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A Digital Strategy for Canada: The Current Challenge

David A. Wolfe

IN BRIEF

Canada's future competitiveness and growth prospects are inextricably linked to our ability to seize the opportunities created by the rapidly evolving digital economy. Ottawa's innovation agenda should be extended to pursue a broader digital policy strategy focused on three main goals: (1) promoting the rapid adoption and diffusion of digital technologies across all sectors of the economy; (2) assisting companies that have demonstrated commercial potential to grow to a global scale; and (3) promoting the creation of businesses capable of developing disruptive technologies. Ultimately, given the pace of change and the complexity of the challenges involved, the most effective way for governments to respond is through continuous innovation in their policy and regulatory frameworks.

EN BREF

La compétitivité et les perspectives de croissance du Canada sont intrinsèquement liées à sa capacité de saisir les occasions créées par la numérisation de l'économie. Ottawa doit donc étendre son programme d'innovation et axer sa stratégie numérique sur trois objectifs clés : 1) accélérer l'adoption et la diffusion des technologies numériques dans tous les secteurs de l'économie ; 2) soutenir la croissance des entreprises ayant démontré leur potentiel commercial à l'échelle internationale ; 3) promouvoir la création d'entreprises aptes à développer des technologies disruptives. Face à la rapidité des changements et à la complexité des défis à relever, la meilleure approche des gouvernements consiste en définitive à réexaminer continuellement leurs politiques et cadres de réglementation sous l'angle de l'innovation.

UNLOCKING DEMAND FOR INNOVATION

ABOUT THIS INSIGHT

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David A. Wolfe is professor of political science at the University of Toronto Mississauga and co-director of the Innovation Policy Lab at the Munk School of Global Affairs and Public Policy. From 2009 to 2014, he was the Royal Bank Chair in Public and Economic Policy at the University of Toronto. He has been the principal investigator on two major collaborative research initiatives funded by the Social Sciences and Humanities Research Council. He is currently leading a five-year SSHRC-funded Partnership Grant for the project Creating Digital Opportunity for Canada. Wolfe is the editor or co-editor of 10 books and numerous scholarly articles.

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INTRODUCTION

Digital technologies are critical to the global economy and to Canada's future economic growth and prosperity. They are creating an opportunity for a vast array of new products, technologies, services, business processes, societal tools and organizations to generate new wealth, but they will also challenge the existing system of production and our way of interacting with the world around us. The digital revolution now under way involves more than just a set of industries; it has the potential to transform virtually every sector of the economy. The rapid pace of innovation and shifting global leadership in digital technology and are creating major challenges for Canada's digital industries; but they are also creating new opportunities. Canada's future competitiveness and our prospects for economic growth are inextricably linked to our ability to seize this "digital opportunity."

These observations, combined with a paucity of research and knowledge gaps on the nature of Canada's participation in evolving digital networks, were the motivation behind an ongoing five-year research initiative designed to situate Canada's digital opportunity in a global context and to identify the most effective policies in response to the challenges posed by a rapidly developing digital landscape.[1] My primary goal in this paper is to examine the federal government's current innovation agenda and policy measures through the lens of this research and its main findings in order to assess where we are in this process and to propose new initiatives to fill the gaps and complement the policies that have been adopted. I build on and update the policy recommendations made in a report produced for the CDO project, "A Policy Agenda for the Digital Economy."[2] Since that report was released, the federal government has undertaken a major expansion and streamlining of its innovation policies. This paper suggests additional measures that are needed to supplement and complement those initiatives.

THE DIGITAL TRANSFORMATION

The pace of the digital revolution is accelerating. A critical feature of this revolution – and one propelling the acceleration – is the rapid spread of mobile devices, cloud computing and data analytics, which has shifted the focus of innovation from hardware to software and the analysis of data.

From the early days of analog computers, cellular phones and other pioneering devices, the focus has turned to less tangible and visible – but no less groundbreaking – software-based technologies that drive many of today's commercial success stories. The leading edges of the digital economy are now platform-based business models, digital networks, cloud computing, artificial intelligence, massive databases,

[1] The resulting research partnership, Creating Digital Opportunity (CDO) (under the auspices of the Innovation Policy Lab at the Munk School of Global Affairs and Public Policy), has members from 16 universities and 11 partner organizations, and it is funded by the Social Sciences and Humanities Research Council of Canada (2014 to 2019).

[2] See D.A. Wolfe, "A Policy Agenda for the Digital Economy," Innovation Policy White Paper 2016-02 (Toronto: University of Toronto, Munk School of Global Affairs, 2016) https://munkschool.utoronto.ca/ipl/files/2016/02/IPL-White-Paper-No-2016-2.pdf.

social media algorithms and smart phone apps, among others.[3] This shift has laid the groundwork for faster, smaller, cheaper and more accessible products and related services, which are having a profound impact on the global economy. They are altering the basis of competition by lowering barriers to entry in an array of industries, thereby spawning a new generation of platform firms that are far nimbler than the giants they are challenging. Virtually no sector of the economy will be left untouched by this transformation.[4] It is no longer possible to underestimate the importance of the digital economy. Not since the introduction of electricity has there been an interconnected set of technologies with such potential to disrupt established industrial sectors and economic patterns. This is creating what Brian Arthur has termed a "second economy": a virtual and autonomous one where intelligence is located externally in the stores of data being generated and the algorithms that interpret and act upon that data.[5]

The rise of platform firms is creating new opportunities for entrepreneurial startups to introduce dynamic new services that turn conventional business models on their heads and are forcing established companies to follow suit. The result is that platform technologies and the digital networks that support them have become essential tools for businesses across a wide array of sectors, from entertainment and transportation to food retailing and hospitality.[6] Most important, the pace of innovation is accelerating, dramatically compressing the time it takes to disrupt established markets and creating greater pressure for firms and industries to respond to the effect of new disruptors.

The implications for Canada are profound. Internet-based services located thousands of miles away can plug into its domestic market in seconds. Upstart firms in China — such as dx.com, everbuying.net, lightinthebox.com, tomtop.com, milanoo.com, chinavasion.com and focalprice.com — now sell more than $2 billion worth of goods a year in global markets. The same digital channels, however, are creating an opening for Canadian firms, which are starting to scale up and connect to this global market of 7.5 billion people. In the future, Canada might be selling fewer hard goods and more intelligent software with a myriad of applications in business and consumer markets.

The growing emphasis on software-based products and digital channels also means that we are shifting from a world shaped by economies of scale, which are locally embedded and capital intensive, to a more flexible environment where economies of scope based on platforms and networks dominate and where economic value is derived from intangibles, such as intellectual property rights and international standards.[7] Canadian firms' challenge

[3] See McKinsey Global Institute, "What's Now and Next in Analytics, AI and Automation," Executive Briefing (n.p., May 2017), https://www.mckinsey.com/featured-insights/digital-disruption/whats-now-and-next-in-analytics-ai-and-automation.

[4] A. McAfee and E, Brynjolfsson, *Machine, Platform, Crowd: Harnessing Our Digital Future* (New York: W.W. Norton, 2017).

[5] W.B. Arthur, "Where Is Technology Taking the Economy?" *McKinsey Quarterly,* October 2017, https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/where-is-technology-taking-the-economy.

[6] G.G. Parker, M.W. Van Alstyne, and S.P. Choudary, *Platform Revolution: How Networked Markets Are Transforming the Economy — and How to Make Them Work for You* (New York: W.W. Norton, 2016).

[7] J. Haskell and S. Westlake, *Capitalism without Capital: The Rise of the Intangible Economy* (Princeton, NJ: Princeton University Press, 2018).

is to develop products and services with broad applications and standards applicable to mass markets beyond Canada's borders.

Canadian challenges and the role of policy

Research for the CDO program has shown, however, that Canadian business has been slow to recognize the extent to which software advances are transforming traditional industries. As a result, many Canadian firms are underinvesting in software and lagging in the introduction of corresponding digital processes and techniques to access markets. Moreover, critical sectors of the economy have been slow to adapt to the challenge posed by dynamic platform firms, and are struggling to respond to the ensuing disruption.

These problems are compounded by other obstacles that hamper Canada's ability to take full advantage of the digital revolution.

- Canada's record in building local successes into global powerhouses is decidedly mixed. Promising startups all too often end up either moving to the United States or sold to foreign (usually US) investors. Without high-growth companies of global scale, Canada will lack the training ground for managers with the skills needed to shepherd startups into successful scale-ups.
- One of the biggest challenges to the growth of digital firms is the shortage of Canadian-based patient capital for high-growth companies. Promoters of digital technologies emphasize their ventures' strong growth prospects, but the reality is that high growth usually implies greater risk, which is a deterrent to traditional sources of investment in Canadian capital markets.
- A related issue is the relative size of Canada's domestic market. Companies must export at an early stage as a base for global success. The shortage of patient capital and the lack of key experienced managers with the skills required to scale a domestic company into global markets make it difficult to transform startups into high-growth firms.
- Competing successfully in the global economy increasingly depends on the ability to use intellectual property and propriety standards as part of a competitive strategy to create what is called "room to operate." Canadian innovation strategies need to pay greater attention to these critical elements of success in the digital economy.
- Canada has a loose innovation system. The National Research Council's Industrial Research Assistance Program (IRAP), the Scientific Research and Experimental Development Tax Incentive Program and other programs provide some support for research and development (R&D) initiatives in advanced technologies and software. However, the system lacks a coherent and strategic focus, and key players, including businesses, research and training institutions, industry associations and government, are not coordinated.[8]

[8] See Expert Panel on the State of Science and Technology and Industrial Research and Development in Canada, Competing in a Global Innovation Economy: The Current State of R&D in Canada (Ottawa: Council of Canadian Academies, 2018); and P. Nicholson, *Facing the Facts: Reconsidering Business Innovation Policy in Canada*, IRPP Insight 22 (Montreal: Institute for Research on Public Policy, 2018), http://irpp.org/research-studies/facing-facts-reconsidering-business-innovation-policy-canada/.

- Despite a significant concentration of digital firms in particular cities and regions, much more could be done to further develop these emerging clusters or regional innovation ecosystems and generate greater benefits.

Software and data thus are the key to Canada's success in the digital economy. The overarching challenge, however, is to recognize that a small, open trading economy such as Canada's must focus on specific sectors and niches where Canadian firms and industries have the potential to compete in global markets. The reality is that, although Canadian entrepreneurs have developed exciting ideas and started innovative businesses, they lack the focused support they need from government to expand these ventures on a global scale.

Canada's ability to position itself as a leader in the ever-changing and expanding digital economy will depend on how effectively governments and policy-makers support Canadian firms in navigating these fast-developing challenges. Our strategy must have three main goals:

- to promote the rapid adoption and diffusion of digital technologies across all sectors of the economy;
- to assist companies that have demonstrated their commercial potential to grow to a scale that helps them succeed in the global marketplace; and
- to support the emergence and growth of firms that could bring new, disruptive products and services to global markets.

BUILDING ON RECENT FEDERAL INITIATIVES

Since 2016, the federal government has introduced a wide range of innovation policy instruments.[9] For the most part, these measures represent a much-needed update of Canada's innovation support policies, but most do not focus directly on the digital sector of the economy and the challenges posed by new digital technologies. Among the most important recent initiatives are the following:

- The Innovation Superclusters Initiative, unveiled in the 2016 budget and formally launched in February 2018, provides support for five years to five consortia across the country: Canada's Digital Technology Supercluster, the Protein Innovations Canada Supercluster, Building an Advanced Manufacturing Supercluster, the AI-Powered Supply Chains Supercluster and the Ocean Supercluster. Although only one of these superclusters specifically focuses on digital technologies, all of them involve the adoption and use of digital technologies in their respective sectors.[10]
- The Strategic Innovation Fund combines existing innovation programs for the aerospace and automotive sectors into a single fund that expands support

[9] Although our focus is on the federal government, we recognize that many of the provinces have also instituted policies that complement those at the national level.

[10] Innovation, Science and Economic Development Canada, "Canada's New Superclusters" (Ottawa, February 18, 2018), https://www.ic.gc.ca/eic/site/093.nsf/eng/00008.html.

for new and emerging technologies, including digital, life sciences and clean technologies.[11]

- Innovative Solutions Canada is a Canadian version of the successful US Small Business Innovation Research (SBIR) program and is designed to position the federal government as a first customer for innovative small businesses that are bringing their products to market. Like the SBIR program, it takes the products through successive phases of support, leading to potential procurement by government departments and agencies.[12]
- Innovation Canada is designed to be the single point of contact for innovative companies, directing them to the most appropriate programs and departments (including provincial and territorial ones) to meet their needs.[13]
- The Venture Capital Catalyst Initiative, unveiled in December 2017, allocates $400 million through the Business Development Bank of Canada to secure more late-stage funding for high-growth businesses. The program will help established companies hire skilled employees, test-market new products and expand into new markets at home and abroad.[14]
- Additional funding has been announced for the Pan-Canadian Artificial Intelligence Strategy, to be delivered through the Canadian Institute for Advanced Research and the Institute for Quantum Computing, as well as new funding for the Smart Cities Challenge Fund, which is generating a tremendous amount of grassroots activity in cities and regions across the country.[15]

In addition, in the 2018 budget, the federal government announced it would streamline the delivery of more than 90 programs that support business innovation, and would undertake several important new initiatives.[16] Federal innovation programming would be consolidated around four flagship platforms: the Industrial Research Assistance Program (which also receives additional funding), the Strategic Innovation Fund, the Canadian Trade Commissioner Service (including the amalgamation of multiple trade promotion programs) and the Regional Development Agencies. As well, support for firms with high growth potential would be promoted by consolidating the Accelerated Growth Service and the Concierge Service of IRAP to reside within Innovation Canada. Lastly, the budget announced a new intellectual property strategy.

The number of new programs, the increased funding and the streamlining and rationalization of federal business innovation programs represent the most dramatic changes to innovation policy over the past three decades. Some of these changes

[11] Innovation, Science and Economic Development Canada, "Strategic Innovation Fund" (Ottawa, December 14, 2018), http://www.ic.gc.ca/eic/site/125.nsf/eng/home.
[12] Innovation, Science and Economic Development Canada, "Innovative Solutions Canada" (Ottawa, July 18, 2018), https://www.ic.gc.ca/eic/site/101.nsf/eng/home.
[13] Innovation Canada, "Find out what we can do for your business" (Ottawa, December 17, 2018), https://www.ic.gc.ca/app/scr/innovation?lang=eng.
[14] Government of Canada, "Venture Capital Catalyst Initiative" (Ottawa, November 5, 2018, http://www.ic.gc.ca/eic/siTe/061.nsf/eng/h_03052.html.
[15] CIFAR, "Pan-Canadian Artificial Intelligence Strategy: Overview" (Toronto, 2018), https://www.cifar.ca/ai/pan-canadian-artificial-intelligence-strategy#overview.
[16] See Finance Canada, *Budget 2018: Equality and Growth for a Strong Middle Class,* February 18, https://www.fin.gc.ca/n18/18-008-eng.asp.

correspond to recommendations in the 2016 CDO report,[17] and will support a new trajectory for Canadian innovation. There is a feeling in some parts of the policy community that the adoption of these new measures and the realignment of existing programs are adequate to ensure that Canada seizes the digital opportunity. Despite this progress, several recent policy reports, including those from the Council of Canadian Academies, the Economic Strategy Table on the Digital Industries and the Institute for Research on Public Policy,[18] suggest that much work remains to be done. The pace of change in the digital economy is accelerating and will continue to do so, making it difficult for Canada's institutional, policy and regulatory frameworks to keep up. To allow Canadian firms to capitalize on the digital opportunities that arise, policy-makers should, in their policy and regulatory frameworks, follow the lead of our most innovative firms and industries and continuously innovate.

Embed digital technology in all sectors of the economy

No sector of the economy, from agriculture and mining to entertainment and transportation, is immune to the digital transformation. To thrive in the digital economy, Canadian firms must be in the forefront of the adoption and use of digital technologies, especially software. Furthermore, there is increasing evidence that companies that are making the most sustained investment by embedding digital technologies and processes in every aspect of their operations are enjoying substantially higher rates of revenue and earnings growth than those who lag.[19] Yet recent studies show that Canada continues to lag in making these investments. The Centre for the Study of Living Standards reports that nominal investment in information and communications technology (ICT) per job in Canada fell from 68.4 percent of the US level in 2008 to 56.3 percent in 2014. Moreover, underinvestment in software accounted for 85 percent of the broader Canadian-US gap in ICT investment, which is seen as a significant contributor to Canada's lagging productivity performance.[20] In its most recent report on the digital transformation, the Organisation for Economic Co-operation and Development (OECD) notes that Canada's overall investment in ICT, at 2.14 percent of gross domestic product (GDP) in 2015, lags well behind both the OECD average and that of the United States.[21]

The short-lived Digital Technology Adoption Program, administered by the National Research Council, was intended to promote technology adoption, but was not in operation

[17] Wolfe, "A Policy Agenda for the Digital Economy."

[18] Council of Canadian Academies, Expert Panel on the State of Science and Technology and Industrial Research and Development in Canada, *Competing in a Global Innovation Economy: The Current State of R&D in Canada* (Ottawa: Council of Canadian Academies, 2018), http://new-report.scienceadvice.ca/assets/report/Competing_in_a_Global_Innovation_Economy_FullReport_EN.pdf; Government of Canada, Economic Strategy Tables, "Digital Industries: The Sector Today and Opportunities for Tomorrow, Interim Report" (Ottawa: Innovation Science and Economic Development Canada, 2018, https://www.ic.gc.ca/eic/site/098.nsf/vwapj/ISEDC_Table_DI.pdf/$file/ISEDC_Table_DI.pdf; Nicholson, *Facing the Facts;*

[19] J. Bughin, T. Catlin, and L. LaBerge, "How Digital Reinventors Are Pulling Away from the Pack" (n.p.: McKinsey & Company, October 2017), https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/how-digital-reinventors-are-pulling-away-from-the-pack.

[20] J. Thomas, "New Evidence on the Canada-U.S. ICT Investment Gap, 1976-2014," CSLS Research Report 2017-17 (Ottawa: Centre for the Study of Living Standards, November 2016), http://www.csls.ca/reports/csls2016-17.pdf

[21] Organisation for Economic Co-operation and Development, *OECD Digital Economy Outlook 2017* (Paris: OECD, 2017), figure 5-1. https://www.oecd-ilibrary.org/science-and-technology/oecd-digital-economy-outlook-2017_9789264276284-en?_ga=2.8333812.758216694.1547584830-410445975.1540838537.

long enough to achieve its objective. The Business Development Bank of Canada (BDC) offers support to small and medium-sized businesses looking to adopt digital technologies through the Smart Tech service.[22] Businesses may also apply for loans for investment in hardware, software and consulting services. The federal government should build on the best elements of these programs to promote the increased application of software across all sectors of the economy and all facets of the innovation spectrum, from product and process innovation to the development of new organizational, sales and marketing innovations. These include digital customer acquisition – the ability to gain new customers through purely digital processes rather than through traditional sales channels – which is key to rapid growth in the digital era.[23]

The interim report of the Economic Strategy Table on the Digital Industries underlines the urgency of accelerating the diffusion of digital technologies throughout the economy. It calls for the establishment of a national digital infrastructure fund that treats digital infrastructure on par with more conventional forms of infrastructure, such as those in place for electric power and water. It also recommends renewing the Digital Technology Adoption Program to help businesses go digital and build the required skill sets among their employees, and establishing mobile-compatible and accessible end-to-end digital government services by 2025. The report also supports increased funding for demand-driven procurement programs, such as Innovative Solutions Canada and the Build in Canada Innovation Program, to encourage innovative digital firms to work with the government to develop made-in-Canada solutions for unmet and existing public sector needs.[24]

Devise a scale-up strategy for global expansion

Ottawa and several provinces have introduced initiatives in recent years to support startups and increase the amount of funding available for the venture capital market, but governments need to go further. A steady flow of startups will not sustain momentum if these ventures cannot be transformed into successful global businesses. Without producing real results on this front, Canada will miss out on some of the most important opportunities that the digital economy affords.[25] Canada has not focused sufficiently on helping successful startup firms grow to global scale. Indeed, governments need to recognize that the challenges facing firms wishing to scale up differ significantly from those of startups, and policy should reflect these differences.
Scale-ups may be defined as companies that have achieved a minimum of $10 million in annual revenues, a growth rate of 20 percent a year for more than three years, and

[22] Business Development Bank of Canada, "BDC earmarks $200 million to help entrepreneurs invest in ICT," October 17, 2011, https://www.bdc.ca/en/about/mediaroom/news_releases/pages/bdc_200_million_help_entrepreneurs_invest_ict.aspx.
[23] O. Matthews, "Digital customer acquisition a missing part in Canada's industrial strategy," *Globe and Mail,* October 11, 2018, https://www.theglobeandmail.com/business/commentary/article-digital-customer-acquisition-a-missing-part-in-canadas-industrial/.
[24] Government of Canada, Economic Strategy Tables, "Digital Industries."
[25] Advisory Council on Economic Growth, "Unlocking Innovation to Drive Scale and Growth" (Ottawa, February 6, 2017), http://www.budget.gc.ca/aceg-ccce/pdf/innovation-2-eng.pdf; B. Bergen, "Canada Has a Scale-up Problem, Not a Start-up Problem" (Waterloo, ON: Centre for International Governance Innovation, April 25, 2017), https://www.cigionline.org/articles/canada-has-scale-problem-not-start-problem; Government of Canada, Economic Strategy Tables, "Digital Industries."

that have more than 10 employees at the start of the period.[26] These firms have established banking relationships, demonstrated growth and are profitable. Current programs that focus on scale-up firms, such as the Accelerated Growth Service, provide part of the solution, but the federal and provincial governments need to undertake a coordinated review of how their talent, skills and innovation programs can help firms of this size grow to a minimum of $100 million in annual revenues. The review should consider the critical challenges facing these firms: expanding their revenue base, particularly by accessing global, not just continental, markets; recruiting, retaining and developing the necessary managerial and technology talent, and ensuring that the talent trained at post-secondary institutions stays in Canada; and ensuring adequate access to patient, long-term capital, not just startup venture capital.

The CDO report advances several recommendations to address these issues.[27]First, a sales and marketing consortium should be established to help give Canadian digital firms the breadth needed to penetrate emerging markets, especially those in East Asia where size matters. The federal and provincial governments could increase direct support for scale-up firms, such as foreign-exchange risk insurance, and provide more aggressive and targeted foreign intelligence on international sales opportunities. These tasks could be made part of the mandate for the expanded Trade Commissioner Service.

Second, strategies are needed to improve the access to talent that is a critical requirement for scale-up firms. The federal and provincial governments could work with Canadian digital firms on how to retain highly qualified talent trained at Canada's publicly funded post-secondary institutions and in demand around the world, and ensure that scale-up firms are able to access the immigrant talent that might be critical to their growth.

Third, access to different forms of long-term patient capital needs to be improved to help businesses remain Canadian once they reach critical size. Canada does not lack adequate sources of capital; what it lacks is pools of long-term patient capital willing to invest in supporting the growth of digitally enabled scale-up firms. The critical challenge for government is how to mobilize existing pools of capital for this purpose.

There is also an opportunity for the federal government to use existing programs, such as the Accelerated Growth Service, to integrate the services offered by various government agencies to support the growth of scale-up firms. There is, in fact, a critical need for a whole-of-government approach to supporting scale-up companies. Firms that qualify for the Accelerated Growth Service should be able to work seamlessly across different government agencies to access the support they need. Program applications at both the federal and the provincial levels should also be harmonized so that companies need provide their financial data only once. For example, once they are approved by the Accelerated Growth Service, companies could be fast-tracked for approval and qualification for support through all the Business Development Bank of Canada's relevant programs. The same would be true for services provided by

[26] This is the CDO's definition.
[27] Wolfe, "A Policy Agenda for the Digital Economy."

organizations such as the Standards Council of Canada and the Canadian Intellectual Property Office.

The importance of providing increased support for Canadian scale-up firms is further reinforced in the interim report of the Economic Strategy Table on the Digital Industries.[28] Among its key recommendations is the establishment of a "hypergrowth passport" pilot program, which is conceived as an accredited designation for Canadian-headquartered firms with more than a $1 million in revenues and 40 percent year-over-year revenue growth. The research conducted for the CDO project supports the general thrust of this idea, but our findings indicate that the critical challenge lies with firms that have reached $10 million in annual sales. Therefore, the passport should aim to help firms grow from $10 million to $100 million in revenues, which is the critical level needed to attain a sustainable scale. In line with our recommendations, the passport would provide hypergrowth firms with the following:

- a single application, with rapid processing available for relevant government programs;
- set-asides in government programs for eligible firms;
- support in navigating domestic and international growth barriers;
- access to an elite network of mentors; and
- the opportunity to showcase themselves to global investors, talent, partners and customers.[29]

Most important, the federal government (and the provinces) should recognize the critical importance of high-growth, scale-up firms in realizing Canada's digital opportunity. To afford them this recognition, the government should establish regular, ongoing discussion forums (as opposed to one-off advisory committees) at which the chief executive officers of Canadian scale-up firms can speak directly with government decision-makers about ideas to improve the innovation support system. If these companies are to grow as an integral part of Canada's digital economy, they must have a continuing seat at the relevant policy tables at both the federal and the provincial levels.

Create a federal innovation agency

Canada has numerous programs to support the emergence and expansion of innovative digital firms, but it lacks the presence of a dedicated agency, such as is found in other innovative economies, with the mandate to make high-risk investments in new, disruptive technologies with the potential for hypergrowth in the global economy. The mandate of these agencies elsewhere tends to be closely associated with a Schumpeterian perspective,[30] recognizing that higher economic benefits flow to firms and industries that succeed in capturing the excess rents commanded by innovative products and processes in the

[28] Government of Canada, Economic Strategy Tables, "Digital Industries."
[29] Wolfe, "A Policy Agenda for the Digital Economy."
[30] A Schumpeterian perspective refers to need for policy-makers to respond to innovation as a "process of industrial mutation, that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one"; see J.A. Schumpeter, *Capitalism, Socialism and Democracy*, 5th ed. (London: George Allen and Unwin, [1942] 1976), Taylor & Francis e-library, 2003, 83.

market. The economic justification for a form of innovation agency based on Schumpeterian criteria is reasonably clear. The process of innovation constantly introduces new technologies with the prospect of generating higher-than-average social and economic returns. However, the long period required to reap the benefits of these investments and the high degree of risk involved result in underinvestment across the economy. This dilemma has provided the policy rationale for some of Canada's successful competitors to create what has been termed "Schumpeterian development agencies," focused on new technologies and industrial sectors with the potential to generate these social benefits.[31] The active involvement of such a low-profile, peripheral, innovation agency has been a critical element of successful digital strategies in many of these countries. Notable examples include the US Department of Defense's Advanced Research Projects Agency (DARPA); Sitra in Finland; A*Star in Singapore; and the Office of the Chief Scientist in Israel, now the Israel Innovation Authority. Despite significant national and agency-specific differences, the experience of these countries holds important lessons for Canada.[32]

Recent work undertaken as part of the CDO project has found that successful innovation agencies vary greatly in terms of their design, which ultimately depends on the agency's mission and the specific type of innovation it pursues.[33] The type of agencies with the greatest relevance for this discussion are *state-led disrupters*, which combine their independence, technological knowledge and R&D management capacity "to pioneer radically new industries and activities";[34] and *transformation enablers*, which engage with nascent industries and firms to support radical innovation through a large number of small-scale experiments. These agencies share several key characteristics. They are staffed by technology experts, often drawn from relevant industry sectors; they are led by experienced managers with a deep understanding of the nature of the innovation process; and they enjoy considerable latitude to make technology decisions free from political or bureaucratic interference. Much of their success is owed to their relative insulation from short-term political pressures.

These agencies make a modest demand on the public purse — although the success of some has led to increased mandates and budgets. Not every investment is a guaranteed success, but the agency model has been effective in putting innovative firms in these countries on a path to develop emerging products for the international marketplace. Agencies with limited resources are exposed to fresh ideas about how to promote restructuring. They are more likely to cultivate alliances with nontraditional domestic or international actors and thus be encouraged to be imaginative and to circumvent bureaucracy.[35]

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[31] D. Breznitz and D. Ornston, "The Revolutionary Power of Peripheral Agencies: Explaining Radical Policy Innovation in Finland and Israel," *Comparative Political Studies* 46, no. 10 (October2013): 1219-45.

[32] See F. Block and M.R. Keller, eds., *State of Innovation: The U.S. Government's Role in Technology Development* (Boulder, CO: Paradigm, 2011); Breznitz and Ornston, "The Revolutionary Power of Peripheral Agencies"; M.Z. Taylor, *The Politics of Innovation: Why Some Countries Are Better than Others at Science and Technology* (New York: Oxford University Press, 2016); L. Weiss, *America Inc? Innovation and Enterprise in the National Security State* (Ithaca, NY: Cornell University Press, 2014).

[33] D. Breznitz, D. Ornston, and S. Samford, "Mission Critical: The Ends, Means and Design of Innovation Agencies," *Industrial and Corporate Change* 27, no. 5 (2018): 885.

[34] Breznitz, Ornston, and Samford, "Mission Critical," 886.

[35] Breznitz and Ornston, "The Revolutionary Power of Peripheral Agencies."

The 2018 federal budget signalled an expanded role for the National Research Council, including the establishment of a new ideation fund described as the Canadian version of DARPA. Both the design and the scale of the fund, however, fall far short of the scope of the agencies discussed above. The same is true of the Strategic Innovation Fund, which focuses on supporting business R&D projects of over $10 million. This suggests that Canada still lacks a strategic innovation agency with both the mandate and the ability to make transformational investments digital technologies comparable to those undertaken by peripheral agencies found among Canada's most dynamic competitors. The CDO researchers argue that policy-makers need to consider carefully the goals they intend to pursue in designing of an innovation agency and to accept that there are tradeoffs in any design. If the policy objective is more radical or disruptive innovation in technology sectors with potentially wide applications, the effective model might be an agency located at the periphery of the federal bureaucracy, with the scope to engage in considerable experimentation and remain relatively free from political or bureaucratic interference.[36]

Monitor the new intellectual property strategy

The importance of patents, designs and other Intellectual property (IP) has grown enormously over the past couple of decades as businesses and researchers seek to protect their cutting-edge technologies. Yet Canada has been slow to appreciate the value of IP, with the result that many homegrown ideas end up owned by foreign companies and used to their own advantage, rather than to Canada's. All too often, Canadian firms pay royalty fees to foreign companies instead of investing those funds in their own research efforts. Innovative businesses must be able not only to protect their ideas, but also to enforce that protection through trade agreements, standards and, if necessary, litigation.[37]

The 2018 federal budget broke new ground with the announcement of a national in IP strategy, which includes funding to pilot a patent collective that will work with Canadian entrepreneurs to pool patents, thus providing small and medium-sized firms with better access to the IP needed to grow their businesses. An additional element is the creation of an IP marketplace, an online listing of public-sector-owned IP available for licensing in order to improve access for Canadian entrepreneurs' access to publicly owned IP. This new policy framework will go a long way toward ensuring that more of the benefits of publicly funded research and domestic talent remain in Canada. Each element of the new strategy will need to be monitored carefully as it is implemented, and changes will need to be made in "real" time to ensure that the policy is working as intended.

Administrators of the new programs must also recognize that the need for IP-related resources differs in IP-intensive industries from that in traditional industries. Policy-makers

[36] Breznitz, Ornston, and Samford, "Mission Critical," 894.
[37] O. Fitzgerald, B. Awad, M. Cadogan, and S. Annisimov, "Thinking Through Intellectual Property Issues: Charting a Path Forward" (Waterloo, ON: Centre for International Governance Innovation, 2017, https://www.cigionline.org/sites/default/files/documents/Round%20Table%20Report_3.pdf.

should ensure that promising Canadian innovators are given the resources necessary to compete on a level playing field with multinational firms. Canadian organizations that grant IP rights also need to focus on increasing the amount of Canadian-owned rights that are filed and registered globally. Finally, it is imperative that policy-makers recognize the growing connection between IP rights and the ownership of data, as data are increasingly a critical source of competitive advantage for digitally enabled firms. The national IP strategy, therefore, needs to be closely linked to a national data strategy.

Create a national data strategy

As Canada adopts a wide range of environmental measures to reduce its dependence on carbon-based sources of energy, there is also growing recognition that data are becoming the driving source of value in the accelerating digital economy. As digital activities move to the cloud, and as the increasing use of embedded sensors, mobile devices and applications generate massive amounts of data that platform firms use to create economic value, the protection and enhancement of Canadians' rights to the data they generate must be integrated into Canada's innovation agenda. This recognition should be reflected in a national data strategy to ensure that Canadians own the data they create and that we possess the tools to help grow the economy and protect Canadians' privacy, public safety, democracy and public health.

The establishment of clear property rights to data and rules for future usage would be a central part of this strategy. With clear and full property rights, individuals would be able to exercise greater control over how their personal data are accessed and the conditions under which they agree to their use by third parties. In addition, secure data storage facilities would need to ensure the quality and accuracy of the data and verify their ownership. The simplest way to guarantee property rights for data would be i) to grant people full property rights over their personal data; and ii) to establish a fully transparent open-source licensing system with limited access/use rights to data gathered as part of public or semi-public services, where a licence to use is granted to the gatherer in exchange for sharing the data with current and future local citizens and companies, either free or for a nominal fee. But for this to work, people need to be able to check the accuracy of the data that pertain to them and to know who wishes to use these data and for what purpose, and then decide whether or not to grant permission for their use.

There is also an urgent need to recognize the growing role of data in international trade in services. Although Canada currently has a sophisticated system of rules for governing trade in goods, services and capital, there is no such system for data. In anticipation of the growing value and importance of data in the digital economy, the federal government should develop a set of rules for governing the international transmission of data as an integral part of Canada's trade agreements.[38]

[38] D. Breznitz, "Data and the Future of Growth: The Need for Strategic Data Policy," in *Data Governance in the Digital Age: A Special Report* (Waterloo, ON: Centre for International Governance Innovation, 2018), 66-72, https://www.cigionline.org/articles/data-and-future-growth-need-strategic-data-policy.

Adopt a national standards strategy

Along with the importance of IP rights and data in the digital economy is a recognition of the strategic importance of international standards as a competitive tool. The definition and international enforcement of technology standards in both hardware and software play a central role, alongside IP rights, in defining the "room to operate" that companies enjoy in the defence and promotion of their innovative products.

Standards are set by international bodies and are used to ensure the compatibility of the different components that make up technologically sophisticated products and systems. When the basic architecture of a product or technology is being developed and agreed upon, there is considerable scope for competing designs and approaches. Once the standards have been agreed to by the relevant international bodies, however, the basis for competition has been set. Companies that succeed in having their products or technologies adopted as international standards enjoy substantial gains through both the increased rents they receive by having their IP incorporated into the standard and the network effects they enjoy as other companies are forced to design their own products in a way that ensures compatibility with the prevailing standard.

More effort is needed to educate Canada's digital companies about the options available to participate in international standards-setting bodies and how technology standards can be used as an additional tool to protect and enforce their own intellectual property. To this end, a national standards strategy should be embedded within all Canadian innovation policies. Furthermore, the federal government should ensure that Canadian technology firms gain prominent positions in international standards-setting bodies. The goal would be to maximize the degree to which Canadian technology products are embedded in, and protected by, international standards, as well as to ensure a strong voice for Canadians in setting and enforcing international technology standards.

Strengthen regional innovation ecosystems

Perhaps no aspect of the federal policy agenda is more poorly understood or inadequately met than the need to support the growth and dynamism of regional innovation ecosystems or clusters in those parts of the country with the greatest concentration of digital firms. The centrepiece of the current government's innovation agenda is the badly misnamed Innovation Superclusters Initiative. The program, which is funding five industry-led research initiatives in five different regions of the country, is much closer in design and intent to the manufacturing institutes that are part of Manufacturing USA or the Catapult Centres in the United Kingdom than they are to a dedicated cluster program.[39] There is no guarantee that

[39] See Manufacturing USA, "Institutes" (Gaithersburg, MD), accessed December 20, 2018, https://www.manufacturingusa.com/institutes; and Catapult, "The Catapult Programme" (Swindon, UK, 2018), https://catapult.org.uk. For a systematic overview and comparison of the similarities and differences between the US institutes, the Catapult Centres and the Fraunhofer Society in Germany, see N. Hepburn and D.A. Wolfe, "Technology and Innovation Centres: Lessons from Germany, the UK and the USA" (Toronto: University of Toronto, Munk School of Global Affairs and Public Policy, Innovation Policy Lab, 2014), https://munkschool.utoronto.ca/ipl/files/2015/01/Technology-and-Innovation-Centres-Haltech-Report-2014_1.1.pdf. For a

investments by firms and the federal government in the research undertaken by the supercluster organizations will necessarily translate into growing a cluster. Although the program might contribute to improving the innovative performance of the individual firms that are members of the respective supercluster initiatives, any secondary effect on strengthening the internal dynamics of regional clusters is likely to be an incidental one, rather than a consequence that has been consciously designed into it.

Another, much smaller, but more targeted, initiative set out in the 2018 federal budget mandates regional development agencies to play a central role in supporting the expansion of regional innovation ecosystems. This is welcome news in principle, but the budget provides little guidance on how these agencies are to carry out this mandate. Regional development agencies have a long and well-established tradition of implementing novel programs designed to stimulate innovation in different regions, but support for clusters has not been a central part of their mandate.[40] Therefore, it will be important to ensure that the agencies are staffed with experts who understand the dynamics of regional innovation ecosystems and local clusters. Canada has a rich research tradition of studying and analyzing industrial clusters that should serve as an invaluable knowledge base for understanding the economic, social and political dynamics that underlie successful clusters or innovation ecosystems.[41]

Although the role of regional agencies should be closely coordinated with the federal supercluster strategy, care should be taken to distinguish between the contributions each can make. Regional innovation ecosystems can facilitate coordination, dialogue and interaction among firms and supporting institutions at the local and regional level. Innovation ecosystems and cluster policies, in contrast, are most effective when they are used to focus the delivery of federal and provincial programs on a group of interrelated companies located in the same region.

Regional development agencies, in partnership with provincial and local governments, research institutions and the private sector, should support cluster organizations by identifying major sources of cluster strength across the country. The recently released Cluster Map of Canada, produced by Innovation, Science and Economic Development Canada in consultation with provincial and territorial counterparts, could serve as an invaluable tool for regional development agencies to identify existing concentrations of digital clusters across the country.[42] Universities and other research institutes could

more comprehensive overview of US manufacturing institutes, see W.B. Bonvillian and P.L. Singer, *Advanced Manufacturing: The New American Innovation Policies* (Cambridge, MA: MIT Press, 2017).

[40] N. Bradford and D.A. Wolfe, "Governing Regional Economic Development: Innovation Challenges and Policy Learning in Canada," *Cambridge Journal of Regions, Economy and Society* 6, no. 2 (2013): 331-47.

[41] For an overview of the key research findings from the research, see D.A. Wolfe, "Introduction: Embedded Clusters in the Global Economy," *European Planning Studies* 17, no. 2 (2009): 179-87; see also D.A. Wolfe, "Cluster Policies and Cluster Strategies: Lessons from the ISRN National Study" (Toronto: University of Toronto, Munk School of Global Affairs and Public Policy, 2008). The complete findings of this federally funded research initiative, as well as a comprehensive bibliography of all publications resulting from the research, are archived at Innovation Systems Research Network, "Cluster Initiative," accessed December 20, 2018, http://sites.utoronto.ca/isrn/cluster_initiative/index.html.

[42] See Canadian Cluster Mapping Portal, "Cluster Map," accessed January 18, 2019, https://www.clustermap.ca/app/scr/is/ccmp/web#!/en/home.

support regional innovation ecosystems by aligning research and training efforts to meet the needs of local digital clusters. They could also align university investments in research infrastructure funded by the Canada Foundation for Innovation and in new research chairs, through their strategic plans, with local and regional areas of strength.

The regional agencies should support cluster development activities by offering advice and guidance to startups; supporting the entry and growth of related firms into an area; assisting scale-up firms to access the programs they need to expand their reach into global markets; communicating the needs of these firms to local universities and research institutes; and collaborating with relevant provincial and federal government agencies. It is imperative that the role the regional development agencies play should be closely aligned with that of other government programs designed to support the growth of digital scale-up firms and their expansion into global markets. The regional agencies should convene existing cluster organizations at the local and regional level into a national collaborative clusters network to share know-how and best practices on how to improve cluster competitiveness, as well as to provide advice on public policy and economic development strategies that reinforce cluster development.

Create a new urban policy agenda

Innovation is increasingly an urban phenomenon, and urban spaces are the crucible for the adoption of many cutting-edge digital technologies, from sensors to smart cities to connected and autonomous vehicles. For a number of years, governments around the world have been actively supporting and encouraging their cities' digital transformation into smart, intelligent and sustainable places. This transformation is estimated to represent a $1-trillion market globally today, the largest market for digital technology applications in the world.

In 2017 the federal government formally announced the Smart Cities Challenge initiative, with a total budget of $300 million to be delivered in three tranches over six years. The Smart Cities Challenge was designed as a pan-Canadian competition open to communities of all sizes, including municipalities, regional governments and Indigenous communities. Its purpose is to encourage communities to adopt a smart cities approach to improving the lives of their residents through innovation, data and connected technology. The finalists in the competition were announced in June 2018, and the announcement of the winners is expected in spring 2019.[43] The challenge generated a tremendous amount of urban planning and civic engagement in cities and communities of all sizes across the country. Given the high proportion of Canada's population that lives in cities and the share of GDP that is generated there, the opportunities for enhancing Canada's global innovation and productivity standings in the world lie in the efficiencies created in its cities through ongoing smart city transformations. Even though the end of the competition will see only a relatively small number of successful smart cities, the challenge should be used as an opportunity both to

[43] See Infrastructure Canada, "Smart Cities Challenge" (Ottawa, November 19, 2018), http://www.infrastructure.gc.ca/cities-villes/index-eng.html.

improve the quality of Canadian urban life and to support opportunities for Canadian firms to participate in this expanding global market.

The policy issues related to the coming of connected and autonomous vehicles and, more broadly, intelligent mobility, are similar to those raised by the smart city phenomenon. Intelligent mobility and smart sensors will be the defining technologies of future cities. Smart cities and intelligent mobility will thrust data governance, along with land use, urban design and transportation planning issues, to the centre of the policy agenda. To prepare for this coming transition, new federal, provincial, territorial and municipal consultation and coordination processes are needed to address four key issues:

- how the data gathered through the development of infrastructure for new forms of urban mobility, such as the Quayside project in Waterfront Toronto, are to be controlled and managed;
- how the adoption of new forms of urban mobility – particularly connected and autonomous vehicles – will influence urban design and the building of new infrastructure;
- what opportunities government should support in developing cross-sectoral innovation and investment at the intersection of the traditional transportation industries and new forms of digitally enabled mobility; and
- what the broader implications are of new forms of connected and autonomous vehicles for the existing transportation sector and its respective labour markets across the economy.

Each of these areas requires complementary strategies to ensure that Canada maximizes the benefits and mitigates the downsides of the profound transformations that are right around the corner.

THE DIGITAL PROMISE

Most countries are positioning their digital sectors as critical drivers of future economic growth. The proposals presented in this paper, and the underlying research that accompanies them, would help ensure that Canada is not left behind. Not since the onset of the first industrial revolution have we seen such an interconnected set of technologies with the potential to disrupt established industries and economic patterns, as well as to generate new opportunities for future generations. Bear in mind that a vibrant digital economy is not an end in itself; it also has wide implications for society. The ability of governments to seize the digital opportunity and lay the foundations for future growth will depend on realizing three key goals: promoting the diffusion of digital technologies across all sectors of the economy, assisting companies with the commercial potential to grow to a scale that enables them to compete in the global marketplace and supporting the emergence and growth of firms with the potential to bring new disruptive products and services to global markets.

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IRPP
1470 Peel Street, Suite 200
Montreal, Quebec H3A 1T1
Telephone: 514-985-2461
Fax: 514-985-2559
irpp@irpp.org