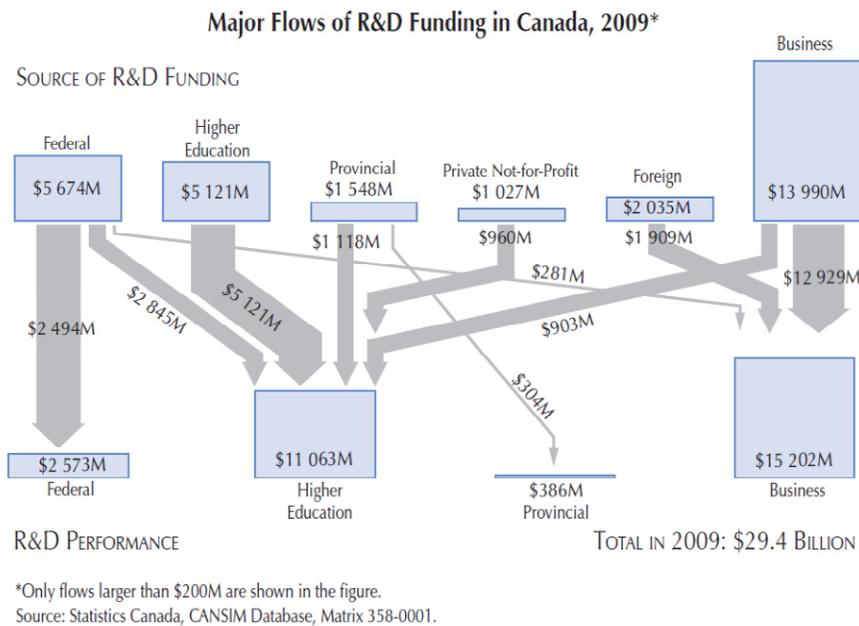


Figure 13. Major flows of R&D funding in Canada, 2009.

Note: Adapted from *Science and technology data, 2009*, by Industry Canada (2011). Retrieved August 11, 2011 from <http://www.science.gc.ca/937918F9-DFCD-42C4-992C-E4948CB883EF/2009-e.pdf>

5.5. The Roles of Other Actors in Western Canada’s Digital Economy

Available infrastructure and cooperation between various actors in the innovation system support innovation growth. Infrastructure such as public research and education institutions allows firms in the region to be more actively engaged in innovation (Tödting & Tripl, 2005, p. 1211). Other actors are also involved in a regional innovation system. This includes legal consultants, industry associations, and stakeholders that may have an interest in the sector, or are associated with the sector (Cooke, 2001). Specialists in legal and financial services provide expert advice to firms in the digital economy (Cooke, 2001). Other organizations such as TEC Edmonton, TRILabs, and FPInnovations also play an intermediary role in the innovation process to facilitate technology transfer. These organizations would fit in the same box as spin-off companies and industry associations in *Figure 14*. Industry associations provide firms with lobbying power, enable firms to maintain their own activities, and encourage others to enter the market and open their own businesses (Lucas, Sands & Wolfe, p. 204). For the IDM sector in Western Canada, there is a variety of industry associations within the region that firms could rely upon. Some are provincial such as Digital Alberta, while others are national such as Canadian Interactive Alliance (CIAIC, 2009). They are instrumental in promoting and building linkages between various sources, allowing new business partnerships and networks to be created (CIAIC, 2009, *Figure 14*). The industry associations act as anchors to the regional and local innovation system to enable knowledge flows and facilitate linkages between various actors in the system (Lucas, Sands & Wolfe, p. 205).

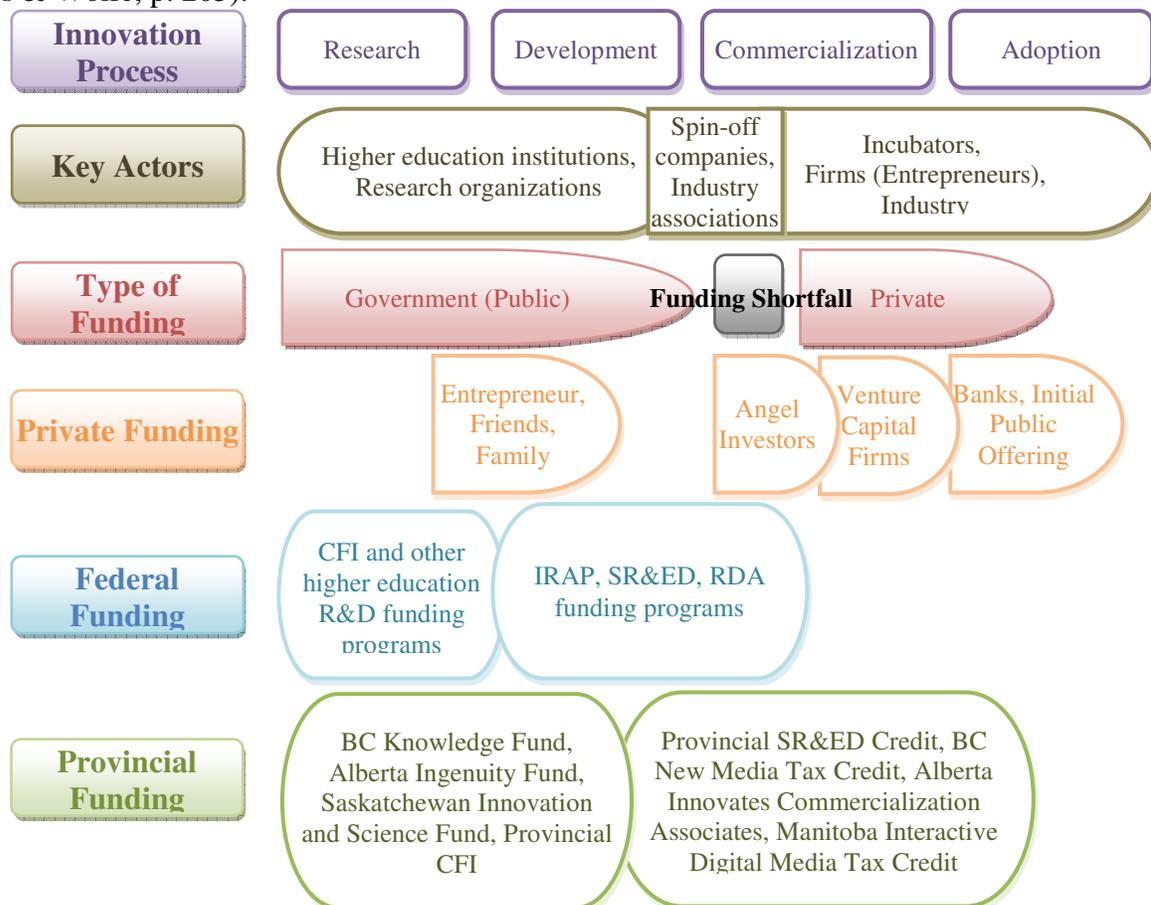


Figure 14. The role of other actors in the innovation process of the digital economy in Western Canada

5.6. Western Economic Diversification

As a federal department, WD provides project-based contributions to not-for-profits organizations for a defined period of time. Between FY2005-2006 to 2009-2010, WD funded a total of \$24.6 million to the digital economy in Western Canada (Table 3). This is approximately 8.6 percent of WD's total funding over the 5 year period (\$286.8 million) (Table 3). A detailed list of WD's funding to the digital economy over the five year period can be found in Appendix A – WD funding to the Digital Economy. The 59 WD funded projects leveraged about \$71.1 million of funding from other sources (Appendix A – WD funding to the Digital Economy). 28 of the 59 innovation projects were awarded to British Columbian recipients, receiving approximately \$4.5 million over the five years (Table 4). Alberta received the greatest amount of WD funding, accounting for \$8.5 million for 16 projects over the five year period (Table 4). The majority of WD's funding to the digital economy went to activities of Technology Research and Development (\$12.5 million over 14 projects) (Table 5).

Table 3

WD Innovation Funding by Sector (FY2005-2006 to 2009-2010)

Sector	2005/06	2006/07	2007/08	2008/09	2009/10	Total
Environmental Technologies	\$ 2,509,321	\$ 2,787,123	\$ 8,056,245	\$ 4,000,000	\$ 15,108,100	\$ 32,460,789
Digital Economy	\$ 6,712,938	\$ 11,867,471	\$ 1,950,500	\$ 2,163,600	\$ 1,919,500	\$ 24,614,009
Life Sciences	\$ 22,696,745	\$ 1,461,442	\$ 40,252,877	\$ 10,329,200	\$ 6,483,000	\$ 81,223,264
Micro/Nano Technology	\$ 2,765,680	\$ 90,000	\$ 3,790,000	\$ 8,934,106	\$ 2,875,000	\$ 18,454,786
Multi-Sector	\$ 7,053,145	\$ 20,478,071	\$ 18,391,927	\$ 17,826,080	\$ 3,186,000	\$ 66,935,223
Medical Isotopes	\$ -	\$ -	\$ -	\$ -	\$ 4,003,320	\$ 4,003,320
Composite Materials	\$ -	\$ -	\$ -	\$ -	\$ 5,803,804	\$ 5,803,804
Synchrotron	\$ -	\$ -	\$ -	\$ -	\$ 4,000,000	\$ 4,000,000
Other Technologies	\$ 10,923,262	\$ 5,356,222	\$ 12,174,605	\$ 20,490,476	\$ 311,669	\$ 49,256,234
Total	\$ 52,661,091	\$ 42,040,329	\$ 84,616,154	\$ 63,743,462	\$ 43,690,393	\$ 286,751,429

Note: Data from Infoquest [database]. Western Economic Diversification. April 2010. Edmonton, Alberta: Western Economic Diversification.

Table 4

WD Funding to the Digital Economy by Province (FY2005-2006 to 2009-2010)

Year	Region	# of Projects	WD Funding
2005-2006	Alberta	11	\$ 5,445,888
	British Columbia	21	\$ 1,025,550
	Manitoba	3	\$ 39,500
	Multi-Region	1	\$ 82,000
	Saskatchewan	5	\$ 120,000
2005-2006 Total		41	\$ 6,712,938
2006-2007	Alberta	2	\$ 1,848,177
	Multi-Region	1	\$ 10,000,000
	Saskatchewan	1	\$ 19,294

Year	Region	# of Projects	WD Funding
2006-2007 Total		4	\$ 11,867,471
2007-2008	Alberta	1	\$ 300,000
	British Columbia	4	\$ 1,482,500
	Manitoba	1	\$ 168,000
2007-2008 Total		6	\$ 1,950,500
2008-2009	Alberta	1	\$ 800,000
	British Columbia	1	\$ 1,000,000
	Manitoba	2	\$ 363,600
2008-2009 Total		4	\$ 2,163,600
2009-2010	Alberta	1	\$ 139,000
	British Columbia	2	\$ 1,030,000
	Saskatchewan	1	\$ 750,500
2009-2010 Total		4	\$ 1,919,500
Grand Total		59	\$ 24,614,009

Note: Data from Infoquest [database]. Western Economic Diversification. April 2010. Edmonton, Alberta: Western Economic Diversification.

Table 5

WD Funding to the Digital Economy by Program Activity (FY2005-2006 to 2009-2010)

Activity	# of Projects	Total Project Cost	Total WD Funding
Community Innovation	1	\$ 50,768	\$ 5,000
Entrepreneurship & Innovation	14	\$ 14,655,797	\$ 6,033,600
Knowledge Infrastructure	2	\$ 71,375	\$ 35,688
Technology Adoption & Commercialization	16	\$ 13,398,946	\$ 3,540,039
Technology Linkages	8	\$ 10,436,280	\$ 2,238,834
Technology Research & Development	14	\$ 56,275,176	\$ 12,513,848
Technology Skills Development	4	\$ 813,000	\$ 247,000
Total	59	\$ 95,701,342	\$ 24,614,009

Note: Data from Infoquest [database]. Western Economic Diversification. April 2010. Edmonton, Alberta: Western Economic Diversification.

Higher Education Institutions (\$6.5 million) and Research Facilities (\$11.9 million) are the major funding recipients of WD support (Appendix A – WD funding to the Digital Economy). Over the five year period, WD provided funding to various infrastructure projects in the digital economy. This includes the establishment of the Centre for Innovative Information Technology at the Southern Alberta Institute of Technology, a Wireless Technology Testing and Commercialization Facility with the Wavefront Wireless Innovation Society of British Columbia and the CUBE – British Columbia Institute of Technology’s 3D Simulation Development Lab (Appendix A – WD funding to the Digital Economy). As well, WD supported the purchase of

equipment at various research facilities, including the purchase of equipment for the Faculty of Science and Multi-media laboratories at Le College Universitaire de Saint-Boniface (Appendix A – WD funding to the Digital Economy).

WD also provides support to incubator facilities and consistent funding to initiatives that are beneficial to firms in the digital economy. In 2006, WD provided \$350,000 via the WEPA program to the Fortune Cat Game Studio incubator in Winnipeg (WD, 2011c, para. 1). The incubator provided a training experience program to promote Manitoba’s video game creation (WD, 2011c, para. 1). WD also provided funding to other industry associations’ initiatives, such as WinBC’s project to “increase connections and synergies among innovation system” actors (WD, internal document, 2009, p. 1). These projects provide resources for firms to be more competitive in the digital economy and encouraged collaboration and technology transfer.

Overall, WD provides funding to support the infrastructure in Western Canada’s digital economy. *Figure 15* indicates that most of WD’s funding goes to technology research and development projects, with some funding going to commercialization initiatives led by industry associations. As such, WD’s contribution to Western Canada’s innovation in the digital economy supports the development of infrastructure in the digital economy (*Figure 15*). For example, the Wireless Technology Testing and Commercialization Facility project with the Wavefront Wireless Innovation Society of British Columbia enabled the Wavefront Wireless Innovation Society to gain new networks and memberships, creating new linkages between actors (Appendix A – WD funding to the Digital Economy). Overall, WD provides support to the digital economy mainly through funding projects that enhance the infrastructure in the region.

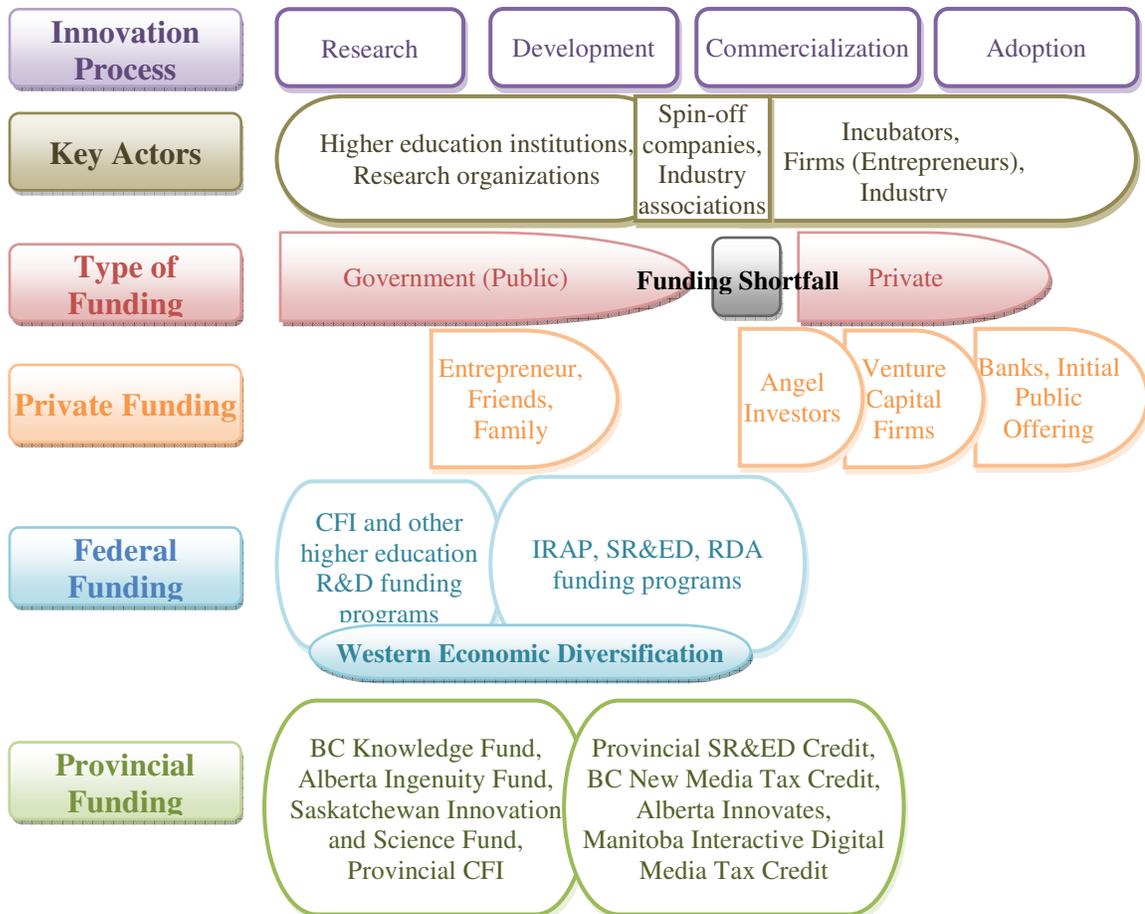


Figure 15. WD's role in the innovation process of the digital economy in Western Canada.

5.7. Discussion

The innovation process in Western Canada's digital economy consists of public, private and research institutions that make up the infrastructure to support innovation. *Figure 15* highlights the interaction of actors that research and develop and commercialize innovation. The figure further outlines the innovation process and how various funders support the various stages of innovation. The shortfall of funding in the region's digital economy is found in the latter stages of innovation (*Figure 15*). While there is funding to commercialization, they come mostly in the form of VC investments and indirect tax subsidies. Therefore, there is a lack of direct funding from public and private organizations that support start-up firms. Direct public funding programs mostly support the earlier stages of innovation, especially in the research and development of innovation. In contrast, the SR&ED tax credit supports technical and scientific risk through tax credits for R&D. Although IRAP is available to R&D, direct federal support remains a small fraction of funding to the commercialization component of business innovation.

Beyond industry associations and infrastructure, government agencies also contribute to the growth of the digital economy in Western Canada. WD also plays a role in encouraging innovations from the digital economy in Western Canada by supporting innovation and collaboration between key actors. Through funding projects to universities, industry associations and other not-for-profit organizations in the digital economy, WD plays an important role in the regional innovation system in supporting the digital economy in Western Canada.

The conceptual framework reveals a lack of public support in the latter stages of the innovation process. As well, from the *Science and Technology Report*, it reveals that while businesses are the largest performer of R&D, the sector has been a self-funding R&D performer (IC, 2011b). This could be a challenge to new firms as VC alone cannot appropriately fund the commercialization of innovation. As firms are at the center of innovation, the challenge to securing funding may hinder the promotion of innovations in the digital economy. For WD, a federal department created to increase the innovation competitiveness of Western Canada, there is a need to expand the department's role to promote innovation in the digital economy. Therefore, the following section will examine four examples from three jurisdictions to provide WD with potential strategies it can adopt to address the shortfall in innovation funding for the digital economy.

6. Cross-Jurisdictional Scan

In examining how WD can expand its role in promoting innovations in the digital economy, it is important to review what other jurisdictions are doing to address the challenges that hinder the growth of the digital economy. This section will examine three jurisdictions and their policies on promoting innovation in their respective digital economies. This includes the rest of Canada, South Australia and Germany. The Atlantic Canada Opportunities Agency (ACOA) and the province of Ontario will be examined to provide a comparison between WD and other government funding agencies in Canada. South Australia was chosen for its similarities with Western Canada. The state is similar to Western Canada as it has traditionally been an agricultural and wine economy and mining economy, with growing industries of clean technology, life sciences and advanced manufacturing (Government of South Australia, n.d., p. 3). Germany was selected because of the country's accomplishments in the digital economy and the country's long term efforts in promoting innovation. A discussion will follow to examine the pros and cons of the programs in the three jurisdictions to determine potential policy options for WD. This will help identify potential areas where WD can improve its support to the digital economy in Western Canada.

6.1. Rest of Canada

Federal and provincial governments in Canada have established different programs to promote innovation in the digital economy. In this section, ACOA's Atlantic Innovation Fund will be examined to assess ACOA's contribution to the digital economy in Atlantic Canada and how its program differs from WD programs. Besides support from regional development agencies (RDA) support, provincial governments have programs to promote innovations in the digital economy. Since Ontario is one of the leading digital economy regions in Canada, the province's involvement in the sector will be reviewed. Overall, the report will examine the Atlantic Innovation Fund from ACOA and the Ontario Emerging Technologies Fund from the government of Ontario.

ACOA is a RDA dedicated to strengthen the economy of the Atlantic region through providing funding to businesses, communities and infrastructure. The Atlantic Innovation Fund (AIF) encourages R&D and commercialization of new technologies (Atlantic Canada Opportunities Agency [ACOA], 2011b). The AIF provides funding to universities, research institutions and private sector businesses to promote firm-based innovation (ACOA, 2011b). The Atlantic Innovation Fund (AIF) provides up to 80 percent of costs incurred by non-commercial projects and 75 percent for commercial projects to encourage innovation (ACOA, 2011a, para. 9). Between 2008 and 2010, ACOA provided approximately \$187.5 million of funding to 85 projects (Table 6). Among the 85 projects, 43 projects were awarded to commercial recipients, amounting to almost \$92.6 million, accounting for almost 50 percent of total AIF funding over the 3 years (Table 6). From 2008 to 2010, the AIF contributed approximately \$18 million to 8 commercial projects in the digital economy compared to \$16.1 million to 7 not-for-profit projects (Table 7). In 2010, 8 of the 30 projects were awarded to innovations in the digital economy, amounting to approximately \$18.0 million (or 29 percent) of the \$62.4 million AIF funding in 2010 (ACOA, 2011a). Two of the eight projects were commercial projects, amounting to approximately \$1.9 million of funding (ACOA, 2011a).

Table 6

Approved AIF Projects 2008-2010

	Total AIF Funding	# of Projects
2008	\$ 73,315,282	31
New Brunswick	\$ 12,561,390	6
Newfoundland	\$ 18,871,733	8
Nova Scotia	\$ 17,391,367	8
Pan-Atlantic	\$ 10,247,500	2
Prince Edward Island	\$ 14,243,292	7
2009	\$ 51,763,517	24
New Brunswick	\$ 20,458,906	9
Newfoundland	\$ 11,718,084	5
Nova Scotia	\$ 9,403,104	5
Prince Edward Island	\$ 10,183,423	5
2010	\$ 62,385,575	30
New Brunswick	\$ 19,632,112	9
Newfoundland	\$ 13,806,505	7
Nova Scotia	\$ 16,691,149	7
Prince Edward Island	\$ 12,255,809	7
Grand Total	\$ 187,464,374	85

Note: Data from *Approved AIF Projects*. Atlantic Canada Opportunities Agency, March 14, 2011. Retrieved May 3, 2011 from <http://www.acoa-apeca.gc.ca/English/ImLookingFor/ProgramInformation/AtlanticInnovationFund/Pages/ApprovedAIFProjects.aspx>

Table 7

Approved AIF Projects in the Digital Economy 2008-2010

	Total AIF Funding	# of Projects
2008	\$ 9,655,091	4
Newfoundland	\$ 4,926,341	2
Commercial	\$ 4,926,341	2
Nova Scotia	\$ 2,976,650	1
Non-Commercial	\$ 2,976,650	1
Prince Edward Island	\$ 1,752,100	1
Commercial	\$ 1,752,100	1
2009	\$ 6,917,358	3
New Brunswick	\$ 2,869,324	1
Commercial	\$ 2,869,324	1
Newfoundland	\$ 4,048,034	2
Commercial	\$ 4,048,034	2
2010	\$ 17,972,377	8
New Brunswick	\$ 4,842,629	2
Commercial	\$ 1,860,542	1
Non-Commercial	\$ 2,982,087	1
Newfoundland	\$ 8,973,665	4

	Total AIF Funding	# of Projects
Commercial	\$ 3,000,000	1
Non-Commercial	\$ 5,973,665	3
Nova Scotia	\$ 4,156,083	2
Non-Commercial	\$ 4,156,083	2
Grand Total	\$ 34,544,826	15

Note: Data from *Approved AIF Projects*. Atlantic Canada Opportunities Agency, March 14, 2011. Retrieved May 3, 2011 from <http://www.acoa-apeca.gc.ca/English/ImLookingFor/ProgramInformation/AtlanticInnovationFund/Pages/ApprovedAIFProjects.aspx>

The province of Ontario supports innovations in the digital economy through the Ministry of Research and Innovation. The Ministry's Ontario Capital Growth Corporation (OCGC) administers the Ontario Emerging Technology Funds (OETF), a cooperative funding program consisting of VC investors, angel investors and other private investors, to provide financial assistance to innovation in clean technology, life sciences and the digital economy (Ontario Ministry of Research and Innovation, 2010, para. 1). Eligible companies include firms in animation software and hardware, 3D software and hardware and computer game development, semiconductor design, computer equipment manufacturing and communications technology development (Ontario Capital Growth Corporations [OCGC], 2010c, p. 12). The program is a \$250 million fund that commits to a maximum of \$50 million per year over five years to projects conducted by innovative, high-growth companies in the province (Ontario Ministry of Research and Innovation, 2010, para. 2). Partner investors of the OETF program include the Blackberry Partners Fund, Brightspark Venture, the Business Development Bank of Canada and other investors (OCGC, 2010a). The OETF began in 2009 and provided funding to new companies in the digital economy like Avvasi, b5media, Bering Media, iStopOver, Morega, Peraso, Shoplogix and TELoIP (OCGC, 2010b). As of April 13, 2011, the OETF has conditionally approved 21 projects, accounting for approximately \$34.8 million of funding (OCGC, 2010b, *Summary of conditionally approved OETF co-investment opportunities and total capital need from OCGC as of April 13, 2011* [table]). The OCGC can provide initial investments and follow-on investments to support the start-up of the companies (OCGC, 2010c, p. 9).

The Ontario example addresses the traditional gaps in business innovation. By providing financial assistance to innovations in new firms, the program minimizes challenges that entrepreneurs face in the early stages of commercializing innovation. The cooperation with private investors creates a larger pool of available funding and minimizes uncertainties. As a result of public participation, other private investors may be drawn to support the public-funded project. This is because government participation provides a certain amount of guarantee that the funded projects have potential success and profit. Contrary to the OETF, the AIF program takes more traditional approach in supporting the development of the sector and reaches a broader category of recipients, promoting innovation without excluding certain groups. These examples have the capacity to provide financial support to for-profit innovations, addressing the issue of low public investments in the business sector.

The Canadian examples focus on business innovation in the digital economy. For example, the OETF is a funding program that specifically contributes to emerging technological innovation in

Ontario. As a co-investment program between public and private sector partners, the OETF reduces the issue involving asymmetric information between entrepreneurs and private funders. This minimizes risks that can potentially drive investors away from providing monetary support to promising innovation. The partnership allows entrepreneurs to secure larger sums of funds without having to approach more funding sources. The AIF is also an effective program. As it provides financial investments to both commercial and non-commercial projects, the fund is more versatile and allows ACOA to more flexibly make strategic funding to different actors in the innovation system. While it has been noted that innovation often occurs in small firms by entrepreneurs, other actors are also important in contributing to a sector's growth.

6.2. South Australia

The state of South Australia's digital economy initiative is examined to review the state's strategic funding to innovation in the sector. In terms of the digital economy, the city of Adelaide is rated by KPMG as the "most cost-competitive city in Australia" (Government of South Australia, 2009a, para. 1) in the software, web and multimedia development sub-sector and second most competitive in software design (Government of South Australia, 2009a, para. 1&2). Currently, the sector hosts approximately 1,100 firms employing about 19,000, with annual revenue of \$5.2 billion⁵ (Department of Trade and Economic Development, 2010).⁶ As a whole, the country invested approximately \$4.5 billion or 25.6 percent of total R&D spending in 2007 (Australian Computer Society, 2010, p. 35).

South Australia has various programs dedicated to promoting the growth of the digital economy. Similar to Canadian provincial funding programs, the South Australian government provides incentives through the South Australian Film Corporation to encourage creation of digital film, mobile content, animation and games (Government of South Australia, 2009b, para. 11). Another program provided by the South Australian government is the ICT Innovation Partnerships (IIP) Grants. The IIP is a joint initiative between the government and the Australian Information Industry Association (AIIA) (Department of Further Education, Employment, Science and Technology, 2010a, para. 1). The joint partnership provides a merit-based grant to "promote business innovation in the [South Australian] government through ICT and to accelerate the development of ICT companies in [South Australia]" (Department of Further Education, Employment, Science and Technology, 2010b, para. 1). The grant supports firms in the ICT sector to increase their ability to commercialize their innovation (Department of Further Education, Employment, Science and Technology, 2010b, para. 2). Successful applicants receive business-focussed mentoring and coaching that would improve their skills in commercialization (Department of Further Education, Employment, Science and Technology, 2010b, para. 2). The grant provides up to \$26,113 to applicants that are developing a product within a degree of measurable risk, are able to demonstrate commercial opportunities favourable to economic outcomes for South Australia and can display capital capacity to provide a share of the project costs (Department of Further Education, Employment, Science and Technology, 2010b, para. 4).

Another major initiative by the South Australian government is the Digital Tomorrow Program. The Digital Tomorrow Program is a grants program administered by Creative Industries

⁵ \$1 AUD = \$1.04 CAD (as of May 27, 2011).

⁶ This is compared to the total national revenue of \$85.2 billion in 2009 (Australia Information Industry Association, n.d., para. 1).

(Creative Industries, 2008). The Creative Industries supports the region's creative industries and focuses on the delivery of the program (Creative Industries, 2008). The program consists of six sub-programs that focus on skills building, industrial development and commercialization for new businesses involved in digital economy innovations. Specifically, the six programs are targeted to assist and promote the digital economy sector in South Australia:

- Tomorrow Start provides small grants (up to \$10,445) to help new firms with business establishment;
- Tomorrow IP makes significant grants (up to \$104,451) to help established firms develop and commercialize their intellectual property;
- Tomorrow Pathways provides initiatives to facilitate graduates into the digital economy;
- Tomorrow Entrepreneur offers business training for entrepreneurs in the digital media sector;
- Tomorrow Worlds delivers educational courses to improve professional skills; and
- Tomorrow Studio provides affordable studio space for start-up companies (Creative Industries, 2008, para. 3).

Both the Tomorrow Start and Tomorrow IP program are grant programs that support firm-based innovation in the digital economy. The Tomorrow Start grant is a competitive grants program that support innovations from digital media start-up companies to develop and commercialize technologies (Creative Industries, 2010a, para. 1). The grant provides financial assistance to activities such as “the costs of obtaining IP advice; legal costs of establishing a company or other business structure; business planning expenses; strategic purchases of software or hardware; license or purchase of software development; market testing; market research and production of marketing materials” (Creative Industries, 2010a, para. 6). The Tomorrow IP program focuses on already established firms, providing firms with capital to develop and commercialize their innovation or intellectual property to improve the firms' competitiveness and increase revenue (Creative Industries, 2010b, para. 3). It provides up to \$104,451 in grants to business innovation that promote product development for commercial sale or licensing (Creative Industries, 2010b).

Programs available to South Australia's digital economy focus mostly on firm innovation. The package of programs under the Digital Tomorrow Program is able to target various innovation challenges faced by firms. It focuses on “improving skills pathways, supporting digital media start-ups and encouraging innovation by South Australian digital media companies” (Creative Industries, 2008, para. 1), thus emphasizing on providing firms with essential resources that would encourage innovation. For example, the Tomorrow Studio offers start-up firms affordable office space to start their business, minimizing a firm's start-up costs to encourage innovation (Creative Industries, 2010c). The program provides networking opportunities and business development training (Creative Industries, 2010d). Skills and capital shortages are highlighted in the program. The \$4.2 million four-year Digital Tomorrow Program enables the application of digital creation and content to other sectors (Cultural Ministers Council Creative Innovation Economy Roundtable, 2009, p. 24). Likewise the IIP grant focuses on supporting innovation at the firm level. The emphasis on business innovation is perhaps the government's response to its relatively low business expenditure on R&D compared to other OECD countries, which is approximately 4.5 percent of Australian total government R&D funding (IC, 2010, p. 22).

South Australia is an example of how a state applies its resources to promote the growth of the digital economy. South Australia, through the Digital Tomorrow program, targets a range of

innovation-related challenges that are faced by the sector. Besides funding projects in the sector, the program promotes the building of skills necessary to increase the competitiveness of the sector. As well, the Digital Tomorrow programs provide infrastructure for SMEs and start-up firms to encourage innovation. The focus is emphasized on assisting entrepreneurs with start-up of firms, increasing the number of skilled personnel that could add to the sector and being innovative.

6.3. Germany

Germany identifies innovation in the ICT sector as a key technology sector that drives innovation development and creates a platform for other forms of technology innovation (Federal Ministry of Education and Research [BMBF], 2010, p. 11). The federal government of Germany increased its overall R&D funding from \$12.6 billion⁷ in 2005 to \$15.2 billion in 2008 (BMBF, p. 38). Overall, the government spent approximately \$2.7 billion on business R&D, \$8.4 billion on government and not-for-profit R&D and \$11.3 billion on higher education R&D. This is more than Canada, who spent \$5.6 billion in R&D expenditure in 2008, of which approximately \$265 million went to business performed R&D (IC, 2010, p. 7). In 2008, the federal government provided \$736.4 million to innovation in the digital economy (BMBF, 2010, p. 60).

Nationally, Germany prioritized the expansion of the ICT sector. The country identified the sector as a vehicle that promotes more than 80 percent of innovations in fields of automotive, medical technology and logistics (BMBF, 2007, p. 4). Innovations in the digital economy are applied to innovations in other industries, allowing growth in other sectors of the economy (BMBF, 2007, p. 10). For example, ICT innovations are important to innovations from the “mechanical engineering and automotive engineering, automation technology, education and the service sector, medical technology, energy technology and logistics” (BMBF, 2007, p. 10) industries. As such, the government’s High-Tech Strategy placed the ICT sector as one of the most important areas for innovation and through the Federal Ministry of Education and Research (BMBF), the government also introduced the ICT2020 research program (BMBF, 2007, p. 4).

BMBF’s ICT2020 is a ten-year open, learning research program that addresses the short cycles of ICT innovations (BMBF, 2007, p. 26). The ICT2020 program, drafted in 2007, projected its funding to ICT subsectors of networked world, nanoelectronics, software systems and microsystem technology to be approximately \$2.1 billion up until 2011 (BMBF, 2007, p. 70). The Federal Ministry of Economics and Technology (BMWi) would provide approximately \$529.7 million to projects in multimedia, thesis and ICT applications from 2007 to 2011 (BMBF, 2007, p. 70). On average, BMBF would provide approximately \$898.8 million funding to the ICT sector per year over the five year period. The ICT2020 aims to encourage innovation in the digital economy through supporting and promoting various types of organizations involved in the innovation process. To promote vertical cooperation, BMBF stresses the importance of “inter-disciplinary forms of cooperation involving various key technologies” (BMBF, 2007, p. 26). By building strategic technology alliances between science and industry, BMBF hopes to promote horizontal cooperation between these actors in innovation to advance the country’s technology initiatives (BMBF, 2007, p. 34). Through the promotion of technology alliances, it would bridge the gap between research and technology and areas of application (BMBF, 2007, p. 34). Another focus of ICT2020 is to integrate new services through service platforms that promote the

⁷ €1 = \$1.40 CAD (as of May 27, 2011)

development and usage of ICT-based services (BMBF, 2007, p. 40). As well, ICT-specific SME funding is available through ICT2020 to promote innovation at the SME level (BMBF, 2007, p. 41).

Coinciding with the ICT2020 is the Digital Germany 2015 Federal Strategy that was revised in 2010. The strategy focuses on the application of ICT in the economy to increase competitiveness, to expand digital infrastructure, to safeguard protected and personal user rights in the Internet and new media, to promote R&D in the sector and technology commercialization, to build talent in the field and to encourage consistent use of ICT as a tool to solve social problems (Federal Ministry of Economics and Technology, 2010, p. 3). Specifically the German government focuses on the promotion of research on the Internet, the development of service platforms to facilitate the creation and application of knowledge-based services, the encouragement for firms to adopt digital technology early on in their innovation process, the availability and attractiveness of supercomputer access and grid computing, and the improvement of 3D technologies and energy efficient electronics (Federal Ministry of Economics and Technology, 2010).

Overall, the strategies for the expansion of the ICT sector in Germany are important in examining how departments proceed with their funding. The BMBF has taken various initiatives to address various challenges faced by entrepreneurs in the sector. While there is a focus on funding SMEs to encourage ICT innovations at the firm level, the BMBF also emphasizes on the integration of the various actors in the innovation system of the sector. Such strategy echoes the importance of various actors in the innovation system beyond the sector. This is particularly important, as it has been noted in the previous sections, that systems of innovation require cooperation of multiple actors in order to facilitate growth and improve the overall competitiveness of the sector. Thus, in order for the digital economy to grow and expand, cooperation between various actors is necessary to promote a R&D culture that encompasses all aspects of innovation.

Germany's ICT2020 strategy focuses on building and fostering vertical and horizontal cooperation between actors in the innovation process. In a regional innovation system, it is not only the business entrepreneurs or entrepreneurs that are important in contributing to an industry's innovative competitiveness. Equally important is the availability of skills, experts and other industrial affiliates that support the growth of the sector. As such, Germany's strategy provides a good example as to how a federal department can actively engage other actors involved in the digital economy.

6.4. Implications for Framework

The examples from the three jurisdictions provide WD with potential strategies to address the shortfalls identified in the conceptual framework (*Figure 16*). The four main programs examined in the cross-jurisdictional scan fit differently in the framework and provide useful implications for WD.

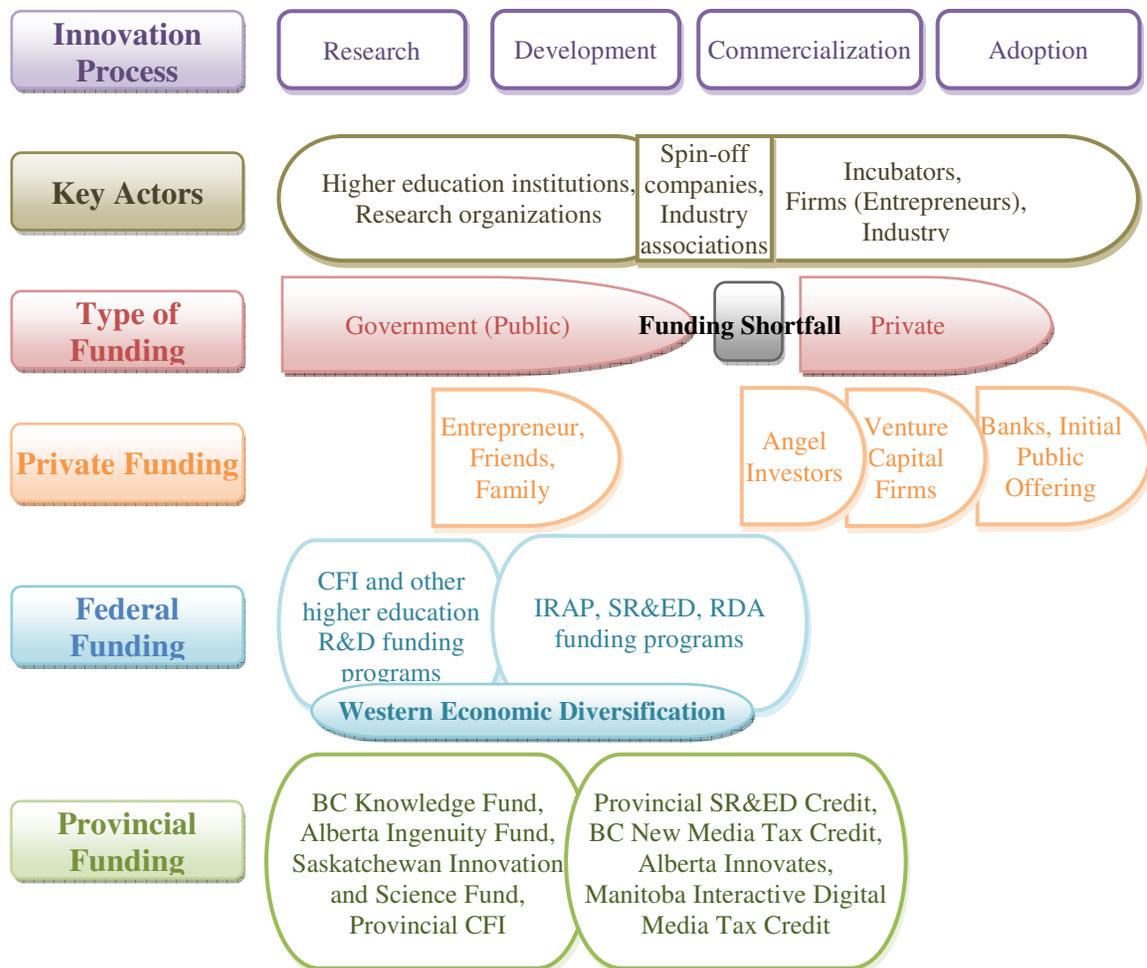


Figure 16. WD’s role in the innovation process of the digital economy in Western Canada.

As ACOA’s AIF program provides funding to both not-for-profit and for-profit innovation projects, it supports a wider scope of actors in the innovation process. Therefore, the AIF provides funding for both research and development and commercialization projects. However, in comparison to other traditional approaches, the AIF has provided more funding to commercial projects than to not-for-profit projects. This reveals the RDA’s interests in supporting innovation in the Atlantic region. Unlike WD, ACOA’s AIF program extends further down the stages of innovation, providing financial support to commercialization projects as well as research and development projects.

The OETF program, however, specifically focuses on firm innovation. It provides strategic funding to the latter stages of the innovation process, as it is a VC partnership program that supports new firms’ innovation in the digital economy. Therefore, the OETF program would be supporting firms in the commercialization stage of the innovation process identified in the framework (Figure 16). The Ontario government, therefore, has greater interests in promoting commercialization of innovation to encourage the growth of the industry.

The South Australian example is similar to the OETF as it focuses on supporting firm innovation. In particular, the Digital Tomorrow program encourages start-up companies to commercialize

innovation. Therefore, the Digital Tomorrow program addresses the shortfall between the R&D and commercialization (*Figure 16*). The program also highlights the challenges faced by new firms, such as securing capital and working space to commercialize innovation. The South Australian example can therefore be seen as a program that specifically targets a key challenge that hinders innovation.

In contrast to South Australia's approach, Germany's ICT2020 strategy takes a broader initiative to address various challenges to innovation. The country's strategy for the digital economy provides incentives across the innovation process to focus on building horizontal cooperation between actors in the process. Although WD's scope of support is not as wide as Germany's strategy, it mirrors some of the aspects. For example, WD's support to technology linkages is similar to BMBF's goal to build both vertical and horizontal cooperation amongst actors in the digital economy. The German strategy also addresses the shortfall between the development and commercialization of innovation in the conceptual framework by (*Figure 16*). This is done by providing funding to both higher education and businesses for innovation and by promoting technology alliances between the key actors of innovation.

6.5. Summary

The strategies employed by the above jurisdictions offer potential strategies that WD can adopt to expand its support to innovations in the digital economy. As a federal department, WD shares similar characteristics with Germany's BMBF. While being a regional development agency, WD also shares similar concerns with the South Australian government. There are lessons to take from the Canadian examples as well. From the Cross-Jurisdictional Scan, WD can better understand how other public agencies support innovations in the digital economy. A common theme between the three jurisdictions examined is the focus on business innovation. In particular, for both South Australia and Ontario, new firms are the emphasis, as they find it more challenging to secure external finances than existing companies in the market.

7. Discussion & Recommendations

Given the uncertainty resulting from the ongoing federal R&D review and the pending digital economy strategy, it is difficult to determine the best approach to support the digital economy sector as a federal department. Although new commitments to the digital economy were announced in the recent federal budget, with additional funding to the IRAP program and to building the HQP capacity for the digital economy, the direction of the digital economy strategy is still uncertain. However, it can be expected that the digital economy strategy will be multifaceted, similar to that of Germany's ICT2020 and South Australia's Digital Tomorrow Program, to focus on more than one area of the innovation process. The objective of the federal digital economy public consultation reveals the government's interest in promoting the sector through extending support to various actors in the innovation process (Government of Canada, 2010). As the government aims to build a world class infrastructure, to harbour and retain talent and to promote collaboration between actors in the innovation process to increase the competitiveness of Canada's digital economy (Government of Canada, 2010), WD can pursue its own strategies to fill the gaps in the innovation system of the digital economy in Western Canada.

Government plays a role in promoting innovations in the digital economy. As an emerging sector, the digital economy consists of new firms that may not have sufficient capital to invest in the commercialization of their innovation. From the Literature Review and the Conceptual Framework, it is evident that to promote innovation in the digital economy, firms, higher education institutions, industry associations and financial companies need to work collaboratively to ensure smooth transition of technology transfer and to commercialize innovation. The Conceptual Framework further reveals that in Western Canada, although there is indirect funding to business R&D, there is a lack of direct government funding to business R&D, which is fundamental to the commercialization of innovation. While a simple answer would be to increase funding to the businesses that conduct R&D, there are more implications to consider. The 1995 Ministerial decision to halt WD's support to the business sector allows WD to focus on other important linkages in the innovation system. While other RDAs tend to focus on promoting business innovation, WD promotes innovation conducted at higher education and research organizations and supports the roles and functions of industrial associations. If WD were to reconsider its policy on not providing direct support to firms, it would enable WD to fulfill a much needed role in supporting the growth of the digital economy in Western Canada.

The Cross-Jurisdictional Scan provides an overview and an analysis of how other jurisdictions promote innovations in the digital economy. The Canadian examples provide WD with suggestions on how it can frame programs to support business innovation in the digital economy. The OETF, in particular, focuses specifically on supporting new firms in the digital economy with capital to commercialize innovation. From the other two jurisdictions examined, it is evident that there is a tendency for governments to take a broader policy approach in supporting the digital economy. While the Canadian examples target the funding gap in business innovation by providing direct funding, South Australia and Germany take a more comprehensive approach. In the South Australian example, the state government places an emphasis on supporting the start-up and growth of new businesses in the digital economy. Germany takes a different approach, as the ICT2020 strategy promotes horizontal cooperation to encourage innovations in the digital economy. Compared with the German approach, the South Australian program is

more narrowly focused on firm-based innovation. Their programs also take into consideration of other actors in the innovation system and the challenges start-up firms tend to face.

The German example emphasizes on building the vertical and horizontal cooperation between actors in the digital economy. As identified in the Literature Review and the Conceptual Framework, it is important to promote technology transfer from higher education institutions to firms for commercialization. This promotes the commercializing of innovation, allowing the sector to be more competitive. The regional innovation system also emphasizes the cooperation of other key actors such as industry associations, specialists and government. A stronger cooperation between key actors will enhance the innovation process. As a regional development department, WD can help build and facilitate the relationships between these actors to encourage horizontal cooperation.

Based on the findings of the report, there are different ways for WD to extend its support to the digital economy, including the ICT and IDM sectors, in Western Canada. However, with considerations of WD's interests and the realities of the industry in the region, there are specific approaches that WD can pursue to promote the digital economy. As such, the report proposes two recommendations for WD to consider.

Recommendation #1: Establish a Digital Economy Team

WD could establish an internal digital economy team to work with various actors in Western Canada's digital economy. The team would be in effect for a defined period of time to focus on assisting firms in Western Canada to work with the 2011 Budget and to actively address the upcoming federal digital economy strategy. This would help position WD and the region for the release of the digital economy strategy. Members of the digital economy team would be drawn from the innovation team, which includes members from Corporate Policy and regional offices. The current innovation team ensures WD meets its innovation priorities, including overseeing the developments of the Digital Economy Strategy.

As the regional development agency representing Western Canada, an internal digital economy team would be instrumental in facilitating cooperation and potential collaboration between various actors in the digital economy. The digital economy team would assess WD's contribution to the sector, liaise with industry partners and clients, provincial counterparts and increase the awareness of funding availability through WD. This would allow WD to strengthen its relationships with current and potential partners and expand its network in the digital economy. If WD is interested in expanding its support to the industry, the digital economy team could examine potential leads and facilitate changes resulting from the Digital Economy Strategy. With a team dedicated to the digital economy, WD could better prepare for the announcement of the federal strategy. This would allow WD to work effectively on assessing the impact of the Digital Economy Strategy and provide strategic options in response.

The team could also act as a linkage to build better cooperation between actors in the digital economy. For example, the team could take a proactive role in facilitating university and industry partnerships to encourage technology transfer and commercialization. The team would be able to encourage private firms to invest in digital economy innovations by working closely with industry associations to create networking events and incubator opportunities. In the long

term, the establishment of the team would enable WD to increase its profile within the digital economy.

Recommendation #2: Create a WD Start-up Funding Program for the Digital Economy

Besides continuing its support to incubator projects and industry associations, WD could consider establishing a specific funding program that would address financial challenges faced by businesses in the digital economy. From the Cross-Jurisdiction Scans, both South Australia and Ontario provide support to new firms through their Digital Tomorrow and OETF programs respectively. Ontario focuses on encouraging private investments to support commercialization, while South Australia places an emphasis on providing grants and resources for start-up firms to encourage innovation. To support new firms in developing innovations in the digital economy, WD could consider establishing a specific funding program that encourages innovation in the ICT and IDM sectors.

Therefore, it is recommended that WD establish a 3-year funding program to support start-up firms in the digital economy. This would align WD's initiatives with the federal digital economy strategy to increase Western Canada's competitiveness in the industry. WD would commit a fixed amount of funding to the program. The partnership program's objective would be similar to South Australia's Digital Tomorrow program, which focuses on providing grants to new companies for commercialization of innovation. The program would enable new firms to secure capital for innovation, and also help position them for VC investments. To successfully implement the program, WD would also need to look into the legalities on how much it could be involved in this policy option.

The creation of a funding program to support start-up firms would focus on funding the commercialization of innovations in the digital economy. The program would expand WD's mandate to incorporate firms as one of the potential funding recipients. This would require a ministerial decision to amend the 1995 decision that placed a hold on WD's support to firms. The program could encourage new firms with ideas for innovation to develop and commercialize. Since innovations in the digital economy are often applied to improve the efficiency and effectiveness of other sectors, an increased productivity in digital economy innovations would improve the competitiveness of other sectors in the region. As such, the program would follow the current mandate of WD to expand the region's economy by strengthening the innovation capacity. If the program succeeds in promoting innovations in the digital economy within the region, WD could examine whether or not it could expand the program to support other emerging sectors, such as environmental technology, as well.

With the establishment of a digital economy team, WD could actively address the upcoming federal digital economy strategy and establish the start-up funding program. As a federal department representing Western Canada, WD could commit a fixed amount of funding to the program. This would address the shortfall in funding for innovation in the region's digital economy and prepare WD for the digital economy strategy.

Future Considerations

The study and the recommendations in this report were based on current available resources. Further investigation on the results of the programs provided by the jurisdictions examined and on Western Canada's digital economy profile would benefit WD with better quality and more reliable data. As well, further examination of hard evidence on the funding gap in Western Canada's digital economy could be conducted to determine the size of the funding gap in the digital economy, the type of assistance (direct or indirect funding) that encourages growth, and the value-added of direct funding to firms. This could be done by the digital economy team in consultation with current WD clients to collect evidence through a survey or a focus group.

8. Conclusion

The digital economy in Western Canada is an emerging sector that is becoming increasingly important to the growth of the region's economy. As firms in the digital economy continue to create innovation that is commercialized and adopted by society, revenue to the sector will continue to grow. WD, as the regional development agency in Western Canada, is committed to promoting the digital economy to fulfill its mandate and align its priority with the federal government. From the findings of the report, it is revealed that within Western Canada, there is a lack of government support to business innovation in the digital economy. In particular, there are challenges faced by new firms in securing capital for innovation. In order to provide both direct and indirect support to firms in the digital economy, WD could adopt the following actions:

1. To create a Digital Economy Team to prepare and address the federal digital economy strategy, and to oversee WD's strategies for the promotion of the digital economy.
2. To establish a specific funding program to support start-up firms in the digital economy.

The recommendations would enable WD to support firms in Western Canada's economy and encourage innovation in the digital economy.

Works Consulted

- Acs, Z.J. & Audretsch, D.B. (1987). Innovation in large and small firms. *Economic Letters*, 23(1987), 109-112.
- Alberta Innovates – Technology Futures (n.d. a). Alberta Ingenuity. *Technology Futures*. Retrieved March 31, 2011 from <http://www.albertatechfutures.ca/Corporate/History/AlbertaIngenuity.aspx>
- Alberta Innovates – Technology Futures (n.d. b). Alberta Innovates commercialization associates. *Technology Futures*. Retrieved March 31, 2011 from <http://www.albertatechfutures.ca/CapacityBuildingPrograms/IndustryFunding/CommercializationAssociates.aspx>
- Almus, M. & Czarnitzki, D. (2002). The effects of public R&D subsidies on firms' innovation activities: The case of Eastern Germany. (Discussion paper No.01-10) Retrieved from Centre for European Economic Research <ftp://ftp.zew.de/pub/zew-docs/dp/dp0110.pdf>
- Amara, R. (1990). New directions for innovation. *Futures*, 22(2), 142-152.
- Angel Investment Network. (n.d). About. Retrieved March 31, 2011 from <http://www.angelinvestmentnetwork.ca/about>
- Arrow, K. (1962). Economic welfare and the allocation of resources for invention. *The Rate and Direction of Inventive Activity: Economic and Social Factors* (609-626). Cambridge, MA: National bureau of Economic Research.
- Asheim, B.T. & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *Journal of Technology Transfer*, 27(1), 77-86.
- Atlantic Canada Opportunities Agency. (March 14, 2011a). AIF Approved Projects. Retrieved April 28, 2011 from <http://www.acoa-apeca.gc.ca/English/ImLookingFor/ProgramInformation/AtlanticInnovationFund/Pages/ApprovedAIFProjects.aspx>
- Atlantic Canada Opportunities Agency. (March 14, 2011b). Program Overview. Retrieved April 28, 2011 from <http://www.acoa-apeca.gc.ca/English/ImLookingFor/ProgramInformation/AtlanticInnovationFund/Pages/AIFProgramOverview.aspx>
- Australia Information Industry Association. (n.d.). ICT Industry Fast Facts. Retrieved May 1, 2011 from http://www.aiia.com.au/?page=fast_facts
- Australian Computer Society. (September 23, 2010). 2010 ACS ICT Statistical Compendium. Media Release. Retrieved May 1, 2011 from <http://www.acs.org.au/index.cfm?action=load&temID=noticedetails¬ID=1066>

- Bauer, J.M. (1997). Market power, innovation and efficiency in telecommunications: Schumpeter reconsidered. *Journal of Economic Issues*, 31(2), pp. 557-565.
- Bérubé, C. & Mohnen, P. (2009). Are firms that receive R&D subsidies more innovative? *Canadian Journal of Economics*, 42(1), 206-225.
- Britton, D.B. & McGonegal, S. (2007). *The Digital Economy Fact Book*. (9th ed.). Washington D.C: The Progress & Freedom Foundation.
- Canada Business. (May 31, 2011). *Commercialization*. Retrieved August 5, 2011 from <http://www.canadabusiness.ca/eng/145/147/4318/>
- Canada Revenue Agency. (December 2009). *About our program*. Retrieved March 10, 2011 from <http://www.cra-arc.gc.ca/txcrdt/sred-rsde/bts-eng.html>
- Canada Revenue Agency. (December 2010). *Scientific Research and Experimental Development (SR&ED) Tax incentive program*. Retrieved March 10, 2011 from <http://www.cra-arc.gc.ca/sred/>
- Canada's Venture Capital and Private Equity Association. (2010). *Think Canada (Again)*. Retrieved from http://www.cvca.ca/files/Downloads/Think_Canada_Again_Web_Version_FINAL.pdf
- Canada Foundation for Innovation. (2010). CFI overview. Retrieved April 2, 2011 from <http://www.innovation.ca/en/about-the-cfi/cfi-overview>
- Canadian Foundation for Innovation. (2011). Summary of projects funded. Retrieved April 2, 2011 from <http://www.innovation.ca/en/projects-funded/summary-of-projects-funded>
- Canadian Intellectual Property Office. (April 27, 2011). About Intellectual Property. Retrieved May 3, 2011 from http://www.cipo.ic.gc.ca/eic/site/cipointernet-internetopic.nsf/eng/h_wr00331.html
- Canadian Interactive Alliance. (February 2009). *2008 Canadian interactive industry profile*. Prepared by Nordicity. Retrieved November 10, 2011 from <http://www.omdc.on.ca/AssetFactory.aspx?did=6604>
- Canadian Interactive Alliance (July 2010). *Canada's digital future*. Retrieved January 17, 2011 from http://digibc.org/pdf/CIAIC_CanadaDigitalFuture.pdf
- Carlsson, B. (2004). The Digital Economy: What is new and what is not? *Structural Change and Economic Dynamics*, 15(3), 245-264.
- Clarke, T. (2001) The knowledge economy. *Education + Training*. 34(4), 189-196.

- Clayman, B. & Holbrook, A. (2004). The survival of university spin-offs and their relevance to regional development. (Working Paper). Retrieved May 16, 2011 from <http://www.innovation.ca/docs/publications/commercialization/clayman1.pdf>
- Cohen, W.M. & Levinthal, D.A. (1989). Innovation and learning: The two faces of R&D. *The Economic Journal*, 99(397), 569-596.
- Colecchia, A. & Schreyer, P. (2002). ICT investment and economic growth in the 1990s: Is the United States a unique case: A comparative study of nine OECD countries. *Review of Economic Dynamics*, 5(2), 408-442.
- Cooke, P. (2001). Regional innovation systems, clusters and the knowledge economy. *Industrial and Corporate Change*, 10(4), 945-974.
- Cooke, P., Uranga, M.G. & Etxebarria, G. (1997). Regional innovation systems: institutional and organizational dimensions. *Research Policy*, 26(4-5), 475-491.
- Council of Canadian Academies (CCA). (April 2009). *Innovation and business strategy: Why Canada falls short*. Ottawa, Canada.
- Creative Industries. (June 15, 2008). Digital Tomorrow Program. In *News Blog*. Retrieved May 1, 2011 from <http://www.creativesa.org/news/digital-tomorrow-program/>
- Creative Industries. (November 24, 2010a). Tomorrow Start Program. Retrieved May 1, 2011 from <http://www.creativesa.org/grants/tomorrow-start-grant/>
- Creative Industries. (November 4, 2010b). Tomorrow IP Grant. Retrieved May 1, 2011 from <http://www.creativesa.org/grants/tomorrow-ip-grant/>
- Creative Industries. (October 14, 2010c). About. Retrieved May 1, 2011 from <http://www.creativesa.org/studio/about/>
- Creative Industries. (September 28, 2010d). Services. Retrieved May 1, 2011 from <http://www.creativesa.org/studio/services/>
- Cultural Ministers Council Creative Innovation Economy Roundtable. (February 2009). *Building a creative innovation economy*. Retrieved May 1, 2011 from http://www.cmc.gov.au/_data/assets/pdf_file/0006/87342/Building-a-Creative-Innovation-Economy---Progress_update.pdf
- Czarnitzki, D., Hanel, P. & Rosa, J.M. (2004). Evaluating the impact of R&D tax credits on innovation: A microeconomic study on Canadian firms. (Working Paper No. 05-01) Retrieved from Groupe de Recherche en Économie et Développement International <http://pages.usherbrooke.ca/gredi/wpapers/GREDI-0501.pdf>

- Denniss, A., Yuan, M. & Withers, G. (2009). Innovation financing and use of income contingent loans. *Australian Journal of Labour Economics*, 12(2), 145-165.
- Department of Further Education, Employment, Science and Technology. (November 24, 2010a). Program Guidelines. In *ICT Innovation Partnership Grants*. Retrieved May 1, 2011 from http://www.informationeconomy.sa.gov.au/policy/ict_blueprint/iip/program_guidelines
- Department of Further Education, Employment, Science and Technology. (November 24, 2010b). IIP details. In *ICT Innovation Partnerships Grants*. Retrieved May 1, 2011 from http://www.informationeconomy.sa.gov.au/policy/ict_blueprint/iip/iip_details
- Department of Trade and Economic Development. (June 15, 2010). ICT and Electronics. In *Industry Profiles*. Retrieved May 1, 2011 from <http://www.southaustralia.biz/Investing-in-SA/Industry-Profiles/ICT-and-Electronics.aspx>
- Doloreux, D. & Parto, S. (2004). Regional innovation systems: A critical synthesis, No. 17, Discussion Papers. United Nations University, Institute for New Technologies.
- Etzkowitz, H. (2003). Innovation in innovation: the Triple Helix of university-industry-government relations. *Social Science Information*, 42(3), 293-337.
- Etzkowitz, H. & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university-industry-government relations. *Research Policy*, 29(2), 109-123.
- Federal Ministry of Economics and Technology. (November 2010b). *ICT strategy of the German federal government: Digital Germany 2015*. Retrieved May 4, 2011 from <http://www.bmwi.de/English/Redaktion/Pdf/ict-strategy-digital-germany-2015,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf>
- Federal Ministry of Education and Research. (2007). *ICT 2020: Research for innovations*. Retrieved May 4, 2011 from <http://www.research-in-germany.de/dachportal/en/downloads/download-files/9438/ict-2020-research-for-innovation-2007-80-pages-.pdf>
- Federal Ministry of Education and Research. (June 2010). *Federal report on research and innovation 2010*. Retrieved May 4, 2011 from http://www.bmbf.de/pub/bufi_2010_en.pdf
- Freeman, C. (2001). A hard landing for the ‘new economy’? Information technology and the United States national system of innovation. *Structural Change and Economic Dynamics*, 12(2), 114-139.
- Friedman, J. And Silberman, J. (2003). University technology transfer: Do incentives, management and location matter? *Journal of Technology Transfer*, 28(1), 17-30.

- Gerstmann, J. (June 11, 2002). Electronic Arts to purchase Black Box Games. *Gamespot News*. Retrieved April 5, 2011 from <http://www.gamespot.com/news/2870301.html>
- Government of Canada. (2010). *Improving Canada's digital advantage: Strategies for sustainable prosperity*. Ottawa, Canada. Retrieved November 10, 2010 from http://de-en.gc.ca/wp-content/uploads/2010/05/Consultation_Paper.pdf
- Government of Manitoba. (n.d.). *ICT Insight*. Retrieved April 8, 2011 from http://www.gov.mb.ca/stem/ict_insight/research_support/rs_90.html
- Government of Saskatchewan. (n.d.). Innovation and Science Fund. *Advanced Education, Employment and Immigration*. Retrieved March 31, 2011 from <http://www.aeei.gov.sk.ca/isf>
- Government of South Australia. (2009a). Overview. In *Information and Communication Technology*. Retrieved May 1, 2011 from <http://www.sa.gov.au/subject/Business%2C+industry+and+trade/Business+and+industry+sectors/Information+and+communications+technology/Overview>
- Government of South Australia. (2009b). Grants and Programs. In *Information and Communication Technology*. Retrieved May 1, 2011 from <http://www.sa.gov.au/subject/Business%2C+industry+and+trade/Business+and+industry+sectors/Information+and+communications+technology/Grants+and+programs>
- Government of South Australia. (n.d.). *South Australia: A brilliant blend*. Retrieved May 8, 2011 from <http://brilliantblend.southaustralia.biz/>
- Hagedoorn, J. (1996). Innovation and entrepreneurship: Schumpeter revisited. *Industrial and Corporate Change*, 5(3), 883-896.
- Hall, B. H. (2002). The financing of research and development. *Oxford Review of Economic Policy*, 18(1), 35-51.
- Hall, B.H. & Lerner, J. (2009). *The financing of R&D and innovation*. (NBER Working Paper 15325). Cambridge, MA: National Bureau of Economic Research. Retrieved June 10, 2011 from <http://www.nber.org/papers/w15325>
- Hall, B.H. & van Reenen, J. (2000). How effective are fiscal incentives for R&D? A review of the evidence. *Research Policy*, 29(4-5), 449-469.
- Hauknes, J. & Nordgren, L. (1999). *Economic rationales of government involvement in innovation and the supply of innovation-related services*. STEP Working Paper. Oslo: STEP-group.
- Industry Canada. (August 2009). *Canadian ICT sector profile*. Retrieved November 10, 2010 from http://www.ic.gc.ca/eic/site/ict-tic.nsf/eng/h_it07229.html

- Industry Canada. (May 2010a). *ICT sector GDP*. Retrieved November 10, 2010 from [http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0107912eng.pdf/\\$FILE/0107912eng.pdf](http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0107912eng.pdf/$FILE/0107912eng.pdf)
- Industry Canada. (May 31, 2010b). *ICT sector employment (2005)*. Retrieved November 10, 2010 from <http://www.ic.gc.ca/eic/site/ict-tic.nsf/eng/it07921.html>
- Industry Canada. (July 2010c). *ICT sector revenue (2005)*. Retrieved November 10, 2010 from <http://www.ic.gc.ca/eic/site/ict-tic.nsf/eng/it07920.html>
- Industry Canada (January 2011a). *Quarterly Monitor of the Canadian ICT Sector*. Retrieved March 20, 2011 from [http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0106100Q32011eng.pdf/\\$FILE/0106100Q32011eng.pdf](http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0106100Q32011eng.pdf/$FILE/0106100Q32011eng.pdf)
- Industry Canada. (April 2011b). *Science and technology data – 2009*. (Cat. No. lu1-5/2009E-PDF). Retrieved August 11, 2011 from <http://www.science.gc.ca/937918F9-DFCD-42C4-992C-E4948CB883EF/2009-e.pdf>
- Invest in Canada. (2011). *Digital media: Canada's competitive advantage*. Retrieved August 12, 2011 from <http://investincanada.gc.ca/download/839.pdf>
- Johansson, B., Karlsson, C. & Stough, R. (2006). Entrepreneurship, clusters and policy in the emerging digital economy. *The Emerging Digital Economy*. (1-19). Berlin: Hiedleberg: Springer-Verlag.
- Kanata Health Solutions Inc. (2009). Overview. Retrieved April 3, 2011 from <http://www.kanatahealth.ca/pages/Company/Overview.aspx>
- Loury, G.C. (1973). Market structure and innovation. *The Quarterly Journal of Economics*, 93(3), 395-410.
- Lucas, M., Sands, A. & Wolfe, D. A. (February 2009). Regional clusters in a global industry: ICT clusters in Canada. *European Planning Studies*, 17 (2), 189-209. Retrieved from http://www.utoronto.ca/progris/publications/pdfdoc/2009/Lucas,%20Sands%20and%20Wolfe_EPS.pdf
- Mahmood, I.P. & Rfuin, C. (2005). Government's dilemma: The role of government in imitation and innovation. *Academy of Management Review*, 30(2), 338-360.
- Marglin, S.A. (1963). The social rate of discount and the optimal rate of investment. *The Quarterly Journal of Economics*, 77(1), 95-111.
- Marshall, T. (2010). How is Canada doing on the digital front? We score three passes and three fails. *Backbone Magazine*. Retrieved April 3, 2011 from <http://www.backbonemag.com/Magazine/2010-09/canadian-digital-economy-report-card.aspx>

- Martin, S. & Scott, J.T. (2000). The nature of innovation market failure and the design of public support for private innovation. *Research Policy*, 29(4-5), 437-447.
- McKendrick, D.G. (2001). Global strategy and population-level learning: The case of hard disk drives. *Strategic Management Journal*, 22(4), 307-334.
- McKenna, B. (April 27, 2011). Flawed R&D scheme costs taxpayers billions. *The Globe and Mail*. Retrieved September 10, 2011 from <http://www.theglobeandmail.com/report-on-business/flawed-rd-scheme-costs-taxpayers-billions/article1939418/>
- Ministry of Advanced Education. (n.d.). *The BC Research and Innovation Strategy*. Retrieved March 39, 2011 from <http://www.tted.gov.bc.ca/TRI/research/Documents/strategy.pdf>
- Ministry of Economic Development. (n.d.). New media sector. *British Columbia Technology Sector Profile*. Retrieved March 31, 2011 from http://www.tted.gov.bc.ca/MIT/SBIIO/Documents/SectorProfile_NewMedia.pdf
- Ministry of Finance. (June 6, 2011). The next phase of Canada's Economic Action Plan: A low-tax plan for jobs and growth. Retrieved June 10, 2011 from <http://www.budget.gc.ca/2011/plan/Budget2011-eng.pdf>
- Ministry of Innovation, Energy and Mines. (n.d. a). Interactive Digital Media Tax Credit. *Knowledge Enterprise Branch*. Retrieved March 31, 2011 from http://www.gov.mb.ca/stem/knowledge/idm_taxcredit.html
- National Research Council Canada (August 8, 2010). *Key industry sectors – Information and communication technologies*. Retrieved November 10, 2010 from <http://www.nrc-cnrc.gc.ca/eng/sectors/information-communication.html>
- National Research Council Canada. (March 25, 2011). *NRC Industrial Research Assistance Program*. Retrieved April 2, 2011 from <http://www.nrc-cnrc.gc.ca/eng/ibp/irap/about/index.html>
- Ontario Capital Growth Corporation. (June 7, 2010a). Ontario Emerging Technologies Fund – Qualified Investors. Retrieved April 28, 2011 from <http://www.ocgc.gov.on.ca/site/en/funds/ontario-emerging-technologies-fund/qualified-investors/>
- Ontario Capital Growth Corporation. (June 7, 2010b). Ontario Emerging Technologies Fund Portfolio Companies. Retrieved April 28, 2011 from <http://www.ocgc.gov.on.ca/site/en/funds/ontario-emerging-technologies-fund/portfolio-companies/>

- Ontario Capital Growth Corporation. (June 16, 2010c). *Ontario Emerging Technologies Fund: Fund guidelines*. Retrieved April 28, 2011 from <http://www.ocgc.gov.on.ca/site/wp-content/assets/OCGC-OETF-Guidelines-DOM-EN.pdf>
- Ontario Media Development Corporation. (2009). *Industry profile – Interactive Digital Media*. Retrieved January 2, 2011 from <http://www.omdc.on.ca/AssetFactory.aspx?did=6564>
- Ontario Ministry of Research and Innovation. (May 12, 2010). Ontario Emerging Technologies Fund. Retrieved April 28, 2011 from <http://www.mri.gov.on.ca/english/programs/oetf/program.asp>
- Organisation for Economic Cooperation and Development. (1997). *National innovation system*. Retrieved May 16, 2011 <http://www.oecd.org/dataoecd/35/56/2101733.pdf>
- Organisation for Economic Cooperation and Development. (November 21, 2001). *OECD glossary: Research and development*. Retrieved August 20, 2011 from <http://stats.oecd.org/glossary/detail.asp?ID=3111>
- Organisation for Economic Cooperation and Development. (April 16, 2003a). *OECD glossary: Applied research*. Retrieved August 20, 2011 from <http://stats.oecd.org/glossary/detail.asp?ID=120>
- Organisation for Economic Cooperation and Development. (April 16, 2003b). *OECD glossary: Basic research*. Retrieved August 20, 2011 from <http://stats.oecd.org/glossary/detail.asp?ID=192>
- Organisation for Economic Cooperation and Development. (April 16, 2003c). *OECD glossary: Experimental development*. Retrieved August 20, 2011 from <http://stats.oecd.org/glossary/detail.asp?ID=908>
- Organisation for Economic Cooperation and Development. (2010). *OECD Information technology outlook 2010*. Retrieved from www.oecd.org/document/20/0,3746,en_2649_33757_41892820_1_1_1_1,00.html
- Organisation for economic Cooperation and Development (n.d.). *Innovation: the OECD definition*. Retrieved June 2, 2011 from http://www.oecd.org/document/10/0,3746,en_2649_33723_40898954_1_1_1_1,00.html
- Parson, M. & Phillips, N. (September 2007). *An evaluation of the federal tax credit for Scientific Research and Experimental Development*. Ministry of Finance Working Paper 2007-2008. Ottawa, Canada. Retrieved September 9, 2011 from http://dsp-psd.pwgsc.gc.ca/collection_2008/fin/F21-8-2007-8E.pdf
- Pohjola, M. (2002). The new economy: Facts, impacts and policies. *Information Economics and Policy*, 14(2), 133-144.

- Porter, M. (2000). Location, competition and economic development: Local clusters in a global economy. *Economic Development Quarterly*, 14(1), 15-34.
- Rasmussen, E. (2008) Government instruments to support the commercialization of university research: Lessons from Canada. *Technovation*, 28(2008), 506-517.
- Robertson, T.S. (1967). The process of innovation and the diffusion of innovation. *The Journal of Marketing*, 31(1), 14-19.
- Rosen, H.S., Wen, J., Snoddon, T., Dahlby, B. & Smith, R.S. (2008) *Public finance in Canada* (3rd ed.). Canada: McGraw-Hill Ryerson Limited.
- Salmenkaita, J-P. & Salo, A. (2002). Rationales for government intervention in the commercialization of new technologies. *Technology Analysis & Strategic Management*, 14(2), 183-200.
- Samra, S. *The history of the iPhone*. (August 16, 2010). Retrieved February 11, 2011 from <http://www.brighthub.com/mobile/iphone/articles/82615.aspx>
- Scherer, F.M. (1992). Schumpeter and Plausible Capitalism. *Journal of Economic Literature*, 30(3), 1416-1433.
- Schumpeter, J.A. (1928). The instability of capitalism. *The Economic Journal*, 38(151), 361-386.
- Schumpeter, J.A. (1947). The creative response in economic history. *The Journal of Economic History*, 7(2), 149-159.
- Schumpeter, J.A. (2002). The economy as a whole: Seventh chapter of the theory of economic development. (U. Backhaus, Trans.). *Industry and Innovation*. (Original work published 1912), 9(1), 93-145.
- Statistics Canada. (August 23, 2010a). *Intellectual property in the higher education sector*. Retrieved June 20, 2011 from <http://www40.statcan.ca/101/cst01/scte04-eng.htm>
- Statistics Canada. (2010b). *Survey of intellectual property commercialization in the higher education sector*. Ottawa, Ontario: Ministry of Industry. Retrieved June 20, 2011 from <http://www.statcan.gc.ca/pub/88-222-x/88-222-x2010000-eng.pdf>
- Stiglitz, J.E. (1989). Markets, market failures and development. *The American Economic Review*, 79(2), 197-203.
- Symeonidis, G. (1996). Innovation, firm size and market structure: Schumpeterian hypotheses and some evidence. *OECD Economic Studies*, 27(2), 35-70.
- Takalo, T. & Tanayama, T. (2010). Adverse selection and financing of innovation: Is there a need for R&D subsidies? *Journal of Technology Transfer*, 35(1), 16-41.

- Tödting, F. & Tripl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy*, 34(8), 1203-1219.
- University of Manitoba. (n.d.). The eureka project: Smartpark's incubator. Retrieved April 4, 2011 from <http://www.umanitoba.ca/research/smartpark/theeurekaproject.html>
- Verspagen, B. (2006). University research, intellectual property rights and European innovation systems. *Journal of Economic Surveys*, 20(4), 607-632.
- Welfens, P.J.J. (2005). Information and communications technology, regulations and growth: Theory and key policy issues. P.J.J. Welfens, F. Knipping & C. Suthiphand, (Eds.). *Integration in Asia & Europe: Historical Dynamics, Political Issues and Economic Perspectives*. (31-65). Berlin: Heidelberg: Springer.
- Western Economic Diversification. (November 3, 2010a). *Innovation*. Retrieved November 10, 2010 from <http://www.wd.gc.ca/eng/107.asp>
- Western Economic Diversification. (November 16, 2010b). *The department*. Retrieved November 17, 2010 from <http://www.wd.gc.ca/eng/36.asp>
- Western Economic Diversification. (2010c). *Where innovation meets opportunity*. Prepared by IE Market Research Corporation.
- Western Economic Diversification. (January 5, 2011a). Western Diversification Program. Retrieved April 28, 2011 from <http://www.wd.gc.ca/eng/301.asp>
- Western Economic Diversification. (January 5, 2011b). What is WEPA? Retrieved April 28, 2011 from <http://www.wd.gc.ca/eng/297.asp>
- Western Economic Diversification. (April 7, 2011c). \$350,000 to video game studio incubator. News Release. Retrieved June 29, 2011 from http://www.wd.gc.ca/eng/77_7232.asp
- Western Economic Diversification. (July 19, 2011d). Western Economic Diversification Canada Programs. Retrieved August 17, 2011 from <http://www.wd.gc.ca/eng/16.asp>
- Western Economic Diversification. (n.d.). Corporate Business Plan: FY2011-2012. Retrieved June 10, 2011 from http://www.wd.gc.ca/images/cont/12983_eng.pdf

Appendix A – WD funding to the Digital Economy

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
2005	Urban and Regional Information Systems Association	Association	2005 GeoAlberta, Calgary	AB	Technology Linkages	\$ 157,500	\$ 7,500	\$ 150,000
2005	Alberta Motion Picture Industries Association	Association	To provide high definition television production training	AB	Technology Skills Development	\$ 450,000	\$ 100,000	\$ 350,000
2005	Southern Alberta Institute of Technology	College	To establish the Centre for Innovative Information Technology	AB	Technology Adoption & Commercialization	\$ 10,750,000	\$ 2,500,000	\$ 8,250,000
2005	The Banff Centre	College	Banff Experimental Audio Research Station	AB	Technology Research & Development	\$ 22,250	\$ 20,000	\$ 2,250
2005	Calgary Technologies Inc.	Not for Profit	2005 Wireless Connections, Calgary	AB	Technology Linkages	\$ 208,000	\$ 10,000	\$ 198,000
2005	Alberta Terrestrial Imaging Corp.	Private	Alberta Terrestrial Imaging Centre	AB	Technology Linkages	\$ 8,288,520	\$ 1,798,334	\$ 6,490,186
2005	Canadian Information Processing Society	Society	ICE 2005 (IT Conference) on Nov 7-10, 2005 in Edmonton	AB	Technology Linkages	\$ 257,000	\$ 5,000	\$ 252,000
2005	University of Calgary	University	To research on global positioning satellite networks	AB	Technology Research & Development	\$ 6,180,000	\$ 900,000	\$ 5,280,000
2005	University of Alberta	University	To develop a proposal for high performance grid computing	AB	Technology Research & Development	\$ 164,500	\$ 80,000	\$ 84,500
2005	University of Alberta	University	Alberta Digital Morphology and Imaging Facility	AB	Technology Research & Development	\$ 5,616	\$ 5,054	\$ 562

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
2005	University of Calgary	University	Canadian Geodetic Network for Earth Systems Monitoring	AB	Technology Research & Development	\$ 22,222	\$ 20,000	\$ 2,222
2005	New Forms Media Society	Association	New Forms Festival 2005	BC	Community Innovation	\$ 50,768	\$ 5,000	\$ 45,768
2005	New Media B.C. Association	Association	Digital Coast - Industry Collaboration and Branding	BC	Technology Linkages	\$ 663,500	\$ 195,000	\$ 468,500
2005	New Media B.C. Association	Association	Vancouver International Digital Festival (VIDFEST) 2006	BC	Technology Linkages	\$ 395,500	\$ 20,000	\$ 375,500
2005	New Media B.C. Association	Association	Mobile MUSE - English to Go research and development	BC	Technology Research & Development	\$ 335,000	\$ 145,000	\$ 190,000
2005	OT&T Information Systems Inc.	Private	Hire graduate to expand operations in China	BC	Technology Adoption & Commercialization	\$ 20,000	\$ -	\$ 20,000
2005	PowerNet Technology Corporation	Private	Hire graduate to improve BC communications technology	BC	Technology Adoption & Commercialization	\$ 20,000	\$ -	\$ 20,000
2005	Techneos Systems Inc.	Private	Hire graduate to develop software for mobile platforms	BC	Technology Adoption & Commercialization	\$ 40,000	\$ 20,000	\$ 20,000
2005	BC EnerTech Ltd.	Private	Hire graduate to assess and implement design software	BC	Technology Adoption & Commercialization	\$ 40,000	\$ 20,000	\$ 20,000
2005	Corinex Communications Corp.	Private	Hire a graduate to develop new technologies	BC	Technology Adoption & Commercialization	\$ 20,000	\$ -	\$ 20,000

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
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2005	IdeaLEVER Solutions Inc.	Private	Hire two graduates to develop e-commerce applications	BC	Technology Adoption & Commercialization	\$ 73,680	\$ 33,680	\$ 40,000
2005	Mercurial Communications Inc. (1996)	Private	Hire graduate to develop a low-cost computer system	BC	Technology Adoption & Commercialization	\$ 20,000	\$ -	\$ 20,000
2005	Colonies.com Holdings Inc.	Private	Hire two graduates to develop web applications	BC	Technology Adoption & Commercialization	\$ 80,000	\$ 40,000	\$ 40,000
2005	Aero Geometrics Ltd.	Private	Hire two graduates to streamline operations	BC	Technology Adoption & Commercialization	\$ 40,000	\$ -	\$ 40,000
2005	Aged Stock Ltd.	Private	Hire graduate to document and improve software applications	BC	Technology Adoption & Commercialization	\$ 23,182	\$ 3,182	\$ 20,000
2005	Air Games Wireless Inc.	Private	Hire two graduates to develop carrier specific compilers	BC	Technology Research & Development	\$ 120,000	\$ 60,000	\$ 60,000
2005	BCNET Networking Society	Society	BCNET Advanced Networks Conference 2006	BC	Technology Linkages	\$ 70,260	\$ 5,000	\$ 65,260
2005	WinBC	Society	Wireless Cluster Development	BC	Technology Linkages	\$ 396,000	\$ 198,000	\$ 198,000
2005	Okanagan Partnership Society	Society	Okanagan Regional Broadband Business Plan	BC	Technology Skills Development	\$ 100,000	\$ 50,000	\$ 50,000

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
2005	Simon Fraser University	University	New Media and Life Critical Infrastructure	BC	Knowledge Infrastructure	\$ 40,000	\$ 20,000	\$ 20,000
2005	University of Victoria	University	Visualization Innovation Centre	BC	Knowledge Infrastructure	\$ 31,375	\$ 15,688	\$ 15,687
2005	University of British Columbia	University	New media research projects, community engagement	BC	Technology Adoption & Commercialization	\$ 385,000	\$ 195,000	\$ 190,000
2005	Greenridge Business Systems Corporation	Private	Develop new modules for the company's web portal technology	MB	Technology Adoption & Commercialization	\$ 40,000	\$ 20,000	\$ 20,000
2005	University of Manitoba	University	To support CFI proposal development	MB	Technology Research & Development	\$ 5,000	\$ 4,500	\$ 500
2005	University of Manitoba	University	To assist U of M to join the Westgrid Consortium	MB	Technology Skills Development	\$ 20,000	\$ 15,000	\$ 5,000
2005	Telecommunication Research Laboratories	Research	TRLabs Transition Activities	MR	Technology Skills Development	\$ 243,000	\$ 82,000	\$ 161,000
2005	Streamlogics Inc.	Private	Hire graduate to integrate webcasting service	SK	Technology Adoption & Commercialization	\$ 80,000	\$ 40,000	\$ 40,000
2005	International Road Dynamics Inc.	Private	Hire graduate to evaluate technical sales	SK	Technology Adoption & Commercialization	\$ 40,000	\$ 20,000	\$ 20,000
2005	Aylsham Agro Ltd.	Private	Hire graduate to put GPS into customized equipment	SK	Technology Research & Development	\$ 40,000	\$ 20,000	\$ 20,000

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
2005	COLLIERS MCCLOCKLIN	Private	Hire graduate to create a database for commercial property information.	SK	Technology Research & Development	\$ 40,000	\$ 20,000	\$ 20,000
2005	Phenomenome Discoveries Inc	Private	Hire graduate to develop and test software	SK	Technology Research & Development	\$ 40,000	\$ 20,000	\$ 20,000
2006	Telecommunication Research Laboratories		Phase III/interim support of the Network for Emerging Wireless Technology.	AB	Technology Research & Development	\$ 2,412,000	\$ 1,200,000	\$ 1,212,000
2006	Calgary Technologies Inc.	University	To support Wireless City, promoting wireless telecommunication technologies.	AB	Technology Adoption & Commercialization	\$ 1,727,084	\$ 648,177	\$ 1,078,907
2006	Soilvision Systems Ltd.	Private	Hire one graduate under the First Jobs in Science & Technology Program	SK	Technology Research & Development	\$ 38,588	\$ 19,294	\$ 19,294
2006	Telecommunication Research Laboratories		To support core operations of the Telecommunications Research Laboratories	MR	Technology Research & Development	\$ 46,850,000	\$ 10,000,000	\$ 36,850,000
2007	Telecommunication Research Laboratories		Test and development facility for visualization, tele-immersion and video-conferencing.	AB	Entrepreneurship & Innovation	\$ 1,250,000	\$ 300,000	\$ 950,000
2007	Innovation Resource Centre Council	Council	Prince George Network Feasibility Study	BC	Entrepreneurship & Innovation	\$ 49,000	\$ 24,500	\$ 24,500
2007	WINBC	Society	Development of the wireless cluster in British Columbia	BC	Entrepreneurship & Innovation	\$ 330,000	\$ 165,000	\$ 165,000

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
2007	Wavefront Wireless Society Innovation Society of British Columbia		Wireless Technology Testing and Commercialization Facility	BC	Entrepreneurship & Innovation	\$ 1,858,700	\$ 1,000,000	\$ 858,700
2007	University of British Columbia	University	Collaborative industry applied research in wireless propagation and channel modeling	BC	Entrepreneurship & Innovation	\$ 463,000	\$ 293,000	\$ 170,000
2007	Telecommunication Research Laboratories		Implement remote virtual reality technology infrastructure for Manitoba	MB	Entrepreneurship & Innovation	\$ 231,000	\$ 168,000	\$ 63,000
2008	University of Calgary	University	Support the development of the Global Navigation Satellite Systems Software Receivers	AB	Entrepreneurship & Innovation	\$ 3,570,000	\$ 800,000	\$ 2,770,000
2008	Simon Fraser University	University	Digital Equipment for SFU's Faculty of Communication, Art and Technology	BC	Entrepreneurship & Innovation	\$ 3,090,897	\$ 1,000,000	\$ 2,090,897
2008	Film Training Manitoba Inc.	Not for Profit	Acquire digital technology for film production and establish an online education program	MB	Entrepreneurship & Innovation	\$ 133,000	\$ 108,000	\$ 25,000
2008	Le College Universitaire de Saint-Boniface	University	Purchase equipment for the Faculty of Science and Multi-media laboratories	MB	Entrepreneurship & Innovation	\$ 284,000	\$ 255,600	\$ 28,400
2009	Telecommunication Research Laboratories		Acquisition of wireless communications equipment	AB	Entrepreneurship & Innovation	\$ 277,000	\$ 139,000	\$ 138,000

FY	Client Name	Client Type	Project Description	Region	Activity	Total Cost	WD Funding	Leveraged Funding
2009	British Columbia Institute of Technology	Higher Education	Establish and operate the BC CUBE: BCIT's 3D Simulation Development Lab	BC	Entrepreneurship & Innovation	\$ 1,528,900	\$ 500,000	\$ 1,028,900
2009	Emily Carr University of Art and Design	Higher Education	Equipment purchase for the Stereoscopic 3D Centre of Excellence	BC	Entrepreneurship & Innovation	\$ 839,800	\$ 530,000	\$ 309,800
2009	University of Saskatchewan	Higher Education	Develop decision support software assessing water impact for the power generation industry	SK	Entrepreneurship & Innovation	\$ 750,500	\$ 750,500	\$ -
Total # of Projects		59				\$ 95,701,342	\$ 24,614,009	\$ 71,087,333