Not the Silicon Valley of the North:

Leveraging the affordances of Toronto's technology ecosystem to design an inclusive Canada

By Jen Serdetchnaia

Submitted to OCAD University in partial fulfillment of the requirements for the degree of Master of Design in Inclusive Design

Toronto, Ontario, Canada, April, 2018

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Abstract

Advancement in connected technologies, known as the fourth industrial revolution, is a driver of progress for our generation. The benefits of progress are not evenly distributed, as regions of concentrated technological innovation disrupt industries in other regions, such as in many parts of Canada. In the face of a combination of external and internal factors, Canada is at an inflection point. Canadian leaders in industry, government and university are looking to strengthen Toronto's innovation ecosystem as a method for reducing the gap in Canada's technological progress. The technology hub in the San Francisco Bay Area, known as Silicon Valley, is considered the benchmark for an innovation ecosystem. Leaders in Toronto are attempting to replicate its properties in developing Internet applications, with some calling Toronto 'the Silicon Valley of the North'. In this paper, the author argues that Toronto is not the Silicon Valley of the North by describing innovation ecosystem components and behaviours, examining the components, behaviours and history of Silicon Valley, and comparing the components, behaviours and history of Toronto. Although Silicon Valley currently dominates innovation in consumer applications and Internet technologies, the author argues that the region is really differentiated by its ability to incubate creative destruction cycles—otherwise known as the successful transition between periods of disparate innovations. The author suggests this was made possible with decades of building the region's entrepreneurial culture, resource mobility, regulation flexibility, and concentration of people, technology and capital. In contrast, Toronto industry is largely concentrated in financial services, tightly-regulated and historically dependent on U.S. innovations. The author recommends that in order for Toronto to thrive as an innovation ecosystem, the region should avoid replicating Silicon Valley's technology-driven innovation in consumer applications. Instead, Toronto should focus on amplifying the region's unique properties (its affordances)—including its expertise in finance, its diversity, its relatively open immigration policies and its affinity for government partnerships—to apply Silicon Valley innovations in unlocking the value of revolutionizing entire industries.

Key words

Toronto startups; Toronto technology; Canadian values; inclusivity; accessibility; diversity; startup ecosystem model; innovation ecosystem model; Silicon Valley; fourth industrial revolution; digital disruption

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1.0 Introduction

1.1 Background

Following several decades of rapid growth that outpaced every other industry, technology is the largest sector in the global economy ("The Path to Prosperity: Resetting Canada's Growth Trajectory", Advisory Council on Economic Growth, 2017). Recently, the largest companies in the world by market capitalization are consistently the technology enterprises that were founded in the last 20 to 40 years, especially those from the technology hub of the San Francisco Bay Area, known as Silicon Valley (see Table 1).

Table 1: Largest companies in the world, by market capitalization, as of March 31, 2018

Rank	Company	Valuation (in USD billions)	Sector	HQ	Year founded	CEO	Founder(s)
1	Apple	851.317	Technology	Cupertino, California	1976	Tim Cook (2011-)	Steve Jobs (CEO until his death in 2011)
2	Alphabet (holding company for Google)	717.404	Technology	Mountainview, California	2015 (Google founded in 1998)	Larry Page (2015-, formerly CEO of Google); Sergey Brin, President (2015-)	Larry Page, Sergey Brin

3	Microsoft	702.760	Technology	Redmond, Washington	1975	Satya Nadella (2014-)	Bill Gates (CEO until 2000)
4	Amazon	700.672	Technology	Seattle, Washington	1994	Jeff Bezos (1996-)	Jeff Bezos
5	Tencent	507.990	Technology	Shenzhen, China	1998	Ma Huateng (1998-)	Ma Huateng

Source: Yahoo Finance

The current wave of technological advancement has been given the moniker of fourth industrial revolution by the World Economic Forum and its founder and executive chairman Klaus Schwab (2016). The fourth industrial revolution is expected to encompass the exponential and unprecedented growth of connected network devices, and the subsequent automation (Schwab, 2016). The potential for labour and industry disruption is great (Schwab, 2016). The regions that are not equipped to foster this advancement are missing out on an opportunity to expand their economy and improve quality of life for their inhabitants; furthermore, they face the risk of automation (Startup Genome, 2017). Action is urgently required to reduce the gap; or at the very least, to reduce the speed at which the gap is widening, as more jobs become susceptible to the automation originating from the regions that foster technological advancement (Startup Genome, 2017).

One method for reducing the technology advancement gap is with technology startups—new companies that specialize in technology innovation (Startup Genome, 2017). However, startups require a healthy innovation ecosystem to grow and to scale (Feld, 2012). Entrepreneur and author Brad Feld said in his 2012 book, *Startup Communities: Building an Entrepreneurial*

Ecosystem in Your City, that it can take close to 20 years for an innovation ecosystem to fully develop.

Silicon Valley is one of the best-known innovation ecosystems in the world, home to majority of the rapidly-scaling technology startups that are on track to raising public funding via initial public offering (IPO) (CB Insights, 2017 Tech IPO Pipeline Report). The similarities among the companies based in this geography extend beyond co-location, and are reflective both of Silicon Valley's current innovation period, and of the broader traits of the ecosystem (Startup Genome, 2017). For example, many of Silicon Valley's enterprises focus on consumer applications and connecting end users for what is known as the network effect, where the value of the product increases with the number of people using it (Ravichandran et al., 2017). Since Silicon Valley startups are also driven by venture capital structuring, where growth can be valued more than profitability, many startups are focused on solving problems for large numbers of people, or on technological and engineering innovation: technology for the sake of technology.

In contrast, the Canadian economy has been generally driven by natural resources, wholesale trade, retail trade and financial industries (Statistics Canada, 2017). Toronto's economy, while more diverse than the national statistics, reflects the Canadian focus in retail and manufacturing (see Table 2). Toronto's economy also mirrors global trends in that the technology industry is growing faster than other industries, and in that tech workers are better compensated: the average salary for a technology ecosystem employee in Toronto is $61,000, compared to the average Toronto salary of $55,000 (TechToronto, 2016). However, Toronto's tech industry is additionally growing twice as fast as the national tech industry as a whole (TechToronto, 2016). This comparative growth suggests that investing in Toronto can launch the city as the nation's innovation engine, and eventually strengthen other fledgling Canadian ecosystems.

Table 2: Largest companies in Canada, by market capitalization, 2017

Rank	Company	Valuation (in CAD billions)	Valuation (in USD billions)	Sector	HQ	Year founded	CEO	Founder(s)
1	Royal Bank of Canada	156.521		Banking	Toronto, Ontario; Montreal, Quebec	1864	David McKay (2014-)	-
2	Toronto-Dominion Bank		107.505	Banking	Toronto, Ontario	1955 (amalgamation)	Bharat Masrani (2014-)	-
3	Bank of Nova Scotia	98.357		Banking	Toronto, Ontario	1832	Brian Porter (2013-)	-
4	Suncor Energy	76.127		Energy	Calgary, Alberta	1919	Steve Williams (2012-)	-
5	Canadian National Railway Company	75.356		Railway	Montreal, Quebec	1918	Luc Jobin (2016-)	-

Source: Yahoo Finance

As Canada faces the entry of disruptive technology upstarts and the expansion of large technology companies—like Google, Amazon, Facebook, Apple and Microsoft—to target services for every industry, the nation is at an inflection point. Staple organizations in finance, insurance, healthcare, telecommunications and more have been operating with limited external competition in recent history (Lacavera, 2017). Nationwide investment in innovation has fallen below OECD (Organization for Economic Cooperation and Development) averages, which has been reflected in the lower productivity levels per worker, and left Canada vulnerable for disruption (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017). At the same time, the aging Canadian workforce presents additional productivity challenges (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017).

As the City of Toronto has recognized the importance of investing in the Toronto technology ecosystem, and as the Trudeau government has set innovation ecosystem formation as a priority, Toronto's headlines have been increasingly filled with comparisons to Silicon Valley, with Toronto and Ottawa alternatively claiming the moniker of 'Silicon Valley of the North'. One headline in *Toronto Life* espoused that all qualities of Silicon Valley are found right here in Toronto: "We have hungry entrepreneurs, deep-pocketed investors, next-level start-ups and an infinite supply of brilliant ideas. Why Toronto is the new Silicon Valley" (*Toronto Life*, "The incredible rise of tech", 2017).

This positioning has been met with some opposition in the media. Some are pointing out the negative traits of Silicon Valley—like its challenges with inclusivity and diversity, and its culture of worker burnout (Stirett, 2017). Others are calling for Canada to look toward its own unique properties, also referred to as affordances (Kelly, 2017). In a 2017 article in *The Globe and Mail*, aptly titled "Canada shouldn't aspire to be the next Silicon Valley", Venture for Canada

fellowship founder Scott Stirrett writes: “In a global competition for investment and talent, we must define ourselves as trailblazers rather than copycats…. Canada can be so much more than “Silicon Valley North”.”

In this paper, the author argues that Toronto is not the Silicon Valley of the North by describing innovation ecosystem components and behaviours, examining the components, behaviours and history of Silicon Valley, and comparing the components, behaviours and history of Toronto. Although Silicon Valley currently dominates innovation in consumer applications and Internet technologies, the author argues that the region is really differentiated by its ability to incubate creative destruction cycles—otherwise known as the successful transition between periods of disparate innovations. The author suggests this was made possible with decades of building the region’s entrepreneurial culture, resource mobility, regulation flexibility, and concentration of people, technology and capital. In contrast, Toronto industry is largely concentrated in financial services, tightly-regulated and historically dependent on U.S. innovations. The author recommends that in order for Toronto to thrive as an innovation ecosystem, the region should avoid replicating Silicon Valley’s technology-driven innovation in consumer applications. Instead, Toronto should focus on amplifying the region’s unique affordances—including its expertise in finance, its diversity, its relatively open immigration policies and its affinity for government partnerships—to apply Silicon Valley technology innovations in unlocking the value of revolutionizing entire industries.

1.2 Research Problem

This paper aims to describe the difference in affordances between the innovation ecosystems of Toronto and of Silicon Valley.

1.3 Objectives

1. Describe a model for a technology innovation ecosystem, including its components and behaviours.
2. Describe components and behaviours for Silicon Valley's technology innovation ecosystem.
3. Describe components and behaviours for Toronto's technology innovation ecosystem, in comparison to Silicon Valley.

1.5 Methodology & Method

The author took an expansive approach to understanding the context for Toronto's innovation ecosystem compared to Silicon Valley's innovation ecosystem. The author conducted research on innovation models and other innovation ecosystems, with the goal of obtaining a broad understanding of regulation, security, culture, venture capital, technology, entrepreneurship, and more.

1.5.1 Method

The method for examining ecosystems was inspired by Current State of the Financial Technology Innovation Ecosystem in the Toronto Region prepared by the Munk School of Global Affairs at the University of Toronto (2015), which reviewed components of Toronto's financial technology innovation ecosystem in comparison to other financial services hubs.

The author reviewed literature to describe a technology innovation ecosystem model. The author then described both the Silicon Valley ecosystem and the Toronto ecosystem based on the components and behaviours suggested by the model. The author then selected five

ecosystems to review from globally-recognized top ecosystems for inspiration on amplifying unique affordances:

- Beijing: Regulatory framework
- Tel Aviv: Small population, strong usage of global linkages
- Berlin: Cultural centre, social safety net
- London: Financial centre
- Taipei: Targeting a specialized phase of innovation or product development

The author then examined the backlash against Silicon Valley in news sources, and reviewed Canada's commitment to diversity, inclusion and accessibility. The author then tied together these factors to argue that Toronto is not suited to replicate Silicon Valley. Finally, the author recommended some unique affordances Toronto can amplify in its ecosystem.

To start the research, the author conducted semi-structured interviews with a number of subject matter experts, including two Toronto-area venture capitalists, two graduates of the Next36 program (one who is developing a startup, another who sold it), one lead for an incubator, and countless technology workers across fintech and professional services, some of whom are experts in accessibility and accessible technology. While the author applied learnings from the interviews to guide the research, the author did not identify the interviewees in the paper, nor include direct quotations from conversations, so as not to misrepresent, attribute or extrapolate unintended meaning.

2.0 Describing a model for a technology innovation ecosystem

An ecosystem is classified by the interconnected network of organizations that lead to the provision of goods and services, and economic and employment benefits in a particular region, defined more by target phase of innovation than by industry (Tech Toronto, 2016). In this context, target phase of innovation refers to the stage of the product development lifecycle: For example, is the innovation in production efficiency or in user-centred design? The components of an ecosystem are generally accepted to encompass some variation on the relationship between government, university and industry (Etzkowitz & Leydesdorff, 2000). Brad Feld said in his 2012 book, *Startup Communities: Building an Entrepreneurial Ecosystem in Your City*, that it can take a startup ecosystem about 20 years to solidify. This suggests that the affordances, needs and objectives of an ecosystem can also be defined by its stage in the formation lifecycle.

2.1 Innovation ecosystem model: Government, academia & industry

Many of the best-known innovation ecosystem models describe a variation of the relationship between government, industry and university as a driving force of the ecosystem (see Figure 1) (Etzkowitz & Leydesdorff, 2000). The nature of the relationship differs according to the model. The triple helix model emphasizes the role of the university in our increasingly knowledge-based society, the national systems of innovation model considers industry to be the leader, while the triangle model looks to government as the driving force (Etzkowitz & Leydesdorff, 2000). Regardless of the specifics, all three of industry, university and government are highlighted as crucial components to consider in an innovation ecosystem model.

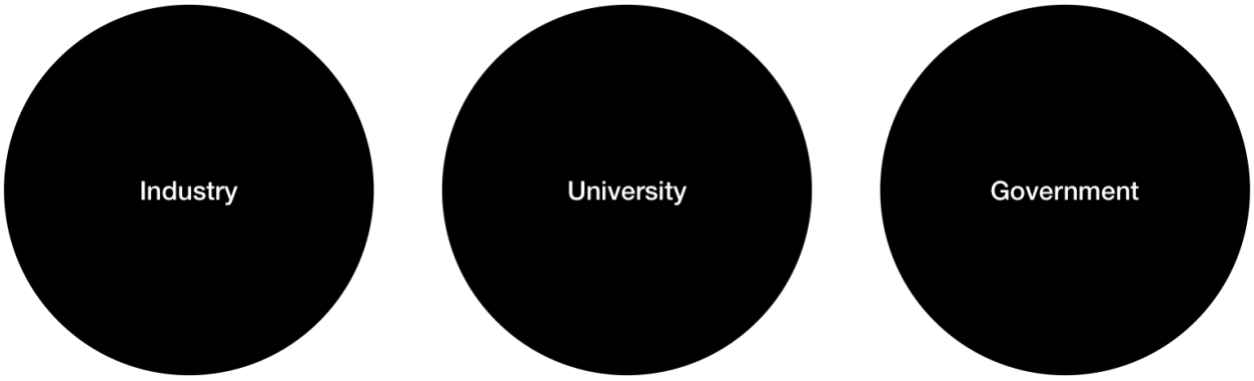

Figure 1: Innovation ecosystem model for government, university and industry

2.2 Target phase of innovation

In the past, ecosystems were known to output entire products—from strategy, to conception, to production—like the silicon chips conceptualized and manufactured in Silicon Valley (Breznitz, 2014). However, today, it is much more likely that a region specializes in a stage of production, rather than outputting a whole product end-to-end (Breznitz, 2014). Breznitz suggests each ecosystem determine the phase of the innovation lifecycle it will target, and who would be appropriate for financing innovation for that phase (2014). One example of such a specialization focus is the ecosystem in Taiwan, which supplies Silicon Valley behemoths and startups with semiconductors, and innovates around the efficiency and quality of the production of those semiconductors (Zanni, 2018).

2.3 Ecosystem components and behaviours

The concept of innovation clusters was pre-empted by Michael Porter's concept of business clusters in the 1990s. Porter defined business clusters as geographic concentrations of

connected organizations, enterprises and institutions in a particular field, where their proximity leads to collective advantages (1990).

By 2009, Porter's definition was extended to the Global Cluster of Innovation (COI) Framework that described clusters by the stage of development and innovation, instead of by industry specialization, as popularized by Jerome Engel at the University of California, Berkeley (2015). Engel characterized an ecosystem by the creation and development of high-potential and high-growth entrepreneurial ventures for increased mobility of resources, including people, capital and information (2015). This focus on innovation meant that clusters were measured based on the rapid formation of new firms, commercialization of new technologies, creation of new markets, and expansion to global markets (Engel, 2015). The components and behaviours for clusters of innovation are well-defined (see Table 3).

Table 3: Components and behaviours for clusters of innovation

Components	**Behaviours**
Universities	Mobility of resources
Government	Entrepreneurial culture
Entrepreneurs	Global strategic perspective
Technology talent	Global linkages
Venture capital	Alignment of interests
Mature corporations and anchor-tenant effect (mature corporation able to mentor young startups)	
Industrial research centres (for applied research with potential for commercialization)	
Service providers and management (support services)	

Source: Engel, 2015

2.4 Ecosystem Lifecycle phases

The Startup Genome suggests that one important aspect of understanding an ecosystem is identifying its lifecycle phase of development from four phases, as different expectations and objectives are tied to different phases (2017).

Table 4: Ecosystem Lifecycle phases

	Phase 1: Activation	**Phase 2: Globalization**	**Phase 3: Expansion**	**Phase 4: Integration**
Traits	• 1,000 or fewer startups • Limited local experience • Resource gaps	• ~2,000 startups • Exits >$100MM • Ecosystem recognized in state, province, or nation • Attracting resources and startups • Some resource gaps	• 2,000+ startups • Ecosystem elevated to global stage • Attracting resources from worldwide • Some gaps in funding and global ties, which reduces ability to produce billion-dollar startups	• Well over 2,000 startups • Competitive with other top ecosystems • National and local flows of resources within and outside of the tech sector • Influence law and policy to sustain competitiveness and growth • Spreading benefits to other industries and geographies
Objective	Grow community of entrepreneurs, talent and investors	Foster connections with global ecosystems to develop world-class startups	Amplify global resource attraction	

Source: Startup Genome, 2017

3.0 Benchmarking Silicon Valley: History, components and behaviours

One of the inventors of the Internet, Bob Metcalfe, once said, ‘Silicon Valley is the only place on Earth not trying to figure out how to become Silicon Valley’ (Metcalfe, 1998). By most measurements, Silicon Valley is the top-performing technology innovation ecosystem in the world (Startup Genome, 2017). Some say the region is the most influential of our generation, and on par with historical influencers like Athens and Florence (Weiner, 2016). Others say Silicon Valley may end its own innovation ruling era—as well as the idea of a central innovation era—with the distributive technologies it invented (Weiner, 2016). Research on Silicon Valley consistently earmarks five key elements that contribute to its ecosystem success: access to technology and technical knowledge, access to venture capital, highly-qualified talent, entrepreneurial culture, and the availability of networks and linkages (Mallett, 2004). Beyond Silicon Valley components and behaviours, one must also examine its history to begin to understand its success.

Beyond the specific type of innovation that Silicon Valley excels at in any given period—which is currently consumer applications and distributed Internet technologies—the region is exceptional in its ability to incubate creative destruction cycles and reinvent itself periodically. Characterized by the role of venture capital funding, new companies are driven to achieve rapid growth and great scale in the name of addressing a globally-strategic challenge, often with a visionary founder—or founders—at the helm, and a meritocratic team on deck. Venture capital funding can also create an alignment of interests both within and outside a company, which aides in the mutual effort toward a common goal. Within a company, share-holding employees benefit from an IPO or an acquisition, while outside the company, the ecosystem is so interlinked that the

success of one spells benefits for many, from strategic partners, to capital sources, to mentors, to mentees. While each individual entity maintains its competitive entrepreneurial spirit, there is also recognition that since so much of what Silicon Valley does is create net new value, that a growth in one slice of the pie often means an increase in the overall size of the pie.

3.1 History of Silicon Valley, target innovation phase & ecosystem lifecycle stage

Silicon Valley is reinforced by the strong collaboration and linkages between government, industry and university (Etzkowitz, 2013). Arguably the first building block of the Valley was Stanford University and its applied sciences and engineering program led by professor Frederick Terman, who would later be credited as 'the father of Silicon Valley' (Etzkowitz, 2013). The first wave of Silicon Valley entrepreneurs (and many of the waves thereafter) was largely educated at Stanford, among them the founders of Hewlett-Packard ("William Hewlett & David Packard", 2008). Hewlett-Packard served as a key anchor company in the ecosystem, sprouting entrepreneurs, talent, capital and mentorship ("William Hewlett & David Packard", 2008). With groups of graduates from Stanford and other Silicon Valley universities entering the technology industry, the universities began to partner with industry. One notable such partnership was the Stanford Research Park, where applied research was conducted in partnership with industry toward the goal of commercialization (Etzkowitz, 2013). When Silicon Valley became the destination for government spending in space and defense, the government became a significant player in the ecosystem, and the triple helix model was solidified (Etzkowitz, 2013).

The formation and evolution of Silicon Valley is grounded in volatility, which has paved the path for Silicon Valley to become the most mature innovation ecosystem in the world. Silicon Valley experiences boom and bust cycles for periods of innovation, known as creative destruction

cycles (Henton & Held, 2013). For example, for many years Silicon Valley was known for its engineering innovation, before transitioning to design-driven innovation, and more recently to social network-driven innovation (Henton & Held, 2013). The transition between innovation periods is not seamless (Henton & Held, 2013). There is a time of mismatch, where outdated practices, old infrastructure and antiquated technologies prevent the full distribution of new technology (Henton & Held, 2013). While employment numbers tend to drop during a bust, over time Silicon Valley has come to house the highest productivity per employee in the nation (Henton & Held, 2013).

Examining the creative destruction cycles in Silicon Valley sheds light on one important factor: creating an environment where these cycles can happen may be more important than empowering any specific industry or organization.

Defense: 1950s, 1960s

World War II, the Korean War, the Cold War, and the space race created a demand for electronic products fulfilled by Silicon Valley firms like Hewlett-Packard (Henton & Held, 2013). The increased government investment developed an infrastructure of technology firms and support institutions (Henton & Held, 2013). Once defense and space spending was curbed in the 1970s, Silicon Valley was pushed to seek commercial applications for defense technology (Henton & Held, 2013).

Integrated circuits: 1960s, 1970s

The integrated circuit was invented in 1959, which led to the growth of the semiconductor industry throughout the 1960s and 1970s (Henton & Held, 2013). More than 30 semiconductor firms were developed in the Valley during the 1960s, including Shockley Semiconductor, Fairchild, Intel, Advanced Micro Devices and National Semiconductor (Henton & Held, 2013).

Silicon Valley dominated the semiconductor industry, housing 40 of the 45 independent semiconductor firms started in the U.S. between 1959 and 1976 (Henton & Held, 2013). By the time foreign competition, namely from Asia, started to threaten the Silicon Valley semiconductor industry, the invention of the microprocessor by Intel in 1971 paved the way for a new shift into specialized chips, microprocessors and personal computers (Henton & Held, 2013).

Personal computers: 1970s, 1980s

Without defense investment, a thriving semiconductor industry rife for a pivot, and the invention of the microprocessor, the personal computer revolution that grew out of the tech talent situated and intersecting in Silicon Valley would not have been made possible (Henton & Held, 2013). More than 20 personal computer companies were born in Silicon Valley in the 1970s, including Apple (Henton & Held, 2013). As the personal computer grew ubiquitous, so the network revolution began.

Internet: 1990s

Since Silicon Valley faced mounting foreign competition against its hardware competencies when the World Wide Web was created in 1993, the region pushed to become an Internet leader with the commercialization of the web (Henton & Held, 2013). Companies like Netscape, Cisco and 3com were born, while older computer and semiconductor companies grew (Henton & Held, 2013). With the dot-com burst of the early 2000s, this growth was temporarily curtailed.

Networks: 2000 & beyond

Silicon Valley is currently home to close to 16,000 active startups (Startup Genome, 2017). The shift toward social media companies shows an increased focus on innovation for the consumer (Henton & Held, 2013). Powering this cycle of innovation are techniques like crowdsourcing,

crowdfunding and collaborative consumption, which break down distinctions between consumer and producer (Henton & Held, 2013).

About creative destruction cycles

Signs of a coming transition between disparate periods of innovation can be spotted by looking for growing levels of competition, narrowing profit margins, and decreasing venture capital investment, which often follows record venture capital investment (Henton & Held, 2013). Silicon Valley is seeing slowing investment in network innovations in recent years, which may be signalling a coming shift and the question of what's next for Silicon Valley (Henton & Held, 2013).

3.2 Silicon Valley cluster of innovation components

Describing Silicon Valley's ecosystem within the framework of Engel's cluster of innovation, the key components to examine are universities, entrepreneurs, government, venture capital, mature corporations, industrial research centres, service providers and management.

Universities

Silicon Valley is home to the world-class institutions of Stanford and University of California, among others (Engel, 2015). Stanford in particular has taken a lead in commercializing technologies over the past century, under the leadership of engineering dean Frederick Terman, who was later credited as being the father of Silicon Valley (Wadhwa, 2013). The universities continue to be highly collaborative with industry, as is apparent with initiatives like the Stanford Research Park (formerly Stanford Industrial Park), and partnerships with organizations such as IBM, Hewlett-Packard and General Electric (Engel, 2015).

Government

In addition to the space and defense spending that launched the Silicon Valley ecosystem, the U.S. government also amended its policy to allow universities to commercialize their research and own their patents, which stimulated private investment (Engel, 2015).

Entrepreneurs

Entrepreneurs rely on venture capital funding, which requires they aim high and take big risks in order to garner an appropriate return on investment for venture capitalists (Engel, 2015). This creates a culture of risk-taking (Engel, 2015). Since investors tend to gain control over the entrepreneurs' ventures, many entrepreneurs end up leaving their startups and recycling their capital and expertise into new ventures (Engel, 2015). One early example of that is Marc Andreessen, who founded Netscape, and then became the angel investor who directed early-stage funding to Facebook, among many other Silicon Valley startups (Henton & Held, 2013). Another such example is Andy Bechtolsheim, who co-founded Sun Microsystems, and then wrote the $100,000 cheque to fellow Stanford dropouts Larry Page and Sergey Brin to help them start Google (Finkle, 2012).

Tech talent

Silicon Valley is home to about 2 million tech workers (Startup Genome, 2017). In a world where talent wants to be where it perceives talent is, Silicon Valley's dominance is assured based on the amount of tech talent it's been able to command thus far (Thompson, 2014).

Venture capital

Of the ~30 billion USD venture capital funding invested in the U.S. annually, about a third of that goes to Silicon Valley (Engel, 2015). The structure of venture capital funding drives startups to rapid value creation, scaling and early exit, and aligns the interests of employees with the

interests of the investors, such as with stock incentive as part of compensation packages (Engel, 2015). Decades ago, the original semiconductor firms in Silicon Valley were funded by operational organizations and not by venture capitalists (Engel, 2015). The funding model changed as the ecosystem matured and fortunes were created in tech IPOs so that individuals amassed the capital and the expertise to invest in and mentor other startups (Engel, 2015).

For many startups founded in Silicon Valley in the past few decades, venture capital funding has been instrumental not just for the cash, but also for the mentorship and the linkages to key partnerships, technologies and talent (Engel, 2015). Getting funding from a prominent venture capitalist can become somewhat of a self-fulfilling prophecy in Silicon Valley, as key ecosystem players get invested in and drive the startup success. The cycle continues as founders in Silicon Valley often end up giving up venture control to the investors that control the capital, thus exiting their ventures and looking for new opportunities fairly rapidly, all in the name of the resource mobility characteristic of Silicon Valley (Engel, 2015).

The new innovation techniques that lower the barrier between consumer and producer, such as crowdfunding and crowdsourcing, have also increased the role of angel investment in funding (Engel, 2015).

Anchor-tenant effect and mature corporations

On an organizational level, many mature organizations in Silicon Valley were startups not too long ago (Engel, 2015). Given this recency, they can effectively partner with new startups for collaboration, investment and acquisition.

On an individual level, successful entrepreneurs who have exited their ventures and alumni from giant tech companies, like Apple and Google, who have made their fortunes in stock options

and bonuses, go on to start their own organizations with their learnings and capital. These individuals get investment and partnership from their former organizations and are poised to repeat the same organization-building cycle. This type of cycle is called the anchor-tenant effect, where success in an ecosystem creates a virtuous cycle of further success (Engel, 2015).

Industrial research centres

Silicon Valley is home to government research labs, research and development units of the many major organizations headquartered there—like Cisco), and the innovation labs of organizations headquartered elsewhere that aim to be close to the innovation in Silicon Valley—like IBM (Engel, 2015). In addition, universities partner with industry for industrial research centres, like the Stanford Research Park (Engel, 2015). These partnerships for applied research with a focus on commercialization is in fact a founding tenet of Silicon Valley.

Service providers & management

Silicon Valley has also developed a strong support industry of professionals with an assortment of functional experience, like marketing, finance and design, whose careers are earmarked with consecutive roles at startups (Engel, 2015). Their expertise is their function, not a particular industry, which allows them to be highly-effective across organizations (Engel, 2015).

3.3 Silicon Valley cluster of innovation behaviours

Describing Silicon Valley's ecosystem as a cluster of innovation, the key behaviours to examine are mobility, culture, global perspective, global ties and alignment.

Mobility of resources

Mobility is the driving force behind Silicon Valley (Engel, 2015). Resources including funding, talent and technology move quickly between startups driven by the structure of funding (Engel, 2015). Founders may pass over the control of their ventures to the investors and exit early to look for a new opportunity with increased expertise and capital (Engel, 2015). There is also global movement in and out of Silicon Valley that includes talent and capital (Engel, 2015).

Entrepreneurial culture

Entrepreneurship is “the relentless pursuit of opportunity without regard for limitations imposed by the resources under one’s control” (Stevenson, 1999). In Silicon Valley, that means innovation in technology commercialization, experimentation with business models and creation of new markets (Engel, 2015). The common behaviour in Silicon Valley is to give it your all while knowing that failure is a probable outcome (Engel, 2015). Short, flexible, segmented venture plans are the norm (Engel, 2015). This type of culture is also very much driven by the structure of venture funding where payoff for big risks is the preferable route for venture capital investors (Engel, 2015).

Global strategic perspective

Entrepreneurs think big and aim to solve big problems, often by creating markets or by looking for problems with high margins for a solution (Engel, 2015). This behaviour is rewarded by the venture capital funding structure, which favours bigger risks for greater returns on investment (Engel, 2015).

Global linkages

Immigration, outsourcing and partnerships are the norm (Engel, 2015). Between 1995 and 2005, about half of Silicon Valley's technology startup founders were born outside of the U.S., creating strong global linkages (Wadhwa, 2013).

Alignment of interests

Venture funding aligns interests so everyone in the ecosystem is incentivized by striving to think big and make big change, from tech talent to entrepreneurs to partners (Engel, 2015). The structure of venture capital funding drives startups to rapid value creation, scaling and early exit, and aligns the interests of employees with the interests of the investors, such as with stock incentive as part of compensation packages (Engel, 2015).

4.0 Describing Toronto: History, components and behaviours

Toronto headlines are touting Toronto as the Silicon Valley of the North, claiming similarities between the ecosystems. Attempts are underway to amplify Silicon Valley-like properties in Toronto. Investors, accelerators and incubators, among others, are encouraging engineering innovation, investing in mobile application startups, and asking entrepreneurs to think big and solve global problems (Barrenechea, 2014). The Government of Canada is setting innovation ecosystem development as a nationwide goal (Government of Canada, "Innovation Supercluster Initiative", 2018). However, ecosystem formation is a complex phenomenon that is unique to the specific properties of the region in question (Feld, 2012). This section demonstrates that not only does Toronto differ from Silicon Valley in its innovation ecosystem components and behaviours—such as less access to venture capital, few mature startups, and

a ‘little brother’ entrepreneurial culture—but that it also differs in its historical context. These differences indicate that Toronto may be optimal ecosystem for different types of innovations compared to the large-scale consumer applications and Internet technologies of Silicon Valley.

4.1 History of Toronto, target innovation phase & ecosystem lifecycle stage

In reviewing the innovation ecosystem model that consists of government, research and industry, experts say the Toronto ecosystem presents gaps within this interrelationship (TechToronto, 2016). Canadian government regulation is often cited for creating barriers to innovation, research commercialization and startup development, while failing to incentivize partnerships between mature enterprises and startup organizations (Lacavera, 2017). While industry has begun to work well with university in a number of accelerators, incubators and partnerships, the interaction within industry remains largely competitive instead of collaborative (Breznitz et al., 2015).

Nevertheless, Toronto is North America’s fourth-largest city (Careless, 2013), and a relatively mature ecosystem based on the ecosystem lifecycle model, with over 2,000 startups active in the region according to some sources (Startup Genome, 2017), and over 4,000 according to others (Zanni, 2018). In interviews conducted by the author, venture capitalists cited that the nature of Toronto’s ecosystem is well-suited to enterprise enablement innovation, as well as to innovation targeted at financial industries. In reality, Toronto pursues a mix of target innovation phases, which may be indicative of some friction points within the ecosystem (TechToronto, 2016).

The Canadian economy remains largely powered by natural resource exports, wholesale and retail trade, and the financial services industry, with Toronto closely mirroring this breakdown (TechToronto, 2016). Beyond the national trends, Toronto is Canada's financial hub and has sprouted some financial technology innovation, much of which is hindered by Canadian regulation (Breznitz et al., 2015). The region's universities have also made early investments in research for artificial intelligence and machine learning (Zanni, 2018). Much of the research being conducted in Toronto is still being commercialized outside of Canada (Lacavera, 2017). Increases in government financing for artificial intelligence commercialization, such as the recently-announced 96 million USD investment, indicate that there is effort underway to change the trend in commercialization underperformance (Zanni, 2018). Recently, Toronto has been the target for increased attention on the international tech scene, as Amazon shortlisted the city as a potential HQ2, and Google announced Toronto as home to Sidewalk Labs, the tech giant's first attempt at creating an urban smart city (Zanni, 2018).

In the face of the fourth industrial revolution, and other external and internal factors, Canada is at an inflection point. Externally, Canada is facing challenges from the fourth industrial revolution, which include increased global competition—like potential entry of Apple, Google, Amazon, Microsoft and others, to every industry—and the technological disruption that is originating from other regions. Internally, Canada is facing challenges with its aging workforce and its lower productivity levels that are also reflective of its historically lower levels of business investment. Canada's relationship and proximity to the U.S. is a challenge that is both internal and external, leading not only to brain drain, but also to the 'little brother syndrome', where Canadians may consume what the U.S. produces and may not feel empowered to step up to the world stage (Lacavera, 2017). The convergence of these challenges incites a call for action for Canada.

In March 2016, the Minister of Finance for the Government of Canada established the Advisory Council on Economic Growth to address the subject of sustained long-term growth for Canada, with the specific goal of informing the Government's policies.

In a series of reports, the Council highlighted several findings around sustaining economic growth in Canada. Some select recommendations from the reports include:

1. Canada's continued prosperity is threatened by the technological disruption of many of its key industries, its aging population, and increased global competition (Advisory Council on Economic Growth, "Pathway to Prosperity: Resetting Canada's Growth Objective", 2017)
2. The rate at which Canada's GDP is growing is expected to slow from 3 percent annual growth over the last 50 years, to 1.5 percent annual growth over the next 50 (Advisory Council on Economic Growth, "Pathway to Prosperity: Resetting Canada's Growth Objective", 2017)
3. Canadian productivity has decreased in comparison to the U.S. over the past three decades, from 90 percent of U.S. levels in 1985, to 78% of U.S. levels in 2016 (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017)
4. Median real wages have grown slower in Canada than in the U.S. (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017)
5. Globally, there is a relationship between investment levels and growth in GDP per capita (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017)
6. Canada is below the OECD (Organization for Economic Cooperation and Development) average for business investment, for both machinery and intellectual property, investing

about 30 percent less on a per-worker basis than the United States since 2000 (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)

7. Although business investment in Canada has recently increased, productivity growth and median real wages have not yet reflected this increase (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)
8. Small and medium-sized enterprises, responsible for 60 percent of Canada’s private sector employment and a third of Canada’s GDP, invest and export less than their Canadian counterparts (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)

In a series of reports, the Council provided a number of recommendations around sustaining economic growth in Canada. Some select recommendations from the reports include:

1. Invest in innovative technologies (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)
2. Create predictable, efficient, consistent and agile regulation so enterprises know what to expect (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)
3. Review Canada’s tax structure and tax incentives (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)
4. Stimulate small and medium-sized enterprise investment (Advisory Council on Economic Growth, “Investing in a Resilient Canadian Economy”, 2017)
5. Enable enterprises to pursue growth opportunities (Advisory Council on Economic Growth, “Pathway to Prosperity: Resetting Canada’s Growth Objective”, 2017)
6. Increase foreign direct investment (Advisory Council on Economic Growth, “Pathway to Prosperity: Resetting Canada’s Growth Objective”, 2017)

7. Attract more immigrant talent (Advisory Council on Economic Growth, “Pathway to Prosperity: Resetting Canada’s Growth Objective”, 2017)
8. Stimulate greater workforce participation via increased inclusion (Advisory Council on Economic Growth, “Pathway to Prosperity: Resetting Canada’s Growth Objective”, 2017)
9. Bridge worker skills gap for the technology economy (Advisory Council on Economic Growth, “Pathway to Prosperity: Resetting Canada’s Growth Objective”, 2017)

Beyond these key findings and recommendations, other historical events have shaped the Toronto of today, including World War II, immigration, and its development as a financial hub. In comparing the history of Toronto since the 1940s compared to that of Silicon Valley, it is evident that both Toronto and Silicon Valley benefited from war-time industry and from an influx of immigrants. However, over history, Toronto has applied the results of these events differently from Silicon Valley, which is especially evident in observing the lack of cohesion among government, industry and university when taking initiative or responding to an event.

World War II: 1940s

Toronto was a centre for Canada’s military during World War II, with the Exhibition Grounds used for military training, the Island Airport used for training for the Norwegian Air Force and the Royal Canadian Air Force, and manufacturing companies, such as Inglis, used for war-time supply manufacturing (Careless, 2013).

Immigration and population growth: 1950s, 1960s

Toronto’s population rapidly increased following World War II, as immigration grew, with newcomers moving to Toronto from Atlantic Canada, Great Britain and beyond (particularly parts of Asia and Africa) (Careless, 2013). Toronto attracted a diversity of newcomers still seen

in the city's demographics today. By 1951, the population of Toronto was over one million, and by 1971, it was over two million (Careless, 2013).

Transportation development: 1950s, 1960s

The original stretch of subway was completed in 1954, followed by highway construction in the late 1950s and early 1960s (Careless, 2013).

Redesigning downtown: 1960s, 1970s

Toronto's downtown core was rebuilt with new skyscrapers and buildings in the 1960s and 1970s (Careless, 2013). These buildings included the Toronto City Hall, the Eaton Centre, the bank towers at the corner of Bay and King Streets, and the University Avenue towers (Careless, 2013). In response to these new, taller buildings, the CN Tower was conceptualized and constructed in order to deliver better radio signal to the newly-rebuilt city with taller towers (Careless, 2013). Like many other real estate projects, the CN Tower was built on former railway lands (Careless, 2013).

Becoming Canada's financial hub and business centre: 1970s, 1980s

By 1981, Toronto reached the population of three million and surpassed Montreal as Canada's most populous city (Careless, 2013). In addition to continued immigration, particularly from Asian and African countries, Southern Ontario benefited from the growing auto industry by signing the Auto Pact with the U.S. in 1965 (Careless, 2013). Compared to Quebec, Toronto had a calmer political climate and lower personal income taxes (Careless, 2013). At this time, financial institutions headquartered in Canada already included RBC, TD, CIBC, Manulife, SunLife, as well as the Toronto Stock Exchange, demonstrating that Toronto was Canada's financial hub (Careless, 2013). In addition, Toronto was also the home to a number of corporate

head offices, including Magna International Inc., Wal-Mart Canada and Brookfield Asset Management Inc. (Careless, 2013).

Becoming Canada's cultural centre: 1970s, 1980s & beyond

Toronto is home to two of Canada's most influential English-speaking newspapers, *The Globe and Mail* and *National Post*, as well as to the Canadian Broadcasting Centre (Careless, 2013). Toronto's Roy Thomson Hall is home to the Toronto Symphony Orchestra, the Four Seasons Centre is home to the Canadian Opera Company and the National Ballet of Canada, and the TIFF Bell Lightbox is home to the Toronto Film Festival (Careless, 2013). Additionally, Toronto is home to Canada's theatre district, which includes the Princess of Wales Theatre and the Royal Alexandra Theatre (Careless, 2013). Finally, both the Art Gallery of Ontario and the Royal Ontario Museum are in Toronto.

Recession: 1990s

Toronto was affected by a Canada-wide recession in the 1990s, with government cutbacks on projects and services that impacted infrastructure development, social welfare programs, and transportation administration (Careless, 2013).

Amalgamation: 1998

The City of Toronto was amalgamated from East York, Etobicoke, North York, Scarborough, York and the old City of Toronto by the Government of Ontario in 1998 (Careless, 2013). Mel Lastman became the first elected mayor of the City of Toronto (Careless, 2013).

SARS epidemic: 2003

Toronto was affected by the SARS epidemic in early 2003, which caused a setback for the Toronto tourism industry (Careless, 2013). The city held the SARS Benefit Concert in July 2003

to raise awareness and help kickstart the tourism industry again (Careless, 2013). The concert attracted 450,000 people, making it one of the ten largest concerts in history (Careless, 2013).

Condo boom: 2010s

A demand for housing and strong economic conditions have resulted in a condominium construction boom throughout Toronto (Careless, 2013).

4.2 Toronto benchmarked against Silicon Valley components

Describing Toronto's ecosystem within the framework of Engel's cluster of innovation and to draw comparison to Silicon Valley, the key components to examine are universities, entrepreneurs, government, venture capital, mature corporations, industrial research centres, service providers and management.

Universities

The Toronto region draws on tech talent from 16 academic institutions, most notably the University of Waterloo, the University of Toronto, Ryerson University and York University (StartupGenome, 2017). Additionally, Toronto area colleges like Seneca, Humber, Centennial and George Brown, produce technical and design talent (TechToronto, 2016).

Toronto is home to a number of university-backed incubators, with the Digital Media Zone at Ryerson consistently being ranked as one of the best university incubators in the world (see Table 5) (Woodrow, 2018).

Table 5: Incubators and accelerators in Toronto region

University	**Incubator/Accelerator**

Ryerson University	Digital Media Zone, the Fashion Zone, Innovation Centre for Urban Energy
University of Toronto	Department of Computer Science Innovation Lab, Impact Centre, Creative Destruction Lab, the Entrepreneurship Hatchery, the Hub Ideation and Experimental Learning Centre
York University	LaunchYU, York Entrepreneurship Development Institute Accelerator
Centennial College	Centre for Entrepreneurship, Student Business Incubator, Wireless Acceleration program in partnership with Wavefront
George Brown College	Digital Media and Gaming Incubator, EmpoweredYouth Startup Hub, Prototyping Lab
Humber College	Humber Launch
Seneca College	The Health Entrepreneurship and Lifestyle Exchange (HELIX) incubator

Source: TechToronto, 2016

Government

As surely as the regulatory environment is cited as a rockblock to startup success in Canada, so is the federal government prioritizing innovation on the national agenda. As Alessandra Jenkins points out in an article in the Wilson Center publication, the continued review of Canada's innovation goals indicates these policies are not just future-oriented, they are also reflective as to why past attempts to spur innovation have not panned out as planned (2017).

In 2011, the Harper government commissioned an expert panel report to examine the innovation landscape and provide policy recommendations, released under the title Innovation Canada: A Call to Action, but better-known as the Jenkins Report. The Jenkins Report provided recommendations to spur innovation around improving access to funding, providing tax credits, and creating industry and university R&D centres, with a focus on stimulating small and medium-sized enterprises while streamlining R&D policy (Jenkins, 2011). Some of the recommendations were implemented with varying degrees of success (Jenkins, 2017). Despite the renewed focus on innovation, global rankings continued to see Canada fall in tech valuations, industry exports and companies with innovative processes (Jenkins, 2017).

On election, the Trudeau government announced its plan to build Canada into a centre of global innovation, and called for a review of the Jenkins Report, claiming that it failed to provide the recommendations necessary to create widespread change (Sulzenko, 2016). Trudeau promised to spend up to $950 million to fund innovation clusters (Innovation Superclusters Initiative, 2018).

According to a 2015 report from the Munk School of Global Affairs, regulatory roadblock is especially pronounced in the fintech industry (Breznitz et al.). Canadian fintechs operates under a “presumption of prohibition” rather than the “presumption of permission” under which the U.S. fintech industry operates (TechToronto, 2016).

One policy that presents roadblocks for the startup ecosystem is the Express Entry process implemented by the federal government in 2013 that poses requirements for organizations to

bring in foreign workers (TechToronto, 2016). This can pose a barrier to startups in need of tech talent, as many do not have the time or funds to overcome bureaucratic processes.

Additionally, while the government is in the investor role, they are most often investing in larger organizations that arguably need the funding less compared to smaller ones (TechToronto, 2016). When the investment is directed at startups, it is often not vetted with a proven methodology, so funds don't get allocated toward potential high-growth ventures (Lacavera, 2017).

The government is demonstrating that it's taking steps toward some regulatory change. One example is the increase in funding toward commercialization, such as with an $86 million U.S. fund directed at artificial intelligence commercialization, and by creating programs for startups (Zanni, 2018). One program created by the provincial government is the Ontario Network of Entrepreneurs (ONE), which has 17 Regional Innovation Centres across the province, with two in the Toronto region (TechToronto, 2016).

Regulation outside of Canada also impacts the technology ecosystem, namely the North American Free Trade Agreement (NAFTA) renegotiation that calls for relaxed cross-border data flow and requirement for local computing facilities (Zanni, 2018). This pressure from NAFTA would most impact the cloud and fintech industries in Canada (Zanni, 2018).

Jenkins highlights that Canadian policies often purposely fail to recognize the great power the U.S. has on Canadian innovation success (2017). Jenkins calls for better recognition of our interdependence with the U.S., and a strategy around our relationship with them both as an ally and a competitor (2017).

Entrepreneurs

Canadian entrepreneurs are labeled to have a “build-to-flip” mindset, meaning that once they achieve annual revenues at about $8 million, they are likely to opt for an acquisition, as opposed to building out a multi-million dollar enterprise (Zanni, 2018). Canada is in need of such anchor enterprises to feed the ecosystem. In a landscape of 1.9 million Canadian businesses, only a handful of them scale, with Shopify, a cloud-based, multichannel commerce platform, being the current standout example (Zanni, 2018).

Tech talent

The Toronto talent pool is multicultural and diverse (Startup Genome, 2017). Toronto is home to 401,000 tech jobs (TechToronto, 2016). Like most regions in the world, Toronto is forecasted to experience a shortage in tech talent in the near future, with 34% Canadian employers saying they already have difficulty filling openings (MaRS, 2018). Women and minorities are underrepresented in Toronto’s pool of tech talent (TechToronto, 2016).

Venture capital

The venture capital landscape in Canada has improved, partially in response to the Jenkins Report as the Harper government invested in risk capital and large venture capital funds (Jenkins, 2017). In response, the Conference Board of Canada moved the grade of this indicator from ‘D’ in 2009 to a ‘B’ in 2013 (Jenkins, 2017). The Toronto region has started to attract larger series A rounds, such as League ($25M), growth rounds for startups like Thalmic Labs ($120M) and Wealthsimple ($50M), and exits such as BlueCat (to Madison Dearbnorn for $400M) (Startup Genome, 2017).

According to Anthony Lacavera, founder of WIND Mobile, Toronto’s greatest venture capital challenge is for mid-sized ventures (Castaldo, 2016). There are incubators and accelerators for

the early stage, and funds like OMERS and Georgian Partners for the large amounts, but a dearth of funding for the mid-sized enterprise that is hoping to scale (Castaldo, 2016).

Anchor-tenant effect and mature corporations

Some experts say the greatest challenge facing the Toronto tech ecosystem is the dearth of startups born and developed here ("The Dream of a Canadian Silicon Valley", 2014). Without anchor organizations, there are fewer people who have 'done it before', making it difficult to support a series of startups ("The Dream of a Canadian Silicon Valley", 2014).

While Ontario has seen some tech startups achieve scale, like BlackBerry and Shopify, neither had actually situated their headquarters in Toronto (Zanni, 2018).

Alternatively, Toronto has attracted the Canadian headquarters for many global tech organizations, including LinkedIn, Facebook and Twitter, and drew interest from Amazon in getting shortlisted for an HQ2 bid, and from Google in establishing Sidewalk Labs, the first urban smart city (TechToronto, 2016). Like Lacavera said in his book, it is exhibitive of Canadian behaviour that even the Canadian tech sector is touting external factors as potential ecosystem boosters (2017). Lacavera urges Canadians to rely on themselves (Lacavera, 2017), but given Alessandra Jenkins' review of the 2011 Jenkins Report, is it realistic for us to ignore the behemoth to the south (Jenkins, 2017)?

Industrial research centres

Communitech, Next and MaRS are also three accelerator bodies that drive the Toronto tech scene. MaRS is the largest urban innovation hub in the world (Startup Genome, 2017).

Service providers & management

Toronto has a strong network of supporting information technology companies, especially in the financial industry (TechToronto, 2016).

4.3 Toronto benchmarked against Silicon Valley behaviours

Describing Toronto's ecosystem as a cluster of innovation and to draw comparison to Silicon Valley, the key behaviours to examine are mobility, culture, global perspective, global ties and alignment.

Mobility of resources

Although Canada is known for its open-arms immigration policy, TechToronto reports that actually the Express Entry process for recruiting an international worker to Canada is bureaucratic and troublesome (2016). In general, regulation creates challenges to mobility.

Entrepreneurial culture

As highlighted in WIND Mobile founder Anthony Lacavera's 2017 book *How We Can Win*, the entrepreneurial culture in Canada generally suffers from a 'little brother' syndrome compared to the United States. Lacavera writes that the culture in Toronto has not encouraged founders to think of billion-dollar ideas and global scale, as we inherently see that as something for our American neighbours to tackle (2017).

Global strategic perspective

As a subset of the little brother syndrome, Canadian entrepreneurs don't tend to expand their vision to look globally (Lacavera, 2017).

Global linkages

Toronto has a diverse population, with half of the city's inhabitants born outside of Canada (Toronto Foundation, 2016). Despite this, many Canadian startups struggle to scale effectively outside of Canada (Lacavera, 2017). On the flipside, some Canadian startups are only able to scale outside of Canada, as seen in some examples in the highly regulated financial space, where a fintech has to leave Canada to get financial institution customers (Breznitz et al., 2015).

Alignment of interests

Since venture capital does not drive the tech ecosystem in Toronto in the same way that it does in Silicon Valley, the alignment of interests isn't as strong. This misalignment of interests between workers and organizations in Toronto is well-documented in the 2018 MaRS report *Talent fuels tech*.

4.4 Attempts to replicate Silicon Valley success

Literature shows examples of attempts to replicate Silicon Valley success to varying degrees with varying degrees of success. While the next section focuses on the regions that may have used Silicon Valley as inspiration to create their own ecosystem, this section outlines some techniques that were applied with a broad, generalized stroke, causing Hospers, Desrochers and Sautet to champion for an approach of 'regional realism' (2008).

Even under the stewardship of visionary Stanford engineering dean Frederick Terman, New Jersey and Dallas each failed to recreate Silicon Valley back in the 1960s, when competing companies refused to work together and universities refused to embrace applied research, effectively demonstrating resistance to forming an ecosystem (Wadhwa, 2013).

Hospers et al. list a number of ecosystems globally whose governments have in some way drawn parallels between themselves and Silicon Valley (2008):

- Silicon Alley (Manhattan—New York)
- Silicon Snowbank (Minneapolis—St.Paul-Area)
- Silicon Desert (Phoenix)
- Silicon Mountain (Colorado Springs)
- Silicon Prairie (Champaign-Urbana)
- Silicon Dominion (Virginia)
- Silicon Hills (Austin)
- Silicon Forest (Seattle)
- Silicon Fen (Cambridge)
- Silicon Glen (Glasgow)
- Silicon Bog (Limerick)
- Medicon Valley (Copenhagen)
- Silicon Seaside (South-Norway)
- Silicon Saxony (Sachsen)
- Bavaria Valley (Bayern)
- Silicon Polder (the Netherlands)
- Dommel Valley (Eindhoven)
- Silicon Kashba (Istanbul)
- Shalom Valley (Israel)
- Silicon Plateau (Bangalore—India)
- Media Valley (Inchon—South Korea)
- Billi— Can Valley (Arnhel Land—Australia)

- Telecom Valley (Minas Gerais—Brazil)

Hospers et al. argue that the government has no place in cluster formation, aside from simplifying regulation, providing tax incentives, and labeling clusters in retrospect (2008). The danger in government design or even facilitation, according to Hospers et al., is that the government may not be more reliable than entrepreneurs in identifying or creating clusters (2008). Additionally, if they don't apply 'regional realism', as per the central topic of the Hospers et al. paper, the government risks trying to create a cluster without the appropriate affordances, or to invest in technologies that have no market just to copy the Valley (2008).

5.0 Drawing inspiration: Unique ecosystems amplifying their affordances

Successful ecosystems often grow out of proactive policy and organized private programs (*Startup Genome,* 2017). Understanding the creation of an ecosystem means codifying how ecosystems function and evolve, quantifying the factors that shape their performance, and identifying the public policies and private practices that accelerate growth (*Startup Genome*, 2017, p.8).

5.1 Beijing

According to a 2018 KPMG publication on disruptive technology, China is right behind the United States in tech leader perception of leading national economies in innovation (Zanni). China is noted for its large tech-savvy consumer base hungry for innovative technology, its government partnership with industry, and its culture of reinvesting in startups (Zanni, 2018). In the same perception survey, half of the tech leaders in China indicated that they predict that the

tech epicenter will move from Silicon Valley to China, although that perception is not shared among the U.S. counterparts (Zanni, 2018).

Beijing is home to over 7,000 startups fed by world-class universities like Tsinghua and Pecking, plenty of foreign investment, and a staggering national commitment to innovation to the tune of designated regional zones and $231 billion U.S. invested in startups by the Chinese government in 2015 alone (Startup Genome 2017). China claims to be home to more than 40 startups that are worth over $1 billion U.S. each, which would mean it is home to more billion-dollar unicorns than any other ecosystem outside of Silicon Valley (Startup Genome, 2017).

China's large consumer base and focus on security makes the country a strong ecosystem for the development and expansion of emerging technologies, such as AI (Zanni, 2018).

While Apple invested in Didi Chuxing and is building a research institution in Beijing, for the most part the ecosystem remains quite insular (Startup Genome, 2017).

Chinese cities like Shenzhen are additionally specializing in hardware innovation (Baraniuk, 2018).

5.2 Tel Aviv

Tel Aviv is home to about 2,700 active startups (Startup Genome, 2017). Tel Aviv has a strong entrepreneurial culture, deep government support and a breadth of tech talent (Startup Genome, 2017). Furthermore, Israel excels in military excellence, which consequently feeds the cybersecurity industry (Startup Genome, 2017). Due to Israel's small size and relationship with

the U.S., Israeli startups are globally-minded at the outset (Startup Genome, 2017). Israel has strong global links to the U.S., with many startups receiving funding and help (Zanni, 2018).

5.3 Berlin

Germany has a large industries of industrial manufacturing, automation and life sciences transforming their businesses with “Digital Factories” to digitize support services (Zanni, 2018). This has potential to fuel an ecosystem.

More specifically, Berlin has the culture and lower cost of life that attracts talent (Startup Genome, 2017). Currently home to about 2,400 startups, it’s a young ecosystem with some potential and scale and a great talent pool (Startup Genome, 2017).

5.4 London

London is home to close to 6,000 active startups, many of them co-located in East London (Startup Genome, 2017). By many metrics, London is the leading startup ecosystem in Europe (Startup Genome, 2017). The ecosystem is strengthened by a combination of big tech companies opening offices in the city, a thriving financial sector and strong ties with leading universities like Imperical College and University of Central London (Startup Genome, 2017).

5.5 Taipei

Taiwan built a $130 billion tech industry supporting the Valley, starting with chip manufacturing (Baraniuk, 2018). They started with fabrication facilities, and then developed technologies around the facilities to allow hardware designers to work more efficiently (Baraniuk, 2018).

6.0 What Canadians want: Defining our values

Long known as a peacekeeper and America's friendly neighbour, Canadians are proud to identify with values of diversity and inclusion. The backlash against Silicon Valley may expose traits of the Silicon Valley ecosystem that may contradict Canadian values and goals.

6.1 What Canadians don't want: The backlash against Silicon Valley

As Mark Zuckerberg addressed the Cambridge Analytica scandal in front of Congress in April 2018, his answers aligned closely with the statement released ahead of the hearing, emphasizing Facebook as an "idealistic and optimistic company" and a "positive force in the world" that ultimately made a "big mistake" (Rushe, 2018).

In response to the Zuckerberg testimonial, Alison Griswold wrote in a *Quartz* op-ed, "If you can only view your failures as an unforeseen consequence of good intentions, how can you ever really hope to change?" (2018).

Optimism and idealism are the principles that Silicon Valley was built on, especially in the most recent wave of social media, network and Internet growth. These companies promised a more connected world, and in some ways, they have delivered on that promise by generating billions of dollars of growth and a better future for some.

Emily Chang writes in her new book about the exclusion of women from technology, which she monikers the greatest wealth creation in the history of the world*:*

> Once Silicon Valley becomes more inclusive, we may all receive, in the

words of Marissa Mayer the “technological future for our world that we really deserve.” (Loc. 253, 2018)

The lack of inclusion may very well be feeding the hype cycle where capital goes toward similar ventures that produce similar innovation. It may also feed into the broader practices around privacy, security and regulation, as well as the overall culture and climate.

6.1.1 Lack of diversity & inclusion

When former Uber engineer Susan Fowler published her blog post reflecting on the sexism she faced while working at Uber, a backlash began that eventually forced out founder and CEO Travis Kalanick. This triggered the analysis of the Uber culture, and with it, a call for review of all the diversity numbers at the large tech organizations. When the numbers were released throughout 2017 (see Tables 4 and 5), they proved that stories like Fowler’s which were slowly trickling out of the Valley may have emerged from systemic odds against women and minorities.

Table 6: Women in tech, 2017

Companies	Overall (%)		Tech roles (%)		Leadership (%)	
	Men	Women	Men	Women	Men	Women
Uber	63.9	36.1	84.6	15.4	78	22
Google	69	31	80	20	75	25
Facebook	65	35	81	19	72	28
Amazon	61	39	73.3	26.7	75	25
Apple	68	32	77	23	71	29
Microsoft	74.1	25.9	81	19	80.9	19.1

Twitter	61.6	38.4	82.7	17.3	67.5	32.5

Sources: Uber Diversity, Google Diversity, Facebook Diversity, Amazon Diversity, Apple Diversity, Microsoft Diversity, Twitter Diversity

Table 7: Diversity in tech, 2017

Companies	White (%)	Asian (%)	Black (%)	Hispanic (%)	Native American (%)	Other (%)
Uber					-	
- Overall	49.8	30.9	8.8	5.6		4.9
- Tech	46.2	47.9	1	2.1		2.8
- Leadership	76.7	20.2	2.3	0.8		0
Google						
- Overall	56	35	2	4	<1	5
- Tech	53	39	1	3	<1	4
- Leadership	68	27	2	2	<1	3
Facebook						
- Overall	49	40	3	5	-	3
- Tech	45	49	1	3		
- Leadership	71	21	3	3		
Amazon						
- Overall	48	13	21	13	-	5
- Tech*	~54.5	39.4	2.6	3.5		-
- Leadership	66	21	5	5		3
Apple						
- Overall	54	21	9	13	-	4
- Tech	52	31	7	8		3
- Leadership	66	23	3	7		1
Microsoft						

- Overall	56.2	31.3	4	5.9	0.5	1.9
- Tech	52.3	38.2	2.7	4.3	0.6	1.8
- Leadership	66.8	25.2	2.2	4.3	0.3	1
**Twitter						
- Overall	43.5	25.8	3.4	3.4	0.1	2.7
- Tech	37.6	31.5	2.2	2.3	0.1	2.7
- Leadership	53.8	14.9	3.6	2.3	0	1.8

*Source: Molla, 2017

**21.1% declined to respond

Sources: Uber Diversity, Google Diversity, Facebook Diversity, Amazon Diversity, Apple Diversity, Microsoft Diversity, Twitter Diversity

The statistical truth is that nearly half of the women that enter the industry leave within 10 years (Wiener, 2016). Bloomberg reporter Emily Chang writes in her 2018 book *Brotopia* about the many ways in which women specifically are held back in the Valley, including a 'boys club' culture where business gets done at bars and clubs, and women face a 'damned-if-they-do and damned-if-they-don't' dilemma for participation.

The lack of diversity in Silicon Valley is especially alarming given they are disproportionately responsible for the ubiquitous products in all of our hands, and the algorithms that increasingly power them. When a singular mindset creates products, that limits the number of people that may benefit from the design. When an unconscious bias is coded into an algorithm, it becomes systemic discrimination (O'Neil, 2016). Furthermore, when a singular mindset dominates company culture and influences who gets hired based on 'culture fit', homogenous companies are built.

6.1.2 Winning at all costs and burnout

“The dominant cultural paradigm in the Silicon Valley tech world is like Max Weber’s Protestant Work Ethic and The Spirit of Capitalism on super-sized doses of Adderall,” reads a website for a substance abuse treatment centre targeting “Silicon Valley burnout” (Summit Estate Recovere Center, 2017).

On the other side of Silicon Valley’s famed mobility of resources is high turnover rate, and the general lack of commitment between a company and a worker (Pfeffer, 2001). Each worker is expected to assume their employment may be terminated at any point, and to work constantly to prove their worth (Pfeffer, 2001). Perhaps the strongest factor of all in the burnout pattern is the structure of venture capital, which demands startups to take big risks and put in immense effort in order to make a return on investment (Tiku, 2017). Basecamp CEO Jason Fried adds that the extreme work culture comes from the fact that startups are driven to focus on growth and revenue, and not profit (Kane, 2017).

6.1.3 Saturated innovation

Some indicators are showing that Silicon Valley’s current iteration of network hub may be growing into a hype cycle, as investment in similar innovations becomes saturated (Henton & Held, 2013). Of the several recent innovations that have struck a chord and exposed ways in which Silicon Valley may be out of touch with the rest of the world, Bodega and Juicero stand out as examples.

Bodega was created by two former Google employees: a sort of sleek glass vending machine marketed as the replacement for corner stores, Mom-and-Pop shops, and, well, actual bodegas (Robertson, 2017). The backlash was swift, especially against the culturally insensitive

application of the bodega term, and the fact that these redesigned vending machines actually were not competitors for bodegas (Robertson, 2017).

Juicero innovated a proprietary juicer that the organization launched for $699, with the former founder of a bankrupted organic restaurant chain at the helm (Carman, 2017). The expensive juicer was compatible only with its proprietary expensive juice packs (Carman, 2017). At first, Juicero faced backlash on the price and the closed ecosystem; but when a Bloomberg reporter published a piece about how the proprietary juice packs are squeezable by hand and don't require the juicer at all, the company could not survive the backlash and shut its doors (Carman, 2017).

McClatchy editor Evan Weiss wrote in a Tweet in response to the Juicero incident (2017):

> Bros: Here's a bougie vending machine.
> Fast Co: These disruptors will change the way you eat and thus alter the course of human evolution.

These examples suggest that the public has begun to set a limit to what is appropriate in the name of innovation.

6.1.4 Regulatory scandals

In a culture that prides itself on disrupting for the sake of disrupting and doing first and asking for permission later, Silicon Valley organizations and founders have come upon their share of regulatory scandals. Among them are the antitrust allegations against Google, Uber's battles with cities over taxi regulation, and AirBnb battles with hotel regulators. As emergent technology

increasingly makes its way out on the city streets, scandals like the pedestrian death from Uber's driverless car accident in Arizona or San Francisco being overrun by motorized scooters leave lawmakers making decisions in absence of precedent.

6.1.5 Big Brother & Fake News: Privacy & security breaches

The Cambridge Analytica scandal is proving to be the gateway to privacy & security conversations for all of big tech. When Cambridge University researcher Aleksander Kogan wrote a quiz in a Facebook app, it exposed a loophole in the Facebook API and allowed the quiz to additionally collect data from the Facebook friends of the people who took the quiz, which is how the data of up to 87 million Facebook users was exposed from the 270,000 who took the quiz. Cambridge Analytica got the data through Kogan and allegedly used it to target users in the Trump campaign, which was also against Facebook policy at the time. Facebook learned of this breach years earlier, and did not publicly acknowledge it until forced by a story published in The New York Times and The Guardian in March 2018. (Chang, 2018)

As Facebook stock dropped, Zuckerberg was brought before Congress in April 2018 to testify about Facebook's privacy and security laws (Nieva, 2018). Regulators are expanding the conversation to include Twitter, Google and other big tech companies (Nieva, 2018).

6.2 Diversity, inclusion and accessibility

Diversity is the variety of ideas and people within a company, while inclusion is an environment where people feel welcomed and involved as their authentic selves, according to a 2014 report on diversity & inclusion by Bersin by Deloitte. Another diversity report from Deloitte published in 2017 states that diversity is a necessary precursor to inclusion. Deloitte's report aims to investigate how many Canadian organizations have taken the step toward diversity and

inclusion beyond compliance, and finds that about half of the organizations had only begun to focus on efforts beyond compliance in the past five years, as of 2014.

Deloitte identifies the untapped potential for full diversity and inclusion in the workforce as Canada's opportunity for improvement over the next 25 years (Deloitte, 2017).

Diversity and inclusion begin with the organizations that make up Canada and build Canada's products. Unlocking Canada's full potential will mean empowering all residents by providing accessible services, systems and products, and thus including as many Canadians as possible.

7.0 Recommendations for amplifying Toronto's ecosystem affordances: Redefining potential in a uniquely Canadian way

The next Silicon Valley will likely be Silicon Valley. The historical context that laid the groundwork for the formation of Silicon Valley is difficult to replicate. Taking any one factor that led to the formation of that ecosystem and applying it to a different ecosystem may not work in a different context with different dependencies. Instead, by examining the holistic makeup of the Silicon Valley ecosystem, leaders from government, industry and university can learn how the region uniquely combined and stimulated its affordances over time. Leaders can then turn toward their own ecosystems and determine how to amplify their affordances.

Toronto is not suited to become Silicon Valley. Canada is a small, open economy with a low population density and a neighbour that is one of the world's most powerful nations. This mix of

factors has often put Canada in the consumer's seat for applications and technologies. The small population makes it difficult for Canadian companies to scale to consumers, and many applications that rely on the network effect require scale. In the same way, the open economy makes it easy for Canadians to consume foreign products and services. At the same time, regulation often does not support startups in helping them work with incumbents. When there are few technology startups that have scaled in the Toronto region, that means that there are few experts who can help scale technology or who navigate the relationship with the government and their policies. However, Toronto can become a hub of second-wave innovation, applying technologies from Silicon Valley in user-focused use cases that emphasize inclusivity, accessibility and other Canadian values.

Canadian Prime Minister Justin Trudeau addressed the fourth industrial revolution at the 2016 World Economic Forum Signature Session in Davos, Switzerland, by delivering the following remarks:

> New technology is always dazzling, but we don't want technology simply because it is dazzling—we want it, create it and support it because it improves people's lives.
>
> If we didn't build the public infrastructure in the early 20th century to support mass electrification only the wealthy would have had heat and running water. And with that, the creation of the middle class—the base of resilient economies—would never have happened.
>
> Technology needs to serve the cause of human progress, not serve as a substitute for it, or as a distraction from its absence.
>
> Simply put, everybody needs to benefit from growth in order to sustain growth.
>
> It's not hard to see how the connections between computing, information, robotics, and biotechnologies could deliver spectacular progress. It's also not hard to imagine how it could produce mass unemployment and greater inequality.
>
> Technology itself will not determine the future we get. Our choices will. Leadership will.

Any recommendation for strengthening the Canadian ecosystem requires that we take into consideration factors that are both internal and external. Internally, Canada is facing challenges with its aging workforce and its lower productivity levels that are also reflective of its lower levels of business investment. Externally, Canada is facing challenges from the fourth industrial revolution, which include increased global competition and the technological disruption that is originating from other regions. Canada's relationship and proximity to the U.S. is a challenge that is both internal and external: this leads not only to brain drain, but also to the 'little brother syndrome', where Canadians may consume what the U.S. produces and may not feel empowered to step up to the world stage (Lacavera, 2017). The convergence of these challenges is an inflection point that incites a call for action.

The call for action from Canadian leaders in research, industry and government comes in the form of a recommendation to strengthen the innovation ecosystems across Canada, one of them being Toronto. The challenges Canada is facing can be categorized within the framework established by Henry Etzkowitz and extended to identify unique affordances and their opportunities. Combining the affordances and opportunities into a potential strategy, and then prototyping a scenario to test the content of this framework helps to extend the possibilities.

7.1 Toronto region framework for affordances, challenges and opportunities

The author highlighted the affordances, challenges and opportunities for the Toronto innovation ecosystem, focusing on the components of industry, government, industry, global linkages and culture.

Industry

Affordances:

- In the industries of financial services, telecommunication and healthcare, among others, Canadian enterprises have historically benefited from limited new entrants and new competition by functioning within what has been labeled an oligopoly (Lacavera, 2017)
- Toronto in particular is a hub for financial and healthcare services

Challenges:

- As many Canadian enterprises have failed to keep up with OECD levels of business investment ("Investing in a Resilient Canadian Economy), in part due to functioning within an oligopoly (Lacavera, 2017), they are left vulnerable to new global entrants and to technological disruption
- Established enterprises have been reported to be uncooperative with startups, especially in the financial technology space, and to resist collaboration (Breznitz et al., 2015)
- The Toronto region has not benefited from the anchor-tenant effect, as there are few startups in the area that have scaled to large enterprises and been in a position to provide guidance to peers
- The levels for productivity per worker have fallen compared to those of the United States (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017)
- The Canadian population is aging, which creates gaps in the workforce (Advisory Council on Economic Growth, "Investing in a Resilient Canadian Economy", 2017)

Opportunities:

- Workforce inclusion: recruit more minorities, women, and people over the age of 55

- Stimulate immigration
- Introduce skills training

University

Affordances:

- Universities in the Toronto region have contributed to research in artificial intelligence and machine learning
- Universities in the Toronto region are recognized globally as teaching and research hubs for technology and computer science: especially the University of Waterloo and the University of Toronto

Challenges:

- Canadian universities lag behind the U.S. in commercializing their research, with graduates and researchers often moving abroad to commercialize (Lacavera, 2017)

Opportunities:

- Create regulation that encourages universities to commercialize their research
- Partner more closely with industry

Government

Affordances:

- Canada has a relatively strong regulatory framework that has been stress-tested by events like the 2008 financial crisis
- Canada's immigration policies remain more open than those of the United States
- Canada has universal healthcare and other affordances

- Justin Trudeau has set an agenda for designing innovation ecosystem superclusters

Challenges:

- Canada's regulation often poses a challenge for new startups and innovations

Opportunities:

- Create predictable regulation with incentive for collaboration, and freedom for research commercialization

Global linkages

Affordances:

- The U.S. is in close proximity to Canada, and is a hub for innovation; Canada and the U.S. are aligned on some cultural aspects

Challenges:

- Canada can tend to demonstrate a 'little brother' syndrome toward the United States, often passively consuming American goods, services and culture, as opposed to producing or competing

Opportunities:

- Stimulate foreign direct investment
- Learn from U.S. innovations
- Use language and cultural similarities to the U.S. to create the possibility of the U.S. being a market

Culture

Affordances:

- Canadians may value inclusivity, diversity and accessibility

Challenges:

- Traditionally entrepreneurial culture calls for big thinking, stepping out of line, and competitiveness, which Canadians are sometimes not conditioned to demonstrate (Lacavera, 2017)

Opportunities:

- Apply inclusion to competitiveness

In conclusion, the external challenges that Canada is facing as a result of the fourth industrial revolution, like the technological disruption and global competition, in addition to the internal challenges that Canada is facing, like the lagging productivity and the aging population, can be addressed by tying a number of the opportunities into a strategy. The key opportunities addressing the workforce revolve around increased worker inclusion, skills training, and stimulation of immigration. The key opportunities addressing lagging productivity, technological disruption and global competition revolve around identifying unique aspects of Canada's economy and investing more, from Canadian investors, from the Canadian government and via foreign direct investment.

8.0 For future research

The author found literature on the Toronto tech ecosystem to be lacking both from an analysis perspective and a historical perspective, and thus had to rely on industry reports to fill in the blanks.

To continue on the outcomes of this paper, the author suggests the recommendations be amalgamated into an ecosystem design.

Due to time constraints, the author did not survey as many people in the Toronto tech industry as she would have preferred. Future research should test the recommendations via survey and interview within the Toronto tech community, and also consider other suggestions via semi-structured interview.

8.1 Potential topics for future research

Potential topics for future research include the current state of the Toronto technology ecosystem and a history of the Toronto technology ecosystem.

8.2 Potential further application

Potential further application for the research includes a recommendation strategy for using the proximity of the U.S. as an affordance, a cohesive strategy for strengthening Toronto's ecosystem, and a service design prototype of how a cohesive strategy could be applied.

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