Learn and Work

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DALHOUSIE UNIVERSITY
FACULTY OF MANAGEMENT

reimagine NS: Learn and Work

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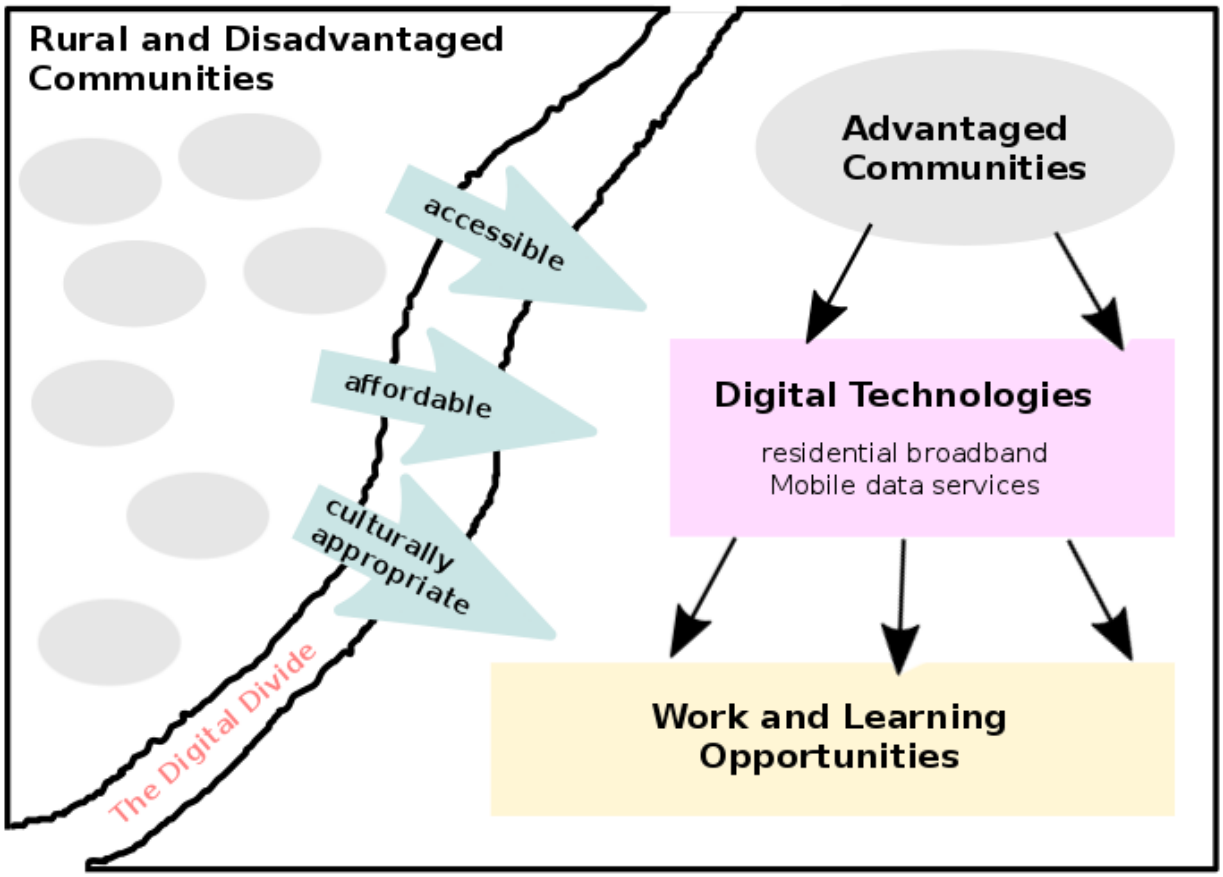
Introduction

This report considers the lessons Nova Scotia can learn in relation to big data, information management, ways of sharing information between sectors, job retraining, small and family businesses and education. We divided our focus into three sub-themes: (I) Digital Literacy and Inclusion; (II) The Digital Talent Pool; and (III) Data, Policy, Evidence.

I. Digital Literacy and Inclusion:

Among myriad social, technological and environmental changes affecting contemporary life, digitalization—the restructuring of our world around digital communication—stands out as a far-reaching change with profound consequences. During the pandemic, many realms of life have shifted online, highlighting the possibilities, but also the gaps in skills, norms and infrastructure needed to support those possibilities. Participation in the global technological revolution requires skills and knowledge across a vast digital domain. We must ensure that Nova Scotia participates and helps its citizens to participate, in an inclusive manner, creating a diverse, digital-ready citizenry and workforce.

Nova Scotian Context. To achieve the goals stated above, the province of Nova Scotia must support the development of accessible learning opportunities for diverse communities, ensure equitable distribution of the resources necessary for digital fluency and data literacy, and invest in the infrastructure required for full participation in the digital realm. The key challenges below highlight the complex intersections of access and education. Increasing access to digital technologies and increasing users' fluency with them must occur hand-in-hand because neither will succeed without the other.



Key Challenges. Key challenges include a lack of access to digital services, the need for widespread digital literacy and social inequality across the regions and populations of Nova Scotia.

Access. Access to residential broadband internet, and to modern mobile data services (including 5G), is a necessary precondition for digital literacy and inclusion. This is a problem in Nova Scotia as rural and disadvantaged communities have been left behind with regard to access to internet and data networks, significantly reducing opportunities for work and learning. Reduced access affects all kinds of people, from seniors who lost access to face-to-face banking services and who need to move their banking online, students whose classrooms include digital and remote learning expectations, self-employed and teleworkers who need a high-speed connection to work from home, to small retailers who want to use Interac for payments. Indeed, whole Nova Scotian communities with poor internet access are at a disadvantage and have found it difficult to attract and retain people and businesses.

Education. To enhance digital literacy and inclusion, the level of comfort, criticality and expertise with digital technology for all Nova Scotians must be increased. At a minimum, the following strategies should be considered:

1. Ensure universal access to broadband Internet. Asymmetric access to learning opportunities for rural and disadvantaged groups can be mitigated by the use of remote learning technologies. These strategies are now being put in place in the K-12 and post-secondary sectors as a result of COVID-19. But, they only work if access is reliable. Fast internet needs to be vastly improved in rural communities and low-income households.
2. Update the K-12 curricula for the digital world and make links to post-secondary training for digital occupations.
3. Create a demand-driven call for more digital access and fluency through increased public education and communication around the economic advantages of digitalization for the public and private sectors. Those in decision-making positions in both sectors need to focus on improving digital access and fluency.
4. Ensure universal access to practice-based remote learning environments for all educators and institutions.

Considerations

Remote learning technologies are now being used in K-12 and post-secondary institutions as a result of COVID-19. Accordingly, access to reliable and fast internet needs to be vastly improved in rural communities, low-income households, and other settings with less access and/or uptake of digital learning. Universal access is required not only in the context of the pandemic, but for any digitalization strategy. Moreover, without a concerted effort by the educational sector to create culturally appropriate pedagogical environments, many students in disadvantaged situations will not be mobilized. Localized efforts to raise the levels of digital fluency (as well as data literacy, discussed below) cannot occur in isolation but must take into account the cultural contexts of students and their communities.

Equality. Experts have long known about a digital divide between those with adequate access to digital technologies, knowledge of how to use them and high rates of adoption, and those without. Even though digitalization has been spreading for decades, access to the internet, digitally delivered learning, and digital work opportunities remain unequal. In Nova Scotia, relevant axes of inequality that impact the digital divide include age, race, rural-urban boundaries and socioeconomic status. This inequality matters for many reasons. Full participation in civic and social life depends on digital fluency and data literacy. Prospects for meaningful employment and prosperity, and the labour market development necessary for job creation and business development, are closely linked to digital literacy and access to the internet. Equality of access to learning opportunities may be achieved by the use of digital technologies to bridge the existing digital divide, provided adequate infrastructure is in place.

One prerequisite for equality of access is universal access to broadband internet. However, access does not guarantee uptake and understanding. Beyond the availability of broadband, the economic realities of being able to afford the basic tools required for a digital presence must be considered. Cultural factors such as comfort with the internet and motivation to get connected,

which may be lower in marginalized groups and communities, should also be taken into account. The same factors apply for achieving ubiquitous access to modern mobile data services, including 5G.

Research Topics. While part of the way forward is clear, there are many questions about how digitalization has unfolded in Nova Scotia and about what needs to be done to reach the goals of access, education and equality. Potential questions for future research include:

- Why is the rate of adoption of information and communications technology (ICT) lower in Nova Scotia than elsewhere?[i]
- Why has rural broadband been so slow to expand in Nova Scotia and other provinces in Canada?
- How does the Canadian telecom regulatory environment affect access?
- What can be learned about work, learning, digital fluency, data literacy and access from the COVID-19 pandemic?
- What are the best strategies to teach digital fluency and data literacy at different grade levels?

The desired outcome of radically increasing digital literacy and inclusion is to raise the productivity of the Nova Scotia economy across all sectors. This will enable Nova Scotia to participate fully in the global tech revolution. As mentioned, however, the digital divide must be eliminated. Specific outcomes should include:

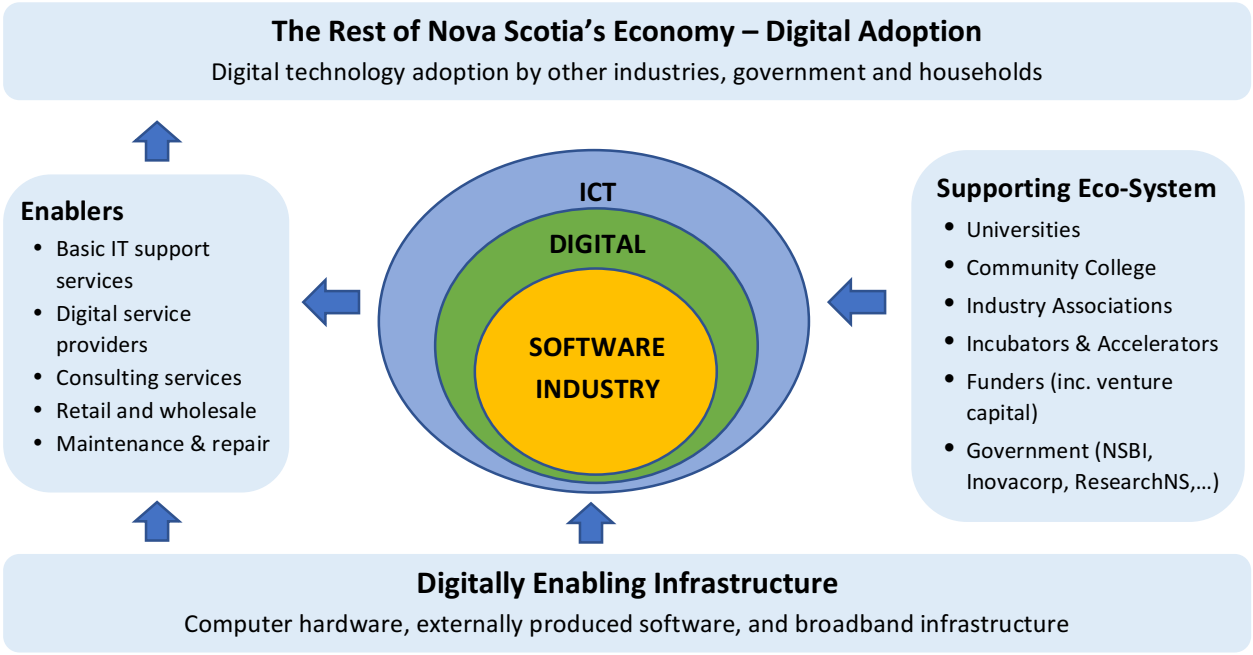
- Universal broadband Internet access for all areas of the province, with a focus on First Nations, rural areas and other disadvantaged groups. Metrics should be developed to track access on a regular basis.
- Coordination among Nova Scotia's educational institutions at all levels to deliver online content using global best practices, explore novel options, use shared governance and shared service models, increase collaborative efforts, and introduce satellite campuses, thereby delivering relevant content more broadly and economically.
- Increased use of digital information delivery technologies across all sectors of the Nova Scotia economy, increasing labour productivity, global competitiveness and economic prosperity in the province.
- Increased supply of qualified digital workers. The Nova Scotia economy is hampered by a chronic labour shortage of software developers, digital engineers, user interface designers, data scientists and similar occupations. We must make changes to the educational environment to produce workers with in-demand skills.

II. The Digital Talent Pool

Digital skills are now integral to every industry's future. Digital transformation, the integration of digital technology into all areas of a business, is fundamentally changing how industries operate and deliver value to their customers. A tectonic shift occurred with COVID-19, which

pushed the clock forward on widespread digital transformation that might otherwise have taken years to occur. Large companies across industries had to rapidly learn to operate in entirely new ways with distributed workforces working from home. They have discovered there is much in this transformation they want to keep.[ii] Small and medium-sized enterprises (SMEs) have shifted business models and changed how they deliver their goods and services. Through rapid ad hoc adoption of digital technologies, much of the economy stumbled and shifted but did not freeze or cease to operate. It is now clearer than ever that digital transformation is at the heart of our economic future.

The Nova Scotian Context. To improve the economic future of Nova Scotia we should strive to dramatically increase the size of Nova Scotia's digital talent pool as this is the key to driving wider digital adoption and transformation in the economy. According to the Government of Canada, ICT is a $184-billion industry with 623,000 workers employed at over 40,000 companies in Canada.[iii]



Adapted from Figure 1 APEC report

At the heart of the ICT industry are digital technology firms that create and provide proprietary digital technology. Included in this category are firms in other industries, such as large manufacturing or oceans firms that have their own specialized IT divisions creating digital solutions for their businesses. These firms are driven in turn by the software industry, which specializes in the design and implementation of software products and services.

In the recent Atlantic Provinces Economic Council's report, "Digital Technology Firms: Their Importance and Role in Atlantic Canada's Economy" (APEC),[i] it was estimated that Nova Scotian digital technology firms had revenues that totaled $2.5 billion in 2017 and increased by 7.1% per year between 2014 and 2017, well above the national rate of 5%. APEC identified 237

digital technology firms and 18,800 people in digital technology occupations. Nova Scotia's per capita rate of Computer Science graduates is the highest in Atlantic Canada, and above the national average, with 689 students graduating from ICT-related programs in 2017. Nova Scotian exports of digital products in 2017 was valued at $1.6 billion and represented Atlantic Canada's third largest export behind oil and lobster.

Key Challenges. The APEC report highlights the need to address the following three key challenges:

1. **The digital talent shortage:** A digital talent shortage was identified as the number one challenge for digital firms, with over half of firms surveyed having difficulty finding software developers. The highest rates of growth are expected for software engineers and designers (3.2% per year) and computer programmers and developers (2.8%). The Information and Communications Technology Council estimated that Atlantic Canada's ICT industry would require around 6,900 new employees between 2017 and 2021.
2. **Larger digital firms are needed:** Nova Scotia has anchor digital technology firms including IBM, Salesforce, NTT Data and CGI, which have helped establish the province as Canada's leading software outsourcing hub.[iv] They employ and train a large share of the local digital workforce and are critical to the digital ecosystem. Together with international consulting firms like EY, Deloitte and KPMG, many of which have established national centres for data analytics in Nova Scotia, they are drawn to the province by the talent pool and the relatively low cost of doing business. These larger firms, which are central to building the critical mass required for a thriving digital economy, are both attracted by and dependent on a large, high-quality digital talent pool. But their needs are growing faster than our supply of labour.
3. **Low digital adoption rates by all firms**: Weak technology adoption poses a risk to our future growth and competitiveness. Nova Scotian firms trail in the adoption of both foundational digital tools (cloud/web services, automation) and key emerging digital technologies (business intelligence, the Internet of Things (IoT), security and advanced authentication and Artificial ntelligence (AI)). Low digital adoption rates can, in large part, be traced to the need for more digital talent. However, rather than a need for core software engineers, the firms need upskilling and retraining in the workforce so they are equipped to harness the recent explosion in web-based software services that are fundamentally changing how firms, especially SMEs, operate and deliver value to their customers.

Considerations

All roads lead back to the need to radically expand the digital talent pool. Growing the pool of software engineers is key to solidifying Nova Scotia's place as Canada's leading software outsourcing hub. It is what drives the local digital industries, much of the startup and innovation ecosystem, and the growth and attraction of larger digital firms. Expanding digital

skills in the broader labour force, together with a vibrant digital and start-up ecosystem, is key to improving digital technology adoption rates by all firms and to driving the widespread digital transformation that is at the heart of our economic future.

Transformation as a result of COVID-19. In some respects, COVID-19 has merely reaffirmed many of the fundamental labour market challenges facing Nova Scotia and the need to widen and deepen the talent pool of digital skills across all sectors. Yet the global pandemic has altered some of the contours of such challenges in important ways, bringing heightened urgency as the digitization of our society is being greatly accelerated on the one hand, while a significant social and economic disruption unfolds on the other.

Digital skills and digital talent have already emerged as important drivers of economic transformation across Atlantic Canada, as witnessed by the growing number of technology-based companies both large and small. The creation and nurturing of SMEs with a digital focus is especially impressive and indicative of the sort of economic transformation called for in the Ivany Report.[v]

At the same time, COVID-19 accelerated the use of digital skills and platforms by companies across all industries, as necessitated by the shifting realities of pandemic responses, notably stay-at-home orders and social distancing. Online service delivery, virtual workspaces, digital payment systems and other aspects of creating and operating businesses have suddenly become the new norm for thousands of Nova Scotia companies struggling and adapting in order to survive.

The urgent uptake of online service delivery channels and remote working arrangements is also transforming the public sector and accelerating the shift to digital government. Such a shift requires an expansion of digital skills within governments and across industry partners, and an expansion of digital literacy across communities and the public at large. Even before COVID-19, the Provincial Government and many municipalities were struggling to recruit and retain specialized workers in information technology and related fields, such as user design and agile software management. Emerging areas such as cloud computing and AI are likely to intensify such pressures as workers with these skill sets are clustered predominantly in Canada's largest cities.

A similar dynamic exists in civil society and especially in the creative arts community where digital innovations have become the lifeblood of content creators seeking to learn, share, create, promote and perform. Expanding this creative sector was underscored as a priority by the Ivany Report and it is one that takes on new urgency in light of the unfolding economic crisis that will invariably impact this burgeoning, though precarious, sector.

A continuum of "digital" skills. A recent study of emerging trends in skills development undertaken for Dalhousie University found that in today's increasingly digital world—even before the pandemic—the notion of "digital" skills was increasingly porous and encompassing of many different types of skills that have a digital component to them. The study presented

"digital" skills as broader than technical skills related to technology, and as a combination of hard, soft and process skills.[vi] Hard digital skills are tangible and technical skills that interact directly with digital systems and services, soft digital skills include emotional and attitudinal competencies and process skills include providing insights for data mapping, understanding complexity and supporting and steering decision-making systems, governance design and organizational change.

The digital transformation that has been accelerated by COVID-19 necessitates a significant expansion of the digital talent pool across each of these realms—rather than addressing digital skills as purely or even primarily a technically specialized (or hard sciences) field. The resulting challenge for educators is to craft holistic strategies for this emerging digital skills ecosystem that embraces cross-disciplinary thinking and integrative skill sets across these interrelated realms. As the Ivany Report observes, whether a company or a cooperative, the essential challenge is to facilitate an expansion of growth opportunities. And as the pandemic accelerates digital transformation, a more systemic and integrative approach to digital skills development is essential.

Organizations must also facilitate access to learning and development opportunities for employees, and rethink traditional training and development models in light of interdisciplinary needs, virtual training and blended learning models. Recent global studies have suggested that most digital workers view the efforts of their employers in this regard as deficient, a theme of a 2017 survey undertaken by the Capgemini Digital Transformation Institute:

> *More than half of today's digital talent say that training programs are not helpful or that they are not given time to attend. Close to half actually describe the training as 'useless and boring.' Nearly 60% of digital talent are even investing their own time and money, most commonly to be on a par with their colleagues on the required digital skills.*[vii]

Across society at large, skills gaps are even more pronounced. For instance, one UK study undertaken in 2019 found that over five million people had "zero basic digital skills" and a further one million adults had "just basic abilities."[viii] Additional research by Lloyds Bank found that nearly 12 million people "do not have the essential digital skills needed for life in the UK."[ix] Such findings are likely to find proportional resonance in Nova Scotia as well. Building on the foundations of full-time educational studies at all levels, there is an especially important challenge for lifelong learning initiatives that seek to facilitate learning and expansion of digital skill sets across cadres of employees and entrepreneurs to deepen economic and social resilience—and to facilitate new venture creation.

Two trends in lifelong learning align with the digital learning needs of employees and entrepreneurs: micro-learning and micro-credentialing. Micro-learning is the breaking up of learning into chunks, smaller than a traditional academic course. Micro-learning can be in chunks as small as five to ten minutes, or up to the 35–40 hours of a traditional academic course. Micro-credentialing is the recognition and proof of micro-learning, captured in a secure digital badge. Embedded in the digital badge is a listing of the competencies learned, the proof

of learning and labour market validation of the usefulness or practical application of the learning.

Interestingly, an additional trend in lifelong learning has been accelerated by the COVID-19 crisis—the migration of lifelong learning to online delivery. While there was significant access to lifelong learning online prior to COVID-19, stay-at-home requirements have driven learning that was traditionally classroom-based into online formats. Ever-improving videostreaming technologies that allow for small group discussions in online breakout rooms, moderated larger group discussions or lectures facilitated by hand-raising functions and simultaneous chat lines, and clearer synchronous transmission have facilitated this transition. The rapid expansion of online lifelong learning options has accelerated instructor and student skill and comfort with online learning technologies. It has also expanded the reach of lifelong learning experiences beyond previously restrictive geographic limits. Every lifelong learning provider now has the potential for global reach with its online learning portfolios. A lifelong learner has access to an almost inexhaustible selection of learning options; therefore, the upskilling potential now available to employees, employers and entrepreneurs is exponentially larger than it was pre-COVID-19. However, whether lifelong learners will take advantage of the myriad options now available as they navigate the post-pandemic world of work is an unanswered question at this point.

III. Data, Policy, Evidence

COVID-19 revealed the weaknesses of restricting data access to physical locations, such as the research data centres. When lockdowns were in place, researchers who use large restricted datasets could not access the data they needed to continue their research. At the same time, the need for coordinated, rapid, evidence-based policy decisions during the pandemic reinforced that secure, but unfettered, data access is perhaps more important than usual during times of crisis. Canadians now generally support even “risky” data-sharing schemes if they are for a defined and understood purpose.[x]

This means that new data from contact tracing, social mobility and sentiment analysis through social media might be used responsibly for the social good, alongside increasingly popular concepts such as generational fairness of public policy issues and occupational risk evaluations, which require interdisciplinary approaches. While there is skepticism about science, buoyed by pandemic conspiracy theories, there is also a new appreciation of science, evidenced by the public grasp of scientific concepts, such as R zero, transmission simulations and “flattening the curve.”

Accordingly, in this sub-theme we looked at the issues of data access within the provincial purview. In particular, the goal was to identify the barriers to significant benefits in the areas of provincial responsibility, and to explore the opportunities that may arise if such barriers are lowered or removed.

Our overarching assumption, and conclusion, is that *data is a key resource for policy, decision-making and education. Data is a public asset. It needs to be treated as such.*

Nova Scotian Context. Currently, one of the key points of access for health and social science data in Canada is through the Canadian Research Data Centre Network, in partnership with Statistics Canada. The one location for access in Nova Scotia, the Atlantic Research Data Centre (ARDC), is located at Dalhousie University. The ARDC contains hundreds of datasets in a secure environment. The data in the ARDC also includes administrative datasets and numerous linkages, such as the hospital admission data being linked to the long-form census data. While the ARDC program has generally been great at facilitating and equalizing access to confidential and sensitive data, access during the COVID-19 shutdown was severely limited. As a response, they have begun to provide real time remote access for selected datasets to help researchers conduct some degree of research during these unprecedented times and continue to develop other means of access.

Some provinces afford access to sensitive provincial data. For example, the New Brunswick Institute for Research, Data and Training provides researchers with secure access to provincial administrative and health data and provides access at the UNB Fredericton campus and satellite research offices at the UNB Saint John campus and at the University of Moncton. While the ARDC program facilitates some degree of data required to make evidence-based policy decisions in Nova Scotia, our province's offering falls short of what is available in New Brunswick. One example of data that is useful but not accessible is the administrative data from 811 services.

The pandemic has highlighted the need to have increased connections between scientists and policymakers. A scientific advisory council that can respond quickly in times of crisis and provide proactive monitoring of risks in the environment would increase the ability of governments (provincial and municipal) to make evidence-based decisions.

Key Challenges

Access. While data may exist, it is often difficult or impossible to access, e.g. for research purposes. Existing protocols to request data access are oriented towards the worst-case scenario. However, viewing data as a resource and facilitating access would benefit researchers, policymakers and, more generally, the Nova Scotia public. Open Data Nova Scotia is a valuable initiative, but the assetization of data held by the province should go further.

Data Policy: Data access and privacy tend to be viewed as fixed, absolute concepts rather than as dynamic, goal-determined attributes of the data. Data policy needs to move away from a worst-case scenario approach and towards a value/risk analysis approach. There are data policy options that could be piloted, including the walled garden concept and federated data. The walled garden concept could be implemented to better use the health data, and to integrate it with other data types, for the benefit of

advanced health research and support needs. Federated data access has been applied at scale to nationwide government databases (e.g. Estonia, Flanders). In federated data networks, the person needing the data sends a query and receives an answer to the query rather than the data itself. That access solution is also a technical data privacy solution. The walled data access would open data to a selected group of researchers who would have the freedom to access, integrate and use the data inside the wall. The data could not be taken outside the wall, only results and aggregates could.

The dominance of the legal model. Canada has fallen far behind the leading nations in terms of data sharing and access by severely limiting the use of data by Canadian researchers. Nova Scotia, with its stable population and advanced information technology maturity in its provincial government—due to its relationship with IBM—could potentially be a leader and steward in data sharing and use policies. Open data initiatives by the government (e.g. Open Data Nova Scotia) are useful for researchers. It would be beneficial, however, if the optics were shifted and data owned by the government were perceived as a public good. Such data would be open by default, meaning that closing it would require a principled process in which the public and the data users would have a say.

Policy and Evidence. The responses to COVID-19 by governments around the world, and the range of experts and data implicated in those responses, raise issues about the ongoing relationship between science, polic and government decision-making. The interrelationships among experts, data, policy and governance have made a difference in what evidence is considered and which tools, models and heuristics are used. This has led to conflicting and confusing information (e.g. use of face masks, spread from asymptomatic people). Who is included in the discussion and whether formal or informal channels are used for advice have also affected outcomes like spread and mortality rate. As noted by Gluckman, the way COVID-19 unfolded worldwide reflects a lack of guidelines related to the role of science in crisis situations.[xi]

These challenges tell us that data ownership issues need rethinking. When properly informed, the public will likely be willing to volunteer their data for health research purposes. This is even more likely to happen if the opt-in approach was to be followed, giving the public the feeling of owning and donating their data. This needs to be connected to the current efforts in the health data area, e.g. One Person, One Record.

The need for data. Multi-faceted, multidimensional, heterogenous data has become a valuable resource in solving a large array of societal problems.[xii] There is a need for micro/high-dimensional data sources to be available to local researchers specifically on healthcare and education (see Hastings et al. for an example).[xiii] Further examples related to the Nova Scotia context are below.

Considerations

The pandemic has highlighted the need to share and publish breaking research during a crisis to inform decision-making while ensuring quality and standards.[xiv] It has also reminded us how much data is collected, daily, by healthcare, education and other institutions in the province, the analysis of which is beyond the capacity of public resources.

Making data more accessible is no small feat. The confidentiality, accreditation and centralization of data are important issues and need careful structuring and investment. Developing a regulated software interface for access, for example, is expensive. But making data subject to cost can create an unfair research environment. This is why the recommendations below point to a public-private partnership.

Recommendations

The preceding review of Nova Scotia's context and key challenges supports the following general recommendations and associated specific actions.

1. Access to the digital world: Break down the digital divide and provide access to all. Access to broadband internet connectivity is fundamental. Coupled with affordable access for specific disadvantaged groups to end-user devices such as computers, tablets and smartphones, the prosperity of Nova Scotia is at stake. Access implies both availability and affordability, with a focus on rural, disadvantaged, First Nations and minority groups.

Gaining the skills to fully participate in the global economy of the 21st century begins with eliminating the barriers that make up the digital divide.

Specific Actions:

- Monitor and ensure the completion of the *Internet for Nova Scotia Initiative* currently administered by Develop Nova Scotia. Broadband internet access implies the availability of high bandwidth, low-latency service such as is provided by Fibre to the Home technologies.
- Modify the terms of reference of the *Internet for Nova Scotia Initiative* to go beyond the current 95% mandate to ensure connectivity to any non-seasonal dwelling in Nova Scotia with connection to the electrical grid.
- Work with telecommunications service providers to ensure modern mobile services, including 5G and IoT roadmaps, are available in all inhabited and traveled areas of the province. Public funding of base infrastructure (tower sites, steel structures and base connectivity) usable by all service providers will promote competition in poorly served areas.

- Consider specifically the needs of First Nations and other identifiable disadvantaged groups with regard to connectivity requirements and the need for end-user devices such as laptop computers. Work in close conjunction with educational initiatives such as Digital Mi'kmaq to ensure resources are appropriately targeted.

2. Education: Promote, enable and facilitate the development of digital skills broadly within all segments of the Nova Scotia education ecosystem. There are multiple ways for Nova Scotians to acquire digital skills, at any point in their education and career journey. Similarly, there are multiple pathways for Nova Scotians to access the labour market roles that require these digital skills. Opening the education and labour market pathways for all Nova Scotians, particularly historically barriered learner groups, current students and recent graduates, requires innovation in digital skills program development to increase interest, engagement, access and learning outcomes.

Specific Actions:

- Conduct a review of global best practices for increasing digital fluency, data literacy and digital technology uptake in all segments of the education ecosystem, including in marginalized communities and among barriered learners.
- Conduct a gap analysis to identify areas for improvement in the Nova Scotia education system compared to best practices, with a particular focus on the gaps in delivery and support in marginalized communities and among barriered learners.
- Partner with the private sector and community-based organizations to address the gaps in interest, engagement, access and learning outcomes in marginalized communities and among barriered learners. Provide equal access to STEM and digital skills courses to all students.
- Explore innovative programming in K-12 education to introduce learners to digital skills at every level of their education journey. Develop dual enrollment courses for Grade 12 students to create connectivity to university-level digital skills programming.
- Strengthen digital skills development programs for college and university students that aim to improve the transition of graduates across all disciplines from education to the workforce.

3. Lifelong Learning: Develop and deliver innovative upskilling, retraining and practical digital training. There is misalignment between the digital skills needed by employers and the actual digital skills of the workforce. This misalignment is a result of employees lacking digital skills when entering the workforce as well as rapid and ongoing changes in digital skill requirements over time. Employees need to upskill to keep their digital skills current or retrain if their existing skills become obsolete. Employee and employer engagement in lifelong learning of digital skills is essential, regardless of sector. This is particularly important for those in sectors significantly impacted by COVID-19.

Specific Actions:

- Develop and deliver innovative, accessible micro-learning experiences for both foundational and emerging digital skills to rapidly upskill and micro-credential the workforce to meet the needs of employers, especially those in sectors disrupted by COVID-19 and by other dynamic sector changes.
- Develop and deliver innovative digital skills learning experiences and targeted employment programs to transition the workforce to a digital world, with 3-, 6- and 12-month postgraduate conversion certificate/degree programs and professional development certificates through higher education institutions in Nova Scotia.
- Ensure efficient evaluation and approval of longer degree programs developing digital skills, at both the undergraduate and graduate levels, to ensure that these programs are implemented in a timely manner so as to be relevant to the labour market's digital skill needs.

4. Software Professionals: Double the size of Nova Scotia's talent pool of software professionals. A shortage of software professionals has been identified as the number one challenge for digital firms in Atlantic Canada. A shortage of such professionals constrains the growth of the whole digital sector, while a relative abundance of such talent not only lifts that constraint but also attracts digital businesses to the province and helps to grow the startup ecosystem. Nova Scotia has become Canada's leading digital outsourcing hub on the strength of past growth in the size of this talent pool, but significant further growth is required to keep pace and build on the past success.

Specific Actions:

- Double the number of university and NSCC graduates in computer programming, computer science and software engineering.
- Establish a "Digital Study and Stay" program that explicitly seeks to attract and support, through essential connections, resources and mentorship, international students pursuing computer science programs during their studies and post-graduation to live and work in Atlantic Canada.
- Establish a consortium of key anchor digital companies and universities to explore opportunities to create software-focused degrees that combine work-integrated learning in new ways beyond co-operative education (co-op). Investigate the potential for "dev degree" models in which students divide their weeks between formal education and work.

5. Digital Adoption: Help to accelerate digital adoption across Nova Scotia SMEs by strengthening digital adoption programs and support. Nova Scotia industry has for many years lagged behind the rest of the country in terms of digital adoption.[xv] With COVID-19, both consumer and business digital adoption leaped years forward in a matter of weeks.[xvi] Grocery stores, schools, medical practices and businesses of all kinds transitioned to digital channels and remote-working models. Now, more than ever, it is critical that Nova Scotia SMEs increase

their rate of digital adoption to recover, grow and increase productivity, resiliency and global competitiveness. Once the immediate survival imperative wanes, digital adoption support programs are likely to be critical if SMEs are to be encouraged to continue to rapidly adopt digital technologies.

Specific Actions:

- Support general and sector-specific digital adoption programs focused on shifting operations of SMEs online, such as those offered by NSBI[xvii] and Digital Nova Scotia.[xviii]
- Support a larger-scale digital adoption program targeting ocean industries, such as those offered by Canada's Ocean Supercluster[xix] and DeepSense.[xx]
- Support SME adoption of key technological advances in cloud/web service, digital marketing, AI and data analytics. Consider models like the IRAP DTAPP program[xxi] that have been proven to be effective.

6. Public Sector: Strengthen digital adoption within the public sector. The public sector has played a significant role in promoting wider-spread digital adoption and capacity building in the province. Nova Scotia's current position as Canada's leading software outsourcing hub can be traced in part to the province's commitment to adopting SAP to support its financial management and other business functions, which led to the establishment of IBM's Client Innovation Centre in Bedford.

Specific Actions:

- Improve digital skills capacity within the province and municipal governments by encouraging partnerships with the Government of Canada, industry and educational partners, and employees and students.

7. Data: Establish an open-by-default policy for Nova Scotia public data. Data privacy, while important, need not prevent beneficial uses of data if properly protected by the federated approach in a walled garden. Privacy protection ought not be a binary decision but a spectrum, depending on the sensitivity of the data and potential benefit from its use. Not all data access needs to be controlled by consulting legal advisors and seeking their approval.

The province should recognize that the data it collects and manages through various programs is a public asset and as such should be exploited as a source of wealth and a tool to improve its operations. The former will be best achieved through a public-private partnership, in which the private partner would add value to the data and share its revenue with the province, while the province would ensure responsible use of this data. Furthermore, if data is a public good, then the approach to data access should be reversed. The default should be that data collected by the province is made public (subject to anonymization to preserve privacy), and data access is constrained only if the province justifies a specific case to its Data Advisory Council (see below).

Specific Actions:

- Establish a Scientific Data Advisory Council incorporating experts from universities, hospitals and industry, able to assess upcoming risk and respond quickly in a crisis. The first task is to assess data availability on COVID-19.
- Develop a process to decide what kind of data should be collected and made available. *(Yearly competition).*
- Health data should be treated as an asset (see above). On the one hand, here is a possibility for the province to make its health data an asset. On the other hand, making its **integrated** health data accessible to Nova Scotians could be a political gain for both the province (in terms of national and global visibility) and the government.
- Implement a pilot project in provincial data access using the value/risk analysis approach.
  Set up a "Yellow Pages" for Nova Scotia data in which metadata is searchable and available. This would require the use of an existing metadata standard that could be adopted from other jurisdictions.

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