

The Canadian Innovation Ecosystem: Description, Strengths, Government Policies,
Challenges, and Remedial Recommendations.

By

Darshna C. Makhecha

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Supervisor: Ibrahim Shaikh, PhD
Faculty of Management

Examining Board: Muhammad Rashid, PhD
Faculty of Management

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ABSTRACT

This report presents a review of the existing literature on the Canadian Innovation Ecosystem, (CIS), with the main focus on digital innovations and green technology innovations. The report covers the description of the CIS, its functions, government policies to promote innovations, strengths and challenges faced by it. Based on the literature review and, with additional considerations, this study proposes a set of recommendations for an improvement of the CIS.

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1.0 Introduction

The development of innovation ecosystem is very important for every economy. Every economy is promoting innovative ideas like switching to green technology, clean energy, smart grid technologies and so on. These new innovative technologies are also providing a variety of employment opportunities. Along with that these technologies are promoting the use of natural resources and helping in reduction of pollution. The success of economies are defined by proper implementation and execution of their innovation ecosystems. This paper focuses on innovation ecosystems in Canada.

The CIS consists of public sector agencies, private sector companies, that includes startups, small businesses, large businesses, and academic institutions that provide Canadian businesses with business tools and support services. These programs and tools help businesses create new goods or services for sale in domestic as well as global markets. (Watters, 2013).

The CIS provides a series of economically important functions in Canada as innovations improves technologies, expand sales to global markets, reduce pollution and thereby improve environment, create a competitive edge for the Canadian business, etc.

Recognizing the importance of innovations, for the growth of the Canadian ecosystem and their positive effects on employment and environment, all levels of government offers a range of programs that encourage innovations. The Canadian academic institutions contribute significantly to the CIS by providing knowledge, skills, expertise, foundational research findings to the private and the public sector. In this study, functions performed by the CIS, along with government support programs are covered.

The innovation ecosystem of Canada experiences several challenges. The greatest problem facing Canadian organizations is that they are excellent at creating new knowledge, but they do not provide the companies with the requisite support to integrate the knowledge into creative strategies for effective business sales. (Watters, 2013).

Canada was ranked seventeenth on the Global Innovation Index in 2017 (Rowe et al., 2019). Canada has a very strong school system; it has a large number of stable public institutions and a multicultural labor force. But amid all this, Canada declined further to 18th position in 2018 (Rowe et al., 2019). Efforts and programs to prioritize innovation are also pursued by the Government of Canada, but very few businesses can transform positively and become internationally competitive companies.

Canada should concentrate on growing competition, encouraging demand-side policies such as investing in education and supporting high-growth businesses in order to become an innovation-based economy (Rowe et al., 2019). Canada should have a clearer view of the rise of creativity and how it can be effectively incorporated into the culture of Canada. Funding to develop innovation ecosystems to improve Canada's innovation networks is supported by the federal and provincial governments (Rowe et al., 2019).

Schwanen (2017) provides main priorities of government policies that aim at to boost efficiency in the CIS. Alton and Oddleifson (2020) cover the emergence of 5G technologies and issues related to the adoption of these technologies. Kaska et al (2019) note that due to significant implications of using the 5G technologies in the civil and defense spheres, the adoption of 5G technologies must not ignore these spheres. They suggest investments in R&D in terms of security and protection particularly given the fact the adoption of current 5G technologies will be irreversible for many years to come.

Farhangi (2010) identifies the main characteristics of the smart grid, explains three components of the smart grid technology, and describes social dimensions of smart grid. Meadowcroft et al (2018) link the use of smart grid to renewable technology and its favorable effect on achieving climate goals and efficiency in energy supply. Nikzad and Sedigh (2017) emphasize a need for green technology, sources of GHG emissions in Canada and challenges in the promotion of green technologies in Canada. Anex (2000) describes the role of public policy in green innovations, the main objectives of green innovations, and investment in green technologies. Winston (2016) provides ways by which Canada, the USA, and Mexico can achieve targets in their joint commitment to the historic Paris Climate Agreement by adopting green technologies.

Jagoda et al (2010) cover sources of renewable energy in Canada and business opportunities these sources provide. Corporate Knights Magazine in its 2018 issue and Krupa (2012) identify benefits to indigenous people in Canada, arising from implementation of renewable energy innovations. Krupa (2012) also provides obstacles faced by aboriginal people in reaping benefits from the utilization of renewable energy sources. Meili and Shearmur (2019) explores the possibility of open innovation in the rural areas of Canada and propose mechanisms for companies in the rural areas to participate in open innovations.

Wolfe (2019) investigates the possible strengths of the CIS while Rowe et al (2019) and Cassidy (2019) attempt to identify the economically viable approaches to utilize those strengths. Both authors also point out the challenges and weaknesses of the CIS. For example, Wolfe (2019), identifies risks that prevent Canadians to take full advantage of the digital revolution.

Finally, Archibugi and Painta (1996) describe how technological changes can be measured through patent and innovation surveys. They find that technology, product, sector of production and sector(s) of use of the invention as the essential requirements for the definition of an invention.

Based on the review of studies described above, this report makes recommendations aimed at to improve the CIS. In addition, this report suggests some recommendations that may be of value to promote innovations and improve clean environment in Canada.

The rest of this report is organized as follows: Section 2 provides description of the CIS, its stakeholders, and their interests along with measurement of technological changes. In section 3 functions provided by the CIS are elaborated. Section 4 presents an analysis of government support programs for innovations. Section 5 provides some important areas of innovations. In section 6, existing strengths of the CIS are listed. In section 7, outstanding challenges to the CIS are provided. Section 8 provides recommendations for improvements. Finally, section 9 gives the summary and conclusions of the study.

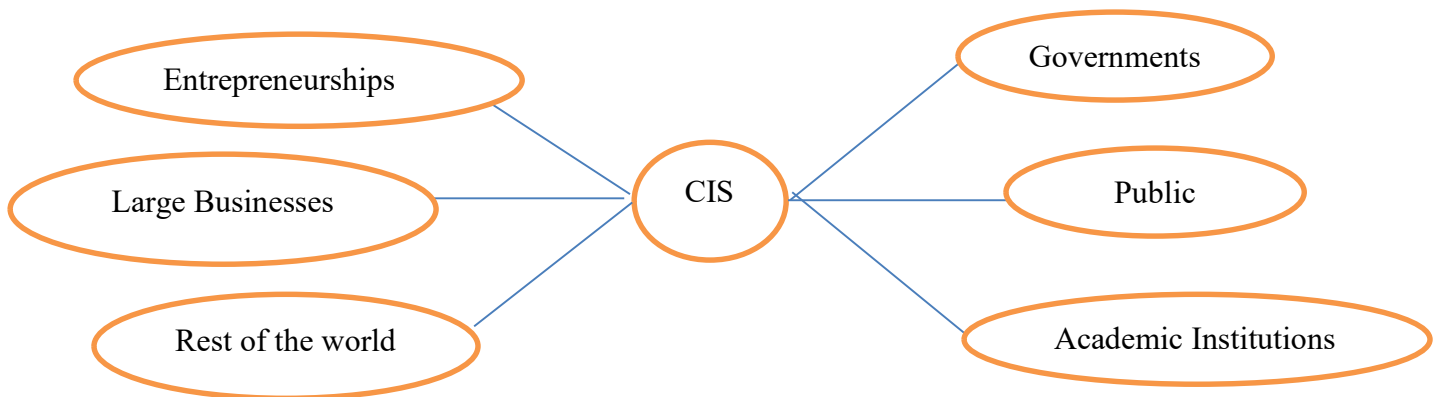
2.0 Description of CIS and Measurement of technological changes

A. Definition:

The CIS refers to interaction among startup companies, established businesses, academic institutions, public at large, governments, and non-residents in order to promote environments that are conducive to promote innovations that improve technologies, produce new products, discovers the use of new materials, discover new markets, etc. Rowe et al (2019) defines an ecosystem as “an economic community supported by a foundation of interacting individuals and organizations which can be visualized as the organisms of the business world.”

B. Stakeholders:

Innovation ecosystems include stakeholders such as entrepreneurs, governments, universities, businesses, etc.



C. Interests of the stakeholders:

(i) **Governments:** The following are the interests of the government:

- An efficient allocation of resources.
- High economic growth rate.

- Increased employment.
- Achieving environmental goals.

(ii) Public: The following are the interests of the public:

- Better qualities of products and services.
- Cleaner environment.
- Increased employment opportunities.

(iii) Academic Institutions: The following are the interests of the academic institutions:

- More research funding.
- Partnership with private sectors.
- More experiential learning programs.

(iv) Entrepreneurships and startups: The following are the interests of the entrepreneurs:

- SEED money.
- Support programs.
- Professional advice.
- Commercialization of innovation.

(v) Large Businesses: The following are the interests of the businesses:

- Improve production technologies.
- Improve qualities of the existing products and introduce new products.
- To access the global markets.
- Profit motive.

(vi) Rest of the world: The following are the interests of the rest of the world:

- Networking in the professional area.
- Imports and exports motive.
- Consideration of financing.

D. Measuring technological changes:

(i) Measuring technological change through patent and innovation survey:

Measurements of technical transition are of growing significance for industry, research, and strategy. Measuring technical progress is, however, a highly daunting job. The components of creativity communicate in the different phases in order to create a dynamic system of relationships (Archibugi & Painta, 1996).

(ii) Archibugi & Painta (1996) found the three key facets of technological advancements as under:

- Technical transition affects codified and implicit information.
- The origins of creativity and innovation may be either internal or external to the organization.
- Creativity and innovation can be either expressed in capital resources and materials or disembodied, i.e. know-how included in trademarks, permissions, architecture, R&D practices.

(iii) Archibugi & Painta (1996) determined the two methods of collecting knowledge on industrial innovation as follows:

- Patents.
- Innovation surveys.

Innovative practices provide a range of measurable effects. Firms are investing in technologies to deliver product and process technologies to the market (Archibugi & Painta, 1996). These efforts can be compensated through creativity surveys. In order to defend their products and processes from future rivals, companies also apply for their invention patents (Archibugi & Painta, 1996).

(iv) Innovation can be analyzed and evaluated from a variety of viewpoints. There are at least four different requirements for the definition of invention that can be seen in both patenting and innovation surveys as per Archibugi & Painta (1996):

- Technology,
- Product,
- Sector of production or development and
- Sector of use.

(v) The essence of patents:

The patent scheme is one means of securing inventions used by companies. Patents are licensed systematically by government agencies for legal purposes. If patents are properly processed, categorized, and arranged, the information on industrial progress may be given by a single source (Archibugi & Painta, 1996).

(vi) The essence of the innovation surveys:

Innovation surveys were originally designed to collect information on the creative behavior carried out in businesses, as opposed to patent records. Until recently, federal departments and statistical agencies or academic institutions were organizing creativity assessments for their own individual needs (Archibugi & Painta, 1996).

3.0 Functions of the CIS

The following are the main functions of CIS:

- Technological advancements.
- Improvement in environment.
- Creation of sustainable full-time employment opportunities.
- Expansion of sales to global markets.
- Improvement of economic efficiency.
- Opportunities for cooperation, collaboration, and integration.
- Expansion of new knowledge.
- Produce new products.

4.0 Government Support Policies

A. Innovation policy in Canada:

A new or better solution for a need or problem is an invention or innovation. The universal acceptance by organizations and citizens of successful inventions improves living standards. In spite of decades of attempts to close this void, Canada is commonly viewed as an under-achiever of innovation (Schwanen, 2017). Innovation strategy is less likely to succeed where policies involving the four main ingredients of expertise and information, business development, government innovation and clarification of intent for government assistance are not closely combined (Schwanen, 2017).

The incentive to continue to boost Canada's innovation efficiency is to improve Canada's overall quality of living (Schwanen, 2017). Standard of living encompass per capital income, but can also include other primary aspects of well-being, such as public and personal health and safety, which are likely to improve through creativity.

B. Main priorities of government policies intended to promote innovation:

In 2017, Schwanen identified the following **seven** priorities:

a. Power to produce and utilize information: Innovation and the ability to utilize innovations are dependent on knowledge. Education and expertise are the cornerstone of an innovation policy. Science, technology, engineering, and mathematics (STEM subjects) are at the forefront of new inventions. However, additional experience and technological design, marketing and corporate or managerial expertise are also required to introduce innovation to the market effectively. Innovation is something that must be achieved differently than how it is done today and requires state-of-the-art expertise that allows one to consider how research, technology, or business can help solve issues.

For this cause, innovation in science and education remains a crucial building block for a nation of innovators.

b. Measures to promote existing or developing markets: Entry to a large or increasingly expanding market promotes creativity by increasing the possibility of incentives. One of the main reasons for this is that the size of development made possible by international exchange is an essential way of amortizing R&D spending. The policy consequences are that if Canadian innovators are unable to enter wider markets, they would be more likely to migrate to where they can. Obtaining access to foreign markets that are equivalent to those enjoyed by rivals in other countries is also an essential component of the innovation policy process.

c. Pro-innovation tax system: A pro-innovation tax system would not deter investment in intellectual resources or risk-taking. Such a scheme must pay attention to the relationship between the capital taxes paid by individuals and corporations and the importance of the public service they get. The disparity in this regard can have an effect on growth incentives. A pro-innovation tax structure would not deter talent-based revenue, or investment in inherently risky business projects that can theoretically offer substantial benefits both to those who participate in them and to society at large. Specifically, it would be vulnerable to the fact that steeply progressive corporate taxes and heavy payroll taxes prevent headquarters to locate or develop in Canada.

d. Pro-Innovation, Intellectual Property Scheme: The right of innovators to safeguard their inventions by patenting or other means has a huge effect on innovation practices, since the expense of making innovations accessible to multiple customers is usually low relative to their production costs. The main social justification for awarding

patents, aside from any motivation they provide to innovate, is because they expose the secrets of the innovator. In return for this commercially advantageous expertise, patent holders are given a time-limited monopoly over their inventions.

e. Pro-innovation competitiveness policy: As Wilson's report says, "For countries, competition is the strongest spur to innovation and value creation." Competition is about what consumers want, it is about output generated, or cost savings. More commonly, rivalry threatens the status quo by having more options, leading to better results. This involves rivalry between public institutions or between public and private entities.

f. Innovation-friendly regulatory approach: Regardless of the government policies, innovation should not be burdensome to achieve it. One simple way to minimize the pressure is to follow regulatory harmonization with existing international norms. Self-regulation may also be an attractive model where there is a lack of administrative coherence between various levels and areas of government.

g. Acceptance of innovation in civil society and the general public: A significant possible drag on the propagation of innovation is the logical political response of those who feel threatened by its effects, such as disruption of one's work, diminishing importance of one's skills or company, or even disruption of personal arrangements. Innovation will give rise to a greater apprehension of major income redistribution or pose ethics concerns that can have a larger effect on social stability, posing the question of who gains from innovation. Governments, organizations, and communities that are not prepared to answer these issues face a backlash towards creativity. Conversely, resolving these issues in a constructive and positive manner will help pave the way for

a smoother adoption of useful technologies. Innovation policies should also be concerned both with paving the way for the gains of long-term development generated by useful innovation and with helping those that do not benefit from these reforms.

5.0 Some Important Areas of Innovation in Canada.

A. Digital innovations and 5G technology:

Nowadays, especially during the ongoing worldwide pandemic developing strategies based on health, safety and the environment is one of the most important issues of management in the organizations. Canada should focus on implementation of innovative green strategies, 5G, clean energy and so on. The main reason for shifting towards a sustainable economy includes depletion of resources as a result of overusing, degradation of the environment and corresponding health and safety risks associated with them.

(i) Introduction to 5G technology

The new paradigm of wireless technologies is the development of 5G. Telecommunications networks across the globe are moving to incorporate and update existing systems with 5G technologies. The emergence of 5G technologies would offer benefits to users, industries, and communities. Huawei is the biggest producer of telecommunications equipment in the world and aggressively pursues business opportunities for 5G growth (Alton & Oddleifson, 2020). Although there is a possibility that security challenges will rise.

Canada is responsible for taking a decision that gives priority to national security and ensures the economic viability of the 5G countries (Alton & Oddleifson, 2020). Canada is undertaking its own study of the prospective role of Huawei in the 5G rollout. Yet political focus has turned away from this issue for the time being with the onset of the global COVID-19 pandemic. The "review" by Huawei is a joint endeavor, and Prime Minister Justin Trudeau has not drawn a definitive conclusion. The major

telecommunications operators in Canada have already signaled their plan to go ahead with alternate 5G equipment providers for key equipment (Alton & Oddleifson, 2020).

The Canadian government would therefore consider the views of Canadians who accept or disagree with decisions. As of now, the Covid-19 pandemic has driven Huawei's interest in Canada's upcoming 5G ambitions to a new low. However, the final ruling is pending. (Alton & Oddleifson, 2020).

(ii) Reasons for consideration of the Canadian decision to adopt 5G technologies:

Alton and Oddleifson (2020) have drawn the following three considerations:

a. Security: The security issue is the most urgent and it therefore attracts greater media attention. Huawei faced criticism by Canadian authorities right before the 5G review process. There have been complaints against Huawei, and they are alleged to be a threat to Canadian national security. The corporation is prohibited from supplying facilities in the central areas of telecommunications used by Canadian carriers to collect and transmit critical data. Huawei, on the other hand, appears to be a corporation incorporated in Canada that observes and abides by Canadian laws and regulations.

There are security issues related to the growth of 5G networks and technology. The new generation of mobile connectivity, which would be 10 times faster than 4G and will also help in faster data speeds, and the potential to accommodate multiple smartphones on a single network. Broadbands are starting to be more readily available. This will lead to improved wireless connectivity and will contribute to the growth of smart cars, highways, rail, and airfields. 5G is also used in the area of essential utilities and infrastructure management.

Nokia and Ericsson have both developed themselves as reliable and stable alternatives to Huawei. It is very important to remember that the use of European equipment would not discourage Canadians from taking risks. There are also security issues involved with virtually all 5G technology, regardless of vendors.

b. Financial: Canada will have to consider the financial consequences of blocking Huawei. While Telus decided to go forward with Huawei as the primary provider of 5G devices, Telus recently announced an alliance with Ericsson and Nokia. Rogers has confirmed a relationship with Ericsson. And Bell has confirmed collaborations with Nokia and Ericsson 5G equipment. As Huawei's infrastructure is interoperable, Telus and Bell's executives speculated in 2018 that they could incur nearly \$1 billion in costs to 'trip and replace' current 3G and 4G equipment when faced with a ban on Huawei's equipment. Bell is planning to use Ericsson, and Telus will use a combination of Nokia and Ericsson.

Rogers uses only a little bit of Huawei equipment, meaning that they would not have to meet any expense obligations if a formal government ban was put in effect. The lack of decision-making by the Canadian government is steadily moving Canadian telecommunications companies away from Huawei, considering the possible costs and time-out consequences.

Huawei is also aggressively implementing a rural Canadian Internet policy by creating opportunities for rural communities. For Canadian customers who pay the highest data rates in the world, Huawei is capable of delivering less costly equipment, and aims to provide Canadian telecommunications providers with a way to reduce costs for final consumers.

c. Political: As Canada-China bilateral relations are strained by Meng Wenshou's extradition hearings and the incarceration of Canadian nationals Michael Kovrig & Michael Spavor in China, there may be political implications that may result from Huawei's barring. China has warned Canada of the consequences if it chooses to block Huawei. This threat is a crucial consideration in Canada's future 5G decisions.

Trade is an important factor as Canada-China trade ties are close. China is Canada's second biggest trade partner after the United States.

The Canadian decision to allow Huawei, even in a small capacity, would anger American officials. The U.S. warned Canada that it could lose access to "sensitive intelligence" if Huawei was able to run on Canada's 5G network.

Canadian politicians often do not want to upset such a close ally. It is impractical for Canada to deviate from a consensus policy posture within its close security allies.

(iii) Huawei, 5G decision making process:

The Huawei 5G roll-out dilemma needs to be assessed in a larger geopolitical context. China's legal and political climate and its well-known practice of 'public-private cooperation' in cyber-espionage remain a worry. The decision of the 5G cannot be taken in isolation from the civil and defense spheres, as it has significant implications for both and thus choices must therefore be informed from both points of view (Kaska et.al, 2019).

Canadian and several other businesses believe that the introduction of 5G technologies by Huawei would lead to a dependency on equipment that can be monitored by Chinese security services. In addition to the fact that these infrastructure decisions cannot be overturned quickly, if a 5G supplier has been selected, it would be very expensive and time-consuming to reverse the decision (Kaska et.al, 2019). Finally, from a security

viewpoint, 5G can only be installed with thorough consideration, since there is a stronger need to consider the costs of the lifecycle when buying digital technology, rather than just the costs of rollout.

It is very reasonable for the Canadian government to expect the best possible security guarantee from 5G technologies that can be used for sensitive communications (Kaska et.al, 2019). Any disruption in functionality and secrecy of such processes can have a major adverse impact on society. Strong governance and risk reduction are necessary in order to benefit from 5G security without undermining national security. Any government, including Canada, needs assurance that their systems and data are secure from foreign meddling, both now and in the future. Cost and speed are not the only deciding considerations in the deployment of the 5G networks. Failure to consider future national security will potentially prove more costly and hurt society's long-term well-being.

Viable alternatives to Huawei technologies are required to maintain the freedom of competition and avoid one supplier from being stuck. To this end, investments in R&D and the strengthening of the regional industry should be considered and followed in terms of protection (Kaska et.al, 2019). The decisions we make now will have an effect on our future.

(iv) Benefits of 5G technology:

The 5G platform promises better efficiency and innovative capabilities. They have the ability to become the automated nervous system in contemporary societies (Kaska et.al, 2019). But it is also a fact that no technology can be guaranteed to be entirely protected, and there will still be a chance of unintended bugs that can be abused by malicious actors. The option of this technology would have economic and national security consequences.

(v) Huawei's history about product security:

There is no public proof of major flaws in the technologies of Huawei. However, the organization is repeatedly accused of industrial espionage and continued breach of international economic sanctions (Kaska et.al, 2019). The company is also known to be engaged in illegal activity and in the prosecution of intellectual property theft in the USA. In recent months, two Huawei executives have been arrested on the grounds of spying by Canada and Poland (Kaska et.al, 2019). Security issues over the use of Chinese technologies are very old.

(vi) Fears involved in selecting Huawei 5G:

The importance of the critical infrastructure renders the implementation of the connectivity infrastructure as a significant decision. This decision would include not only mobile providers, but also the intervention of the government. As a result of these issues, many nations have chosen to place limits on the use of Chinese technologies in their domestic networks (Kaska et.al, 2019). Global tradition of limiting or embracing Chinese technologies differs from state to state. Relevant means could be used to minimize threats, but they will require Huawei's willingness to cooperate.

In mid-January 2018, Canada demonstrated interest in Nokia technology by offering \$40 million in 5G related R&D funding to the venture (Kaska et.al, 2019). Canada has now agreed to choose alternate suppliers. Such ways of stimulating supply diversity would help to escape unwanted market control by any one business. A variety of service providers are taking steps to introduce 5G. Ericsson is also a very good rival to 5G technology.

(vii) Suggestions for Huawei's 5G decision:

a. 5G rollout needs to be recognized as strategic rather than a technological choice:

Given the complexity of socioeconomic and security issues affected by the Huawei decision, it cannot be solved by technocrats alone. It will also require political help to tackle complex aspects of technology, economy, and security (Kaska et.al, 2019).

b. One size does not suit all: There is a growing need for risk awareness and risk assessment resources. Global positions on the adoption or limitation of Huawei technologies are likely to stay organized by the degree of criticality of the danger to a specific service or industry (Kaska et.al, 2019). In order to deal with these problems in an effective way, nations need to reassess the basic roles of their economies in the modern age, the extent and degree of reliance on digital technology and the frameworks of continuity.

5G is an example of China leveraging economic leverage to achieve a more dominant role in global relations (Kaska et.al, 2019). As countries become more assertive in their tradition of placing 'sovereignty' on their 'knowledge space' and economies, reluctance to deploy essential network solutions, such as Huawei 5G, is expected to increase. As yet, there are no comparable solutions to Huawei technology (Kaska et.al, 2019). Through issuing security advice to increase the security of essential government and commercial operations, by improving risk evaluation and management systems, or by deciding on transparency and accountability structures, national responses are likely to aim to improve risk reduction.

B. Smart grid technology

(i) Introduction to smart grid technologies: The existing power grid is unidirectional in nature. It transforms just one third of fuel energy into electricity and therefore does not recover waste heat (Farhangi, 2010). The new generation power system, known as the smart grid, is intended to fix the main limitations of the current grid. Smart grid will provide energy providers with full monitoring and control of their resources. The smart grid are immune to machine anomalies (Farhangi, 2010). In order to enable widespread control and tracking, the smart grid is evolving as a combination of information technology and communication technology with power system engineering (Farhangi, 2010).

In 2010, Farhangi found the following characteristics of smart grid:

- Smart grids are automated and digital.
- They are promoting two-way contact and communication.
- They have distributed generation.
- There are cameras and sensors all around.
- They're self-monitoring and self-healing.
- They're adaptive and insular.
- They make remote control and research tests.
- They've got widespread influence and pervasive control.
- They make a lot of consumer options.

Asset management is the foundation for smart grid growth. It is on this basis that the utilities create a base for the smart grid by a thorough redesign of their IT, connectivity, and circuit networks (Farhangi, 2010). The smart grid will materialize by monitoring

devices inside and alongside the current electricity grid. This smart grid embryos would promote the development and cogeneration of electricity transmitted (Farhangi, 2010). They would allow for the incorporation of renewable energy sources and the control of emissions and carbon footprint of the grid. This will allow utilities to make effective use of their current assets through quality management. The exponential rise in the cost of fossil fuels, along with the failure of energy providers to extend their generating capacity in line with increasing demand for electricity, has increased the need to modernize the network by incorporating technology that can assist with demand-side management and revenue security (Farhangi, 2010).

(ii) Smart grid topology: In 2010, Farhangi noted that the smart grid topology is defined by the following three components:

a. Smart Microgrids: Smart grid is characterized as a grid that accommodates a broad range of generation options, e.g. central, dispersed, intermittent and mobile. It empowers customers to engage with the energy management system in order to change their energy consumption and reduce their energy costs. Smart grid cannot be a substitution for the current power grid, but a complement to it.

b. Microgrid topology: A smart microgrid network can run in both grid-bound and island-based modes.

c. Smart grid topology: The smart grid is expected to evolve as a well-planned plug-and-play aggregation of smart microgrids that will be interconnected by dedicated highways for command, data, and power exchange.

(iii) Smart grid analysis, growth, and demonstration:

Power utilities are well aware of the challenges inherent with pushing their networks, organization, and operations towards an unknown future. Significant problems facing utilities around the world include the lack of near-real-world research and development capabilities to allow them to build, test and qualify technology, applications, and solutions for their smart grid programs (Farhangi, 2010). The challenge faced by most service providers is not the shortage of technology. In the opposite, several disparate solutions have been developed by the companies to solve energy applications and address future problems within the smart grid (Farhangi, 2010).

To conclude, the energy sector is experiencing a dramatic transition. Rising electricity prices, mass electrification of daily life, and climate change are main factors that will decide the speed at which the transition will take place (Farhangi, 2010). Whatever the pace at which different utilities adopt smart grid ideas, technology, and processes, they agree on the inevitability of this major transition. This move would have an impact not only on company operations, but also on organization and technology (Farhangi, 2010).

(iv) Social dimensions of smart grid:

The following are the two major reasons why Canadians are implementing smart grid technologies:

a. First, the ongoing influence of the Information and Communication Technology (ICT) revolution opens up opportunities for technical advancement in main markets, including personal transport, power supply and end-use of all sorts, including manufacturing, commerce, and households (Meadowcroft et. al, 2018).

b. Second, increasing appreciation of climate threats promotes a transition away from the generation of GHG-emitting technologies that have shaped the backbone of energy supply in many countries (Meadowcroft et. al, 2018).

Research into future long-term low-carbon growth pathways indicates that achieving international climate goals would enable developing countries to speed up full decarbonization of power production, dramatically increase end-use performance, and double (or triple) electricity supply, as renewable technology is needed to assume energy loads in transport, homes, and industrial equipment (Meadowcroft et. al, 2018).

Thus, we are at the verge of a potentially drastic transformation in energy systems that will transform not only how power is generated and what it is used for, but also who generates and uses it and when. New technology and social standards are now disrupting traditional economic structures and regulatory arrangements. Smart grids are a key factor of the coming developments, reflecting both technical and social progress that could promote the introduction of renewables, broaden family, neighborhood and business participation in energy decision-making, improve productivity, extend demand control, enhance sustainability and open up new energy markets (Meadowcroft et. al, 2018).

However, the smart grid also helps to express very different visions of the future of energy grids, including more or less autonomous and fragmented patterns of output, use, ownership, and regulation (Meadowcroft et. al, 2018). Smart grids have the ability to shift the way intermittent solar energies and other energy vectors are incorporated into the overall energy structure, changing pathways for heating, transport, and smart cities (Meadowcroft et. al, 2018).

Smart grids are usually viewed as embedded in a progressive, technologically ambitious, future that provides a package of social benefits, including improved infrastructure reliability, economic gains, and energy stability and resilience, as well as encouraging communities to solve pressing environmental challenges such as climate change (Meadowcroft et. al, 2018).

Yet there are a variety of common smart grid dreams. The concept of smart grids involves a variety of technical configurations and several distinct societal models for designing the energy networks of the future. In one end, smart grids may be largely about "micro grids" and a built and decentralized supply chain (Meadowcroft et. al, 2018). In the other side, they could require a "super grid" transferring vast volumes of electricity around continents (Meadowcroft et. al, 2018). Ownership, power, and knowledge flow could be coordinated in a number of ways, including existing utilities, new entrants, municipal governments, and cooperatives. In reality, certain areas of the smart grid are now privileged by the social debates, energy planning and investment decisions being made today (Meadowcroft et. al, 2018).

C. Clean energy

(i) Introduction to clean energy: Canada has made a joint commitment with the United States and Mexico to develop a clean economy (Winston, 2016). These include the production of 50% renewable energy by 2025; the elimination of methane emissions from the oil and gas industry by 40% to 45% by the end of 2025; the alignment of fuel efficiency requirements for appliances, facilities and vehicles; the incorporation of cross-border electrical grids to create resilience and safety; the adoption of measures that promote

historic Paris climate agreements, which consists of reducing global temperatures and phasing out fossil fuel subsidizes (Winston, 2016).

(ii) Five aspects of green technologies:

The following are the five aspects in which these agreements can be reflected by governments and businesses:

a. There will be added demand on utilities: A revolution in energy markets will affect the way utilities and energy providers work. Utilities will face more oversight and demand to raise the percentage of renewable electricity on their grids (Winston, 2016). In order to help this crisis, the government will need to seize opportunities in the Renewable Energy Initiative, which will concentrate on reducing carbon consumption by energy suppliers.

b. The natural gas industry will have to confront its leakage problems: Methane leakage at gas pipeline and transport sites is never assessed and this is a major problem, as untreated, unburned methane can absorb 100 times more heat than CO₂ (Winston, 2016). This places more pressure on gas suppliers to measure pollution to prevent and deter leakage.

c. Canada, U.S.A, and Mexico will have to place a price on carbon: As people and decision makers prepare to curb global warming, ambitious policies will be determined to do the same. Carbon costs can be raised and investments in renewable energy should be promoted. Putting a price on carbon would have an effect on sectors that rely on fossil fuels such as chemicals which would also have an impact on energy spending for all businesses. (Winston, 2016).

d. Clean technologies will win: The government will invest on renewable technology and this would reduce prices for all consumers of energy efficient and clean energy. The

expectations for equipment and car quality are increasing and will improve the opportunities for businesses that can achieve these standards (Winston, 2016). Clean energy firms will also see a rapid rise in demand in the near term.

e. Corporate goals for renewable energy need to be rethought: Several businesses have set aggressive and science-based targets for meeting clean energy and greenhouse gas reductions. A major portion of the carbon footprint of the companies falls from the utility-based electricity they use, since the grid itself becomes greener, meaning that companies can decarbonize immediately (Winston, 2016). This will allow businesses to reduce greenhouse emissions.

Thus, U.S., Canada, and Mexico have come together to accelerate the clean economy in North America.

D. Green technology

(i) Introduction to green technologies:

Climate change has become a global threat to the world, impacting global warming, rising sea levels, and growing adverse weather conditions. Climate change is a direct result of rising amounts of greenhouse gas (GHG) in the atmosphere. Emissions of GHG can be minimized by a range of methods, such as energy efficiency, the use of improved construction materials and transport processes, and the creation of renewable sustainable energy sources, called green technology. (Nikzad & Sedigh, 2017).

Government funding for the use of renewable and green technology is mandatory. Government policy will help promote the transition to renewable energy and help resolve market deficiencies related to sustainable products and services and this will eventually help to drive the phase of green innovation (Nikzad & Sedigh, 2017).

(ii) Sources of Greenhouse gas emissions in Canada:

The main contributors to Canada's GHG emissions are the energy industry (including power and heat generation), transport and fugitive sources (irregular releases of gas into air arising from leaks in equipment and pipeline). (Environment of Canada, 2012). Industrial activities and the waste sector produce a large amount of GHG pollution within Canada. In addition, cold winters and warmer summers contribute to the need for heating and cooling, which contributes to more GHG emissions. Canadians' lifestyle preferences, such as frequent commuting and the use of fewer fuel-efficient cars, often lead to increased energy consumption and GHG emissions (Nikzad & Sedigh, 2017). The share of emissions from manufacturing and construction industries in Canada's overall GHG emissions is low. Over the years, the Canadian economy has undergone a shift from an industry-oriented economy to a service-based economy and as service sectors have lower GHG emissions than industrial industries, there is a reduction in Canadian GHG emissions (Nikzad & Sedigh, 2017).

In terms of energy and environmental R&D budgets as a proportion of overall government R&D budgets, Canada is ranked second in the Organization for Economic Co-operation and Development (OECD) during 2017 (Nikzad & Sedigh, 2017). As of 2020 rankings Norway tops the list, followed by Australia, Iceland, and Canada.

The Government of Canada's industrial GHG pollution regulations are very stringent and have played a crucial role in enabling industry to optimize the process of lowering GHG emissions. (Nikzad & Sedigh, 2017).

The Canadian government has been working to create and introduce strategies to tackle climate change through technical advancement and diffusion. This measures may be

distinguished as market-based and non-market-based instruments (Nikzad & Sedigh, 2017). Market-based instruments may be further categorized as environmentally related tax and trading carbon emission permit schemes (Nikzad & Sedigh, 2017). Non-market-based pollution can be further categorized as monitoring and control policy, active infrastructure support strategies and voluntary approaches (Nikzad & Sedigh, 2017). Market-based tools mitigate pollution at a lower cost than non-market-based.

(iii) Challenges in promotion of green technologies:

There is confusion regarding the overall global and national costs and the gains of investing in renewable and green technologies. In addition, climate change forecasts and their implications differ considerably. As a result, there is a great deal of confusion about the real effects of global warming and the strategies of GHG reduction (Nikzad & Sedigh, 2017). GHG emissions are a global problem and the effect of one country's expenditure in reducing emissions is not readily quantifiable.

One of the strategies recently used to foster green technology advancement applies to intellectual property rights (Nikzad & Sedigh, 2017). A well-functioning IP security and compliance mechanism will provide resources to promote and disseminate green innovation globally. Canadian countries have strategies to accelerate green technologies by introducing fast-track green patent applications (Nikzad & Sedigh, 2017). Patents can be used to calculate the degree of creativity and the proliferation of green technology.

(iv) Meaning of green technological innovation:

Technological innovations, especially in industrial processes, which help to reduce waste generation, are called green technological innovations (Anex, 2000).

Lowering industrial pollution is seen as a challenging job in which any change in the atmosphere comes at the expense of decreased industrial production. Green technology advancement ensures that emerging technologies can enable us to change the environment while sustaining economic development.

(v) The role of public policy in green innovation:

Government policy can encourage technological innovation and progress either by growing the demand for new technologies or by actively enhancing the supply of innovation. Policy interventions that influence demand for technical advancement include knowledge supply, government procurement and performance requirement standards (Anex, 2000). Supply-side reform initiatives include direct financing of research, research tax credits, rate setting, enforcement of trademarks and copyrights, and relief of competition and liability laws (Anex, 2000). The effectiveness of government attempts to encourage technical advancement relies on how efficiently government controls the production and demand of technology.

(vi) Two main objectives of green technical advancement:

- a.** The first goal is to integrate environmental goals into the implementation of all technologies and not to establish a new form of technology (Anex, 2000).
- b.** Secondly, there is no national consensus on the extent of environmental security that is acceptable or the need for the government to be active in stimulating green technology growth. (Anex, 2000).

These goals limit the success of government initiatives to create supply of or demand for green technologies, thus making it clear that these policies would be more successful by targeting private sector.

It is necessary to build incentives for green technology innovation. These benefits can be direct or indirect. Direct economic benefits may be generated through policies such as fees, subsidies, or fines for non-compliance (Anex, 2000). Indirect benefits can be generated by schemes that affect public opinion, such as those that disseminate favorable or derogatory facts on the environmental success of the organization. (Anex, 2000).

(vii) Investments in green technology:

Investments in green technologies are determined by two factors: technical and economic uncertainty (Anex, 2000). By having appropriate details, technical risks may be minimized. Markets and strategies are causing global economic uncertainties. Business risks can be minimized by direct government procurement (Anex, 2000). To minimize policy risks, policymakers should convey a long-term commitment to constant development of the environment and create an environment in which companies would be able to make long-term investments in creative technology to reduce waste. (Anex, 2000).

E. Renewable energy sources:

(i) Three approaches to handle energy processes efficiently are as follows:

a. Energy Efficiency: This relates to the ways and means of reducing wasting of energy in generation and distribution.

b. Energy Conservation: This concerns with the introduction of strategies and applications to minimize the volume of energy required for the supply of goods and services.

c. Switching to green energy sources: Renewable energy is produced from renewable energy sources. Hydro, solar, wind, geothermal and biomass, for example.

(ii) Transitioning to renewable energy sources aims to meet two objectives:

a. Reduction of reliance on fossil fuels: With demand for fossil fuels, the price of fossil fuels has risen and adversely influenced the productivity of small companies.

b. Reduction of greenhouse gas emissions: Global climate change and increased awareness have contributed to people seeking ways to minimize GHG emissions.

Many countries have launched incentive schemes for green energy systems, diversifying their energy mix to minimize reliance on fossil fuels and reducing GHG emissions (Jagoda et. al, 2010).

(iii) Increased interest in green energies offers two big prospects for SMEs:

a. The use of green energy sources would lower their energy prices in the long term (Jagoda et. al, 2010). As there are several benefits offered by state, municipal and local governments, the initial costs of those programs are smaller. Solar energy and wind power are becoming popular among small and medium-sized companies.

b. Small and medium-sized companies can achieve a sustainable advantage by being environmentally sustainable and creating environmentally conscious consumers. Many businesses have put in motion a green marketing campaign to distinguish their goods and services from rivals (Jagoda et. al, 2010).

Innovation is the driver of global growth and has been seen as a significant cause of new jobs and skills advancement. National innovation can be characterized as the flow of information and power, between various actors and institutions within the context of innovation structures. Federal, regional, and local government policy strategies to promote emerging technologies initiatives are informed by capital supply, position of alternative energy sources, existing market status, innovation systems, and demand for energy sources (Jagoda et. al, 2010). Citizens play an important role in the creation, application, and

adoption of green energy systems. Local societies are becoming more influential in energy policy by playing an active role in the decision-making process, balancing their local demand with energy sources.

(iv) Canadian renewable energy sector:

The energy sector plays a vital role in the economy of Canada. Rapid industrialization of countries and increased demand for energy in the world is on the rise.

The scale and geographic positioning of Canada offers access to a wide range of green energy sources. It has vast deposits of biomass, solar, wind, geothermal and other sources of energy, offering immense opportunities for growth and commercialization (Jagoda et. al, 2010). Canada has used only a portion of it to produce energy. The key reason for the poor adoption of renewable energy is the lack of rapid technical developments, expanded supply of natural gas and modest aspirations for the consumer adoption of new technologies (Jagoda et. al, 2010).

The Canadian government has initiated a range of projects and programs to encourage solar energy. This range from corporate tax incentives for the start-up of a solar energy plant, subsidies to enterprise customers, industry incentives for electric retailers to generate electricity from green energy sources (Jagoda et. al, 2010).

To summarize, the Green Energy Innovation Strategy states that the mutual goal of growth between policy makers, the government, industry, and the support network is important for the achievement of common objectives. There is a tremendous opportunity for small and medium-sized businesses to be active in the renewable energy industry in Canada. Proper systems and products, targeted to a particular market, may give rise to considerable business opportunities. However, each market has its own challenges, so the

selection of the right form of renewable energy is the secret to effective commercialization (Jagoda et. al, 2010).

(v) Benefits to indigenous Canadians

a. The aim of Canadian innovation programs is to ensure that every person profits from innovation environments, including the empowerment of indigenous Canadians. Indigenous Canadians are deeply active in the renewables industry (Corporate Knights Magazine, 2018).

b. The energy market in Canada is undergoing rapid change and is generating opportunities for indigenous people. Many renewable energy ventures have major indigenous participation. Indigenous ownership of the project is an estimate of 25 per cent, reflected by direct ownership, revenue-sharing agreements, lease agreements, partnerships, among other instruments (Corporate Knights Magazine, 2018). Indigenous renewable energy initiatives are ongoing everywhere in Canada. These ventures produce a power output of 19,516 megawatts, which constitutes almost a one-fifth of the country's energy and an estimated \$842 million in construction revenue for Indigenous jobs (Corporate Knights Magazine, 2018). While this covers solar, bioenergy, hydro, and wind, 26 per cent were wind projects and 63 per cent of the projects included hydro-electric plants (Corporate Knights Magazine, 2018). Few solar ventures have arisen as well. More than 1,200 small green energy projects developed with Indigenous involvement, often targeted towards serving the energy needs of local First Nations or Inuit groups in the vicinity (Corporate Knights Magazine, 2018).

c. Canada will extend the supply of renewable energy to globally linked power grids throughout the world. In Canada, Aboriginal people are the community with the largest

ability to address the needs for green energy implementation. Aboriginal interest in the production of green energy in Canada has been diverse and has embraced a variety of strategies to address energy supply needs (Krupa, 2012). However, there are certain challenges and problems encountered by Aboriginal people that hinder them from achieving their full potential. The Canadian government has announced its intention to make Canada a "energy powerhouse (Krupa, 2012)." Minor incentives are now being provided at the federal level to grow Canada as a Renewable Energy Superpower (Krupa, 2012). Transition to green energies would provide advantages such as energy protection, environmental security, and economic growth. Renewable technology is robust, decentralized, and capable of reacting to challenges of energy stability.

The provinces of British Columbia and Ontario have recognized the substantial advantages of increasing the use of green energy and are adopting mechanisms to make the implementation of renewable energy extremely desirable. Alberta is taking efforts and looking on the future of green energies. Canada aims to have the potential to achieve real sustainable development (Krupa, 2012).

Aboriginal people in Canada are diverse and range from the Inuit, Haida, Indian and Metis peoples (Krupa, 2012). They are also known as the "First Nations" of Canada. Renewable electricity is an appealing alternative as a core component of the First Nations Growth Policy. There is a great deal of space for accelerated implementation and First Nations citizens across Canada are well placed to begin the process (Krupa, 2012).

d. Obstacles faced by Aboriginal people:

- **Cash:** According to the Canada Revenue Department, native citizens are excluded from taxation on money generated from on-reverse operations (Krupa, 2012). This

would build a growth window when both resource-based and non-resource-based resources are open. Federal and regional agencies have provided funding and financial opportunities. While the situation is improving by subsidies, First Nations struggle with lack of financial capital to fulfill the financial needs for new green energy production (Krupa, 2012). In certain instances, there is not enough cash to satisfy the demands of communities on a regular basis.

- **Capacity:** Clean energy production remains a core concern in both the public and private sectors across Canada. Preliminary project planning, legislative procedures and group consultation are impossible to accomplish without sufficient funding and experience (Krupa, 2012). This problem is difficult to resolve, particularly when there is a lack of basic capability in the reserve. It is very difficult for First Nations to find the best potential paths to follow. Technologies are difficult to navigate and require outside advice.
- **Clarity:** Due to a lack of large-scale implementation, renewable energy had trouble reaching grid parity and thus tends to be rated as commercially uncompetitive with fossil fuels (Krupa, 2012). Renewable technology helps society to solve the free rider dilemma of energy suppliers who are not responsible for the full cost of their goods. This makes it impossible for those involved in creativity to explain the millions of dollars needed in research and development costs (Krupa, 2012). Proliferation of clean energies ensures greater stability and accountability, but it is unclear if the government can promote further advances. There is little certainty regarding long-term development.

- **Circumstances:** Another hurdle that green energy technology in Canada must address is the circumstances or underlying features of renewable energy production. The chemical essence of clean energy technology varies from that of fossil fuels. As a result, the energy density per unit is smaller, rendering it impossible to incorporate clean energy as an option (Krupa, 2012). Broad incorporation of decentralized generation into grid networks is a big obstacle. Large-scale distributed generation is rare worldwide, and technological challenges are expected to occur (Krupa, 2012).
- **Lack of legitimacy:** Many green energy ventures affecting First Nations are restricted by a lack of social license in Canada. Treaty problems also remain unanswered, and the consultative mechanism for proposed proposals can be difficult (Krupa, 2012). This lack of social license has limited First Nations attempts to completely exploit the region's rich natural resources.
- **Lack of equality:** Despite development in recent years, there is still a significant economic divide between First Nations and mainstream Canadian culture (Krupa, 2012). The lack of equity is visible at all levels, for example representation in government, industry, and post-secondary education. While these mechanisms are being reversed by benefits and funding for Aboriginal involvement, a great deal of change needs to be made.

To sum up, the Aboriginal population in Canada has a huge potential to form the most relevant policy areas, and the obstacles to their inclusion should be overcome as

quickly as possible. Aboriginal relevant improvements that promote the uptake of additional Aboriginal-owned renewable energy projects include:

- Price adders for generation and transmission (Krupa, 2012),
- Additional financing and procurement agencies for Aboriginal projects (Krupa, 2012), and
- Continued education services that allow Aboriginal people in the reserve to develop their own project capacity (Krupa, 2012).

(vi) Open innovation in rural areas

It is widely agreed that cities are conducive to creativity, as their density and diversity of industries and individuals build a dynamic climate. However, creativity is also taking place in rural areas (Meili & Shearmur, 2019). Furthermore, rural social networks demonstrate that diversity is multidimensional.

Innovation is not a closed process. Open innovation is defined as collecting, assembling, and using information and expertise obtained from external channels, and cooperation with external collaborators with a view to innovating (Meili & Shearmur, 2019). Psychological research suggests that at the human level, imagination and invention are focused on loneliness, isolation, and intensive experiences (Meili & Shearmur, 2019). Effective initiatives takes place in rural areas because they are remote, sparse and they lack diversity. Open experimentation may take place in non-dense areas that can benefit from little local diversity.

The mechanisms proposed for companies in rural areas to participate in open innovation by Meili & Shearmur (2019) are as follows:

- Firms in rural areas should network outside the region.
- Firms in such an area will recognize issues that are unique to the regions and these businesses rely on local expertise to find creative solutions.
- The scale and importance of companies in niche sectors can help to create internal diversity as a replacement for external diversity.
- If there is lack of external diversity companies may participate in social connections and relations that exist in small cities.
- Companies pursuing external knowledge would be able to diversify their networks and knowledge resources.

Thus, we can see that progress can also take place in small areas where knowledge bases and industrial profiles do not tend to represent complexity or variety. Innovative companies in rural areas depend extensively on extra-regional information linkages and use various knowledge outlets relative to their urban peers (Meili & Shearmur, 2019). They seem to depend more on internal capital and technological skills and rely more on social networks.

6.0 Strengths of the CIS

(i) Opportunities and Possibilities:

Innovations are important to the global economy and the economic development and stability of Canada in the future. They build opportunities to produce new wealth for a vast array of new goods, technology, services, business processes, social instruments, and organizations. The digital revolution has the ability for virtually transforming every area of the economy. New opportunities are being created by the rapid speed of innovation and shifting global leadership in digital technology. The rate of the digital revolution is picking up. The rapid speed of data analytics, cloud computing and mobile devices are a crucial aspect of this revolution, which has changed the emphasis of innovation from hardware to software and data analysis (Wolfe, 2019). Smart phone applications, artificial intelligence, social media algorithms, platform-based business models, vast databases, digital networks, and cloud computing are now the pioneers of the digital economy. This transition would leave no sector of the economy untouched. Innovation is accelerating, significantly reducing the time it takes to disrupt existing markets and generating greater demand for businesses and industries to react to the impact of new disruptors (Wolfe, 2019).

Thus, Wolfe (2019) determined the prospects for entrepreneurs are as follows:

- a. Ecosystems of innovation will help facilitate the rapid adoption and distribution of emerging technology across all economic sectors.
- b. Assist businesses that have shown commercial potential to expand on a global scale.
- c. Promoting the creation of an organization capable of producing transformative technologies.

(ii) Cassidy (2019) points out the following three strengths of the CIS:

a. Entry to markets and funds: Canada has a very large investor and capital base to promote the growth of innovation ecosystems. Due to the above-average wealth of Canada, there is also a great opportunity for additional investment sources to assist in business development and advancement. In Canada, there are a lot of prospects for investment.

b. Partner mentorship: The critical drivers for the creation and growth of Canadian innovation ecosystems are collaborators across different ecosystems. A strong network of mentorship that involves highly successful people and leaders of the community. Well-established businesses have sponsored innovation ecosystems. Canada is well placed because mentorship and community volunteerism are well known in Canada.

c. Partnership with post-secondary colleges and universities: There are different academic institutions in Canada. As these post-secondary institutions are an important component of the success of innovation ecosystems, entrepreneurs should develop strong partnerships with universities and colleges. Collaborative programming may also be developed and helpful in improving and offering business knowledge and resources to entrepreneurs.

7.0 Challenges and Weaknesses Faced by Canada

(i) Challenges:

a. Canada has a risk-averse culture: Risk-averse clients are very hesitant to try any new products or services. For Canadian businesses, this is a really big obstacle.

b. Difficulties in effectively receiving government funding: Some grants are subject to age limits and these grants favor grants belonging to age groups of under 25, 30 and, in certain cases, 40 (Rowe et al., 2019). This will evidently have a negative effect on older entrepreneurs. This also means that if the individual is in his 50s, he will be forced to fund his business 100% without any support from grants and monetary benefits provided by the government.

c. Personal challenges: These essentially involve personal challenges faced by entrepreneurs. This includes a disturbed work-life balance.

d. Difficulties in accessing needed talent: Accessing talent with sales experience and abilities, subject matter expertise and skilled management is very difficult (Rowe et al., 2019). For long-term success, these talents are necessary.

e. Difficulties facing ecosystem navigation: It is difficult for independent entrepreneurs to access the available tools. It is tough to grasp what is important to a specific venture (Rowe et al., 2019). And once that is understood, it's another struggle to figure out who to talk to. They will have a feeling that services are not accessible if anyone does not know how to access the system, and this will frustrate them eventually. The importance of the assistance received is often understood and valued by those entrepreneurs who received the help (Rowe et al., 2019).

f. Lack of long-term growth support: Support earned from the community has not allowed entrepreneurs to benefit from it in the long-term (Rowe et al., 2019). Entrepreneurs felt that very little support for the success of their projects was given.

g. Ineffective and inefficient government support: Government inefficiencies in funding new projects will generate mistrust of the ecosystem's worth. Entrepreneurs obtained sufficient resources, but they were often unable to obtain the right resources at the right time (Rowe et al., 2019).

h. Lack of clarity in processes for support: The environment should be user-friendly. Government funding processes should be open and available to all, regardless of the requirements for age groups.

(ii) Additional challenges:

a. Entrepreneurial leadership and promotion: Canada's culture has prosperous businesses and business leaders. Many of the innovation ecosystem participants and leaders are solopreneurs, entrepreneurs working alone or involving contractors, and lifestyle entrepreneurs whose aim is to promote lifestyle rather than produce income (Cassidy, 2019). Therefore, there is a need to enable effective entrepreneurs to be more involved in promoting innovation ecosystems through leadership roles. This is possible by rising the number of group meetings and activities taking place. This will also assist in linking different entrepreneurs (Cassidy, 2019).

b. Coordination and connectivity: There is a growing need and strong demand from entrepreneurs to ensure that stakeholders are highly organized and closely linked in the delivery of services and in fostering innovation ecosystem. Cross promotion and customer referrals among partners are significant contributors to the success of innovation

ecosystems (Cassidy, 2019). Building a room where partners would co-locate together with the addition of collision space will be a significant step in creating collaboration synergies and providing startups with a consistent support service destination. (Cassidy, 2019).

c. Talent pool: The scarcity of affordable houses and office space for young people and early stage enterprises is a major limitation in creating and maintaining an innovation ecosystem (Cassidy, 2019). Nevertheless, there are several regions that provide considerably lower rates for living, office, and industrial rentals, as well as some co-working and incubator rooms. Despite the lack of supportive space available for entrepreneurs, Canada has a large base of highly skilled and seasoned professionals and many existing businesses involved in engaging with and supporting early stage businesses (Cassidy, 2019).

(iii) Risks:

Wolfe (2019) listed the risks that hamper the willingness of Canadians to completely take advantage of the digital revolution as follows:

- a.** Often, promising companies travel to the US or are sold to overseas investors.
- b.** The lack of patient capital in Canada for high-growth companies is one of the greatest obstacles to the growth of digital companies.
- c.** The absence of seasoned managers with the expertise needed to scale a domestic business into global markets makes it difficult to transform start-ups into high-growth businesses.
- d.** As these are crucial elements of success in a digital environment, Canadian innovation policies need to pay more attention to the opportunity to use intellectual property and property standards as part of their strategy.

e. Canada's got a loose structure of creativity. A strategic emphasis is missing in the structure, and the main players are not organized.

8.0 Recommendations to improve the CIS

Based on the review of literature in the previous sections of the report, I list below a series of recommendations which are helpful to improve the CIS. In addition, I also make recommendations which are not completely covered, by the literature reviewed in this study.

(i) Recommendations derived from the extant literature:

- **Government support policies:** These policies can be made more valuable for the CIS if the funding process is made more time efficient, limits, like age limits are eliminated , local, national, and global mentorships are facilitated and stages of process of innovation and size of funding requirements at various stages are more adequately coordinated.
- **Support from academic institutions:** In order for innovators to contribute towards the development of the CIS, it is recommended that the present disconnect between foundational research and pertinent knowledge, skills and talents at the academic and development innovations be cured.
- **Risk Aversion:** Canadians are fearful for trying something new. For reducing the impact of risk aversion, a better financial support and incentives are needed. This can be reduced by entrepreneurs offering good discounts and attractive prices to Canadian customers and develop a market base, once the entrepreneurs experience a strong customer base, it is to survive in the market. Making profits should be a secondary goal for entrepreneurs.

Many entrepreneurs are also facing personal challenges which are necessary to be resolved. The ongoing worldwide pandemic adds more challenges. One of the most obvious challenge faced by everyone these days include a transition to work-from-home. This concept has made it very difficult to differentiate between work life and personal life. So, it is very important to have a healthy work life along with having a good personal life. Setting timelines, having proper timetable, and taking necessary breaks will help to have a balance life.

- **Encourage entrepreneurship:** Canada has a very large capital base, they have above-average wealth, and Canadians should use this excessive funds to invest in sources which can assist innovation of businesses. The challenges of lack of business knowledge and resources can be overcome by successfully partnering with Universities. Universities are encouraging the entrepreneurs to participate in various programs like co-op programs, internship opportunities, career fairs, and so on. The main advantage of this partnership and collaboration is entrepreneurs will receive the right talent at the right time.

To overcome the **challenges** the government should promote programs which will encourage the entrepreneurs to be involved in the process of innovation. This is possible if the provincial government collaborates with the federal government and organizes online events where entrepreneurs in different provinces can meet with each other, shares their ideas and opinions, and can benefit from the experiences of their fellow colleagues.

- One of the biggest **threats** to Canada is copying or imitating the United States decisions and technological innovations. In some areas, Canada often does less

research by itself and directly copies ideas from United States. Even for Huawei decision Canada was relying on U.S's decision. But if Canada does its own research, it will come up with conclusions which will favor Canadian citizens. U.S. take decisions in way that favors U.S. citizens, two countries have different social, political, and economic components. Thus, more research is recommended for the success of technological innovations in Canada.

- One of biggest **opportunities** for Canada is abundance of resources. With the governmental financial support and research Canada can achieve the sustainability goals faster than any other country. As we know that Canada has a lot of resources and if they are used in right direction, they would definitely work out wonders. Canada is promoting immigration and recently they issued permanent residency letters to maximum number of people possible. Thus, we see that Canada will have immense knowledge from all over the world and will benefit from their knowledge and experiences. Canada can achieve success if this knowledge is pulled together in the destined directions.

(ii) Additional recommendations:

- **5G Technologies:** It is recommended that Canada should have Huawei technologies for rural areas. For urban areas Canada can have Nokia or Ericsson. In this way Canada is not relying only on one network provider. Canada is highly influenced by U.S. decisions and tries to follow their decisions, but I would suggest that Canada should take decisions keeping the cost factor as a priority. Huawei

offers a budget-friendly plan. At least in the rural areas Canada should implement Huawei 5G, so that they are not deprived of the 5G experience.

Huawei 5G technology is not fully interoperable technology and would involve a huge cost if Canadian telecommunication providers change their mind at a later date. Even Nokia's 5G is not easily interoperable. Ericsson 5G networks are the only one which are interoperable. Thus, in my opinion, Canada can have Huawei and Ericsson 5G networks for rural and urban areas respectively. In this way, the whole Canadian economy will benefit from the perks of 5G technology. Having two technologies will save Canadians from relying heavily on one supplier.

- **Smart grid technologies:** It is recommended that a transition to smart grid be made mandatory as it will help in monitoring energy usage. This technology uses energy efficiently and reduces the wastage of electricity. The old technology is outdated, and smart grid will replace the old technology. For example, in Canada Siemens is taking advantage of this opportunity in the evolving energy markets. Siemens is working on energy automation and smart grid projects. This has also opened up new employment opportunities. Siemens Power Academy is a development partner in the area of power transmission and distribution. They are open for enrolment and provide customized training with the help of certified trainers (Siemens website). They do offer classroom as well as digital training and this training covers topics (Siemens website) such as smart infrastructure solutions, grid management, and grid planning and simulation.

Considering the continuous increase in the energy consumption patterns, it is necessary to switch to renewable sources of energy. Smart grids are intelligent

and smart products to keep the grids running. It definitely promises efficient functioning and a greener future. Thus, every Canadian should take efforts and try to support this technological innovation.

- **Clean energy:** It is recommended that the following measures should be implemented by Canadians to promote clean environment:
 - Canadians should start using alternative fuel vehicles. As petrol and diesel both are responsible for air pollution.
 - Government should encourage use of alternative fuel vehicles. This is possible by increasing the prices of traditional petrol and diesel.
 - Various examples of alternative fuels can include biodiesel and natural gas.
 - Other precautionary measures may include using energy efficiently. For example, using efficient lighting for households and commercial purposes.
 - Every Canadian should strictly adhere to reduce consumption of energy by practicing energy conservation. Technologies should be implemented to lower the amount of energy used. Basic practices like turning off lighting when not needed should be strictly followed.
 - Solar energy should be used for generating power as this will help in eliminating the production of harmful pollutants and preventing air pollution.
 - Wind energy can also be used for generation of electricity.

Thus, we see that Canada has enormous amounts of natural sources of energy and if they are used efficiently and effectively than Canada can reduce as well as eliminate

the greenhouse gas emissions from fossil fuels and reduce some types of air pollution.

- **Green technology:** It is recommend that, if every businesses or entrepreneurs make environmental sustainability as priority and understand that it is equally important as earning profits for the business, it is possible to “go green”.

Everyone should promote ecofriendly businesses. Canada is taking efforts to achieve this goal. For example, if we purchase plastic bottles or cans, we pay a security deposit, and we get this refunded when we take it to the recycling centers. However, we see that despite efforts are being taken, it is difficult to completely transition to natural sources of energy. This is a slow process and it would definitely take time to see and experience the change. Ecofriendly environment will help reduce waste and eventually improve business efficiencies. It can also help business get credits, incentives, and exemptions from the government. It will help in creating a healthy workspace. It will help in creating a sustainable environment.

At individual level, we should use heating and cooling system very efficiently and effectively, as misuse or overuse can lead to emission of GHG which are hazardous. We should also prefer walking or using bikes (bicycles) as much as possible. Reducing the use of car, will save the environment from harmful emissions and will also save our health as we would indulge in some physical activities. Thus, by taking efforts we will see reduction in GHG emissions in the near future, it is a slow process but not an impossible process. Together we can achieve success.

- **Policy proposals to help green technology advancement:**

These are derived from Anex, 2000 as:

- Provision of economic and policy rewards for innovation.
 - Flexibility to adapt to regulations should be given to businesses.
 - Controlling technical and economic risks.
 - Consideration of the whole life cycle of the commodity or products.
 - Addressing pollution to all media.
 - Stimulating the creation and distribution of information.
 - Consideration of the life cycle of technologies.
 - Serving as policy experiments.
- **A few examples:** An Ontario Provincial park is now light-free so that public can gaze into a natural sky full of stars. The Quetico provincial park, which is located outside of Thunder Bay, is now offering an amazing experience which is free from light pollution. The light pollution free area will benefit animals who rely on cycles of natural light and darkness for eating and migrating (Forsyth, 2021). Thus, we see that having a light-free park will help us save electricity along with that give humans and animals a natural experience.

Another example I would like to share would be about University of New Brunswick's (UNB) efforts to achieve sustainability. UNB has its own community food gardens where they produce fresh fruits and vegetables. Students and any UNB member can purchase freshly grown produce at affordable prices. UNB also has its own sustainability plan. UNB has many gardens on the campus, they are planning to have a new rose garden near the Harriet Irving Library, and they have already started working on that project. UNB has recycling

opportunities on the campus. UNB has a mandatory bus pass facility for its students which helps preventing air pollution. They have increased opportunities, awareness, and education for sustainable events.

At individual level we can take the following efforts to make the best use of renewable energy sources:

We can use solar energy for cooking, heating, and other purposes. For example, we can use solar cooker to cook food. Solar energy can also be used for heating water. The households can use sun's energy to generate electricity through solar panels being installed on the roof.

Similarly, wind energy can also be used to generate electricity for household purposes. This will save us from paying huge electricity bills.

- **Better coordination among various countries:** Considering the fact that Canada has abundance of resources, and Canadians are taking efforts to use renewable sources of energy, they can have conversations with countries like United States and European countries, to understand what steps they follow to save the environment. Canada should promote job openings with various companies who are working on sustainable environment projects. These jobs should be promoted with a good pay scale and working hours flexibility. Nowadays, we are all surviving in a worldwide pandemic. This pandemic also necessities technological innovation. Since because of the pandemic, we are doing everything online, many of us have work from home, schools and universities are also promoting online delivery of education. For example, Deloitte shut down its four offices in United Kingdom permanently and moved around 500 staff to work from home

permanently, I believe it is a good step towards sustainable environment, less people will use their vehicles to reach their place and zero electricity consumption by office as they planned to shut offices permanently. Thus, we see that in the long run technological innovation will not be an option but a mandate.

- **Benefits to indigenous Canadians:** To increase the indigenous involvement in the technological innovation process, they should be provided with the tools, education, and support to survive in the digital age. Government funding is necessary to ensure that they are financially stable and capable to participate in the process of innovation. Online delivery of education will attract active participation from Indigenous communities. Another advantage for being involved in clean energy projects can be creation of job opportunities. There are training opportunities available for members. And, indigenous communities are significantly involved in these projects, Canadians just have to ensure that this situation stays consistent and the numbers do not fall.

The Truth and Reconciliation Act was created by Canada, to support and favor the Aboriginal group and protect them from any dangers and harmful activities conducted against them. This act facilitates the reconciliation among former students, their families, and their communities. Since then this act is supporting the First Nations community. Any harm done to this community can lead to reparations under this act. Despite that there is funding available to Aboriginal Canadians, they are still facing shortage of funds as sometimes it is expensive to fund the renewable energy products. Solar panels are expensive, and they are purchased at cost per watt. This cost is under \$5 but it differs from

province to province. So, depending on the use of solar energy, around 370 watts per panel is being used for residential purposes. I believe this is the reason why there are facing cash shortages. The aboriginal communities in the past have stayed and resided in the dense forests, grasslands, deserts, barren lands, swampy terrain. Since they were exposed to these natural climatic conditions, they understood the nature, much better than the other communities. They used to be involved in hunting and farming. They used to make portable homes erected from materials found in environment. Their clothing composed of animal skin. Since they were drastically interacting with the natural environments, they are the best people to convert to renewable forms of energy. So, it will be very useful to use their knowledge and experience to easily switch to using renewable forms of energy on a regular basis.

- **Open innovation:** It can help in value creation. As the main difference between open and closed innovation is that closed innovation carries out work in a self-contained innovative environment. But by using open innovation, companies rely on external sources of knowledge for innovation. In rural areas, since there is less population, people tend to share ideas and use external knowledge. I would recommend having a mobile application or a webpage, where entrepreneurs can share their innovative ideas and connect with other entrepreneurs to promote innovation. So, this application will function similar to skip the dishes food delivery application in Canada, just like the customer can enjoy meals without visiting the restaurants, in the same way innovative ideas can be exchanged. This

will benefit the rural areas as they can enjoy innovative ideas from all over Canada. This will help promote open innovation in rural areas.

- **Geographical clusters:** Canada should develop clusters to pool the knowledge. Just like in USA, Silicon Valley is the center for innovative technology companies. In the same manner, Canada needs to have a home for all its companies and individuals with innovative ideas such as green technology, clean energy, smart grid technologies and so on. This will give Canada a competitive advantage.

Canada has its Finance hub in Toronto, and it has benefitted the finance sectors. In the same way, Canada's innovative technologies hub will benefit all innovative ideas. The issue in the current situation is different individuals have different innovative ideas but there is no coordination. If there is a common platform where people can share these ideas, they can come up with innovative techniques and execute the ideas.

The following are the advantages of forming clusters: it will help in increasing productivity, there will be rapid innovation, clustering within different geographical areas will bring together ideas from variety of skilled individuals, partners, and organizations, and will help in supporting local economies.

Therefore, the government should support formation of clusters and encourage various entrepreneurs to participate and share their ideas with various talented people belonging to different geographic locations. This would help promote and encourage innovative ideas.

9.0 Summary and Conclusions

To summarize, we first discussed the innovation ecosystem of Canada. Then we described the CIS by providing the definition of CIS and listing down various stakeholders and their interests in the CIS. This was followed by listing various functions of the CIS. Then, government support policies were discussed and explained in detail. After which we discussed most important areas of innovations in Canada, these included:

- 5G technology
- Smart grid technologies
- Clean energy
- Green technologies
- Renewable sources of energy
- Benefits to Indigenous Canadians
- Open Innovation in rural areas.

Then the strengths and the challenges of the CIS were discussed, and this was followed by a longlist of recommendations to improve and strengthen the CIS.

10.0 Bibliography

- Alton, T., & Oddleifson, E. (2020). Canada & 5G: Security, Diplomacy, and Policy. China Institute- University of Alberta., 1-21.
- Anex, R. P. (2000). Stimulating innovation in green technology. Sage social sciences collections, 188-212.
- Archibugi, D., & Painta, M. (1996). Measuring technological change through patents and innovation survey. Technovation, 451-468.
- Cassidy, A. (2019). Realigning economic development to support company start up and scale up. Papers in Canadian Economic Development , 44-55.
- Corporate Knights Magazine. (2018). Indigenous Canadians heavily involved in renewables sector. Corporate Knights.
- Farhangi, H. (2010). The Path of the Smart Grid. IEEE power and energy magazine, 18-28.
- Forsyth, M. (2021, February 23). *An Ontario Provincial Park Is Now Light-Free So You Can Gaze Into An Endless Starry Sky*. Retrieved from Narcity: <https://www.narcity.com/amp/ontario-dark-sky-park-is-a-magical-new-spot-for-stargazing>
- Jagoda, K., Lonseth, R., Lonseth, A., & Jackman, T. (2010). Development and commercialization of renewable energy technologies in Canada: An innovation system prespective. Renewable Energy, 1266-1271.
- Kaska, K., Beckvard, H., & Minarik, T. (2019). Huawei, 5G and China as a security threat. CCDCOE Nato cooperative cyber defence centre of excellance, 4-22.

- Krupa, J. (2012). Identifying barriers to aboriginal renewable energy development in Canada. *Energy Policy*, 710-714.
- Meadowcroft, J., Stephens, J. C., Wilson, E. J., & Rowlands, I. H. (2018). Social dimensions of smart grid: Regional analysis in Canada and the United States. *Renewable and sustainable energy reviews*, 1909-1912.
- Meili, R., & Shearmur, R. (2019). Diverse Diversities- Open innovation in small towns and rural areas. *Wiley growth and change*, 492-514.
- Nikzad, R., & Sedigh, G. (2017). Greenhouse gas emissions and green technologies in Canada. *Elsevier Environmental Development*, 99-108.
- Rowe, A., Dong, L., Landon, J., & Rezkalla, E. (2019). Scaling Start-Ups: Challenges in Canada's Innovation Ecosystem. 1-18.
- Schwanen, D. (2017). Innovation Policy in Canada: A holistic approach. C.D. Howe Institute Commentary, 2-23.
- Watters, D. B. (2013). Q&A. *Technology Innovation Management Review*, 38-41.
- Winston, A. (2016). 6 ways North American clean economy agreement will affect business. *Harvard Business Review*, 1-5.
- Wolfe, A. D. (2019). A digital strategy for Canada: The current challenge. *IRPP Insight*, 1-19.

Curriculum Vitae

Candidate's full name: Darshna Chetan Makhecha

Universities attended: University of New Brunswick

Publications: None

Conference Presentations: None