

Systemic Design: Social Systems (SFIN-6008)

CANADA'S REAL INNOVATION GAP

Leverage points & opportunities for change in the Canadian innovation system





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Innovation in Canada

Putting it in Context

"Innovation drives an economy's ability to create more economic value from an hour of work, thereby increasing economic output per capita. The resulting productivity growth creates potential for rising wages and incomes, and thus for a higher standard of living."

(University of Lethbridge Research Services, 2015)

A robust innovation ecosystem has the ability to improve productivity, economic growth, and job creation metrics in countries adequately supporting this process. In these countries, there also tend to be more resources available to support spending in education, health, and infrastructure, to name a few ("Innovation details and analysis", 2013). Accordingly, the importance of a healthy innovation system is tied closely to that of a healthy national economy, along with its people, communities and institutions.

In Canada, however, economic discourse around innovation and entrepreneurship has recently pointed towards a decline in productive returns from startup investment. Although an improvement from previous years, in 2015 Canada was ranked 9th out of 16 peer countries in innovation by the Conference Board of Canada, receiving a letter grade of "C" on its Innovation Report Card ("Innovation details and analysis", 2013). This ranking points to a persistent weakness in the Canadian innovation system, commonly referred to as the "innovation gap". This phenomenon is being reported by some of the country's top journalists, startup CEOs, established investors, think-tanks, and members of various levels of government across the country. While these reports highlight culture, politics, economics, and education as the cause of this gap, and underlining the need for reform, policy changes, and new programs, few of these calls to action are gaining traction. There is no easy answer to this wicked problem.

With the above in mind, we initially sought to answer the question "Why are investments in innovation resulting in diminishing returns in productivity?" through our research, but we quickly realized that in order to address this issue, we would first need develop a thorough understanding of the innovation ecosystem in Canada and thus we broadened our research questions to "How might we understand the Canadian innovation system?" all the while still focusing on this oft reported, elusive innovation gap.

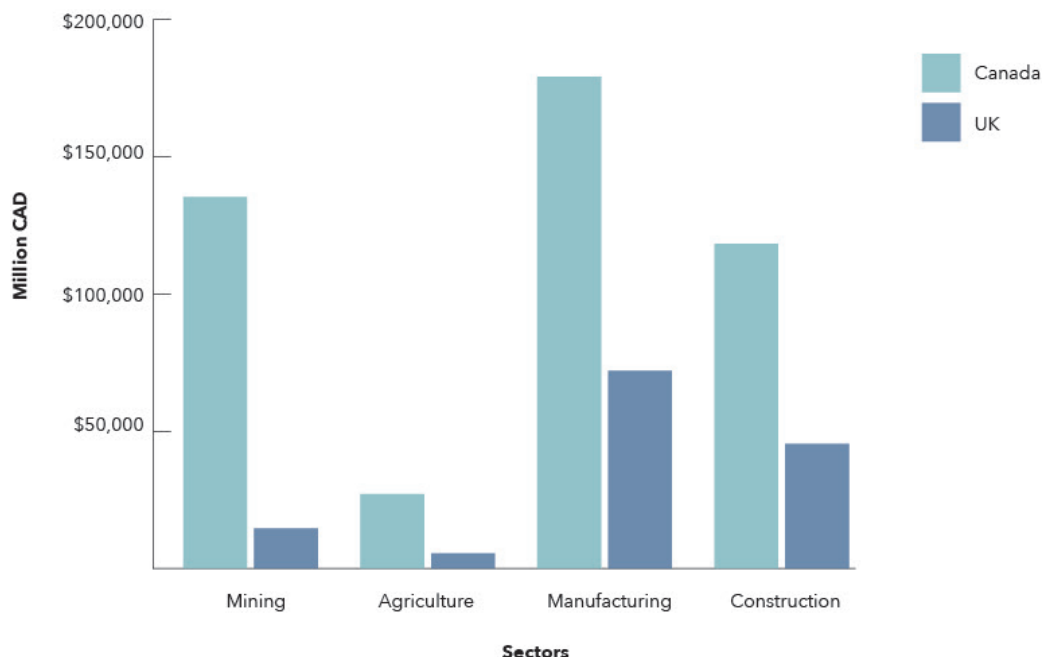
Our early literature review, however, began to point toward broader issues. We discovered that Canada's economic capacity to innovate was actually improving, and that popular examples of declining innovation were often narrowly cast. Further, as we moved through the research process, our discussions with research participants led us to recognize that our focus on an innovation "gap" blinded us to the possibility of Canada's strategic innovation strengths. This final redirection was critical to our ultimate, more complete, understanding of the Canadian innovation system.

What we uncovered is that while Canada may receive mixed ratings on how well it innovates, the reality is more nuanced than what the reports and articles mentioned earlier might suggest. The perception that Canada is failing to innovate is not inaccurate, it is just not the complete story. For the most part, Canada has done well to innovate across sectors and industries that for decades (if not centuries) have employed thousands of Canadians spanning generations across the country.

For this paper, we define innovation the generation of new value through the combination of an idea with the requisite talent and capital supports. In Canada, innovation is tied to

our national capacity to build successful enterprises that can do business while adapting to their competitive environment. In Canada, much of those successful enterprises are built around “core competency” sectors - industries that continue to prosper through differing (and difficult) economic climates and while not necessarily the largest markets in the world, are generally perceived as stable (Groff, 2013). For example, Canada is one of the largest suppliers of agricultural products in the world, with agriculture accounting for approximately 8% of Canada’s GDP. Manufacturing accounts for approximately 14% of the country’s GDP. Mining and oil and gas extraction as well as other forms of energy production remain key industries as well.

**GDP per Sector in CAD Million January 2016
Comparing Canada and the United Kingdom**



The above chart shows GDP per sector in a variety of leading Canadian industries as compared to the UK. All amounts have been converted to Canadian Dollars for ease of comparison. Information derived from <http://www.tradingeconomics.com/canada/indicators>

When examining these particular key industries, it becomes apparent that innovation is happening in Canada, it is just taking place in sectors different than the ones we typically pay attention to. From mining to agriculture, manufacturing to energy, Canadian enterprises are recognized for having invested both time, talent and money into generating new ways of doing business better. Despite this, Canadians still tend to measure themselves against the enviable success of the Americans and the innumerable hubs dotting that nation and that generate legions of disruptive technology firms. There is a pervasive sense of tech solutionism, the notion that very problem has a solution based in technology in Canada (Morozov, 2014). So, when Canadians evaluate *our* Waterloo against *their* Silicon Valley, they are prone to fall into a national anxiety, a paralyzing fear that we have already or are rapidly falling behind.

What is the matter with Canadian innovation? Who’s to blame? Simply put, no one in particular is at fault. Canada’s innovation capacity is just so complex an issue that to truly understand it requires more than a Saturday morning spent with the Globe and Mail. Innovation is also fickle, and any thorough conversation concerning its key features, like this one, must acknowledge that it comes in many distinct forms. As stated, we tend to focus almost explicitly on digital technology-led innovation, much to the detriment of other industries. No matter the focus, many will agree that innovation can touch any sector and

industry within an economy and can stimulate and maintain economic growth. Innovation is the economy, to a certain degree, with its presence driving pipelines of productivity while its absence may suggest economic stagnation. Innovation is accelerated by culture and empowered by various structures, though it enables more frequently than it hinders, but it is hindered more easily than it is enabled. How, then, might we begin to untangle this ball of yarn that is Canadian innovation? In pulling at the proverbial string, how might we untangle the knot of innovation? All of these elements combine to make any effort to develop a more effective innovation system a complex problem.



Complexity Explored

The social system's scope, description, and boundaries

As touched above, the Canadian Innovation System is resoundingly complex, with a scale of depth that is measured not only in numbers of businesses or entrepreneurs, but in the billions of dollars in value that it contributes to the Canadian economy annually. It reaches across sectors and industries (realizing that reality frequently differs from perception) and is scrawled into the agendas of numerous levels of government. Innovation holds real estate across campuses, incubators and hubs in cities and centres across the country, and holds the precious attention of those around tables - in corporate board rooms down to inventor's lair - or more commonly known as the garage.

Accordingly, a succinct description of the scope or boundaries of this system is somewhat problematic. For this project, our team cast the net wide when researching the various elements in the system, and in consideration of our evolving research question, we decided not to look at any one sector, industry or even stakeholder exclusively. Doing this meant that our research team was able to diverge in our research and focus on the impact of different actors, layers and levers within the system at any one time. In reflection, this meant we stared at a Gordian knot for some time, but even this step proved vital as our research question and our understanding of the system co-evolved throughout the study. This evolution was also paramount to the group's capacity to deliberately break down various (and widespread) elements within the Canadian Innovation System and to understand their relationship and impact on one and other. While we will thoroughly investigate (below) how the application of the tenets of network analysis provided our team with insights into the systems functioning; in the meantime it is important to understand that we converged in a way that precluded any exclusivity in our lens of analysis. To do so - to focus solely on the role of education in fostering a stronger culture of innovation, or the entrepreneurial experience with investments within one sector - would have resulted in a weaker analysis of the system-at-large. We acknowledged that this meant touching many components of other systems, but this encompassing approach is mandatory if we were serious about exploring a system as nuanced and intricate as this.

Thus, the complexity of this system is so great that it deserved our undivided attention to research, analyse and synthesize a series of initial findings that would lead to an intervention. As we will explore below, we used a series of implements as varied and storied as time itself to thoroughly dive into the depth of disparate elements that compose this leviathan-like system. Understanding the gaps within the Canadian Innovation System - both real and perceived - revealed greater challenges, such as the Canada's dissonance with the notion of the idea economy itself. Combing the cultural elements of this schism revealed a need for a change in the mindsets, of the conversations that take place between Canadians from the garage floor all the way to the House of Commons. This is only one other component of a systemically broad issue striking at innovation in Canada, for it also and ultimately requires a shift in the elemental structures in place today that might hinder more than help Canada to achieve a more productive and profitable tomorrow. While the current government (and its antecedents) have proposed steps to address what they perceive as the innovation gap - and have rounded up some impressive support from the antechambers of public opinion - the time is nigh to take concerted action across sectors and industries to effect sustainable and positive change for the Canadian Innovation System.



Stakeholders in Innovation

An overview

As with most complex social systems, there are a myriad of primary and fringe stakeholders within the innovation space in Canada. Considering the differing points of view a variety of stakeholders is critical to understanding dynamic and complex problems, and while this was done throughout our research process, this report has ultimately been shaped with the Federal Government as its primary audience. This decision was made with consideration to the Federal Government's significant role within the Canadian innovation system as well as their unique ability to leverage influence across aspects of the structural and cultural factors to help or hinder innovation in Canada. This is not to exclude all other stakeholders within this system, including industry and sector leaders, Canadian workers, investors, inventors; along with entrepreneurs and educators that shape and form the core cultural elements of the system. Ultimately, we decided on focusing on the Federal Government as the most influential stakeholder who can harness the resources and capacity to shape the talent and capital supports required to optimize innovation in Canada.

It is worth noting at this point that the individual entrepreneurial journey is one fraught with varying amounts of challenge and opportunity. While we are generally focused on evaluating the system-level challenges, such as the structural and the functional, that prevent the realization of innovation across the Canadian economy; we recognized that these factors frequently manifested themselves at the individual level, in the form of systemic barriers. For successful entrepreneurship to blossom, we discovered that certain elements - or variables - had a direct and measurable impact on an individual's capacity to successfully generate value from an idea. These go deeper than the basic elements outlined previously, such as the need for talent and capital and include: ideas, education, socio-economic status, risk tolerance, knowledge, network access, awareness, luck and opportunity. These factors, whose impact varies as much as its presence or absence in an entrepreneurs' life, tends to have an impact on the likelihood of success that that individual may encounter in their journey.

All of this taken together, we resolved to provide insights and initial findings to the Federal Government (something that evolved over the course of the research) since this would be the most effective way to reach both the individual and the system within it. This approach was facilitated by our decision to conduct research with participants representing the diverse elements of the system described above. As we will explain below, these participants provided insights into the complex realities facing the innovation system in Canada. These initial findings along with next steps that detail various points of engagement, is explained in subsequent sections of the paper.

Research & Design

The Research Plan & Approach

To build a comprehensive understanding of the Canadian Innovation System and the challenges it is facing, our team decided to build a causal loop systems map to incorporate the insights of our research. To do this, we designed a research protocol that applied a Delphi methodology to a combination semi-structured expert interview and a design probe. Our design probe was actually our research system map – simple at first, growing more complex throughout the research – through which we sought to capture the dynamic causal relationships known to our participants within the innovation system in Canada. Inspired by the Delphi Survey, this hybridized approach reflected our belief that a participatory or even co-creative process would allow for more rigorous insights from our rounds of expert interviews (with our design probe).

Participants provided input on the design probe/system map in iterations, allowing us to redesign the probe to reflect any changes and test those suggestions with the next participants. Ultimately, we returned to all participants in a final round for further feedback. This continual evolution allowed our team to discern a more holistic and nuanced understanding of a complex ecosystem. Our research protocol comprised of several research methods to elicit insights that profoundly shaped the system map at the core of our work and thus, our understanding of the innovation ecosystem in Canada.

Research Methods

As we will discuss in greater detail below, the overall timeline for this research was condensed - a direct result of the confines of the academic term being so brief. Also, due to the nature of the Delphi-inspired approach we chose to take, some phases overlapped, ultimately allowing us to cover more ground as a research team by iteratively engaging participants throughout the evolving research journey. From embarkation through to the journey's end, our team came together to collaborate on many shared elements over each phase of research. Certain proficiencies did enter into the division of tasks, with those decisions being made collectively to ensure everyone was able to contribute to the research project in as happy a way as possible.

Phase 1: Research & Design Assets

First, the research team conducted a comprehensive and thorough literature review using contemporaneous news periodicals along with accredited academic journal and government reports on innovation in Canada. All team members were responsible for ongoing research and continuously scanned sources for incorporation into a central database. We used Airtable - an online database platform - for all our research to be shared and easily accessible (<http://www.airtable.com>). An initial literature review started our research process by enabling an educated discussion on the challenges for innovation in Canada. Through group and participatory research tools, including Ackoff's D.I.K.W. framework (see below), we generated insights, shaped plausible hypotheses, identified bias, and articulated key assumptions. Acknowledging the shared bias among all team members, we chose to incorporate a red teaming method to challenge our strategic pathway by bringing in oppositional points of view. Doing so allowed the team to identify gaps in our logic, such as how key players interact within the innovation space.

Finally, we used Gharajedaghi's Iterative Process of Inquiry to begin visually representing our understanding of the Canadian innovation ecosystem (Gharajedaghi, 2004). We mapped various subsystems and actor relationships in this initial map, consolidating insights and capturing knowledge. This early map provided the basis of the first rendition of the causal loop diagram that would become our design probe. Contributions to the literature review and the core system map continued throughout the evolving process, requiring ongoing participation from all group members.

■ Phase 2: Pre-Test Protocol

Second, our team pilot tested the research protocol during Data Circus. This was a vital step as we chose to test our interview questions and design probe protocol for effectiveness and viability. Leveraging the experiences of our peer group, we were able to anticipate problems and identify improvements in our research procedure. These lessons would contribute directly to the quality of our expert interviews, helping us to develop and articulate key insights with those experts in later phases of the research project. At the Design Circus, our team split into pairs, with one person interviewing and the other recording the exchange. The Data Circus proved extremely useful to the group; we explore this in greater detail below in our reflection on the research journey.

■ Phase 3: Data Collection

Third, our team deployed to the field to conduct our research. Building on the successful learnings from the Data Circus, this phase of research activity involved semi-structured expert interviews and the design probe. To accomplish this, we solicited near-peer networks either via email or in-person with a letter of invitation explaining the purpose of our research and nature of their participation in our study. If they agreed, we would share a consent form for the participant to review that outlined the confidential nature of their participation (see Appendix). Upon obtaining consent, we could officially begin to collect primary data through semi-structured interviews with these participants. These interactions would begin with questions to gauge the participant's experience with innovation, followed by their perspective on innovation in Canada and our country's relative strengths and/or weaknesses (see Interview Protocol in Appendix). This was followed by a discussion around the design probe where we asked the participant to actively edit, add, or comment on a hardcopy design probe. This method encouraged a different form of insight elicitation in comparison to the interview: even if there might be confusion over the system map, the ability to interact with the design probe added another conduit to stimulate further discussions on innovation.

After several expert interviews, we integrated insight into the core system map and remodelled it as a design probe for the next iteration of interviews. Finally, once all interviews had been completed, we aggregated and synthesized all of the insights into a final design probe and reshared with our network of participants for further feedback. This iterative journey allowed the team to continuously refine our understanding of the innovation system in parallel with the insights and analysis we conducted throughout the process.

■ Phase 4: Data Analysis & Synthesis

The final phase of our research protocol involved data consolidation and analysis. To track participant feedback with the design probe, our team used an online systems mapping software named Kumu (<http://www.kumu.io>). Using Kumu gave our team the capacity to rigorously analyze the complexity within the system and to understand the value, strength, and nature of the relationships within the system. Courtesy of Kumu's Centrality Analytics (discussed below), our group was able to identify a variety of leverage points along with a number of systems traps to help understand the system in greater detail. Additionally, these

tools gave us the ability to weigh the strength of certain connections, and where the most potential opportunity or capacity for change might exist. The strength of Kumu's algorithms and visualization tools allowed the team to determine priorities as we moved closer to a set of initial recommendations for our stakeholder, the Government of Canada. To tie off this final phase of analysis, our group revisited the literature review and scanned the environment to ensure we absorbed and aligned with certain distinct realities, like the release of the latest Federal Budget.

Next Steps

For purposes of this section, we are purely examining the implications of this research for future research efforts, whereas implications for our stakeholders (i.e. initial recommendations) are explored in greater detail elsewhere in this report.

In reflection, our research team would like to acknowledge that this process was an iterative one that saw our research question evolve and develop based on various findings. Illuminated by these findings, we delved into the complexities of the Canadian Innovation Ecosystem and the twizzle of structural and cultural barriers that inhabit it. While this phase of the research is officially over, we recognize that these findings by their nature beget further research to uncover additional layers of evidence to support our initial findings.

Moving forward, we envision this future research will likely involve an examination of industry-specific innovation in Canada, such as the advances being made in Agricultural Technology. These sectoral insights might inform other industries desirous of innovation. On a similar tone, an intra-provincial analysis would provide a more contextualized understanding into the unique challenges and opportunities that may exist across Canada's regions. Along these lines, a more penetrating analysis of the Canadian Innovation System might be assisted by a comparative study with other innovation ecosystems. Further, working with and alongside various entrepreneurial hubs that operate within the Greater Toronto Area (for example), may provide a unique point of entry into the system and permit a more rigorous approach to materialise.

On a final note, we acknowledge that should this research to continue, we should employ more elemental data to inform our approach, along with other models and simulations that might shed new light on the findings we had previously identified. At this point, it may also benefit the study to deploy other research methods (such as additional statistical and quantitative tools) and to expand our sample size to inform a more robust set of findings.

Design Rationale

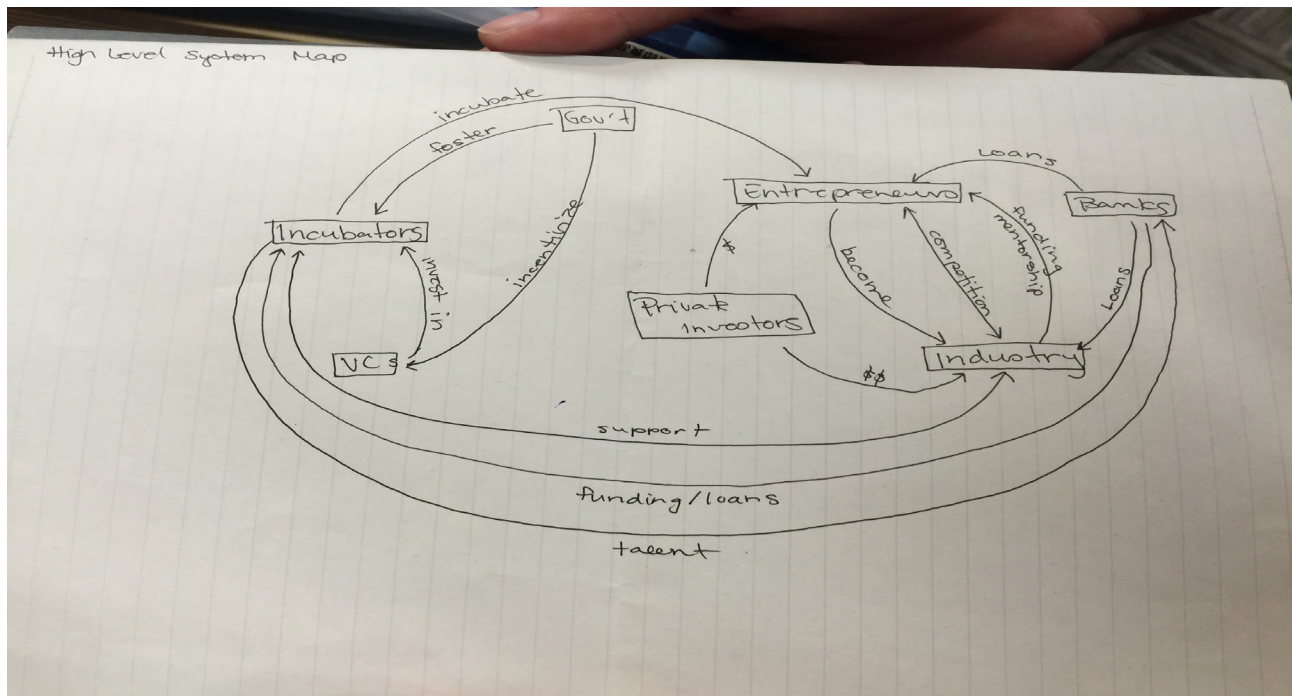
In recognition of the fact that the innovation landscape is perceived differently depending on the participant's vantage point in the ecosystem- area of expertise and experience, it was agreed at the early onset of our research design phase that we would use the Delphi method to allow for continuous input and iteration to our design probe and thus, our understanding of the complexities underlying the innovation ecosystem in Canada. By identifying industry experts in several different sectors, we were able to unpack specific areas of the design probe based on the participant's core strengths. For example, through a semi-structured interview with a portfolio manager of a venture capital fund in Toronto, we were able to dive deeper into the complexities that underlie the flow of venture capital funds in Canada. This revealed that venture capitalists are focused on funding Canadian companies that are innovating in commodities, manufacturing and health care because that is what Canadian investors understand. The value derived from our expert interviews led to a high level of informed and focused insight into many components of the design probe, leading to the iterative nature of

our research and finally, the determination of our findings.

The Methods chart in the appendices outlines the methods used in each phase of our research process and the corresponding rationale from a research and systems perspective.

Mapping the System

Our systems mapping of the Canadian Innovation System began with our own understanding of the system, supplemented by secondary research in popular media. We used Gharajedaghi's Iterative Process of Inquiry to map out the functions, structure, processes, and contexts of the system in broad, surface-level form until we had a map robust enough to explain the basic components and interactions of the system (Gharajedaghi, 2011). This early map was later synthesized into a causal loop diagram to create our basic map and the first design probe.



This design probe is in the DePlyi-inspired generative research design discussed above. Throughout the research, we iteratively remodelled and improved this map by working with 11 experts who represented different components of the system. The iterations of the map can be viewed and explored [here](#). By the end of our research we concluded with the map found in the appendices.

Map Overview

In the following pages we will explore this map in detail with several modes of analyses. At the surface, though, there are a few prominent elements and connections worth highlighting.

First, there are many interlocking reinforcing and balancing loops at play in this system. We have labelled several of particularly prominent significance – namely the *Scaling* and *Gazelle loops*, and the particularly problematic *Bubble loop*. The former two describe common patterns of development for Canadian startups. Those trying to scale quickly follow the *Gazelle loop*, where they quickly cycle through rounds of fundraising, product development, and pivoting in order to do so. The related *Scaling loop* simply tracks the pattern of how a business might expand its operations over time. The *Bubble loop*, on the other hand, describes a problematic cycle of emphasis on overvalued startups – this loop is how unicorns develop.

Arguably, however, each possible loop in the system is significant to some of our stakeholders, and so we do not attempt to complete this loop-identifying analysis here. Instead, we pulled from our holistic analysis four critical systems traps, which we discuss further below.

Before moving on to this archetypes analysis, however, we wanted to note several important elemental phenomena that do not feature prominently in the following analysis.

- *Brain drain* is the tendency for entrepreneurs (and investors) to leave for bigger spoils in a more innovation-driven economy.
- *Privilege* and *Low socio-economic status* were two elements that surfaced from our expert interviews: several pointed out the significance of access to opportunity in the entrepreneurial journey.
- *Relevant knowledge of investors* was an important discovery that came from conversations with those working in investment. Simply put, investors will not make bets on industries they don't understand. For example, if a wearable tech startup is looking for funding, they're unlikely to find it in Canada where our investor community is focused mostly on other industries.

Systems Traps

We discovered four systems traps profoundly influencing the Canadian innovation landscape. These traps, taken together, point toward three critical emergent challenges sustained by Canada's entrepreneurial systemic behaviour. Later, we use these three challenges to light the way toward potential reform. First, we outline the problems themselves and the traps that cause their perpetuation.

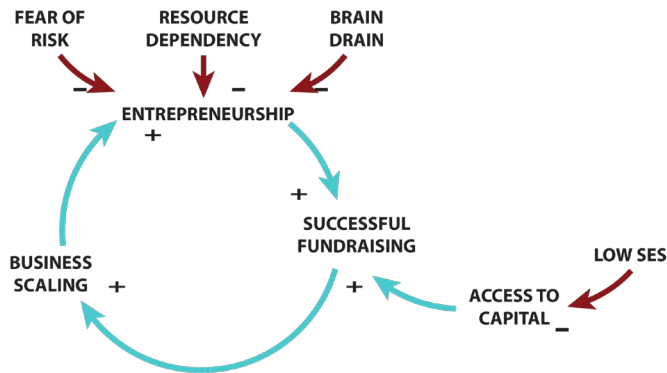
Canada's "Idea Economy" is troubled

Two key systems traps are limiting the success of Canadian tech innovation.

Limits to Growth:

First, pressures on the system at many scales and from many directions are preventing the system from scaling up. This Limits to Growth archetype is powerfully constraining, as these myriad factors impact the system on a variety of levels. Two come from Canadian history: our dependency on natural resources, and a culturally unique aversion to risk. Third, entrepreneurs are sometimes prevented from scaling their ideas because of a lack of access to the necessary networks – an absence of privilege. Finally, these barriers compound, making Canada an unfavorable environment for entrepreneurs and investors in the tech sector causing brain drain of entrepreneurs and investors.

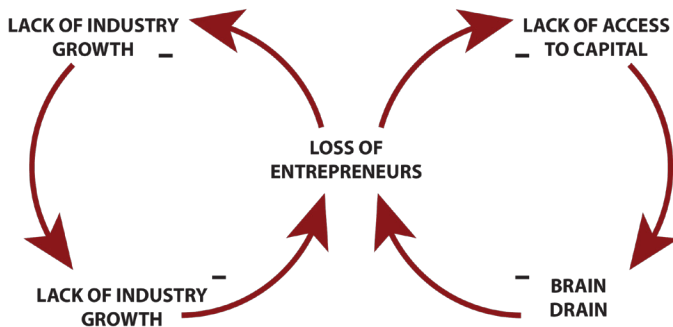
SYSTEM TRAP 1: LIMITS TO GROWTH



Escalation:

Brain drain of entrepreneurs and investors further leads to a second systems trap: escalation. The more unfavorable the Canadian system is and the more attractive other systems are, the more entrepreneurs brain drain out of Canada. These patterns become double-reinforcing loops and cause escalation.

SYSTEM TRAP 2: ESCALATION



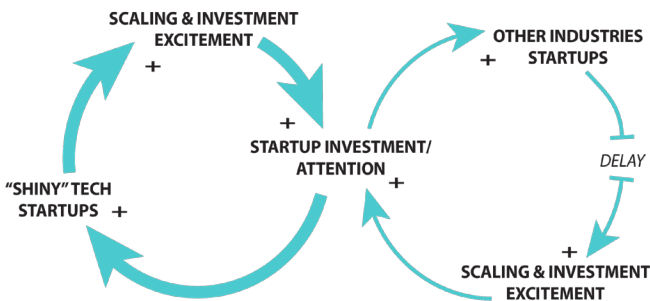
Strategic Canadian advantages are ignored

This is Canada's *real* innovation gap: a gap in the public perception of Canadian innovation and the actual strategic innovation capacities we excel in. The recent focus on consumer technology startups has dwarfed the innovation successes found in other sectors.

Success to the Successful + Delayed Balancing Loop:

Success to the Successful + Balancing Process with Delay: Two systems traps combine to cause the real innovation gap in Canada. 21st-century focus on technology startups leads to increasing excitement in technology innovation. This leads to further investment, creating a reinforcing loop. Simultaneously, other industries compete for this attention and receive less. At the same time, innovation in non-tech industries typically costs more and takes longer to scale, reducing further the attention they receive. The behaviour that emerges from this trap is an overemphasis on tech startups and a disregard for entrepreneurship in other industries.

SYSTEM TRAP 3: SUCCESS TO THE SUCCESSFUL + DELAYED BALANCE



Our resources are misdirected

Because of our obsessive focus on consumer technology, the system's resources are currently geared towards maximizing this kind of entrepreneurship. This leads to an ignorance of entrepreneurial education and supports for non-tech entrepreneurship.

Top Canadian Venture Capital Deals First Nine Months 2015

Rank	Company Name	Location	Deal Value (CAD\$ Mil)	Industry	Investor Participants (Disclosed)
1	Lightspeed Retail	Montreal, QC	\$80.0	Software	Caisse de dépôt et placement du Québec, Investissement Québec, Accel Partners, iNovia Capital
2	Kik Interactive	Waterloo, ON	\$65.3	Software	Tencent Holdings
3	Real Matters	Markham, ON	\$60.0	Software	Whitecap Venture Partners
4	Ethoca Solutions	Toronto, ON	\$58.3	Software	Spectrum Equity
5	Enerkem	Montreal, QC	\$50.0	Biofuels	Undisclosed Investors
6	Resverlogix Corp	Calgary, AB	\$50.0	Pharmaceuticals	Shenzhen Hepalink Pharmaceutical Co, Eastern Capital
7	Benevity	Calgary, AB	\$38.0	Software	JMI Equity
8	Telesta Therapeutics	Belleville, ON	\$37.5	Pharmaceuticals	Consonance Capital Investors, Tavistock Life Sciences, Omega Funds
9	Northern Biologics	Toronto, ON	\$36.1	Biotechnology	Celgene Corporation
10	Scribble Technologies	Toronto, ON	\$35.0	Software	OpenText Enterprise Apps Fund, Emerillon Capital, Blue Cloud Ventures, Northleaf Venture Catalyst Fund, Rogers Ventures, Summerhill Venture Partners, Georgian Partners, Export Development Canada, Waterloo Innovation Fund.



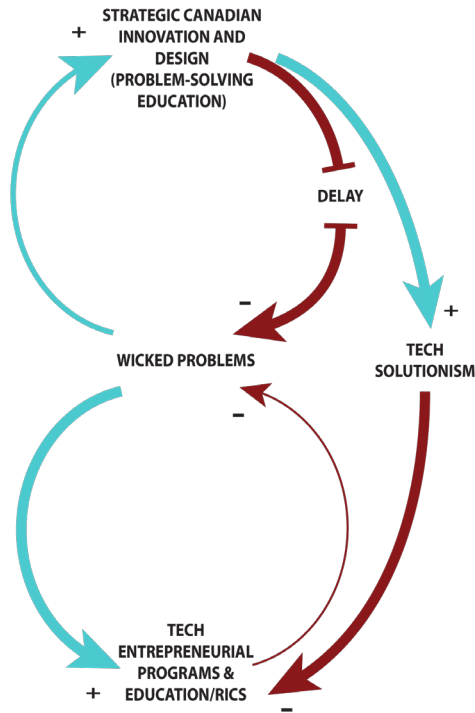
The above chart demonstrates the largest VC deals in Canada in 2015. Sourced from <http://betakit.com/reuters-vc-investment-in-canada-at-14-year-high/>

Shifting the Burden:

The 21st century focus on tech solutionism creates a systems trap that reduces the education and resources we provide to foster ideas and innovation in non-tech industries. Entrepreneurial education, incubators, and other programs currently focus predominantly on developing tech ideas. These tech solutions contribute modestly and quickly to problem

solving. Meanwhile, deeper problem solving and innovation education that builds on strategic Canadian capabilities is underemphasized, and solutions that come from these efforts take longer to come to fruition. This ultimately means that the burden of solving wicked problems is shifted to tech solutions.

SYSTEM TRAP 4: SHIFTING THE BURDEN



Leverage Points

Our last phase of systemic analysis in this project deeply examined the system map in search of leverage points: places to intervene in a system. As eloquently captured by Donella Meadows, leverage points are points of power. They are “places within a complex system ... where a small shift in one thing can produce big changes in everything” (Meadows, 1997). We sought to identify the Canadian innovation system’s leverage points based on a multidimensional analysis of centrality. That analysis and its results are presented interactively on the Kumu.io platform [here](#).

The leverage points we identify focus mostly on the idea economy itself, as that was the basis for our causal loop diagram. Naturally, centrality measures can only show us what phenomena are important in various ways – they can’t tell us what to do about them. In the next section, therefore, we explore three initial recommendations for how Canada might address its innovation “gap”.

Recommendations

To address the systemic challenges within the Canadian Innovation System, below is a description of the initial recommendations for the Government of Canada.

Problem	Proposed Initial Recommendations	
<p><i>Canada struggles to understand how it can fit the 'idea economy' into the broader context of the economy (i.e. other sectors)</i></p>	<p>Foster the Idea Economy</p>	<p>The world is changing, and Canada needs to understand how the tenets of the idea and knowledge economy will best flourish across the primary sectors that drive the broader Canadian economy. Building regional collectives (like the Waterloo-Kitchener corridor) to advance innovation is only one step, whereas our findings suggest the need to take a collective leap and author a White Paper that will activate a national approach on the new, ideas-based economy. In doing so, the Government of Canada will engage a collective of stakeholders, thought leaders and businesses both large and small to lead a national dialogue on how innovation ought to play out across Canada's diverse communities, companies and campuses.</p>
<p><i>Canadians do not recognize the unique strengths of the economy as it is; and neglect to recognize the innovations already taking place.</i></p>	<p>Change the Narrative</p>	<p>Innovation is happening, but it is taking place in sectors and industries different than the ones we tend to pay attention to. Increasing awareness about the need for, and impact of, innovation within advanced manufacturing, natural resources and agriculture will help cross pollinate the economy with more robust, productive approaches and solutions. This will also help to shift the culture of entrepreneurship by empowering a generation of Canadians to create sustainable value and ensure they and their communities prosper.</p>
<p><i>Canada currently allocates a disproportionate amount of resources (talent and capital) to one industry at the cost of others.</i></p>	<p>Redirect the Pipeline</p>	<p>The ultimate step is to increase the carrying capacity of the system to generate value for entrepreneurs from outside the technology sector. Drawing sectors and industries together with the innovation ecosystem will build deeper and more diverse connections. Diverting the flow of resources – talent and capital – and binding it with existing infrastructure and institutional support will build a depth that will support a more robust Canadian economy. Furthermore, investing in improving the structures that nurture prosperity – incubators, accelerators, entrepreneurship, and innovation programs – and bringing them together with campuses and companies already making an impact, will propel Canada forward.</p>

Barriers, Obstacles & Remedies

In any estimate of recommendations, our team must acknowledge that barriers exist that might prevent these initial recommendations from ever seeing the light of day. The most pressing barrier is the limit of our knowledge and the lack of credibility our research might have in the community, if we were to re-engage stakeholders within the system. As a first step, we would need to expand our sample and research and apply a more rigorously academic lens of study to this topic. (Perhaps with a generous research grant from SSHRC, OCAD U, or MaRS) This would involve at least another four to six months of teamwork, collaborating with a larger sample, refining our methods, expanding our analysis and likely maturing certain elements of the initial recommendations provided here, above and below. This step - what amounts to a leap in fact - would provide this research with increased credibility and more robust pediments off which to launch into greater action for social good and happiness.

Getting beyond that is an important first step will surely bring these initial recommendations up against a number of even broader barriers to implementation. These include: the speed of government and bureaucratic processes to internalize and manifest change; the silos, both industry and regional, that dot the Canadian landscape; the entrenched attitudes and behaviours of certain key-stone industries, organizations or sectors that may be reluctant to change due to social, economic or political impulses.

To remedy these issues, some of which may be more stubborn than others, we suggest a proactive, methodical and sustained campaign to engage every moving part that may prove an obstacle. Most importantly, this campaign must be a-political in nature, and engage Canadians across the political spectrum. This will require high-level and unrestrained engagement by senior officials within the the public and private sector. An initial thought might be to engage sympathetic advocates within those organizations, industries or institutions that may prove an obstacle later on, and to instead bring them on-board as partners from the outset. Listening to their concerns and incorporating them into the journey at the outset ought to effectively put a lid on most issues. Identifying a broader network of sympathizers and building out a coalition of support will also help to circumnavigate problem spots (or organizations) and ensure the government's innovation agenda generates the sustainable momentum it requires.

Systemic Impacts

It is important to note that the interventions we propose above deliberately involve systemic engagement in their execution (*Foster the Idea Economy*, for instance, begins with the authoring of a federal White Paper; likewise *Change the Narrative* is dialogic in nature, and *Redirect the Pipeline* builds directly from this dialogue). Thus, we hope to avoid and/or unify emergent systemic effects as a part of our systemic design.

Nonetheless, systems are what they are, and complex unprecedented impacts are sure to occur. Here we briefly explore several of the intersecting systems entangled in these interventions, taking time to guess at how they might respond to the changes we propose.

Foster the Idea Economy

There are two potential phases to the systemic impacts of *Foster the Idea Economy*. The first is throughout the change process: we are suggesting using a government-authored White Paper to catalyze further stakeholder engagement by discussing the leverage points unearthed in report and map. Doubtlessly, however, the investor community will feel differently about the problems with investment than the entrepreneurial community – likewise, every

leverage point we identify will generate strong opinions. That's why this White Paper process must be deliberately dialogical, in order to provide opportunity to allow these communities to share and understand their differences.

Nonetheless, this process has the potential to create a loud conversation, heard by the media and the public. If this communication is managed improperly, the attention might be a bad thing, leading to an ever-deeper loss of confidence in the Canadian idea economy. This underlines the need for effective planning around the dialogical design, ensuring that communication and cultural side-effects are planned for with systemics in mind.

The second phase of systemic impacts will come about after changes from the White Paper begin to take effect. These changes are likely to be rooted in some of the leverage points we identified in [this presentation](#), and while it's difficult to predict exactly what the ecosystem will want to try, we hope that the ultimate result is an increase in power to the Canadian tech innovation economic engine. This, however, directly antagonizes our latter two recommendations: should the issues with Canada's idea economy be truly fixed and tech innovation pipelines come into full force, it will provide a mighty distraction away from other industries. Thus, these recommendations must be executed in parallel, at least in part.

■ Change the Narrative

To reiterate, *Change the Narrative* addresses two interlinked but discretely cultural aspects of Canadian innovation. The first is the 21st century obsession with tech solutionism, leading to a focus on "to save the world, click here"-type innovation and an ignorance of the kinds of innovation we need in most sectors (Morozov, 2014). The second is the idea that Canada is bad at innovation. Predicated on this app-obsessed tech myopia, there is a cultural belief that we cannot compete effectively with other innovation economies.

The systemic impact of shifting these two cultural behaviours is multifold. Indeed, that this narrative is so entrenched in many other systems – public media, education, investment, startup communities, etc. – is an indication of how arduous it may be to change it. Nonetheless, if our strategy works, each of these connected systems will begin to shift, too.

Once media emphasis on app startups has been relieved, for example, there might be a more celebratory focus on less "sexy" spaces. Much like how we've recently placed the Canadarm2 on our currency (albeit space is arguably a well-attended area of innovation around the world), the Canadian public might become more enamored with homegrown innovation in engineering, fisheries, agritech, genetics, and beyond. This shift in foci could result in an escalation archetype by itself, as more Canadian innovators get involved in trying to innovate in these sectors. This archetype would be welcomed, as it would accelerate a change in the Canadian narrative. Of course, as discussed above in *Foster the Idea Economy*, this escalation may draw on the attention and resources of Canada's tech innovation efforts. This competition for resources is tenuous and must be balanced as best as possible by decision-makers.

While the above speculation is tied to a systemic shift in the *meaning* of innovation to Canadians, we must also consider the impacts of a shift in recognition of Canada's innovation successes. This is a shift of social perception. A re-emphasis on Canadian successes could lead to a new identity for Canada. In the best of worlds, we would no longer be defined by maple syrup, hockey, and friendly travellers – we would also be seen as an international player on creative problem solving in robust and significant industries. This, in turn, might change our self-definition, perhaps even building upon the garrison mentality that is so foundational to our culture. This neo-garrison mentality could be a world in which Canadians begin to see their own innovation capacity as a form of bastion. In practical terms, this means a redoubling

of effort on Canada's strategic innovation capacities – with this effort being owned by the entirety of the Canadian identity, not simply the ivory towers where they currently reside.

■ Redirect the Pipeline

Since *Redirect the Pipeline* directly follows from *Change the Narrative*, many of the systemic echoes of these strategies will parallel. Still, *Redirect the Pipeline* focuses exclusively on certain systems – those systems are what we will discuss here.

The first system this recommendation must directly change is education. More precisely, it is centred on the current push towards the commercialization of research and proliferation of accelerators, incubators, and entrepreneurial education on Canadian campuses. These shifts will doubtlessly run headlong into an ancient debate around universities: the economy vs. the academy. The pursuit of knowledge for knowledge's sake is the predicate upon which the modern university system was founded, and the economic benefits of that pursuit have long been secondary (see "GLOBAL: What are universities for?" for an example of this discussion; Boulton, 2009). Universities and, in particular, the academic faculty that research and teach in them, might resist a renewed emphasis on the commercial capability of their work. This implication is complex on its own: we are encouraging a relaxation of focus on consumer tech- and app-based innovation and a new focus on innovation stemming more directly from other areas of research, which could actually benefit the academy and "basic research" efforts. Nonetheless, the pressure to innovate will still be a difficult one to enforce in many academic environments.

Second, we may run into challenges with sunk costs. Much of Canada's entrepreneurial systems have only recently emerged, including startup communities, regional innovation centres, and accelerators/incubators. These were founded on the tech solutionism that we are discouraging. A shift in both culture and how we currently allocate resources in these relatively young institutions might be challenging to execute, as it runs counter to their *in situ* culture.

■ Proposed planning & delivery horizon

As a team, we collectively decided to craft our initial recommendations with a view to their operationalization and implementation. With the Government of Canada named as the primary audience of our research, we sought to articulate a set of recommendations that would leverage both the resident opportunities and challenges that may exist when dealing with government. In our research, our team identified the Government of Canada as having the greatest capacity to shift the system, through its control of various structures and its inherent ability to shape various cultural elements. That said, and in light of the challenges articulated in the previous section, we are fully aware that any proposed time scales are completely dependant on the machinery of government. Regardless, we know the innovation economy is a hot topic of discussion in Canada, and that public awareness (being of a cyclical nature) is at its zenith and therefore commands the attention of the current government.

Accordingly, we propose that the Government of Canada embark upon an initial three year program to address the system-wide issues that our report identified as existing within the Canadian Innovation System. This proposal coincides with the end of this current government's term for a reason - with any efforts to engage the federal government, we are conscious of the need to plan to their cycles. With that considered in our initial planning, however, we would strongly recommend that any future government to include the various departments that will be engaged in support of this project remain committed to continuing this program beyond the three year initial sprint. This is compounded by various findings

that, for lack of a better phrase, recognizes the virtue of patience: Rome wasn't built in a day. While the following plan involves extensive system-wide engagement and consideration, the time is now for the Government of Canada to seize the locus of control and to usher positive, sustainable and productive change for Canadians.

Over the course of the first three years of this project, we envision a phased, iterative deployment of activities that will cascade into follow-on approaches that will build and improve upon previous accomplishments. We envision the first year of this project as focussing almost exclusively on Fostering the Idea Economy. This will involve the Government of Canada engaging private and public sector partners, along with community agencies representing diverse social, economic and political interests, to come together and discuss what the future holds for Canada's economy. We recommend the Government of Canada collaborates with leading universities and colleges; tapping into the tremendous wealth of knowledge, experience and potential, to produce a special White Paper on the New Economy. Channeling big thinkers and leading minds across every sector and industry, and including the voices of Canadians from coast to coast to coast, will ensure a truly national dialogue ensues. Most importantly, this White Paper will generate a set of action items that the government and its partners will commit to achieving within a two year time frame.

This first phase will be followed closely, if not to a degree concurrently, by Changing the Narrative. We know that the innovation is taking place across Canada; the challenge is that many Canadians aren't yet aware of it. As a result, we envision a public information campaign that will engage private sector partners to help get the message out - that Canada is in business and is ready to shine. We believe many elements are in place to support quick wins to generate increasing awareness, Canadian businesses are actively leading the way with innovations in agriculture, health and manufacturing. What is therefore required are the appropriate channels with adequate support to ensure these enterprises are receiving the attention they deserve. Connecting entrepreneurs with the supports they require, and then further connecting the hubs with various leading Canadian enterprises, will facilitate a broader dialogue across industry silos. Beyond broadcasting success, we also suggest that the government partners with educational institutions - from local boards of education through to post-secondary - to supercharge the pipeline and engage, educate and mentor Canadian youth. Engaging communities, both urban and rural and rich and poor, will bring the leaders of tomorrow the opportunity they deserve today.

The final chapter will involve implementing the findings of the White Paper - Redirecting the Pipeline. Due to the fact that it is not yet known what the White Paper and its authors will write, we must initially build our planned activities based on the initial research project. At its core, we believe that various structural changes are necessary to divert the flow of talent and capital away from digital technology and over to other sectors and industries in need. This is not a complete diversion, for it is not our intent to damage the great impact that the Canadian technology sector has made on the economy. Rather, our intent - building upon the anticipated success of the White Paper and the ensuing narrative campaign - is to redirect some of the longstanding systemic supports that have traditionally funnelled capital and talent towards certain sectors. Working with and alongside partners in education and across industry, the government will be well positioned to leverage influence and control to support the evolution of Canadian Innovation in cities and centres across the nation.



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Appendices



Appendix A: System Maps & Analytics

Two key presentations are available for your review online.

The first is a walkthrough of the iterations of the map as our participants' feedback was integrated into it through four iterations. This map is available here:

<https://systemicdesign.kumu.io/canadas-innovation-system>

The second is a walkthrough of a variety of quantitative analytics we used to understand the potential leverage points of Canada's innovation system. That is available here:

<https://systemicdesign.kumu.io/centrality-analytics>



Appendix B: Methods Chart

See next page.

Phase	Research Activity	Methods	Systems Rationale	Roles	Team Organization & Task Allocation	Timeline
Research & Design Assets	<u>Independent Research</u>	Literature Review	Conducting a comprehensive and thorough literature review using contemporaneous news periodicals along with accredited academic journals and government reports on innovation in Canada provided knowledge about the key stakeholders, drivers and systemic barriers present in the innovation ecosystem in Canada.	Research & Populate AirTable	All members responsible for on-going research and AirTable populating. All sources are automatically shared in our Slack forum once posted to keep all members updated.	March 3rd - April 11th
	<u>Initial Design Probe Design</u>	Brainstorming & Collaboration	Discussions were aimed at generating ideas, identifying cognitive bias and assumptions as we unpacked the various components that compose the innovation ecosystem in Canada. Tools to generate discussion included DIKW and a challenge map sensemake the information gathered during the interviews and structure the information in a framework that seeks to uncover the knowledge derived from our data points. In doing so, we were able to unearth the casual relationships and key systems traps in our systems map.	Active Participant in Group Discussion	All members present and actively participate in group discussion and collaborative efforts.	
		Red Teaming	Often we would recognize confirmation bias that would limit the truth of our findings. In attempts to challenge our assumptions, we used red teaming as a method to introduce an oppositional viewpoint that would counter the suggested strategic pathway, casual relationships and overarching hypotheses governing the direction of our systemic design. In doing so, we were able to uncover the fact that innovation in Canada is happening! This vital pivot in our systemic understanding facilitated through red teaming exercises led to a much more reflective systems map.	Red Team (2 members)	Two members designated with red-team responsibility during design discussion.	
		Stakeholder Analysis	To determine the network of stakeholders that occupy the innovation ecosystem in Canada, we conducted a rigorous stakeholder analysis whereby we identified key decision makers including politicians, investors, entrepreneurs, professors, tax payers etc. This led us to recognizing that our "solutioning" must be directed at the federal government as they control the most levers to influence change in the system. Positioning our systems map to influence changes on a federal level clarified the recommendations required.	Active Participant in Group Discussion	All members present and actively participate in group discussion and collaborative efforts.	
		System Mapping	In attempts to determine the casual relationships between stakeholders and their interaction with their environment, we distilled the insights gained from our stakeholder analysis, literature review and brainstorming to build out the first iteration of our perceived understanding of the Canadian innovation ecosystem.	Active Participant in Group Discussion	All members present and actively participate in group discussion and collaborative efforts.	
Pilot Testing	<u>Pre-test Protocol</u>	Data Circus	To pre-test interview questions and design probe protocol, we piloted our procedure in-class at the Data Circus. This provided an opportunity to collect data from participants familiar with systems mapping.	A) Interviewer B) Interviewee C) Recorder	Teams of two (1 interviewer, 1 recorder) responsible for conducting the interview and diligent data collection	March 3rd - March 13th
Data Gathering	<u>Preliminary Participant Interaction</u>	Letter of Invitation	Present letter of invitation and consent form prior to starting data collection. This letter explains our research question and the procedure the participant will be involved in.	Writer and Editor	Michael was responsible for writing the letter. The letter was then vetted and edited by team.	March 13th - March 26th
		Consent Form	The consent form is a mandatory to ensure the participant is aware that the data will be analyzed and published in a study however, no personal identifiers will be associated with the data published.	Writer and Editor	Robyn was responsible for writing the form. The form was then vetted and edited by team.	
	<u>Primary Data Collection</u>	Semi-structured Expert Interview & Design Probe	Through semi-structured interviews and the presentation of a design probe, we were able to generate insight that built on our understanding of the casual relationships represented in the design probe. In addition, we were able to identify stakeholders, elements or links missing that would be more representative of the innovation ecosystem in Canada.	A) Writer (Interview) B) Designer (Probe) C) Interviewer & Recorder	All team members contributed to brainstorming interview questions which were later structured and distilled by Robyn. Ryan was responsible the design of the probe. Interviewer and recorder were organized as stated above.	
	<u>Secondary Data Collection</u>	Delphi Probe	Aggregate and synthesize the interview findings; and consider re-casting design probe based on inputs from participants in round one. The iterative nature of our research allowed for us to unpack distinct areas of the map throughout the process. Our delphi approach allowed us to focus in on specific areas of the map relevant to the participants experience providing a more refined representation of the systemic interactions in our final output.	A) Data Analyst B) Designer C) Emailer	Data analysis was done as a group and recorded by Robyn. After thorough discussion, data was integrated into our first iteration map and sent out to participants by Ryan.	
Data Analysis	<u>Consolidate Data & Analyze</u>	Kumu	Back-end algorithms provided by KUMU, allowed our group to determine points in the systems map of most influence based on connection points. In addition, we were able to quantitatively determine weight of connection between two elements in the map to attribute a quantitative value in relation to other elements. This allows us to determine hierarchies and prioritization as we move closer to recommendations.	Designer	Based on technical skills and knowledge, Ryan was allocated responsibility to produce and manipulate KUMU designs to generate our systems maps.	March 13th to April 8th
		Literature Review Cross-Referencing	Continuous literature review allowed our literature reviews to be as current as possible. Reading the 2016 fiscal plan as well as reports that contradicted our perceived notion of the Canadian innovation system opened a completely new direction and conclusion to our analysis.	Research & Populate AirTable	All members responsible for on-going research and AirTable populating. All sources are automatically shared in our Slack forum once posted to keep all members updated.	



Appendix C: Research Protocols

See the following pages.

Interview Protocol

All participant interviews will begin with a review and signing of the Consent Form, including a re-statement of the purpose, scope, and structure of the study.

The Interviewer then thanks the Participant for agreeing to join the study and frames the Interview. This includes:

- Detailing the interview - design probe - Delphi survey approach
- Describing the categories of the questions that the Interviewer will be asking and providing the Participant with the list of pre-written questions. (This is so that the Participant understands the flow and direction of the interview.)
- Describing the structure of the interview (semi-structured) (e.g., sometimes the Interviewer might ask the Participant to expand on a point they'd previously made, even if that is not in the interview script)

After giving the Participant the opportunity to ask any questions about the process of the interview, the interview begins. The Interviewer will ask the Participant the following open-ended questions, recording their responses and asking for clarification or more in-depth answers when they feel it necessary for the purpose of the study. Depending on the depth and breadth of the Participant's answers throughout the interview, some later questions may not be necessary, and thus will not be asked.

All participant interviews will end by engaging with the Design Probe.

Interview Structure

DEMOGRAPHICS

1. What is the nature of the organization you work in?
2. What is your role in the organization?
3. What general roles/titles might we compare that to in other organizations of this type?
4. How are you and/or your organization involved in Canadian innovation, if at all?

UNDERSTANDING

5. How do you define “innovation”?
6. What are the key actors of the Canadian innovation system?
 - a. Who are the key stakeholders of Canada’s innovation system?
 - b. Who are the key decision makers of Canada’s innovation system?
7. How would you describe the state of Canadian innovation? Why?

INFLUENCE

8. What are some of the causes of the negative aspects of Canadian innovation?
9. What are some opportunities for improving Canadian innovation?

CONCLUSION

10. Is there anything you’d like to add?
11. Is there anything you think we should research further?
12. Do you have any feedback for this interview process?

Design Probe Protocol

We will present each expert interviewee with the current iteration of our systems map. After giving them a moment to review it and to answer any clarifying questions, we will ask them a series of questions to leverage their expertise on improving the map for the next iteration. Those questions fall into three categories: **System Story**, **Accuracy**, and **Depth**.

SYSTEM STORY

1. Given the current map, what is the “story” of Canada’s innovation system to you? Where would you start on this map, and where would you end? (As we go through the story, we hope to develop a more detailed understanding of your perspective on the current system and our model of it).

ACCURACY

2. Are there any incorrect links on the map?
3. Are there any erroneous elements on the map?

DEPTH/DETAIL

4. What **elements** are we missing on this map? How do they fit in?
5. What **links** are we missing on this map? What is their influence?
6. Which of the elements are the most important? Why?
7. Which of the links are the most important? Why?
8. Which of the loops are the most important? Why?