4 Benefits of Broadband – Socioeconomic Effects

4.1 Overview

The ultimate value of a community's investment in high-speed broadband derives not from the infrastructure itself but from the economic and social ecosystem that grows and evolves around it.[21] Figure 16 depicts the complex web of effects and interrelations that exist between the economy and society that stem from increased broadband speeds. Very diverse economic and social benefits are apparent.[22] The map is a simplification – in reality there are even more factors and linkages.

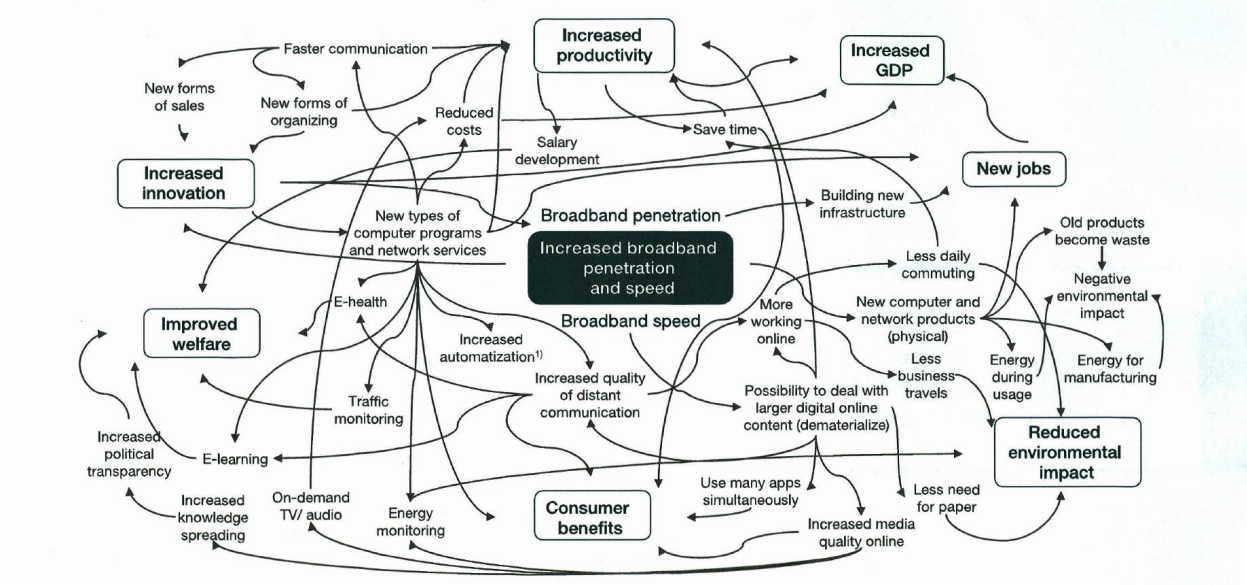

Figure 16 – Effect and interrelations that stem from increased broadband speeds.

Many economic and social benefits have been correlated with having access to broadband. In the late 1990s, Internet connectivity was transformed by '*always-on*' digital subscriber line (DSL) and cable modem services provided by the telephone and cable television companies, respectively. These first-generation broadband services dramatically improved broadband connectivity to the Internet, which led to the development of new inventions, processes, and business models; new and improved goods and services, and increased competitiveness and flexibility in the economy. While these first-generation technologies led to an estimated incremental economic benefits of 1.1% GDP to the United States economy, the Analysis Group predicts the next generation of connectivity, '*gigabit broadband*,' will provide an additional 1.1% GDP.[23]

Houlin Zhao of the International Telecommunication Union (ITU) Broadband Commission describes the importance of broadband networks to global social and economic development as follows:

> "*Broadband networks offer perhaps the greatest opportunity we have ever had to make rapid and solid advances in global social and economic development – across all*

[21] Smith, Steve; *The Economic Development Benefits of Broadband; Broadband Communities;* Broadband Communities Magazine; 2017-05/06.

[22] *Socioeconomic Effects of Broadband Speed;* Ericsson, Arthur D. Little, and Chalmers University of Technology; 2013-09.

[23] Sosa, David; *Early Evidence Suggest Gigabit Broadband Drives GDP*; Analysis Group.

sectors, including healthcare, education, new job opportunities, transportation, agriculture, trade and government services. In the twenty-first century, broadband networks therefore need to be considered as basic critical infrastructure, like roads, railways, water and power networks." [24]

4.2 Wealth Creation and the Knowledge-based Economy

For the third time in history, society's system of wealth is changing. In knowledge-based economies, wealth creation is largely independent of place, local resources, and physical assets compared to the previous industrial era where wealth was based on significant physical resources, access to raw materials, manpower, and efficient transportation. Wealth now arises from human ingenuity, intellectual property, and novel business models. With growth and development timeframes in the new economy largely unconstrained by the building of physical infrastructure and the movement of goods and services, knowledge-based businesses often grow exponentially. For example, Instagram, a social networking application (app) developed for sharing photos and videos from a smartphone, was developed in 18 months by 13 people. On April 9, 2012, the company was sold to Facebook for $1 billion US. Noteworthy is that those 13 people could have been located anywhere Internet access was available (and not necessarily in the same physical location). Also, with the availability of cloud computing resources such as Amazon Web Services (AWS), no local server farms were required and the service could be rapidly scaled globally. Instagram could have been developed in any community within the northern Alberta study area. There may be more to be gained from nurturing entrepreneurs than in creating traditional employment.

The presence of high-speed broadband in a community enables it to think globally. Remote work is one of the most immediate and obvious benefits – residents can be employed with companies in distant cities, and therefore, creating new opportunities beyond the reach of the local economic base. As well residents can remotely acquire the skills necessary to participate in the knowledge-based economy. Light manufacturers and specialty retailers even in small towns are afforded the opportunity to connect to a global marketplace through electronic commerce, which is vital to community sustainability and growth.[25] The development of manufacturing and retail economies are possible in more rural settings. High-speed, reliable broadband is a significant enabler for small businesses participating in manufacturing and professional services sector – especially, where there is a need to move significant volumes of data such as engineering designs and high-resolution colour product images on a regular basis. For example, entrepreneurs in a rural northern Alberta community could set up a 3D printing farm implement (toy, boat, parts, etc.) manufacturing facility in an old barn or other suitable vacant building. Alternatively, car enthusiasts in the region might sign on to Local Motors[26], the maker of the first 3D-printed car, and help design cars in their spare time. For approximately $20,000 US, a small urban community could send a person with high potential to Singularity University[27] (SU) and have him/her trained in how to establish a billion-dollar business in five years. Ten years ago, this prospect would have been a joke. Today, it is not and SU is a serious institution created to support entrepreneurial initiatives in a knowledge-focused economy.

[24] Zhao, Houlin – Secretary General of the ITU and Co-Vice Chair of the Broadband Commission for Sustainable Development, ITU; 2017-08-23.

[25] Smith, Steve; *The Economic Development Benefits of Broadband; Broadband Communitie;* Broadband Communities Magazine; 2017-05/06.

[26] Local Motors; https://localmotors.com

[27] Singularity University; https://su.org

From this perspective, the correlation between a community's economic development and its local capabilities and assets will likely decrease with time. If so, then perhaps what is more important than economic development premised on a local strengths, weaknesses, opportunities, and threats (SWOT) analysis,[28] is the ability of the community to be able to recognize, utilize, and leverage the types of capabilities and opportunities that digital technologies and networks are making possible. This new reality is being harnessed by a number of municipalities in the Calgary region.

4.3 Economic

4.3.1 Economic Impacts of New Broadband Investments

Research conducted by Ericsson in collaboration with Arthur D. Little, and Chalmers University of Technology found that increased broadband speed contributes significantly to economic growth. Doubling broadband speeds for an economy can add 0.3% to GDP growth.[29] The benefits of faster broadband can have both economic (e.g., increased innovation and productivity in business) and social effects, (e.g., better access to services and improved healthcare).

The study's authors further categorized the economic and social effects over three different timeframes: short-, medium-, and long-term (Figure 17). In the short-term, direct effects such as changes in employment, economic production, and behavior are generated during the course of the deployment of new infrastructure and rise GDP. In the medium-term, indirect effects are apparent. Examples of indirect benefits include cost savings, cost avoidance, productivity gains, and incremental economic activity. The third category, termed '*induced effects*', occurs over the long-term and include transformative impacts on the economy such as the introduction of new industries/industry clusters or new ways of working.

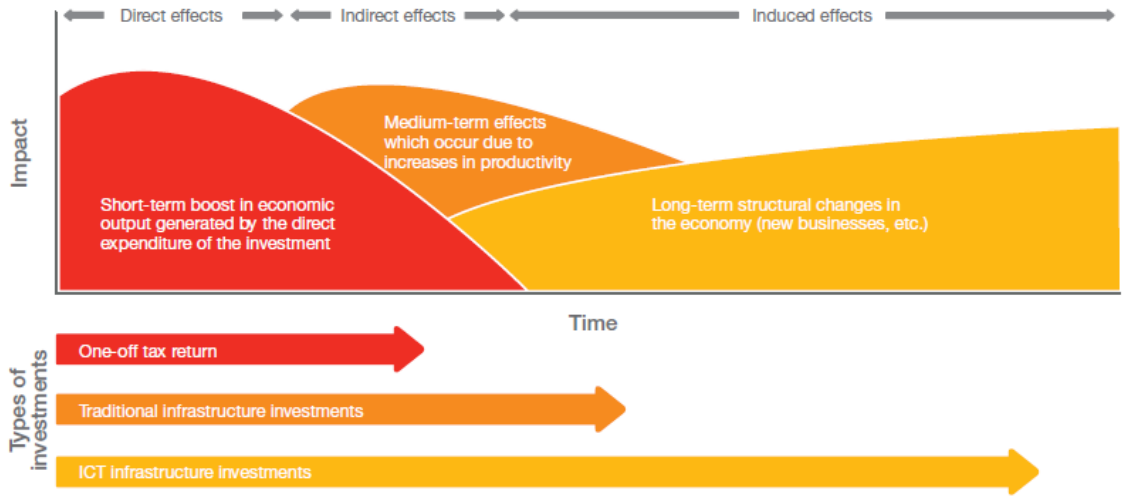

Figure 17 – Economic impacts of broadband speed upgrades over time.

[28] A SWOT analysis is a traditional business tool that first evaluates one's internal strengths and weaknesses and then uses the results as context and in addition to an analysis of its external strategic environment to identify its opportunities and threats. Ideally, the one's strategy would build on its strengths to exploit opportunities, counter threats, and resolve weaknesses.

[29] *Socioeconomic Effects of Broadband Speed;* Ericsson, Arthur D. Little, and Chalmers University of Technology; 2013-09.

4.3.2 Digital Adoption and its Impact on GDP

Canadians require more bandwidth for activities that require high-speed (such as telecommuting, telehealth, and videoconferencing), above-the-network services (such as cloud storage of digital files) and as more devices become Internet-enabled. Examples of important telecommunication services needed to participate in the digital economy include the following: telehealth, distance-learning, e-commerce, software and video game development, photo and video sharing, data analysis sharing and processing, telepresence robots for remote working and virtual tourism, and contributing to global work and research projects using shared software, and open network technologies and topologies. [30]

A study by the McKinsey Global Institute (MGI) estimated the potential impact the adoption of digital technologies could yet make on business productivity in various economic sectors – see Figure 18. [31]

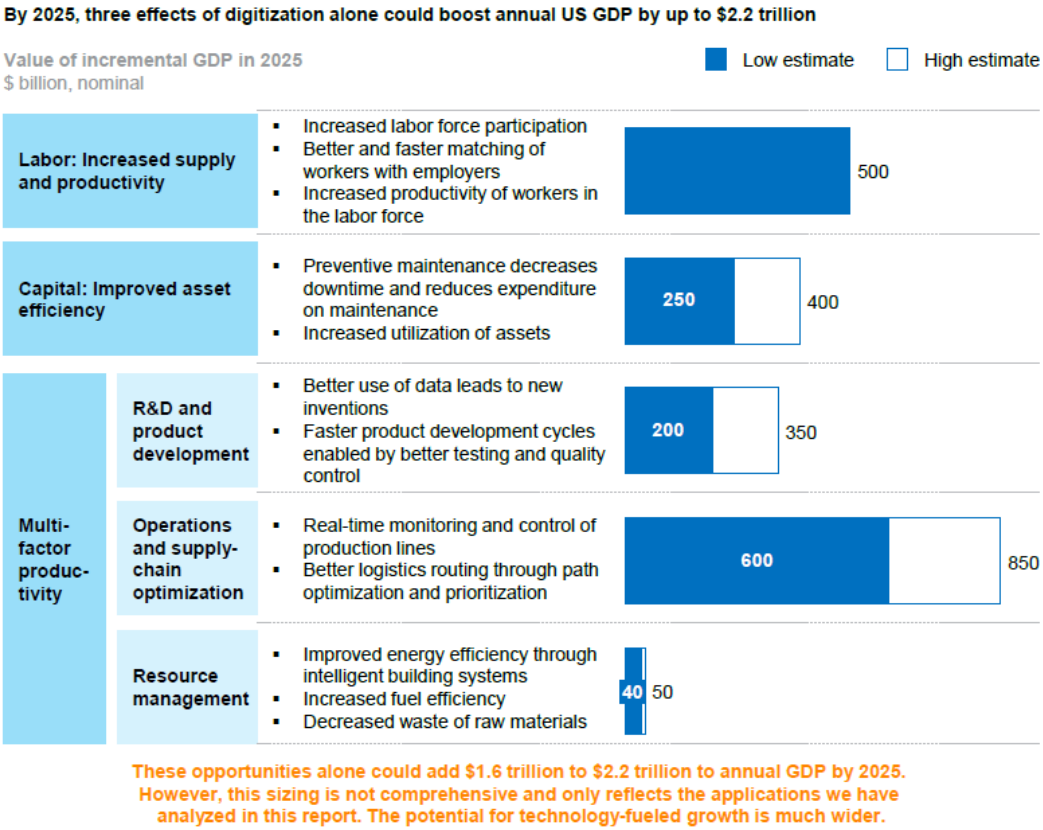

Figure 18 – Industry digitization & growth of annual GDP in the United States by 2025.

Examples include decreasing the costs of service delivery for education, healthcare, land and resource management, and many other sectors. Digital technologies also enable the virtual workplace – where a company can work with employees from anywhere and, equally important, enables local residents to freelance (instead of being employed by a particular company) and market their capabilities globally. The MGI study identified three effects of digitization and estimated that these three effects would be capable of boosting US GDP by up to $2.2 trillion by 2025. Scaling MGI's estimates to Canada, Taylor Warwick Consulting Limited estimated the potential impact of a wider adoption of digital technologies by Canadian

[30] Submission to Review of Basic Telecommunications Services; CRTC Telecom Notice of Consultation 2015-134; Cybera.

[31] Manyika, James, et al; *Digital America: A Tale of the Haves and Have-Mores;* McKinsey Global Institute; 2015-12.

industry could boost Canadian GDP by up to CAD$330 billion dollars. Assuming Canadian impacts to be 10% of those in the US, but 2025, three effects of digitization alone could boost Canadian GDP by $330 billion.

Over the past 200 years, automation has eliminated 99% of the farming jobs.[32] Advancing technology, however, has created far more jobs than it displaced and, as a result, society as a whole has moved forward. With the maturing of many digital related technologies, society is at the cusp of a profoundly new era and an era in which the possibilities are limited only by our imaginations.

4.3.3 Agriculture

While there are many futuristic videos available to highlight the potential of high-speed broadband for agriculture, a more currently grounded view can be viewed at the following website:

https://www.youtube.com/watch?v=Fr29UKzm2CI, starting at 1:48.

A growing global population coupled with the expectation that climate change will make food harder to produce, the agriculture industry is at the cusp of a new industrial revolution.[33] According to the United Nations, global agricultural output will need to increase by as much as 70% by the year 2050.[34] Globally, this challenge has been recognized. For example, the central theme of EXPO 2015 was *Feed the Planet, Energy for Life*. Each participating country was asked to examine its own position and offer solutions regarding the major challenges related to the future of food. To feed the forecasted population levels identified to the right (i.e., 9.7 billion), the agriculture industry will need to increase efficiency in growing food or increase the acreage allocated to food production and the landbase for agriculture is shrinking.[35] Farmers are also looking for ways to farm more precisely and profitably. The same technology that's propelled growth in other industries, such as robotics and data analytics, hold the promise of producing more food on less land.

[32] Friedman, T.; Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations; Farrar, Straus and Giroux; 2016-11-22.

[33] Tunney, Catharine; *To Take Advantage of Coming Agriculture 'Revolution' Canada Needs Investment, Says Expert*; CBC News; 2017-02-18.

[34] Penn, J. B. – Chief Economist, John Deere; *Agriculture's Past, Present and Future*; John Deere Journal; 2016-03-31. https://johndeerejournal.com/2016/03/agricultures-past-present-and-future/

[35] Mark, Tyler, Whitacre, Brian, and Griffin, Terry; *Assessing the Value of Broadband Connectivity for Big Data and Telematics: Technical Efficiency*; selected paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting Atlanta, Georgia; 2015-01-31 to 02-03.

Technological Change and Advancement

Farmers initially adopted the Internet to access discussion forums, social media, commodity prices, weather forecasts, and shop for parts. Recent advancements in wireless capabilities allowing farmers to wirelessly evaluate irrigation systems, weather stations, field equipment, and employees. Those making the most of broadband connectivity are transferring data between a variety of strategically located sensors on the farm and cloud-based storage, pushing prescriptions to applicators, and monitoring real-time alert systems for immediate pest threats.[36]

It is interesting to note that in Statistics Canada's most recent census, the 2016 Census of Agriculture, agricultural operators were queried about their use of emerging digital devices, including those associated with Precision Agriculture (PA) as well as those devices that require wireless and wireline technologies.[37] The Appendix 13.1 provides the Statistics Canada applications and technologies usage data for northern Alberta producers. For farm management, 52% of farms in the region are using computers or laptops while 42% reported using smartphones or tablets.

What is changing is the connectivity of agricultural equipment and the variety of sensors providing raw data to cloud-based analytics services. This is evident at the farms in southwestern Ontario, where wireless devices and technologies feed data from multiple access points on the farm, such as the residence, barn, and fields, to cloud services. Figure 19 – The Connected Farm, provides a schematic diagram of the various data transmission paths. Accessing cloud services will only be possible (or at least work more effectively) when fibre comes closer to the rural areas/farms or when more advanced wireless technologies become available. The cloud will support farmers with other technologies and services such as decision support services. In addition to farmers, the data and analytics can be sent to analysts and others with access rights. New lines of business, businesses, and jobs are being created, often by intermediaries (i.e., information or data brokers). As more data is re-purposed and sold, agriculture product and food value chains are becoming more heavily data driven.[38] A recent study of field crop producers in southwestern Ontario found that the three access points mentioned above compete for bandwidth and as a result some businesses are subscribing to more than one service provider to ensure mobility and reliability.[39] It should be noted that most PA data needs to be uploaded rather than downloaded.[40]

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[36] Mark, Tyler, Whitacre, Brian, and Griffin, Terry; *Assessing the Value of Broadband Connectivity for Big Data and Telematics: Technical Efficiency*; selected paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting Atlanta, Georgia; 2015-01-31 to 02-03.

[37] Hambly, Helen; *Release of 2016 Census of Agriculture – Relevance to Rural Broadband in Ontario*; Rural and Remote Broadband (R2B2) Project blog; 2017-05-12.

[38] Hambly, Helen – R2B2 Project Lead and Associate Professor, University of Guelph; Telephone Interview; 2017-04-12.

[39] *Role of Broadband Internet Access in the Adoption of Precision Agriculture Applications;* Executive Summary, Draft Report; R2B2 Project.

[40] Mark, Tyler and Griffin, Terry; *Defining the Barriers to Telematics for Precision Agriculture: Connectivity Supply and Demand;* selected paper prepared for presentation at the Southern Agricultural Economics Association's 2016 Annual Meeting, San Antonio, Texas; 2016-02-06/09.

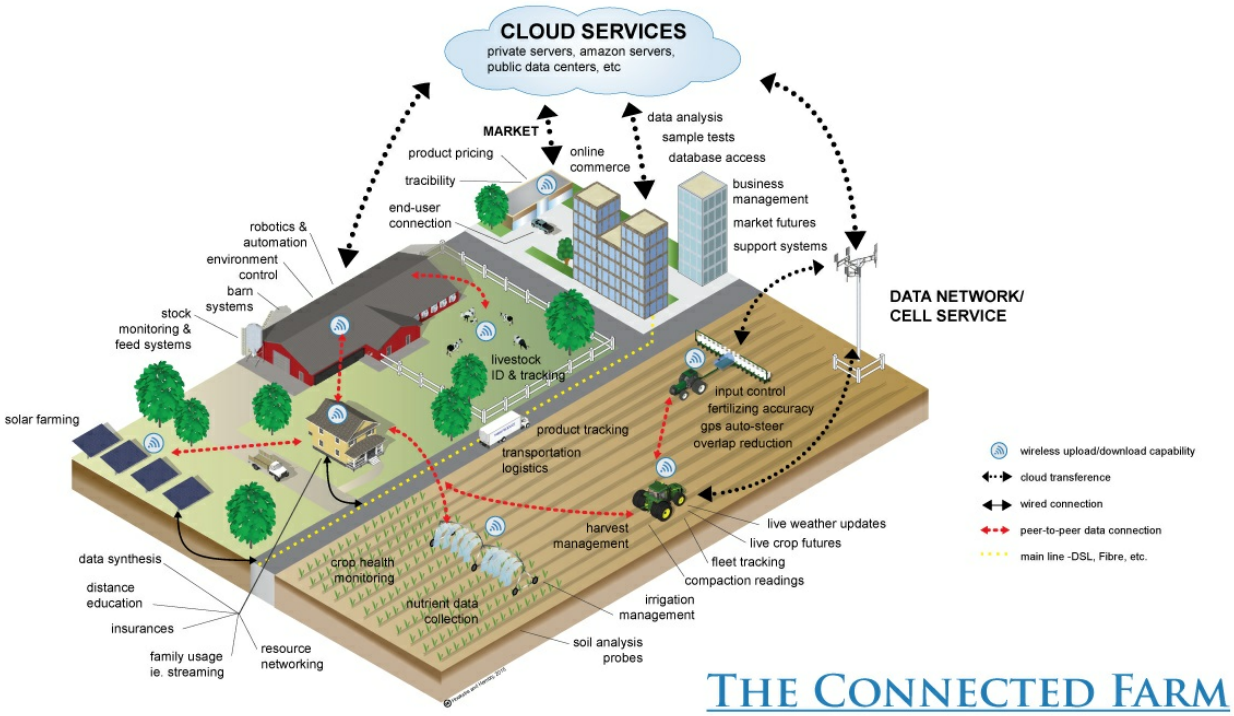


Figure 19 – Next generation farms and rural communities.

Trimble, provider of advanced location-based solutions that help various industry sectors maximize productivity and enhance profitability using core technologies in positioning, modeling, connectivity, and data analytics, identified the following trends in agriculture technology (Figure 20).

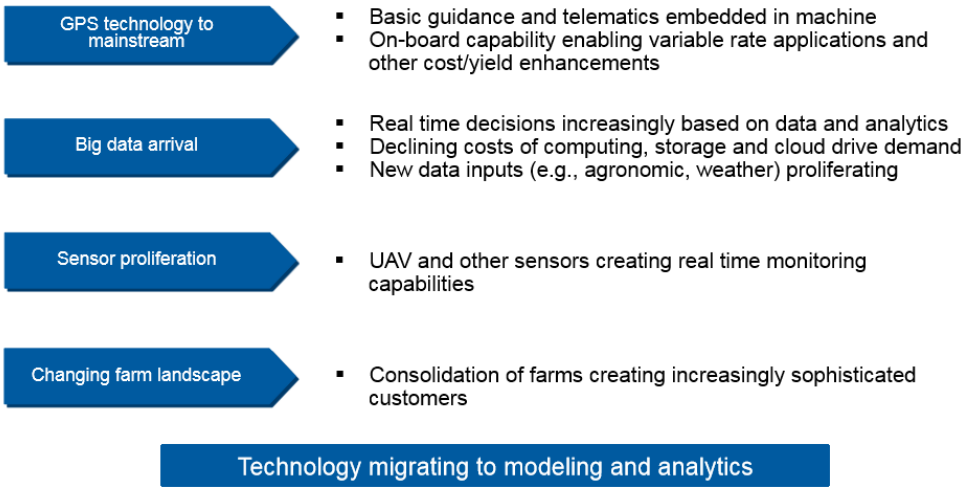


Figure 20 – Trends in agriculture technology.

Patchy rural wireless and broadband coverage is a barrier to the adoption of PA as shown in Table 9.[41]

[41] *Towards Smart Farming, Agriculture Embracing the IoT Vision*; Beecham Research Ltd.

Table 9 – Adoption of Precision Agriculture - Technology Drivers and Barriers

Drivers	Barriers
• M2M-based monitoring and tracking becoming more mainstream across industries • Reducing costs of sensors, connectivity • Improving data management technologies to manage tidal wave of M2M data • Farmers becoming more familiar with everyday IT use	• Rural wireless and broadband coverage patchy • Standards for sensor networks and data communications still under development • Specialist agricultural software still maturing • Uncertainty as to how to treat and safeguard data

Quantifying the Indirect Benefits of High Speed Broadband to Agriculture

Quantifying the value of high-speed broadband to the agriculture industry, specifically the level of efficiency that can be created at the farm level, is not an easy task. Agricultural economists Tyler Mark, Brian Whitacre, and Terry Griffin, used simulation data and envelopment analysis to assess the increase in efficiency and net producer income for grain producers who would be able to fully implement telematics - made possible by broadband connectivity. They found that if producers were able to adopt PA technology along the continuum to data and data use (i.e., Big Data), average net farm income would increase by 9.8%.[42]

4.4 Social

4.4.1 Connected Communities

To quote Thomas Friedman: *More people than ever can now compete and collaborate on more things, for less money, with more ease and equality than ever before*.

4.4.2 Education

Olds College is prime example of how the benefits of gigabit networking can be leveraged in an educational environment. An overview is available in the video produced for the College's 100th anniversary:[43]

https://www.youtube.com/watch?v=55iJvk57nrQ&list=PL-Ua1K2KRZdmaXPlqEv-Is1c51ykrib3l&index=4

Robust, reliable broadband is a necessity for achieving excellence in 21st century learning - information, media, and technology skills have become the foundation for learning. Equitable broadband access means that all students have the same learning opportunity regardless of where they live.[44]

In Alberta, K-12 and advanced education learning environments are adopting cloud-based computing and service delivery (e.g., Google Cloud, Microsoft Office 365, and other cloud-based providers).[45] Cloud-

[42] Mark, Tyler, Whitacre, Brian, and Griffin, Terry; *Assessing the Value of Broadband Connectivity for Big Data and Telematics: Technical Efficiency*; selected paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting Atlanta, Georgia; 2015-01-31 to 02-03.

[43] Olds College; *iPad Integration*; YouTube; 2013-02-22.

[44] Ontario; *2017-18 Education Funding Engagement Guide*; Ministry of Education.

[45] Luedtke, Ralph – Senior Manager, Education Technology and Hauschildt, Dave – Education Manager, Technology Leadership Branch, Field Services Sector, Alberta Education; Telephone Conversation; 2017-05-04; Sokolowski;

based services require broadband connections. Figure 21 shows the evolution of broadband in a typical K-12 educational system – basic connectivity needs give way to more advanced and scalable connectivity needs.[46]

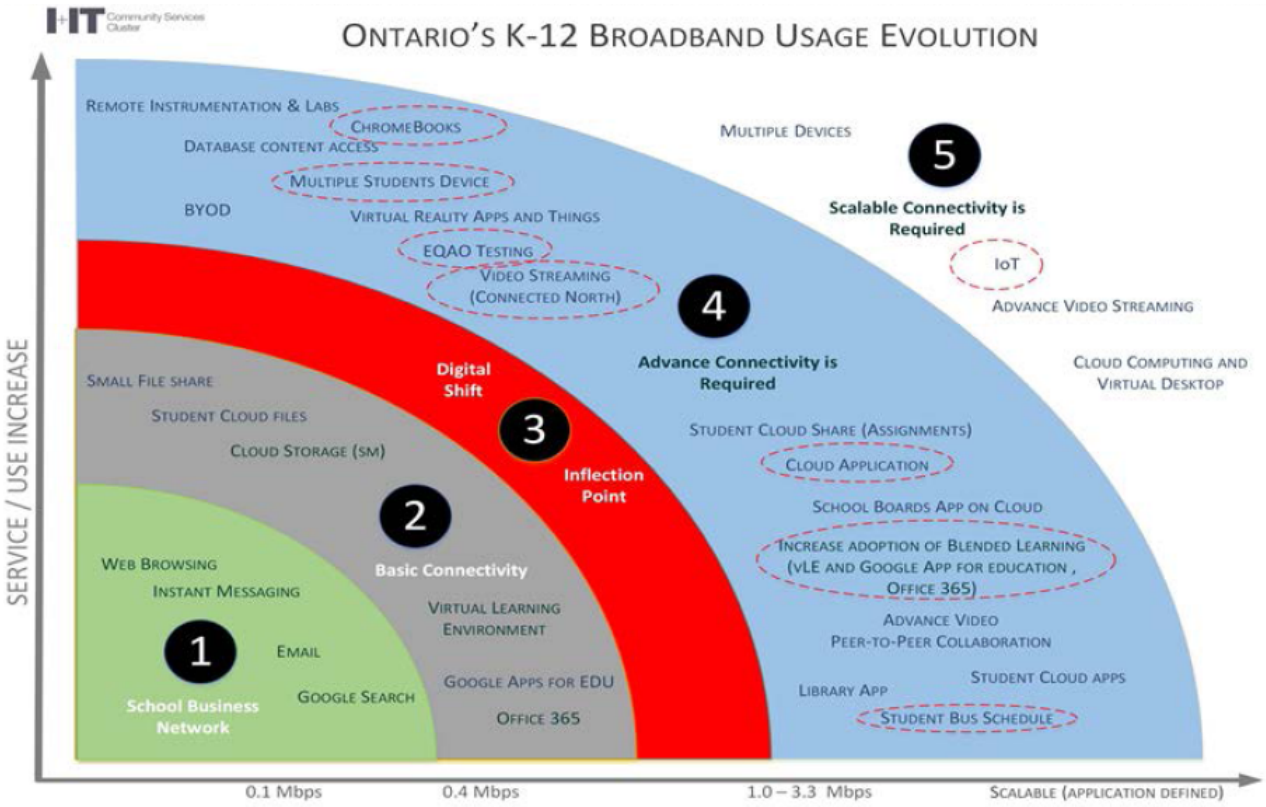


Figure 21 – Evolution of broadband in K-12 schools.

Today in Alberta, web-based products, such as Google G Suite,[47] are being used by school communities for such things as word processing and document storage (i.e., stage 2 in the figure above). Even the Stage 2 advancements of this increasingly complex array of technology solutions and tools is very reliant upon adequate Internet connections for students, parents, teachers, and administrators in schools and at home.

Improving equity in education is a high priority for Tallcree First Nation's Chief – it is his goal and his ambition.[48] Located in remote northeastern Alberta, education and employment opportunities are limited.

To compete in today's economy, you must have a skilled workforce with specialized training. The education attainment levels among Indigenous (First Nation, Métis, and Inuit) people are lower than non-

Carol – Director, External Stakeholder Relations, Information and Technology Management Sector, Alberta Advanced Education; Telephone Conversation; 2017-05-09.

[46] Education Funding Engagement – Digital Education presentation; Ontario; 2016-11-10.

[47] Google G Suite is a set of intelligent apps including Gmail, Docs, Drive, and Calendar.

[48] Cardinal, Mike – Band Manager, Tallcree First Nation; Telephone conversation; 2017-04-13.

indigenous people. The graph on the left side of Figure 22 indicates that 29% of Indigenous people in Canada did not attain a certificate, diploma, or degree while 13% of non-Indigenous people did.[49] Data specific to Alberta was not available from Statistics Canada.

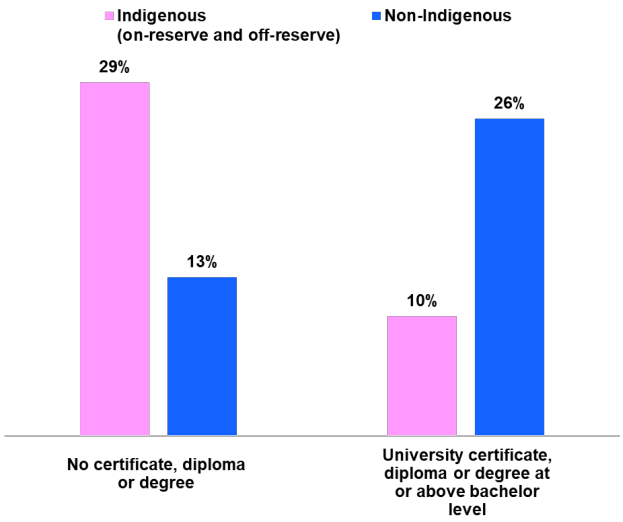


Figure 22 – Comparison of education attainment levels – indigenous verses non-indigenous.

The Tallcree First Nation is interested in providing more educational opportunities for its people (which will lead to more employment opportunities). They are redesigning and implementing a new curriculum and training opportunities, which will be based on communication with post-secondary institutions using videoconferencing and platforms such as Skype and Facetime. They need to confidently know that their system is capable of the required bandwidth and streaming. After distance learning with the Northern Alberta Institute of Technology (NAIT) failed due to inadequate Internet bandwidth, Tallcree First Nation and NAIT collaborated on a pilot program, involving NAIT deploying mobile education units to the Tallcree reserves in the High Level area for trade-related training (e.g., electrical, millwright).

The use of learning management systems is proliferating in Alberta.[50] These software applications support administration, documentation, tracking, reporting, and delivery of educational courses or training programs. In some cases, access is made available for parents to review a student's assignments, progress, or other content and provide feedback. Enabled by technology, teaching and learning is moving away from '*point-in-time-assessment'* to a more continual assessment of learning. It is estimated that 80% of the districts in Alberta's K-12 system is moving towards some degree of Google-based platform. Google developed a blended learning platform, Google Classroom, for schools that aims to simplify creating, distributing, and grading assignments in a paperless way. It was introduced as a feature of G Suite for Education 2014.

For students, high-speed broadband can offer a higher level of authenticity as they gain access to '*real-world'* audiences for collaboration or feedback.

[49] *Distribution of the population aged 25 to 64 (total and with Aboriginal identity), by sex and highest certificate, diploma or degree* – Table 477-0096; Statistics Canada; 2011.

[50] Luedtke, Ralph – Senior Manager, Education Technology and Hauschildt, Dave – Education Manager, Technology Leadership Branch, Field Services Sector, Alberta Education; Telephone Conversation; 2017-05-04.

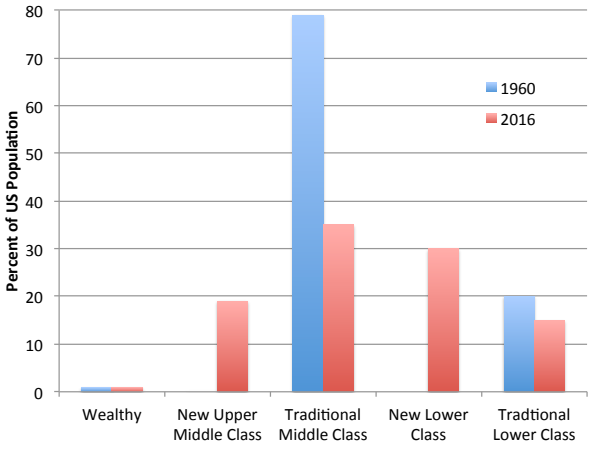
4.4.3 Entrepreneurship

Three generations ago, for example, the opportunity was to electrify everything (i.e., take manual product X (say, a manual pump), add electricity, and obtain new, enhanced, and more valuable product Y (electrical pump)). Now, the opportunity is to add intelligence to everything (i.e., take dump product X (laundry), add intelligence, and obtain a new, enhanced, and more valuable product Y (clothes that tell a washing machine how to wash them)).[51] Likewise for many other services:

- Medical: after winning Jeopardy in 2011, Watson was repurposed to do medical diagnoses. It has since moved to the cloud and variations are being developed to provide the services to medical practitioners world-wide;[52]
- Stock Portfolios: manage stock indices and currency exchanges to optimize and balance portfolios in real time vs once a year;
- Real Estate: match buyers and sellers and suggest optimal financing packages; and
- Project Management: take into account change orders, weather, traffic, currency exchange rates, and so on.
- Law: sift through mountains of evidence and legal arguments and suggest lines of defense.

4.4.4 Employment

Within this changing environment, the days of good, stable, middle-class jobs and the age-old advice, '*go to college, get a job, get married, buy a house, raise kids, and retire on a good pension*' are over. Of the jobs left, one in three will be converted to software, robots, and smart machines within eight years, half will be susceptible within 20 years, and both high and low skilled members of the workforce will be affected.[53] To thrive, it's becoming more about '*go create a job*' than the traditional '*go find a job*'.[54]



All the tools one needs are online – help' computing, and storage resources are available at scale and are virtually free – all you need is a capable network. A small sampling of the resources available in key categories appears in Table 10 below. All you need is a capable fibre network to support the digital traffic.

Table 10 – Online Resources

Computing Resources	Intelligence on demand	https://www.ibm.com/communities/analytics/watson-analytics/
	Unlimited computing power	https://aws.amazon.com/ec2/
	Quantum computing	https://aws.amazon.com/ec2/

[51] Kelly, Kevin; The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future; Penguin; 2016-06-07.

[52] Watson has also been made available as a general purpose artificial intelligence (AI) engine that can be harnessed by going to: https://www.ibm.com/communities/analytics/watson-analytics/

[53] *The Americans We've Left Behind;* Trends Magazine; 2016-03.

[54] Friedman, Thomas L.; Thank you for Being Late; Farrar, Strauss, and Giroux; 2016-11-22.

Education	Tailoring skills to employment requirements	https://www.coursera.org https://www.khanacademy.org
Employment / Hiring	Contingent work	https://www.freelancer.com/
	Matching individuals to traditional jobs	http://www.careerbuilder.ca https://www.linkedin.com https://www.monster.ca
Product Development	Design	https://99designs.ca
	Invention platform	https://www.quirky.com
Venture Funds		https://grow.indiegogo.com https://www.kickstarter.com

4.4.5 Healthcare

Need for Productivity Improvements in Healthcare

In 2016, Canada's total health expenditures reached an estimated $228.1 billion—representing 11.1 per cent of total GDP or $6,299 per Canadian. Despite the recent slowdown in health spending growth, Canada's looming baby-boom bulge is likely to have a major impact on health and social service demand and expenditures.[55]

As future health care funding is estimated to consume between 44% and 55% of provincial and territorial revenues, there are concerns that without additional strategic funding, Canada's provinces and territories will need to find substantial annual productivity improvements to maintain the health care spending and service levels.[52]

Alberta is moving towards community-based care, which includes shifting from a focus on hospitals and facilities to more community-based care closer to home, planning and structuring health care around people and their community, and enabling Albertans to be active partners in their own health.[56]

Health system capacity in rural and remote areas

There is a need for trained healthcare workers to provide continuing care and other health services if the transition of the system from '*hospital to community'* is to be successful. In professions where staff levels are sufficient, unequal distribution across Alberta remains a factor, with particular difficulty in recruiting to rural and remote areas where the planned expansion of home and community care services is most needed.[57]

The percentage of physicians practising in rural and remote areas in Alberta has decreased. Despite growth in Alberta's overall physician supply, physician access continues to be an issue in many rural and remote areas as well as in some urban areas. These trends also impact the affordability and sustainability of the health system.[58]

Digital Health Technologies

[55] Brichta, Jessica, Dinh, Thy, and Stonebridge, Carole; *A Road Map to Health System Sustainability, CASHC Compendium Report, 2011-16;* Conference Board of Canada; 2017-05.

[56] Alberta Budget 2017, Fiscal Plan 2017-20.

[57] Alberta Health Business Plan 2017-20.

[58] *Physician Resource Planning*; Alberta Health; 2017-02-14.

The following short video by Canada Health Infoway (Infoway) describes some of the digital innovations in healthcare, which assist in tackling some of the issues mentioned above:[59]

https://www.infoway-inforoute.ca/en/component/edocman/resources/videos/3068-innovation-in-health-care?Itemid=101

Infoway defines digital health technologies as telehealth and remote patient monitoring (RPM) (also know as telehomecare); drug information systems; diagnostic imaging systems; and physician office and electronic medical records (EMRs).

The Alberta SuperNet supports telehealth in Alberta. Currently this model of healthcare delivery or tool primarily uses videoconferencing technology with the equipment located at videoconference sites in the communities or in nearby communities. The evolution of this remote service would allow for '*virtual visits'*, where consultations would take place directly in the patient's home and on any device. The ability to provide virtual care has significant cost saving for providers and patients.

RPM is transforming traditional healthcare service delivery models in Canada and has the potential to improve patient outcomes through self-management and home-based care and decrease the use of health system resources. Figure 23 shows the relationship between technology complexity and patient acuity as well as the associated impact on the use the healthcare system resources, both in health resource intensity and per capita costs.[60]

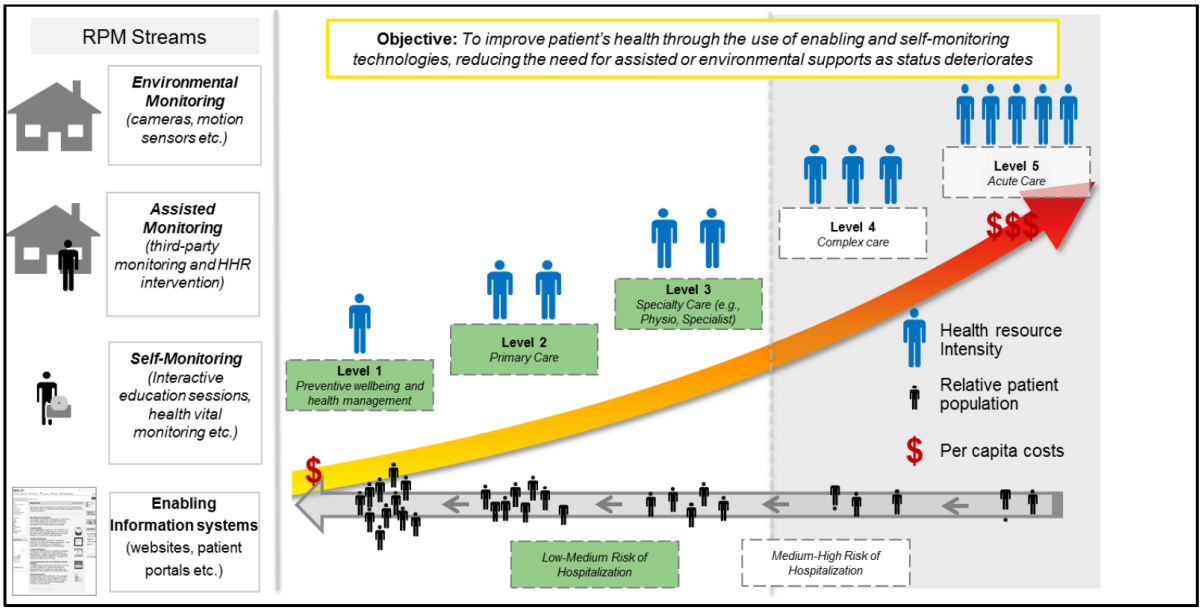


Figure 23 – Continuum of patient acuity and use of healthcare system resources.

Infoway's RPM study found evidence of the benefits shown in Table 11.[61]

[59] *Innovation in Healthcare*; Canada Health Infoway; 2017-08-28.

[60] *Connecting Patients with Providers – A Pan-Canadian Study on Remote Patient Monitoring;* Ernst & Young for Canada Health Infoway; 2014-06.

[61] *Connecting Patients with Providers – A Pan-Canadian Study on Remote Patient Monitoring;* Ernst & Young for Canada Health Infoway; 2014-06.

Table 11 – Benefits of Remote Patient Monitoring

	Benefits
Quality	▸ ↑ **Patient satisfaction** ▸ ↑ **Patient compliance** ▸ ↑ **Quality of life** ▸ Promote integrated care
Access	▸ ↓ **Caregiver burden** ▸ ↑ Access to specialists ▸ ↑ Dissemination of health data
Productivity	▸ ↓ **ED visits/hospitalizations** ▸ ↓ **Per client health $** ▸ ↓ Per client care time

The increasing adoption of the Internet of Things (IoT) technology is resulting in the convergence of mobile, social, and sensors. By integrating data collected from IoT sensors, wearables, and connected patient monitoring devices with applications such as EMR, clinical professionals can focus on leveraging that data to apply the most appropriate clinical protocols. Computer-based intelligence will also play an important role in turning data collected via IoT-enabled sensors into actionable information and insights for both patients and clinicians.[62]

Recently Infoway selected TELUS Health to be the technical solution provider for PrescribeIT, a e-prescribing service. The multi-jurisdiction e-prescribing service will promote medication safety and greater convenience and efficiency for patients and providers. Infoway describes the benefits of e-prescribing in the following video:[63]

https://www.infoway-inforoute.ca/en/component/edocman/resources/toolkits/knowing-is-better-for-clinicians/videos/3093-the-benefits-of-e-prescribing?Itemid=101

According to Canada Health Infoway, digital health technologies result in an estimated $2.5 billion in annual benefits (2015 study) for Canada. Figure 24 shows momentum building in the adoption and use of these technologies. As well it breakouts out each technologies' contribution, with telehealth and telehomecare contributed an estimated $407 million in 2015. Extrapolation of these telehealth and telehomecare data to estimate the annual benefits for 2017 resulted in $681 million. Softer benefits include improved patient quality of care, outcomes, comfort, and safety; access to specialists, timeliness, and productivity.

[62] *Vendor Spotlight – Making Digital Transformation Real for Healthcare and Life Sciences Organizations;* IDC Health Insights; 2017-01.

[63] *The Benefits of e-Prescribing*; Canada Health Infoway; 2017-08-28.

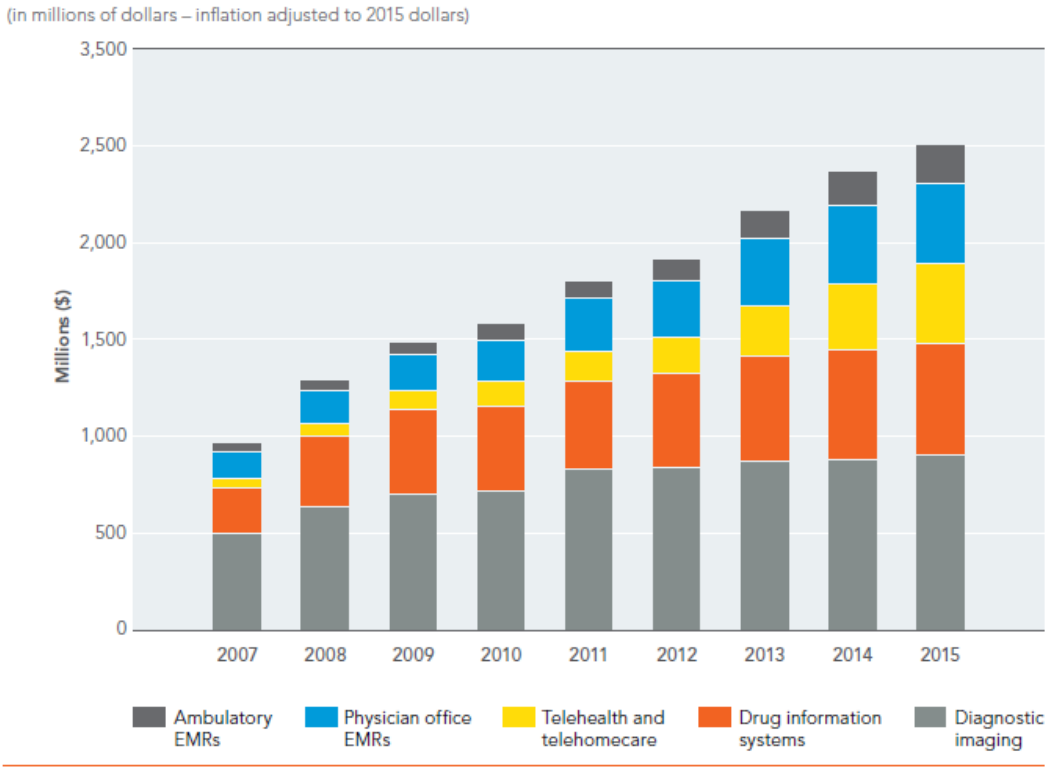


Figure 24 – Adoption and use of digital health technologies in Canada.

Quantifiable rural telehealth benefits include potentially generating local revenues for lab work and pharmacies as well as savings in travel cost, lost wages and hospital costs. These were the findings of the National Telephone Co-operatives Association (NTCA) – The Rural Broadband Association. National average estimates of annual cost savings were done on a per medical facility basis and after conversion to Canadian dollars are as follows:[64]

- Travel savings - $7,654;
- Lost wages - $4,593;
- Hospital cost savings - $27,898;
- Increased lab work revenues - $12,320 to $53,386 per type of procedure; and
- Increased local pharmacy revenues - $3,104 to $8,352, depending on the specific drug prescribed.

4.4.6 Government Delivery of Public Services

Organizations around the world are riding the digital transformation wave to drive innovation. In addition to innovation, the government sector is also looking to digital transformation to improve operational effectiveness and efficiency, often leveraging SMACi technologies. Astute governments are integrating ICT in their operations across multiple domains and jurisdictions to generate sustainable public value.[65] Figure 25 shows four key areas of focus for governments.

[64] Estimates were converted to Canadian dollars using the Bank of Canada's average exchange rate for the month of March, 2017.

[65] *Imagining the Digital Future – How Digital Themes are Transforming Companies Across Industries;* Ernst & Young; 2015-02.

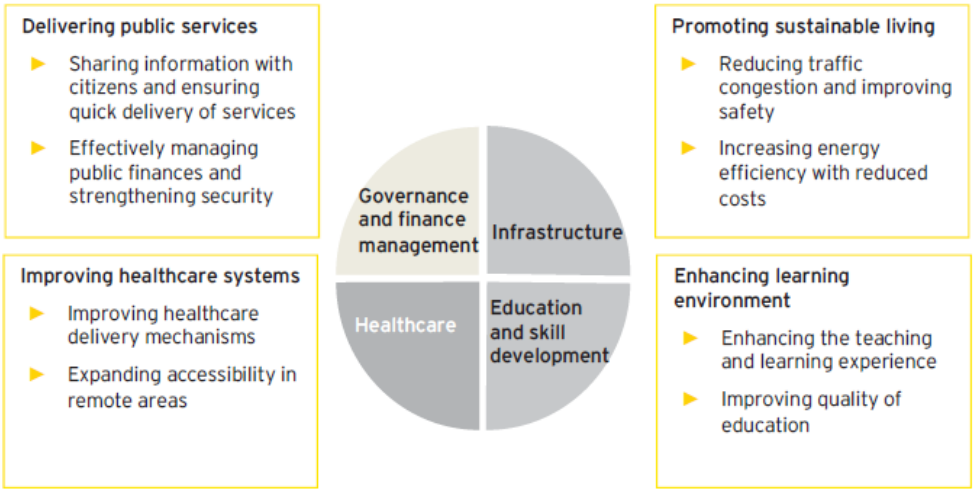


Figure 25 – Government sector – areas of digital transformation.

With advent of social media, citizens are now communicating and interacting differently than ever before with each other, the companies they do business with, and the service providers they rely on for healthcare, education, and other services. Public service delivery needs to accommodate these changes and embrace new channels and approaches. And this is why delivery is shifting away from specialized agencies and discrete services towards more streamlined, citizen-centric processes, as demonstrated in Figure 25.[66]