RGI
Regulatory Governance Initiative

Regulating for Innovation in an Age of Disruption

DISCUSSION PAPER

A discussion paper prepared by Jonathan Butler and Ian Currie
Strategy, Research and Results Branch
Innovation, Science and Economic Development Canada

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Prologue

What's a government to do? A technology emerges that stimulates productivity and economic growth, provides economic and social opportunities for the middle class, and attracts vast sums of private capital. Significant investment in supportive public infrastructure is required. The new technology enables the development of global value chains of production with the high value segments being captured by the home country. A number of the new technology companies grow to international scale. Many others are speculative and lose large sums of money invested by the middle class. Market bubbles threaten the financial stability of financial institutions. Patent infringement by foreign companies is a growing concern as, conversely, is the abuse of patent privileges by rights' holders. The larger technology companies are discriminating monopolists, charging different prices to different groups of consumers that are unrelated to costs of providing services. There is public criticism of dominant incumbent companies: inferior services for lower-income consumers; insufficient attention to public safety and security; restricted and high-priced access to ancillary communication services; the negotiation of exclusive deals with suppliers; and protection of technical standards to keep rivals at bay.

The time is the mid-nineteenth century. The technology platform is the steam locomotive railway. The government is that of the United Kingdom (UK). The strategic problem is inadequate transport in the context of an industrial revolution in a globalizing economy.

The UK Government's substantive response began in the 1840s with the regulation of prices, safety standards, exclusive dealing, standards for third-class travel, and new public obligations on railway companies (for example, the carrying of mail, troops, and police and broadening access to rail company telegraph lines and rights-of-way). Patent reform in the 1870s provided for a reduction of patent protection to seven years, strictest examination of patent applications, forfeit of patents not utilized after two years, and compulsory licensing of patents. To address financing issues, regulatory reforms to corporate finance and corporate governance are made in the 1850s (for example, allowing the introduction of limited liability companies and permitting the development of financial corporations). Yet the waves of speculative booms in railways continued and, in 1866, led to a financial crisis requiring a bail out of the UK banking sector.

The UK Government's regulatory framework for the steam railway was one determinant of the form, timing, and distribution of benefits derived from innovation in the nineteenth century. The diffusion of the steam railway (and its technological cousin, the steamship) helped fuel the British Empire's economic growth through to at least 1900. The purchasing power of wages in the UK climbed during the second half of the nineteenth century although income inequality in the UK diminished only after 1900. Economic and social opportunities for the middle class opened up through improved physical mobility.

Sources: Cruikshank (1991); Gratwick (2001); McLean (2002); Stern (2003); Satya (2008); Marsh and Marshall (2009); Odlyzko (2010); Piketty (2014); and Simpson (2015).

INTRODUCTION

Today's digital and data-driven economy opens up new opportunities for innovation, growth and jobs but also brings new competitive challenges for businesses and public policy challenges for governments. Businesses and governments are focussing their effort on areas that are prerequisites for success: adopting new digital technologies and capabilities aligned with business ambition, strategy, and market potential; supporting the acquisition by citizens of skill sets that are robust even as the pace of digitally driven change in the workplace accelerates; and preparing themselves today for continuous disruptive economic and social change that is shaped in part by the marrying of data and digital technology.

It is increasingly evident that governments and regulators must respond with greater agility and speed to the pace and form of change today if they are to better meet regulatory objectives — economic and social — set out in law and policy. How they might do so requires attention to frequently linked questions of regulatory policy content and regulatory process. When should the regulator intervene, if at all? What form of intervention best takes into account the uncertainties of an innovation? How long should the regulatory intervention last? Should there be an enforcement regime and, if so, what form should it take? What are the implications for regulatory governance arising from the blurring of boundaries between industry sectors and between regulatory authorities?[1]

Within this context, the purpose of this backgrounder is to provide, through many different examples drawn from Canada and abroad, an overview of the current state of the relationship between regulation and innovation. This backgrounder is presented in three sections:

- section I highlights policy drivers and lessons from past Canadian federal regulatory reform efforts. Recent developments in regulatory best practices are then reviewed from an innovation policy perspective;

- section II presents examples of regulatory responses in Canada and foreign jurisdictions to disruption in the six Economic Strategy Tables announced in Budget 2017: clean tech; clean resources; health/biosciences; agrifood; digital industries; and advanced manufacturing; and,

- section III presents considerations for future federal regulatory reform in favour of innovation.

[1] Several of these questions have been raised by Cortez (2014).

SECTION 1 — CONTEXT AND BEST PRACTICES

1.0 Context

The Canadian federal regulatory experience has been marked by episodic efforts for whole-of-government regulatory reform driven by a variety of macro-drivers — in the 1970s, economic nationalism; in the 1980s, neoliberal economic thinking; in the 1990s, federal budgetary pressures; and, since 2000, commodity price volatility, a global financial crisis and recession, intensifying global competition, the rise of the digital economy, and climate change challenges. Annex I contains a list of the major milestones in federal regulatory reforms associated with these and other macro-drivers.

Over time there has been an effort to develop more systematic regulatory review processes in Canada and other OECD jurisdictions. In Canada there are statutory requirements stipulating periodic legislative and regulatory policy reviews. Canadian federal cabinet directives on regulatory management have included requirements for systematic reviews of federal regulatory regimes (Canada, 2012). In 2017 the Treasury Board of Canada published for public consultation revisions to the 2012 *Cabinet Directive on Regulatory Management*. The draft revisions emphasize a lifecycle approach to continuously improve the regulatory system. They suggest regulators should be required to seek out opportunities to engage Indigenous Peoples and stakeholders. They propose that regulatory co-operation and regulatory alignment across all levels of government should be undertaken to minimize cumulative and unintended impacts of regulations on Canadians, business, and the economy (Canada, 2017c).

Embedded requirements for periodic regulatory reviews, including life-cycle approaches, have value. They may also result in regulatory delay in responding to rapidly changing circumstances. On this subject area, the *Review of the Canada Transportation Act* (Emerson) states: “One objective should be to eliminate the necessity to hold periodic major reviews of the Act, in favour of an evergreen process of consultation, dialogue, and adaptation.” (Canada, 2015a: 17) For over a decade the OECD and the Treasury Board of Canada have cited periodic regulatory reviews and life-cycle approaches as best practices in regulatory management. But it may be argued that such best practices have not yet been shown to be as powerful an influence on regulatory reform as have larger macro drivers, such as those identified in Annex I, or various shocks to regulatory systems.

Shocks to regulatory systems are a driver of specific regulatory reforms

Shocks to regulatory systems have historically been a regular driver of regulatory reform and new interventions in specific areas. Examples include:

- the thalidomide drug tragedy in the early 1960s led to the complete revision of the *Food and Drugs Act* and regulation of drug approvals;

- federal reforms to health and food regulatory systems followed the contamination of the national blood supply, water contamination, the appearance of Severe Acute Respiratory Syndrome (SARS), a widespread outbreak of listeriosis, and the emergence of Bovine Spongiform Encephalopathy (BSE) in beef cattle;

- two Canadian bank failures in the 1980s contributed to a government decision to establish a regulatory agency responsible for the regulation and supervision of all federally chartered, licensed or registered banks, insurance companies, and trust and loan companies; and,

- the 2013 Lac-Mégantic rail disaster led Transport Canada to issue an emergency directive and a series of prescriptive regulatory amendments for rail safety.

When things go wrong, there is often an initial bias in favour of prescriptive regulation

When the function of a regulatory regime is to address risk to human health and life, and this objective is not achieved, reform and prescriptive (command and control) regulation often follows. Potential administrative burdens and costs are generally not viewed as unreasonable. When regulatory objectives are less directly intended to address risk to human health and life (including wide swaths of economic regulation but also areas of social regulation), shocks to regulatory systems may initially result in extensive new prescriptive regulation, but concerns over administrative burden often return with a vengeance. One example is the European Union (EU) and US regulatory response to the 2007 global financial crisis that has been followed by second thoughts (see Haldane, 2012).

Major areas of economic and social risk are no longer domestic, but global in reach

Innovation is accompanied by new uncertainties and risks that cross borders. This is why the federal government has increasingly focused on international regulatory co-operation and harmonization initiatives. Federal Budget 2017 provides the Treasury Board Secretariat with $6 million over three years to promote regulatory alignment with Canada's trade partners.

Technology by itself has not been a major driver of regulatory reform

Technology developments can change underlying costs and competitive structures and open up room for the development of new business models. Their role in driving regulatory reform is less clear. In general, regulators focus on how technologies are used and applied, including within the context of new business models, rather than on the technologies themselves. This is not a distinction without a difference. It is, as described in Section II of this backgrounder, a prominent feature of Canadian federal regulatory systems.

The main technical means to assess the costs and benefits of regulation is Cost-Benefit Analysis (CBA)

CBA is conducted by Canadian federal regulatory departments for major regulatory proposals. The draft revision to the *Cabinet Directive on Regulatory Management* refers to "business opportunities, growth and innovation" as an example of regulatory benefits that should be considered in regulatory CBA (Canada, 2017c). In Canada and other jurisdictions the available taxonomies of benefits are not as sophisticated as the ones developed for costs, including when it comes to innovation (see Renda, 2016). Moreover, after-the-fact analyses of whether a regulatory CBA proved to be accurate within a margin of error are generally not undertaken. Another challenge for regulatory CBA is maintaining public trust and confidence. Studies conducted over the past decade suggest that CBA, as designed and deployed today, is often distrusted in a social media age where citizens are less willing to accept the opinions of traditional sources of authority (Nou, 2007, Flyvbjerg, 2009, Scott et al., 2016, OECD, 2017a, Lewis and Currie, 2018, and Kavanagh and Rich, 2018).

1.1 Recent Developments in Best Practices

The world and its markets can be messy places. This can work in favour of regulators who seek to accommodate innovation. It provides them with space to calibrate their strategies to the circumstances at hand. How well they do so depends on their knowledge of the state of competition and innovation. Cortez (2014) suggests that regulators rarely have sufficient information in cases where the diffusion and application of a new technology gives rise to business models that do not square well with regulatory frameworks. They are confronted with making four types of decisions to which the best answers are not always apparent.

Four Decisions When Regulating for Innovation

- **Timing.** When should the regulator intervene, if at all? Does waiting necessarily generate a better informational basis on which to regulate? What are the drawbacks of waiting?
- **Form.** Should the regulator act via rule, adjudication, guidance, or some alternate form? Given the costs and benefits of each, which best accommodates the uncertainties of the innovation? Does form even matter?
- **Durability.** Should the agency's intervention be permanent, or temporary, or conditional? How long should it endure? And are there ways to better calibrate regulatory interventions to the innovation?
- **Enforcement.** How rigorously should the agency monitor and sanction noncompliance? How much should agencies temper enforcement against novel products, firms, or industries?

Source: Cortez (2014)

Performance-based and prescriptive regulation

Performance-based regulation specifies required outcomes or objectives, rather than the means by which they must be achieved. Firms and individuals are able to choose the process by which they will comply with the law. This allows them to identify processes that are more efficient and lower cost while also promoting innovation and the adoption of new technologies on a broader scale (OECD 2012, 2015a and 2015b).

Prescriptive regulation defines how activities are to be undertaken and precisely how results are to be achieved. This approach emphasizes a known degree of risk mitigation over innovation or cost management (Guerin, 2003). Beginning in the 1980s, prescriptive regulatory approaches increasingly fell out of favour – notably at the same time that the role and size of government in the economy came under scrutiny.

The federal government's 2003 External Advisory Committee on Smart Regulation (EACSR) sought to move federal regulation in a direction more accommodating to technological change and innovation. EACSR reported that greater use of performance-based regulatory standards would give stakeholders the flexibility to comply with these standards through innovative means while still respecting the policy goals of the regulation (Canada, 2004).

Draft revisions to the *Cabinet Directive on Regulatory Management* under consideration by the Treasury Board of Canada reinforce this regulatory policy direction, stating that departments and agencies should seek to design outcome-based or performance-based regulations, when appropriate, with a view to minimizing the amount of regulatory burden imposed on businesses and Canadians (Canada, 2017c).

Judith Hanebury (2014), former General Counsel of the National Energy Board (NEB), has written on the NEB's experience in designing and implementing performance-based regulation. She observes:

- performance-based regulation places more emphasis on inspections and audits, the timing and frequency of which are underpinned by a determination of where the Board's resources should best be focussed. In the early 2000s, NEB audits were criticized as too infrequent, which brought into question whether the Board was assured that compliance was occurring. The NEB later took a risk-based approach to determining the frequency and location of audits and inspections; and,

- performance-based regulation requires investment by the regulator and regulatees in performance indicators and monitoring arrangements. Several stakeholders indicated to the NEB that they would prefer to simply comply with what regulators wanted, rather than be required to develop and implement management or other systems to comply with goal-oriented regulations.

Other best practices in regulating in favour of innovation

There are a number of lists of best practices for regulating in favour of innovation (see Annex II) but they have yet to be endorsed by any government. The lists vary in content and scope. They offer different views on how questions of timing, form, durability, and enforcement might be addressed when regulating for innovation.

The Australian Productivity Commission suggests that regulators adopt a "wait and see" approach to new business models and products rather than reacting quickly to regulate what may be unrealized risks (APC, 2016: 101). In contrast, Mandel (2009) asserts that the emergent phase of technological disruption is characterized by great uncertainty for all parties. He proposes that a high degree of uncertainty and a low degree of attachment to the status quo can present a unique opportunity to bring together diverse stakeholders to produce collaborative governance in favour of innovation.

There are examples of collaborative regulatory governance in today's digital age. One model is represented by the emergence of internet governance. In 2005, the UN-sponsored World Summit on the Information Society defined internet governance as the development and application by governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programs that shape the evolution and use of the internet (UN, 2005). According to Masters (2014), many information policy experts emphasize that internet governance is not the product of an institutional hierarchy, but rather, it emerges from the decentralized, bottom-up coordination of tens of thousands of mostly private-sector entities across the globe. Often referred to as internet stakeholders, these include network and server operators, domain name registrars and registries, IP address and standards organizations, internet service providers and individual users. Civil society organizations and governments participate alongside these stakeholders in contributing to the development of technical policies.

Collaborative regulatory governance models are not without their own challenges compared to traditional and often adversarial forms of rule-making. There are issues relating to participation and impact on the legitimacy and reputation of regulation and regulators (Haber and Heims, 2016). Ansell and Gash (2007) identify variables impacting on the outcomes of collaborative governance models: the prior history of conflict or co-operation; the incentives for stakeholders to participate; power and resources imbalances; and leadership and institutional design. They suggest that success factors include: face-to-face dialogue, trust building, and the development of commitment and shared understanding.

In Canada, Sunil Johal and Michael Crawford Urban of the Mowat Centre think tank have offered an extensive list of practical and useful proposals to strengthen regulation from an innovation perspective (Johal and Crawford Urban, 2017). Many of their proposals fall within the realm of best practices in regulating for innovation (see Annex II). Johal and Crawford Urban suggest that a new Deputy Minister level federal position of "Innovation Advocate"

reporting to the Clerk of the Privy Council be established (or even a new Officer of Parliament for Innovation position be established). It remains for consideration if, rather than setting up another level of regulatory review and oversight (a function already exercised by the Treasury Board of Canada), it may be better for federal regulatory authorities to take their own initiatives to regulate in favour of innovation.

Recommendations from the Advisory Council on Economic Growth (2017) and the early reports of the six Economic Strategy Tables

In December 2017 the federal government's Advisory Council on Economic Growth published a report on *Investing in a Resilient Canadian Economy (*Canada, 2017h). The report contains an extensive discussion on regulating in favour of innovation. In response to the Council's report, and early reports of the six Economic Strategy Tables, Budget 2018 proposes to provide $11.5 million over three years, starting in 2018–19, for the Government to pursue a regulatory reform agenda focused on supporting innovation and business investment. The 2018 Budget states that the goal is to make the Canadian regulatory system more agile, transparent and responsive, so that businesses across the country can explore and act on new opportunities, resulting in benefits for all Canadians. The approach includes:

- targeted reviews, over the next three years, of regulatory requirements and practices that are bottlenecks to innovation and growth in Canada, with an initial focus on agri-food and aquaculture, health/bio-sciences, and transportation and infrastructure, including emerging technologies such as autonomous vehicles.

- Canada's leadership on internal trade at the Canadian Free Trade Agreement (CFTA) Regulatory Reconciliation and Cooperation Table. (The CFTA establishes a process for reconciling regulatory measures that act as a barrier to trade, investment, or labour mobility within Canada, cooperation in the development of future regulatory measures, and a requirement for notification when a Party to the agreement proposes to adopt or modify a regulation that may have a significant effect on trade or investment within Canada).

- developing an e-regulation system — an online platform modelled on the U.S. Office of Information and Regulatory Affairs website Regulations.gov — to engage Canadians on regulation in order to improve the transparency and efficiency of the overall rule-making process.

Budget 2018 also announced that the Government proposes to introduce legislation to reduce the regulatory burden face by businesses, including streamlining Canada's *Customs Tariff* legislation in order to simplify its structure and administration (Canada, 2018a: 118).

SECTION II – REGULATING IN FAVOUR OF INNOVATION

2.0 Approach

This section presents examples of regulatory approaches in Canada and abroad to disruption in the Economic Strategy Table sectors of: clean tech; clean resources; health/biosciences; agrifood; digital industries; and advanced manufacturing. Many of the Canadian examples are from the federal regulatory domain, but disruptive business models — and innovation more generally — do not always recognize constitutional niceties. How well federal regulation can seamlessly work with provincial and local regulatory systems is an important underlying theme in the following pages.

It is worth recognizing at the outset that Canadian regulators, and those in most OECD jurisdictions, are generally neutral when it comes to technology. This may be regarded as a good thing from both an innovation as well as a practical perspective. Canadian legal scholar Carys J. Craig writes that, from a principles perspective, neutrality and non-discrimination in the law are almost always laudable goals and, from a practical perspective, technologically neutral regulation holds the promise of sustainable laws in a time of rapid technological change. However, she also points out that technological neutrality has many shades of meaning, and, of course, different meanings can produce differing applications with more or less desirable results (Craig, 2013: 273). Examples of federal regulatory policy based on the principle of technological neutrality are:

- technological neutrality is a principle followed by the Canadian Radio-television and Telecommunications Commission (CRTC) as a result of a 2006 Order in Council (Canada, 2006);

- the federal *Personal Information Protection and Electronic Documents Act* (PIPEDA) takes a technology-neutral approach;

- the principal of technological neutrality is included within the Canada-European Union Comprehensive Economic and Trade Agreement's regulatory co-operation chapter (CETA, 2016);

- The Competition Bureau of Canada's 2017 market study on technology-led innovation in financial services recommends that regulation be technology-neutral and device-agnostic (Canada, 2017m: 8).

Technological neutrality, in and of itself, is not necessarily at odds with sector-specific regulation. As we now turn to look at sector-specific regulatory regimes, starting with clean tech, the two can often work in concert.

2.1 Clean Tech

2.1.1 Introduction

The Government has said that clean tech is key to its approach to promoting sustainable economic growth and Canada's transformation into a low-carbon economy (Canada, 2016b and 2017). There are many examples of regulatory systems in Canada designed to accommodate innovation in clean tech. Some recent government and industry sponsored statements and studies find existing regulatory regimes are falling short. But the regulatory issues of concern and potential solutions are seldom set out with any great precision (see Canada, 2016d, WGCT, 2016, Williams, 2016: 53, and SCNR, 2017: 13).

2.1.2 Energy Optimization

National Codes

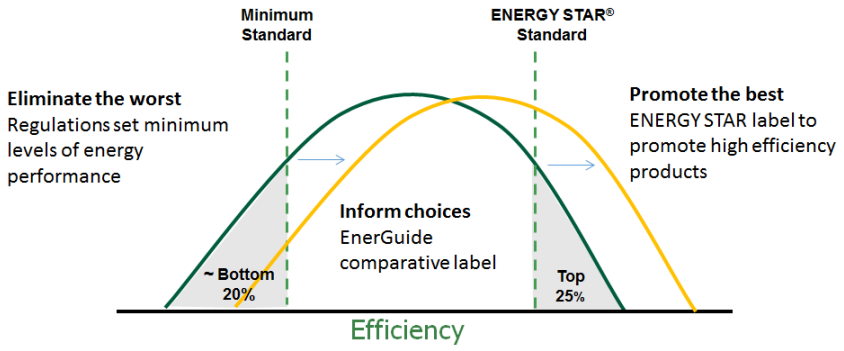
Canada's 2016 *Pan-Canadian Framework on Clean Growth and Climate Change* provides that federal, provincial, and territorial governments will: develop and adopt increasingly stringent model building codes starting in 2020; and meet the goal that provinces and territories adopt a "net-zero energy ready" model building code by 2030. The Framework states that new building codes will spur innovation and support Canadian businesses in developing more efficient building techniques and technologies (Canada, 2016c: 15). Some business stakeholders suggest that governments take a prudent approach to implementing the net-zero model building code (McCarthy, 2016). The Canadian Home Builders' Association (CHBA) is a supporter of the Net-Zero housing concept and has said: "…any additional code and regulatory requirements must follow proven technology innovation and ensure that their implementation does not reduce affordability." (CHBA, 2016: 8)

Energy Efficiency Regulations

Canada's *Energy Efficiency Regulations* are a distinctive regulatory model (Canada, 2017i). The regulations set out Minimum Efficiency Performance Standards (MEPS – which manufacturers can choose the best method to meet) that work in tandem with the ENERGY STAR® labelling program — an international standard for the labelling of energy-efficient products. The MEPS and labelling programs drive product innovation by raising requirements for minimum energy performance and pulling the market forward with labels

for top-performing products (Canada, 2016a: 1171). This regulatory model for energy efficiency, GHG reduction, and innovation, is generally acknowledged to have worked well (Science-Metrix, 2015, AHAM, 2017, and UN, 2015).

Figure 1
A regulatory model to eliminate the worst and promote the best and most innovative



Source: Natural Resources Canada.

The US Environmental Protection Agency (EPA) and the US Department of Energy (DOE) have operated a similar regulatory model in the US since 1991. Work has been underway for some time to ensure that Canadian and US energy efficiency standards and ENERGY STAR® labelling programs are harmonized (Canada, 2017i). In early 2017 the US Administration proposed eliminating the US ENERGY STAR® program or transferring it to a non-governmental entity (US, 2017a). In July 2017 the US House of Representatives Appropriations Committee recommended reducing the program's funding levels. As of this time of writing, the US Congress had not yet passed an appropriations bill for FY 2018 (US, 2017, Ungar, 2018, and HPC, 2018).

The US Administration set out a further proposal for the future of the ENERGY STAR® program in its FY 2019 Budget released in February 2018. The US Administration proposes that product manufacturers that seek to label their products under the program would pay a modest fee to support the EPA's work to set voluntary energy efficiency standards and to process applications. Fee collections would begin after the EPA undertakes a rulemaking process to determine which products would be covered by fees and the level of fees, and to ensure that a fee system would not discourage manufacturers from participating in the program or result in a loss of environmental benefits (US, 2018: 105-106).

2.1.3 Vehicle emission, fuel economy, and clean-fuel standards

Vehicle emission and fuel economy standards

On January 13, 2017, seven days before the inauguration of a new US President, the US Environmental Protection Agency (EPA) affirmed its determination on carbon dioxide emission and fuel efficiency standards for light-duty vehicles. The EPA found that automakers are well positioned to meet the standards at lower costs than previously estimated (US, 2017e). Then, in March 2017, a new US Administration announced that the EPA would reinstate the Midterm Evaluation of the Corporate Average Fuel Economy (CAFE) and greenhouse gas emissions (GHG) standards for the automotive industry (US, 2017b).

Canada has historically sought to harmonize its vehicle energy efficiency and emissions standards with those of the US given the integrated structure of the Canada-US automotive industry. Evolving US regulatory circumstances at both US federal and state (i.e., California) levels may have implications for Canadian regulatory standard setting in both areas. They may be one consideration for the federal government's National Advisory Group on a National Zero-Emissions Vehicle Strategy (Canada, 2017g).

Clean-fuel standards

In November 2016 the federal government announced that it would start development of a performance-based clean fuel standard (CFS) that would incent the use of a broad range of low-carbon fuels, energy sources and technologies. The Minister of Environment and Climate Change Canada (ECCC), the Honourable Catherine McKenna, stated that: "This clean fuel standard will be a made-in-Canada approach that will provide flexibility to industry in how they innovate, and reduce emissions throughout the fuel system." (McKenna, 2016)

Stakeholder consultations on the proposed CFS were held throughout 2017. Several stakeholders expressed support for the application of the CFS to the transportation sector first, followed by the building and industrial sectors. Some stakeholders called for a voluntary opt-in option to the CFS for the industrial sector and for accompanying incentive-based funding programs. Others requested differentiated treatment under the CFS with due consideration given to intermediary products, regional circumstances and competitiveness (IISD, 2017: iv).

In December 2017 ECCC issued design elements for CFS regulation, including its scope, regulated parties, carbon intensity approach, timing, and potential compliance options such as credit trading. ECCC plans to publish draft regulations in the Canada Gazette, Part I in 2018 and final regulations in the Canada Gazette, Part II in mid-2019. Carbon intensity requirements for liquid, gaseous and solid fuel streams will come into force at the same time (Canada, 2017b). Some observers report that, because of the multiple layers of regulations that are already in place at the federal and provincial levels in this area, ECCC

will need to give careful consideration as to how the implementation of the CFS may impact provincial initiatives in the same area (Lee-Anderson, 2017).

2.1.4 Other regulatory instruments for clean tech

Using regulation to help drive demand for clean tech innovation is not risk-free. Successes and failures have marked regulatory designs in Canada and abroad, including those that incorporate feed-in-tariffs, renewable portfolio standards, carbon pricing, smart grids, and other features intended to stimulate demand for clean tech development and adoption. Taken together, the lessons learned — and there are different views on what these may be — represent a regulatory learning curve for governments and business. For example, the initial regulatory regime implementing the Government of Ontario's 2009 *Green Energy and Green Economy Act* has been reported as creating a "gold rush" response from potential developers seeking feed-in-tariff contracts for renewable energy (see Winfield et al. 2013, Rodger, 2014, and Auditor General of Ontario, 2015). The Government of Ontario later revised many technical features of the regulatory regime.

Summary

Regulatory systems in Canada are often more accommodating of innovation in clean tech than generally may be thought. They sometimes set a pace that is faster than incumbent businesses and other stakeholders wish to take. Evolving US regulatory circumstances may pose a challenge for developing innovation friendly regulations for clean tech in Canada.

2.2 Clean Resources

2.2.1 Introduction

IBM Canada and the Calgary-based non-profit Centre for Resource Solutions (CRS) have written that Canada's natural resource sectors are being disrupted by many economic and social forces, including: volatile energy prices; reduced production reliability; uncertain market access; government climate change agendas; and tightening environmental policy along with safety and compliance requirements. At the same time, the natural resource sectors have access to a tremendous amount of valuable data, technology and research capabilities to address these changing circumstances. How well are they doing? IBM and CRS report that:

- in general the sectors are very good at collecting data as illustrated by the growth in data management service providers; however,
- in the last five to ten years the growth in computing power and advanced technologies to capitalize and draw insight, understanding and predictions from historical data, and public data sources, has not been fully realized; and,

- the Canadian oil and gas industry still struggles with turning data into actionable insights that drive faster, safer and more intelligent work: “The evolution of the industry from outdated legacy systems — not capable of handling the data and computer processing power available today — to more powerful operational focusses enabled digital systems will take time, effort, capital and most of all, a significant cultural change in the way the industry works and operates.”(IBM and CRS, 2017)

In light of these circumstances, how can regulatory systems for clean resources be more accommodating of innovation?

2.2.2 Environmental assessment and approval processes

Resource industry stakeholders have pointed to the administrative and operational burden of the combined federal and provincial regulatory systems as a constraint on their ability to: invest in innovative resource extraction, recovery, and distribution technologies; and compete against other suppliers in Canadian, North American, and global markets (CAPP, 2017).

Two federal expert panel reports on regulatory regimes impacting on the natural resource sectors were delivered in early 2017: one on the modernization of the National Energy Board; and the other on the federal environmental assessment process (Canada, 2017a and 2017f). In June 2017 the Government initiated an extensive public consultation process based on a *Discussion Paper on Environmental and Regulatory Reviews* (Canada, 2017e).

In February 2018, the Government announced that it will bring forward better rules to: protect the environment, fish and waterways; rebuild public trust in how decisions about resource development are made; encourage investment; and create new jobs and economic opportunities for the middle class (Canada, 2018b). The Government proposes, among other changes, to establish a new Canadian Energy Regulator (CER) to replace the National Energy Board and a new single agency, the Impact Assessment Agency of Canada, to lead all impact assessments for major projects (Canada, 2018b).

The Government has said that among the many benefits of the proposed new rules and institutional changes are: modern and effective governance, greater transparency, predictability and timeliness in decision-making, increased Indigenous participation, advancing a clean-growth economy, better positioning Canada to maintain its global competitiveness, strengthening safety and environmental protection, a more efficient and predictable impact assessment system that will give companies the clarity they need, and greater coordination with provinces and territories to reduce red tape and duplication (Canada, 2018).

2.2.3 RegTech for clean natural resources

There are other emerging regulatory opportunities in the natural resource sectors to encourage innovation and achieve better economic and social outcomes that are starting to appear in Canada and other jurisdictions. For example, it was pointed out earlier in this backgrounder that monitoring and compliance costs associated with principles-based regulatory models have been a significant issue in the past both for regulators and regulatees in natural resource sectors. There are a growing number of new digital technologies – including in oil and gas production and distribution industries – that might be drawn upon to help address this issue (Redutskiy, 2017, and Mittal, 2017).

For example, regulators for the natural resource sectors — and very likely all regulators whatever their sectoral focus may be — will need to consider the role of what is known as Algorithmic Regulation (AR). The main features of AR have been described by Silicon Valley entrepreneur Tim O'Reilly (2013) as being: a deep understanding of the desired regulatory outcome; real-time measurement to determine if that outcome is being achieved; algorithms (i.e., a set of rules) that make adjustments based on new data; and periodic, deeper analysis of whether the algorithms themselves are correct and performing as expected.[2] Advanced AR applications are becoming a more prominent feature of the regulatory environment in financial services (e.g., meeting reporting and compliance requirements) but their application in natural resource sectors remains at an early stage of development. The potential benefits and risks of AR in natural resources and other sectors are drawing the attention of academia, businesses, and governments (see Andrews et al., 2017, Yeung, 2017, and UK, 2018).

Summary

US federal regulatory directions in its resource sectors are diverging from those in Canada's resource sectors. This makes it more important than ever that the Canadian regulatory environment is shaped to achieve Canadian social and environmental objectives but in ways that strengthen innovation and competitiveness. The Government's February 2018 proposals to strengthen environmental assessment and approval processes may move Canada in this direction. There are emerging areas of opportunity where the application of digital innovations could improve regulatory system performance for natural resource sectors.

[2] Algorithmic Regulation is a subset of the broader concept of RegTech. Samuels and van den Dolder (2017) describe RegTech as the intersection between new technology and regulatory compliance. It applies cognitive computing, data analysis, a seamless user experience, and other fintech principles to regulatory requirements in order to simplify, streamline, and automate the process. According to these authors, Regtech has already begun reducing overhead for larger firms and reducing barriers to entry for market entrants, including fintech firms competing in the traditionally heavily regulated and big-player centric financial services market.

2.3 HEALTH/BIO-SCIENCES

2.3.1 Introduction

Many studies have highlighted how digital technologies are disrupting the health sector (e.g., Frost and Sullivan, 2016, European Commission, 2016, and OECD, 2017). The current disruption is bringing new subjects onto the regulatory agenda while casting older subjects, such as the speed of regulatory review of new products, in new light.

2.3.2 Software as a Medical Device

Internationally harmonized frameworks for Software as a Medical Device (SaMD) are being developed through the International Medical Device Regulators Forum (IMDRF). Whether the IMDRF will be able to keep pace with the changing medical-technological landscape remains to be seen. In the US, the Food and Drug Administration (FDA) has established a new Digital Health Unit (DHU) geared to the regulation of software as a medical device. The DHU staffing plan calls for 13 engineers in the fields of software developers, artificial intelligence, and cloud computing (Brennan, 2017 and Molteni, 2017).

In October 2017 the Senate of Canada's Standing Committee on Social Affairs, Science and Technology (SCSST) issued a report on *Integrating Robotics, Artificial Intelligence and 3D Printing Technologies into Canada's Healthcare system* (SCSST, 2017). According to the report, Health Canada indicated to the Committee that: under the *Canadian Medical Devices Regulations* the department has approved and issued licences for innovations in robotics, AI and 3D printing; and that the current regulatory framework is appropriate for responding to evolving technologies. However, other witnesses suggested that the regulatory framework could be more responsive (SCSST, 2017: 28). The report contains 14 recommendations, including that: the Government of Canada convene a national conference on robotics, artificial intelligence and 3D printing in healthcare; and that various expert working groups be established, one of which should be on regulatory oversight to address specifically, but not exclusively, whether any updates to the *Medical Devices Regulations* are required (SCSST, 2017: 39-40).

2.3.3 Cybersecurity

Cybersecurity in the field of healthcare is of concern for health regulators around the world (and obviously is a key issue across all digital economy sectors). For example, in December 2016 the US FDA issued a final guidance document on post market management of cybersecurity in medical devices. The guidance provides a non-binding recommendation for managing post-market cybersecurity vulnerability for marketed and distributed medical devices (US, 2016). The guidance came in the wake of several medical device cybersecurity incidents in the US. Most recently, in August 2017, the US FDA issued a safety communication on potential cybersecurity concerns involving malicious interference with

battery life or essential programming functions in several pacemaker models made by a US-based medical device company (Kramer and Fu, 2017).

The US FDA's approach to cybersecurity for medical devices is closely coordinated with broader US federal government policies for cybersecurity, including an emphasis on sharing of cyber risk information. Companies who voluntarily participate in federally certified cybersecurity Information Sharing Analysis Organizations gain certain protections, including relief from enforcement of certain reporting requirements under the US *Federal Food, Drug, and Cosmetic Act*. These protections remain subject to a variety of conditions (Farell and Hanet, 2016).

2.3.4 Artificial intelligence (AI) and big data

The emerging models of collaboration between AI businesses and national healthcare systems can be controversial and subject to investigation under regulatory frameworks for privacy. For example, the sharing of patient data information between a UK National Health Service Trust hospital and Google's DeepMind AI unit was scrutinized by the UK's Information Commissioner's Office (ICO). In July 2017, the ICO ruled the Royal Free NHS Foundation Trust failed to comply with the UK *Data Protection Act* when it provided patient details to DeepMind (see UK, 2017c and 2018, and Powles and Hodson, 2017).

The UK Government's 2017 Autumn Budget announced that £75 million would be allocated to take forward key recommendations of an independent review on AI, including exploratory work to facilitate data access through 'data trusts'— a set of relationships underpinned by a repeatable framework, compliant with parties' obligations (including regulatory obligations), to share data in a fair, safe and equitable way (see UK, 2017, 2017a, and 2017b, Hall and Pesenti, 2017, and LSISB, 2017).

In Canada, the Canadian Agency for Drugs and Technologies in Health (CADTH) is monitoring developments in AI as part of its horizon scanning activities. Regulatory approaches to data ownership, privacy and data protection in Canada and abroad are emerging as being of equal importance for AI innovation in healthcare as are product classification and review processes (see ICDPPC, 2016 and SCSST, 2017).

2.3.5 Regulatory review times for innovative health products

A December 2017 report from the federal government's Advisory Council on Economic Growth states that regulatory review times for drugs are lagging in Canada relative to other countries: "For instance, researchers cite the stringency and detailed filing requirements of our regulatory system as one of the reasons that new drugs are introduced to Canada, on average, almost a year and a half after they are in the United States or Europe." (Canada,

2017h: 12)[3] The Council cites peer-reviewed research by Hollis and Sharjarizadeh (2015) to support this assertion. In fact, Hollis and Sharjarizadeh do not attribute Canadian regulatory lags to "the stringency and detailed filing requirements of our regulatory system." On the contrary, the two authors conclude that although stringency may have had some impact on the timing of submissions, it was not a strong factor for differences in submission delays between jurisdictions (Hollis and Sharjarizadeh, 2015: E49). They do find that:

- accessibility to new drugs in Canada is delayed primarily because of delays in submission to Health Canada by pharmaceutical companies and not because of a longer approval-processing time at Health Canada.

- corporate capacity of the pharmaceutical companies and priority status of new drugs appear to be the most important determinants of submission delays.

- harmonization of the regulatory processes of the FDA and Health Canada may accelerate new drug submissions in Canada. (Hollis and Sharjarizadeh, 2015)

Hollis and Sharijarizadeh report that not all companies have the capacity inside Canada to navigate the regulatory submission process. Larger companies are more likely than smaller ones to have dedicated staff in Canada with such expertise. Therefore, smaller companies may choose to prioritize their submissions to larger markets (Hollis and Sharjarizadeh, 2015: E49). This is important, as it suggests that, from an innovation perspective, only minor although not unimportant benefits may arise from attention to "regulatory stringency and detailed filing requirements" while greater benefits may be gained from addressing regulatory capacity issues for smaller innovative firms seeking to scale up.

2.3.6 Price regulation through the Patented Medicine Prices Review Board (PMPRB)

The PMPRB and its regulatory framework (*Patented Medicines Regulations*) were created in 1987 to protect and inform Canadians by ensuring that the prices of patented medicines sold in Canada are not excessive and by reporting on pharmaceutical trends, including R&D spending. In December 2017 proposed amendments to the *Patented Medicines Regulations* were published in the Canada Gazette Part I for consultation (Canada, 2017i).

The proposed amendments take greater account of the value of a patented medicine for patients and impact on the health care system. They change reporting obligations on companies, with reduced reporting obligations for companies whose products pose a lower

[3] The Centre for Innovation in Regulatory Science (CIRS) is a reliable source of internationally comparable data on drug approval times. CIRS reports that the last decade has seen a continuation of the convergence and general decrease in the approval times between six major regulatory authorities, including Health Canada (CIRS, 2016 and 2017). Moreover, a recent and peer-reviewed review of Health Canada's current regulatory practices concludes that Canada offers a flexible, reasonable yet stringent environment which facilitates development of cell, gene and tissue-based therapies, medical devices and combination products (Viswanathan and Bubela, 2016).

risk of asserting market power and charging excessive prices. They revise the schedule of comparator countries used to help determine excessive prices. Drug expenditure containment and providing faster access to innovative medicines are cited as the main reasons for the regulatory amendments (Canada, 2017k and PMPRB, 2017: 8).

Summary

Canadian federal regulators are demonstrating new product review time performance that is trending toward that found in other foreign jurisdictions. New regulatory challenges in areas outside the traditional purview of health product regulators are emerging, including in such areas as artificial intelligence, big data, data access, and privacy.

2.4 Agrifood

2.4.1 Introduction

Regulatory reform in Canadian agrifood over the past decade originates from a series of food safety incidents. The three main regulatory authorities — the Canadian Food Inspection Agency (CIFA), Health Canada, and Environment and Climate Change Canada (ECCC) — have sought to ensure that Canada is at the international regulatory frontier for food safety. The form and scope of this regulation has important implications for innovation. Maintaining and strengthening Canada's excellent reputation for agrifood at home and abroad also requires attention to the functioning of other regulatory regimes that are important for the transformation to the digital farm. For example, in Canada and other jurisdictions, the emerging impact of digital technologies is illustrated by the rise of precision agriculture: a whole-farm management approach using information technology, satellite positioning data, remote sensing and proximal data gathering. These technologies have the goal of optimizing returns on inputs whilst potentially reducing environmental impacts (see European Commission, 2014, and Van Es and Woodard, 2017).

2.4.2 The *Safe Food for Canadians Act* (SFCA) and proposed regulations

The SFCA received Royal Assent on November 22, 2012. Four years and almost two months later, on January 21, 2017, the *Safe Food for Canadians Regulations* were published for consultation in the Canada Gazette Part I (Canada, 2017l). The SFCA and proposed regulations represent a major overhaul of federal oversight of the Canadian food system although not its fundamental institutional features. There are several areas of regulatory reform that are anticipated to have a positive impact on agrifood innovation, including:

- Outcome-based regulation. The proposed regulations are presented as being performance-based where appropriate. They include a requirement that regulated parties produce and maintain a written Preventive Control Plan (PCP) demonstrating

how preventive controls and other requirements (e.g., for packaging and labelling) are met (Canada, 2017l: 270). The Canadian Food Inspection Agency (CFIA) recognizes that the proposed outcome-based PCP approach will create a financial and administrative burden on industry. The CFIA proposes to minimize this burden by exempting smaller businesses in some sectors from the written PCP requirement (Canada, 2017l: 324-325).

- Incorporation of standards, methods and guidelines by reference. Incorporation by reference is a term used to describe a means to allow a document, not in the body of the regulation, to be made part of the regulation. Such documents could be technical or non-technical standards, methods and guidelines. The legal effect of incorporation by reference is to write the words of the incorporated document into the regulation as if it had actually been reproduced word for word (CFIA, 2014). The CFIA states that incorporation by reference will increase the agency's regulatory flexibility and responsiveness to concerns of industry and consumers by responding more promptly to "modern science and innovations, which might otherwise require regulatory change." (Canada, 2017l: 268-269)

- FPT regulatory alignment. In some cases the proposed reforms would represent federal regulatory alignment with provincial/territorial food safety regulations. Conversely, the updated CFIA and regulations will make it easier for PTs to align their regimes with the federal one. In both cases, this has the potential to lead to greater domestic and international trade opportunities (Canada, 2017l: 297). For example, agrifood businesses that start small and comply with regulations in their home provinces may have less difficulty in complying with CFIA regulations should they seek to scale up through exporting to other provinces or internationally.

The CFIA received over 1,700 submissions in response to the proposed SFCA regulations and anticipates that the final regulations will be published in the Canada Gazette, Part II in 2018 (CFIA, 2017a).

Quantifying the potential impact of the SFCA regulations on innovation through CBA

The CFIA's Cost-Benefit Analysis (CBA) of the proposed food safety regulations does not quantify the monetary value of the expected opportunity for innovation (although various annual industry growth rate scenarios are incorporated within the CBA). Innovation is treated within the CBA largely as a positive qualitative impact for the agrifood sector (Canada, 2017l: 303). The CFIA is developing a food program performance framework to measure its activities, processes, and services contribute to desired outcomes. To date the CFIA has proposed two indicators — neither directly related to innovation — for inclusion within the framework (Canada, 2017l: 333).

Food Labelling

The CFIA's Food Labelling Modernization (FLM) initiative began in 2013 and is now entering its final phase of consultations. The CFIA is proposing that government take a larger role in managing high-risk claims with industry and consumers taking a larger role in managing lower-risk claims. These and other changes would harmonize Canadian requirements with those in the US and those set out in international Codex Standards (CFIA, 2017: 1).

2.4.3 Biotechnology regulatory frameworks

In 1993 the Government of Canada issued a *Federal Regulatory Framework for Biotechnology Products* consisting of six high-level principles. The framework is intended to ensure that the benefits of biotechnology products and processes are realized in a way that protects health, safety, and the environment. One of the key principles adopted by the regulatory departments includes the use of existing laws and regulatory processes to avoid duplication. Regulatory authority for products derived from biotechnology falls under several federal departments and agencies, with the three main federal regulatory authorities being: Health Canada; the Canadian Food Inspection Agency (CFIA); and Environment and Climate Change Canada (ECCC). (Canada, 2017o)

In general, the current institutional structure appears to working well from an innovation perspective when it comes to novel foods derived from biotechnology. For example, in 2016 the House of Commons' Standing Committee on Agriculture and Agrifood (SCAA) issued its *Report on Genetically Modified Animals for Human Consumption*. The report highlights regulatory capacity and resource issues, including recruiting those who will become regulators in the future (SCAA, 2016: 7). The report does not recommend any major change in regulatory processes or institutional structures.

The stability that has marked Canadian regulatory approaches to novel foods stands in contrast to evolving regulatory circumstances in the US. For example, on July 29, 2016, the US Congress enacted the US *National Bioengineered Food Disclosure Standard Law*. It pre-empts an emerging patchwork of state laws mandating labelling of food products containing genetically modified organisms. The law directs the US Department of Agriculture (USDA) to develop regulations and standards to create mandatory disclosure requirements for bio-engineered foods by July 2018 (Jaffe, 2016). The public consultation process launched by the USDA has revealed differences of opinion among and between industry and consumer stakeholder groups on how rule-making in this area should proceed (US, 2017d).

US regulatory change in agrifood biotechnology (and also many other agrifood areas) may pose challenges to ongoing efforts to harmonize regulations in a Canada-US bilateral trade context and also internationally. Submissions by agrifood industry stakeholders to two House of Commons' committees in 2017 (the Standing Committee on International Trade and the Standing Committee on Agriculture and Agrifood) reflect a strong consensus that

Canada-US regulatory impediments to agrifood trade exist and directly or indirectly constrain opportunities for agrifood innovation in Canada (see CIIT, 2017: 48-47, and SCAA, 2017).

2.4.4 Regulation for the digital farm

In Canada and other jurisdictions, various regulatory initiatives to make regulatory regimes more innovation-friendly for agrifood producers have been undertaken but progress is slow in some jurisdictions. Beroun (2016) reports that in the EU the regulatory situation is uneven in three key areas that will affect digital farming: digitization, data and automatization. According to Beroun, a key area that will need to be addressed is farmers' concerns regarding data ownership and transfer (primarily between companies). Interoperability of machines and platforms from different suppliers must improve or farmers will be reluctant to sign up to services. Some even argue that a common European platform should be built to contain the data from all farms across the continent (Beroun, 2016: 3).

Digitization, data and automatization are also important areas for regulation in Canada from a digital farm perspective. In at least one area, the regulation of drones by commercial users, including in agricultural applications, Canada has been ahead of the international pack. A 2016 US Library of Congress report on drone regulation in Canada notes that, reflecting the exponential growth of the unmanned aircraft industry over the past few years, the 345 special flight operation certificates (SFOCs) for unmanned aerial vehicles that Transport Canada issued in 2012 had grown to 1,672 by 2014 (US Library of Congress, 2016).[4] In contrast, some US drone industry participants consider that the US has lagged behind when it comes to developing an enabling regulatory environment for commercial drone applications (Cooper, 2014).

Summary

Proposed federal regulations for food safety will consolidate and modernize Canada's regulatory framework. Canadian regulatory systems for novel foods are proving robust in the face of technological change and this stands in contrast to evolving circumstances in the US. Regulatory systems beyond food safety are implicated in driving forward to tomorrow's digital farm and strengthening Canada's agrifood brand at home and abroad.

2.5 Digital Industries

2.5.1 Introduction

The ubiquity of digital technologies and services across sectors is a defining feature of today's digital and data-driven economy. This section provides examples of regulatory

[4] Transport Canada introduced further proposed rules for drones in 2017, including a special category for users operating in rural areas for agriculture and other natural resource purposes (Canada, 2017j).

challenges and responses related to financial services, digital platform companies, and sharing economy companies.

2.5.2 Financial services

The arrival of FinTech requires all financial sector regulators in Canada and abroad to confront a central question posed by Mark Carney, Governor of the Bank of England: whether or not FinTech really is something new under the regulatory sun? His answer to this question is essentially no. He suggests that: "By enabling technologies and managing risks, we can help create a new financial system for a new age… under the same sun." (Carney, 2016 and 2017: 14)

Financial sandboxes under the same regulatory sun

A regulatory sandbox is a "safe space" where businesses can test within existing regulatory frameworks innovative products, services, and business models. Financial service regulatory sandboxes are found across many jurisdictions: the US, the UK, Abu Dhabi, Malaysia, Indonesia, Thailand, Hong Kong, Australia, and Singapore.

The UK Financial Conduct Authority (FCA) presents their sandbox, launched in June 2016, as a significant channel for encouraging FinTech innovation within existing regulatory frameworks. It regards success as being measured by the large number of applications received and authorizations made for participation (FCA, 2017 and 2017a). In contrast to the UK FCA experience, the Chief FinTech Officer of the Monetary Authority of Singapore (MAS) has said that the MAS regulatory sandbox is a last option within its broader Smart Financial Architecture strategy for innovation in financial services. In other words, if large numbers of companies enter the MAS sandbox, that would be a sign of broader problems with Singapore's financial regulatory system, including lack of flexibility (see Mohanty, 2016 and 2017).

In Canada, the Ontario Securities Commission (OSC) created a regulatory sandbox for FinTech through its 2016 LaunchPad initiative. Under LaunchPad, the OSC makes time-limited exemptive relief or registration relief. In October 2016, the OSC issued its first exemptive relief Decision for a FinTech company that covered a period of two years (OSC, 2016). The Decision does not explain why the exemption applies for two years rather than some shorter or longer period of time.

In February 2017 the umbrella organization of Canada's provincial and territorial securities regulators, the Canadian Securities Administrators (CSA), established its own regulatory sandbox. As of December 2017, five firms had been authorized in the CSA Regulatory Sandbox (CSA, 2017). Because the OSC has not joined the CSA passport system, the OSC continues to conduct its own review of requests for exemptions or relief regardless of head office location.

The relationship between FinTech innovators and incumbent businesses

The concentrated structure of the Canadian banking system can incentivize Canadian FinTech players to enter into partnership arrangements with incumbent financial institutions. Each partner brings assets that are different but complementary: the depth of financial capacity by financial institutions; and nimbleness and tech savvy by FinTech companies. Whether this development — which some regard as a strategic response by incumbents to potential rivals — will be of benefit to Canadian consumers remains to be seen (King, and Young, 2016, and King, 2016). The Canadian Competition Bureau's 2017 market study on technology-led innovation in Canadian financial services finds that pro-competitive collaboration between industry participants would help bring more products and services to market, but adds the caveat: "while recognizing the potential for anti-competitive collaborations." (Canada, 2017m: 21)

Crowdfunding

Crowdfunding is a further example of how digital technologies are impacting the financial services sector and with ripple effects for the financing of companies. The OECD (2015) reports that, by design and regulatory limitations, crowdfunding is suited to start-ups and projects that request relatively small amounts of funding. In May 2015 the securities regulatory authorities of six provincial jurisdictions (BC, Saskatchewan, Manitoba, Quebec, New Brunswick, and Nova Scotia) announced they were adopting "substantially harmonized" registration and prospectus exemptions including start-up crowdfunding exemptions (CSA, 2015). The crowdfunding exemptions are subject to conditions (e.g., an issuer group cannot raise aggregate funds of more than $250,000 per distribution and is restricted to not more than two start-up crowdfunding distributions in a calendar year). In early 2017 Ontario also adopted a crowdfunding exemption with conditions (OSC, 2017).

Distributed ledger technology (DLT) and blockchain

DLT and blockchain have many different potential applications. Central banks and partners from the financial sector are testing DLT/blockchain within the context of the operation of the payments system (Carney, 2016 and Bank of Canada, 2017). The early phases of the Bank of Canada's own testing of DLT, known as Project Jasper, came to an end in May 2017 when it was concluded that it was not yet mature enough to run a national interbank payment system (Wilkins and Gaetz, 2017). Applications in other sectors are generally in proof-of-concept phase.

Cryptocurrencies

Cryptocurrencies typically rely on DLT/blockchain technology. To date most jurisdictions do not regulate cryptocurrencies directly, but rather the activities surrounding them. For example, Singapore requires digital-currency intermediaries such as exchange operators to

comply with requirements to combat money laundering and terrorism financing. Those that resemble a sale of securities are regulated under Singapore's *Securities and Futures Act* (Chanjaroen, 2017).

In August 2017 the Canadian Securities Administrators (CSA) issued a *Staff Notice on Cryptocurrency Offerings*. The Notice states that many cryptocurrency offerings involve sales of securities and provides guidance on their regulatory treatment (CSA, 2017a). The Ontario Securities Commission (OSC) has stated that it may impose terms and conditions on the firm's registration to ensure adequate investor protection. For example, terms and conditions have been imposed on firms that have proposed to establish, manage or advise cryptocurrency investment funds to ensure the firm's compliance with securities law requirements such as custody requirements (OSC, 2017a).

Open banking and Application Programming Interfaces (API)

Since 2014 the UK Government has been developing an open banking initiative, including an open API standard. An API is a way for electronic information held in one place to be shared in a controlled and secure way and makes it easier to access and compare product and service information from different financial service providers. The value of such an initiative in the Canadian context is examined in the Canadian Competition Bureau's December 2017 market study on technology-led innovation in financial services. The study finds that, since open banking in the EU does not come into effect until 2018, it is too early to know what may come from such proposals, although the potential impact on competition and innovation is promising. The study also states: "While Canada's complex federalist system make it more difficult to follow the lead of other jurisdictions, the [Canadian Competition] Bureau encourages policymakers to continue to examine the experience of peer jurisdictions and adopt best practices as they balance the potential risks with the competitive benefits." (Canada, 2017m: 71)

Proposed amendments to implement proposals from the federal financial sector legislative review

Budget 2018 proposes to introduce legislative amendments to implement targeted proposals from a federal financial sector legislative review led by Finance Canada. Priority amendments would adapt the legislative framework and facilitate greater partnering in response to the emergence of financial technology. Proposed changes would include:

- greater flexibility for financial institutions to undertake and leverage broader Fintech activities that enable the delivery of financial services in new and innovative ways;

- permitting life and health insurance companies to make long-term and predictable investments in infrastructure;

- providing prudentially regulated deposit-taking institutions, such as credit unions, flexibility to use generic bank terms, subject to disclosure; and,

- renewing the sunset date in the federal financial institutions statutes. (Canada, 2018: 356)

2.5.3 Regulating the sharing economy

In 2016 the Environics Institute for Survey Research and the Institute for Corporate Governance asked Canadians what their favoured approach is to regulations for sharing economy businesses. According to the authors of the survey, Canadians believe these businesses should be subject to regulation in such areas as insurance, taxation and safety standards, whether this involves the current regulatory structure or a new one that accommodates both traditional and sharing economy businesses (Environics, 2016).

Airbnb (in the accommodation business) and Uber, Lyft and Didi Chuxin (in the ride-sharing business) are the poster children of the sharing economy and are posing competitive challenges to incumbent businesses and policy challenges for governments as they undermine old business models (PWC, 2015).

In Canada much of the responsibility for regulating the sharing economy in the accommodation and ride-sharing sectors lies at provincial and local government levels. The potential for the federal government to support provincial and local regulation of sharing economy companies was illustrated in the proposal contained in federal Budget 2017 to amend the definition of a taxi business under the *Excise Tax Act* to level the playing field and ensure that ride-sharing businesses are subject to the same GST/HST rules as taxis. Uber Canada labelled the proposed change a "new tax on innovation" (Black, 2017). However, it may also be viewed as a reasonable accommodation of innovation. It is in line with 2015 recommendations from the Competition Bureau on *Modernizing Regulation in the Canadian Taxi Business* (Canada, 2015).

2.5.4 The regulation of digital platforms

Digital platforms are commonly understood to include a wide range of software-based technologies, from search engines and social networks to price comparison websites and collaborative economy platforms. Examples of major companies operating in this space include Alphabet (owner of Google and YouTube), Facebook (owner of WhatsApp, Messenger and Instagram), and Amazon. One of the central issues the presence of the dominant digital platform companies gives rise to is how they are using their market power and whether the current regulatory environment remains, in the words of one UK Parliament study on the subject, "fit for purpose" (UK, 2016).

In the US in 2013, and Canada in 2016, competition authorities closed investigations into Google's conduct. The respective investigations focussed on different allegations, but essentially came to the same overall conclusion: that Google was not engaging in anti-competitive conduct (US, 2013 and Canada, 2016). In June 2017, the European Commission completed its investigation of Google and fined the company €2.42 billion for abusing dominance as a search engine by giving illegal advantage to its own comparison shopping service (European Commission, 2017). The European Commissioner for Competition, Margrethe Vestager, stated that Google's wrongdoing — abusing its overwhelming control of a market — was as old as market capitalism itself: "I don't think the case as such is new… We are dealing with the same things as the Commission has been dealing with over decades, that a company is abusing its dominant position. And that is kind of old-school." (Vestager, 2017)

Summary

In financial services, regulatory authorities are seeking to accommodate innovation within existing regulatory frameworks. In contrast to the US and Canada, competition authorities in the EU have determined that the exercise of market power by digital platform companies is happening and is subject to sanction. In two major sectors of the "sharing economy", ride-sharing and accommodation services, there are areas where the federal government can support provincial and local regulatory approaches that work in favour of innovation and competition.

2.6 Advanced Manufacturing

2.6.1 Introduction

The federal government's regulatory footprint is found in three main areas within the Canadian advanced manufacturing sector: international regulatory co-operation, standard-setting processes and product specific regulatory regimes; international trade rules; and foreign investment rules. All three areas are relevant to innovation across many economic sectors, but advanced manufacturing stands out as a major potential beneficiary of approaches that are more accommodating of innovation.

2.6.2 International regulatory co-operation, standards, and product specific regulatory regimes in advanced manufacturing

International regulatory co-operation

International regulatory co-operation is important for all economic sectors, but particularly for advanced manufacturing where global value chains of production and innovation are a prominent feature. In 2011 Canada and the US established the Canada-US Regulatory Co-operation Council (RCC). The RCC focusses on fostering regulatory co-operation and

reducing the incidence and cost of regulatory differences and duplicative procedures. Progress has been reported in such areas as regulation of the products of nanotechnology, transportation technology, and workplace standards (RCC, 2016).

The effectiveness of institutional machinery for regulatory co-operation is dependent on continued and sustained interest by business stakeholders and adequate resourcing. Past Canadian and US efforts may be falling short on both these counts (CCC, 2016: 19). In 2017 the Business Council of Canada recommended that the RCC, or some version of the RCC, should be established as a permanent entity with a clear mandate to identify opportunities for harmonization: "The approach should be to harmonize regulations except in cases where regulatory authorities demonstrate convincingly that doing so would pose a risk to health and safety." (Business Council of Canada, 2017: 4) The opportunity to revitalize the RCC is recognized by the federal government (Freeland, 2017). In December 2017 the House of Commons Standing Committee on International Trade recommended that Canada should continue to work on initiatives like the RCC and should consider the establishment of a similar initiative with Mexico (CIIT, 2017: 50).

Standards

Many countries and companies recognize the importance of standard setting for successfully competing in the global innovation race. For example:

- The Government of Australia has identified DLT/blockchain as an area of national interest. In March 2017 Australia's national standards authority, Standards Australia, issued a *Roadmap for Blockchain Standards* (Standards Australia, 2017). During 2016, Standards Australia promoted the establishment of a DLT/blockchain committee within the International Organization for Standardization (ISO). Today Australia leads the secretariat for the ISO's technical committee on DLT/blockchain.

- The People's Republic of China (PRC) is targeting standard-setting as part of its *Made in China 2025* plan (released in 2015 and updated in early 2018) aimed at transforming China into an advanced manufacturing leader. In 2015, the PRC State Council released its *Guideline to Deepen Reform of Standardization System* and stated: "The creation of world-class quality standards for China, enhancing the country's "go global" strategy, will promote Chinese products, technologies and services in global markets, according to the guideline." (PRC, 2015) The PRC is demonstrating interest in 5G telecommunication standards in order to achieve its objective of a commercial launch of 5G services by 2020 (GSMA Intelligence and China Academy of Information and Communications Technology, 2017, and Duesterberg, 2017).

- In 2016 the UK Office of Science recommended that quantum technologies receive greater attention from UK regulatory and standard-setting bodies than they do at present (UK, 2016a). Also in 2016, the European Commission announced that it would launch a €1 billion flagship initiative on quantum technology to help yield unprecedented computing power, guarantee data privacy and communication security, and provide ultra-high precision synchronization, measurements and diagnostics for a range of applications available to everyone locally and in the cloud. A High-Level EC Steering Committee on quantum technologies issued its final report in June 2017. The report states that as governments and companies worldwide, including Google, IBM, Intel, Microsoft and Toshiba, are investing substantially to unleash the potential of quantum technologies, there is a strong urgency for Europe to start fast with focused and consolidated efforts to keep up with global developments. The report highlights key areas for attention, including developing quantum-based standards. The Committee proposes in the report that the first Flagship-funded projects should start in 2019 (European Commission, 2017a).

There are many other considerations relating to the relationship between standards, regulation and innovation that bear keeping in mind. For example:

- in some areas the pace of standard-setting is out of sync with regulatory requirements and is constraining innovation in advanced manufacturing. For example, 3D printing standards have been reported as not always being sufficiently exacting for the aerospace industry and related aerospace regulatory certification processes (Defence IQ, 2016, Roca et al., 2016, EASA, 2016, and US, 2016a); and,

- smaller firms face financial and other constraints in adopting more advanced standards relative to larger firms. This is a key consideration when addressing the broader challenge of scaling up small innovative advanced manufacturing companies. It has led the Standards Council of Canada (and standard-setting authorities in the EU) to seek to engage more innovative small businesses in standard setting activities and strengthen educational outreach programs for small businesses (Parkouda and Marcovitch, 2017).

Product-specific regulatory regimes: the case of connected and autonomous vehicles (CAVs)

Transport Canada leads federal regulation for CAVs. Federal officials are working to establish a progressive and flexible regulatory approach that can foster the innovation needed to bring CAV technologies to market while maintaining the safety and security of the Canadian public (Higgens et al., 2017). Examples of areas of attention include: technical standards; exemptions from regulation; and spectrum allocation. There are also provincial government regulatory initiatives underway to allow CAV testing. Notwithstanding all this activity, some observers consider that only the tip of the regulatory challenge iceberg is

being addressed. For example, David Ticoll, Distinguished Senior Fellow at the Munk School of Global Affairs' Innovation Policy Lab, has highlighted a range of "information asset" issues, such as:

- if Canadians switch from car ownership to on-demand CAV mobility, a handful of global mobility companies could end up owning and managing most of the cars on our streets. Is this good or bad? How should governments respond?; and,

- should governments learn to treat mobility data as an appropriately regulated public asset comparable to the money supply, health, urban land, and natural resources? Data policy is about a lot more than privacy and security (Ticoll, 2017).

In 2017 Sandeep Chennakeshu, President, Blackberry Technological Solutions, testified before the Canadian Senate's Standing Committee on Transport and Communications (SCTC) hearings on the regulatory and technical issues related to the deployment of CAVs. He warned that a patchwork or divergent laws and standards across Canada may emerge. He suggested that it would be helpful for all stakeholders, including the public, if multi-level government coordination were more visible and that stakeholders could have one window or primary contact point with the government (Chennakeshu, 2017). These concerns once again point to the potentially valuable role of collaborative regulatory governance models. Because regulations for CAVs have not yet been set in stone, an opportunity exists for ensuring all levels of government — federal, provincial, and municipal — as well as stakeholder groups and citizens have a voice in the development of regulatory regimes that may well cut across jurisdictions and involve multiple regulatory authorities.

In January 2018 the SCTC tabled its final report on *Driving Change: Technology and the future of the automated vehicle*. The SCTC found that harmonized policies across Canadian federal and provincial jurisdictions — and bilaterally with the US — on the use of CAVs on public roads will be important if Canada hopes to attract CAV developers, capture the potential economic and environmental benefits from CAVs, and provide safeguards from potential risks in such areas as privacy and cyber security (SCTC, 2018: 9-12).

2.6.3 International trade rules and associated institutions

In future trade negotiations Canada may need to take into account of the opportunities to increase the innovation benefits for advanced manufacturing that go along with a liberal rules-based system of international trade. Three among many areas deserving of attention from this perspective are: intellectual property; commercial data flows; and rules of origin.

Intellectual property (IP)

Since the 1990s, international trade agreements have included IP provisions that directly or indirectly speak to new types of innovation. The IP provisions impact on many different

sectors, including advanced manufacturing (advanced manufacturing is increasingly digitalized and, therefore, has a direct interest in IP provisions for ICT supplier industries). The provisions have given rise to controversy. Curtis (2017) underlines a divergence of views on the value of such IP provisions from an innovation perspective: some argue that they will enable and indeed promote further innovation; others claim that such provisions will do little to advance innovation in newer and rapidly expanding areas of domestic and international activity. It is claimed by those less persuaded by the overall benefits that such provisions favour primarily the existing innovation-intensive countries.

Budget 2017 announced that the Government will develop a new intellectual property strategy that will help ensure that Canada's IP regime is modern and robust and supports Canadian innovations in the 21st century (Canada, 2017 and 2017n). Budget 2018 proposes to invest $85.3 million over five years, starting in 2018–19, with $10 million per year ongoing, in support of the strategy. Initiatives announced in Budget 2018 to increase the IP literacy of Canadian entrepreneurs, and to reduce costs and create incentives for Canadian businesses to leverage their IP include:

- to better enable firms to access and share IP, the Government proposes to provide $30 million in 2019–20 to pilot a Patent Collective. This collective will work with Canada's entrepreneurs to pool patents, so that small and medium-sized firms have better access to the critical IP they need to grow their businesses;

- to support the development of intellectual property expertise and legal advice for Canada's innovation community, the Government proposes to provide $21.5 million over five years, starting in 2018–19, to Innovation, Science and Economic Development Canada. This funding will improve access for Canadian entrepreneurs to IP legal clinics at universities. It will also enable the creation of a team in the federal government to work with Canadian entrepreneurs to help them develop tailored strategies for using their IP and expanding into international markets; and,

- to support strategic IP tools that enable economic growth, Budget 2018 also proposes to provide $33.8 million over five years, starting in 2018–19, to Innovation, Science and Economic Development Canada, including $4.5 million for the creation of an IP marketplace. This marketplace will be a one-stop, online listing of public sector-owned IP available for licensing or sale to reduce transaction costs for businesses and researchers, and to improve Canadian entrepreneurs' access to public sector-owned intellectual property.

The Government will also consider further measures, including through legislation, in support of the new IP strategy (Canada, 2018b: 116-117).

Cross-border data flows

The Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (CPTPP) contains extensive provisions addressing digital trade. Not all have welcomed these provisions, expressing a variety of concerns most notably their implications for privacy (see Geist, 2016). It is a subject worthy of future research how existing and new digital trade provisions might be in Canada's interest from the perspective of: attracting to Canada major investments for development of connected and autonomous vehicles and other advanced manufactured products; and ensuring that Canada's lead in AI (AI applications sometimes rely on access to Big Data not located in Canada) is maintained and strengthened.

Rules of origin

Rules of origin specify the criteria for determining the national source of a product and its treatment under various regional and international trade agreements. Rules of origin are important for all sectors. In the automotive sector, software alone is estimated to account for upwards of 10 percent of the value of today's cars and may eventually reach 40 percent of a car's value with the advent of connected and autonomous vehicles (Clements and Kockelman, 2017). Rules of origin negotiated in most trade agreements in force today do not meaningful include advanced electronics or software costs in their calculation. How they might do so in future trade agreements will need to take into account that current rules of origin arrangements are already complex and costly in economic and business terms (see Estevadeordal et al., 2014, and Canadian Council of Chief Executives, 2014).

2.6.4 Foreign direct investment (FDI)

Given evolving national security threats in a fast-changing and complex global environment, the Government has increasingly taken action to protect national security through the *Investment Canada Act*. This is in line with actions of other jurisdictions. There is no evidence that Canada's foreign investment review regime today is less transparent or more complex than those found in comparator countries (OECD, 2015c). Analogous regimes in comparator countries are trending toward greater complexity. For example, the EU and a number of its member states (France, Germany and the UK), Australia, and the US, are reconsidering how they regulate FDI, including FDI from China, in advanced manufacturing and other industries (see Brunsden, 2017 and Smyth, 2018).

Summary

The pace of innovation is accelerating across advanced manufacturing, driven by such technologies as the Internet of Things, robotics, artificial intelligence, and 3D printing. As a consequence, international regulatory co-operation, standard-setting processes and product specific regulatory regimes are key areas for attention. International trade rules could be more accommodating of innovation in advanced manufacturing and other sectors. Canada's

FDI regime is in line with a rules-based, secure, and liberal global investment environment that facilitates economic growth.

SECTION III – ASSESSMENT & POLICY IMPLICATIONS

This report has examined the state of the relationship between regulation and innovation. There are many features of this relationship that carry policy implications for how the Canadian federal government might regulate in favour of innovation.

There is an emerging toolkit of approaches to regulating for innovation

Regulators are creating safe harbours for testing of new business models within existing laws. They are issuing various guidelines in place of formal rule-making. They are incorporating evolving product and performance standards into regulatory systems on an evergreen basis. They are providing temporary exemptions (with conditions) from regulatory requirements. They are seeking early engagement with innovators to understand their prospective business models and how they can be accommodated within regulatory systems. They are engaging with other national regulators in international forums to find common ground in managing risk without stifling innovation.

Instances of Canadian federal regulators drawing on the emerging toolkit of approaches have been illustrated in this backgrounder. However, the extent to which federal regulation accommodates and encourages innovation varies across the federal regulatory landscape. One policy implication is that federal regulators might consider if new approaches to regulating in favour of innovation can or should be employed more broadly than at present.

Sector-specific challenges and opportunities for regulating in favour of innovation

Sector-specific circumstances present challenges and opportunities for regulating in favour of innovation. One policy implication is that, especially in disrupted sectors, a window of opportunity is open to regulate in favour of innovation before entrenched positions are taken by businesses and other stakeholders. There are various models of collaborative regulatory governance that might be drawn upon.

Common challenges and opportunities for regulating in favour of innovation

This backgrounder points to common challenges and opportunities for all regulators: new business models arising from the pace and scope of technological change; assuring privacy and security in today's digital economy; updating intellectual property policies and strategies; and always seeking to effectively balance risk and innovation. It is also apparent

that just as the application of new digital technologies are blurring traditional boundaries between industry sectors, they are also blurring boundaries between regulatory authorities. The relevant implication may be that while greater horizontal coordination between regulatory authorities has long been a desired state of affairs, it is now a far more pressing issue.

US regulatory change poses a strategic challenge to regulating for innovation in Canada

In light of ongoing US regulatory change — driven in part by the January 30, 2017, *US Presidential Executive Order on Reducing Regulation and Controlling Regulatory Costs* (US, 2017c) — it remains important to consider: where regulatory alignment with the US is critical for Canadian economic growth and innovation; and where divergence may be justified and in spite of the potential economic costs and foregone innovation opportunities.

Performance-based regulation is more innovation-friendly than prescriptive regulation

There is a strong consensus across Canadian governments and the Canadian business community that principle or performance-based regulation is more innovation-friendly than prescriptive regulation. What is less commonly recognized is that designing and implementing effective performance-based regulation is not cost free. It requires commitment and investment on the part of both regulators and regulatees. In this area, there are opportunities to make greater use of regulation technologies (RegTech) to improve performance and reduce costs. In spite of the merits of performance-based regulation from an innovation perspective, prescriptive regulation in some cases is appropriate and even when it may result in economic costs, including lost opportunities for innovation.

The globalization of risk

The globalization of risk and the emergence of new sources of risk (shaped in part by new digital technologies) reinforce the need and the opportunity for reinvigorating Canada's efforts in international and regional regulatory co-operation forums, including for standard setting. The federal government's Budget 2017 commitment to support specific sectors, high-growth firms, and superclusters, opens up opportunities to build the required level of industry support and engagement.

Seamless FPT regulatory systems

This backgrounder has highlighted the importance of coordination and co-operation across FPT jurisdictions in regulating in favour of innovation. In this context, progress can be made through the 2017 Canadian Free Trade Agreement (CFTA). Under the CFTA a senior-level federal-provincial-territorial Regulatory Reconciliation and Co-operation Table (RCT) has been established to lead work on: reconciling regulatory measures identified that act as a barrier to trade, investment, or labour mobility within Canada; and cooperating in the development of future regulatory measures (CFTA, Article 403 and Annex 404).

The CFTA provides that, based on information provided by stakeholders or other sources, a potential barrier to internal trade may be identified by a province, territory or the federal government. Once a barrier to trade has been identified, a government (federal, provincial or territorial) can submit the matter to the RCT for reconciliation. Once barriers are submitted for reconciliation, participating CFTA governments and their relevant regulators begin negotiations toward a reconciliation agreement. The reconciliation agreement details how the barrier to trade will be addressed (e.g., mutual recognition, harmonization, or some other method), which governments will participate in the reconciliation agreement, and the timelines for its implementation. CFTA governments that agree to adopt the reconciliation agreement will be bound to adhere to the commitments that it contains. Governments may opt out of negotiations if they do not have an existing measure to reconcile or determine that reconciliation is not a desirable option for their jurisdiction.

The CFTA also includes regulatory notification commitments, such as publishing online a description of proposed regulations impacting on innovation at an early and appropriate stage (Committee on Internal Trade, 2017). Moreover, Article 408(1) of the CFTA provides that may identify and propose to the RCT that the Parties cooperate in the development of future regulatory measures to:

(a) avoid regulatory divergences that may impair trade, investment, or labour mobility within Canada;

(b) facilitate innovation, competition, or growth in emerging industries, technologies, or sectors; or

(c) ensure that, if feasible, common processes exist among Parties for implementing future regulatory measures in order to help streamline approval processes and minimize the administrative burden for enterprises working in multiple Provinces. (CFTA, Article 408(1)).

Article 408(2) states that a Party is not required to participate in the development of the future regulatory measure or adopt the future regulatory measure at the end of a joint development process.

The main technical means to assess the costs and benefits of regulation is Cost-Benefit Analysis (CBA)

As regulatory CBA is practised today, its results are often distrusted in a world where citizens and stakeholders are less willing to accept the opinions of traditional sources of authority and expertise. In response, the federal government might consider: incorporating innovation benefits more explicitly into CBA for specific regulatory proposals; introducing ex-post assessments of CBA results; and encouraging greater citizen and stakeholder involvement in the conduct of regulatory CBA.

Conclusion

Regulation is a central feature of democratic governance and, in that context, often reflects economic and social trade-offs between different policy objectives. New approaches to accommodate and encourage innovation hold the promise of achieving apparently conflicting objectives to a greater extent than conventional wisdom might suggest. Making strong progress in this area carries potential dividends – certainly innovation, economic growth, skills, and jobs – but also through the stronger path it represents for achieving social and economic regulatory objectives set out in law and policy.

In Budget 2018, the Government is taking a comprehensive approach to better support the growth of firms in Canada by consolidating and streamlining programs, modernizing regulations and improving trade opportunities. Well-designed and efficient regulations ensure a level playing field, as well as, economic and social resilience, to capture emerging opportunities while minimizing potential barriers to success. These efforts are believed to help in establishing a more agile regulatory system designed for the new economy.

SOURCES

AHAM. 2017. "Home Appliance Industry Applauds Publication of Canada's New Energy Efficiency Regulations." Accessed at: http://www.newswire.ca/news-releases/home-appliance-industry-applauds-publication-of-canadas-new-energy-efficiency-regulations-609815875.html

Andrews, Leighton, Bilel Benbouzid, Jeremy Brice, Lee A. Bygrave, David Demortain, Alex Griffiths, Martin Lodge, Andrea Mennicken, and Karen Young. 2017. "Algorithmic Regulation." Centre for Analysis of Risk and Regulation, Discussion Paper No. 85. Accessed at: http://www.lse.ac.uk/accounting/CARR/pdf/DPs/DP85-Algorithmic-Regulation-Sep-2017.pdf

Ansell, Chris and Alison Gash. 2007. "Collaborative Governance in Theory and Practice." *Journal of Public Administration Research and Theory*, 18 (4) pp. 543-571. Accessed at: https://sites.duke.edu/niou/files/2011/05/Ansell-and-Gash-Collaborative-Governance-in-Theory-and-Practice.pdf

APC. 2016. "Digital Disruption: What do governments need to do?" Australian Productivity Commission Research Paper, Canberra. Accessed at: http://www.pc.gov.au/research/completed/digital-disruption/digital-disruption-research-paper.pdf

Auditor General of Ontario. 2015. "2015 Annual Report of the Office of the Auditor General of Ontario." Accessed at: http://www.auditor.on.ca/en/content/annualreports/arreports/en15/3.05en15.pdf

Bank of Canada. 2017. "Central Bank Digital Currency: Motivations and Implications." Walter Engert and Ben S. C. Fung. Bank of Canada Staff Discussion Paper 2017-16. Accessed at: http://www.bankofcanada.ca/wp-content/uploads/2017/11/sdp2017-16.pdf

Beroun, Vladimir. 2016. "Europe's Opportunity in Digital Agriculture." Accessed at: http://fticommunications.com/2016/11/europes-opportunity-digital-agriculture/

Black, Ian. 2017. "Statement from Uber Canada on the 2017 Federal Budget." News Release, March 23, 2017. Accessed at: http://www.newswire.ca/news-releases/statement-from-uber-canada-on-the-2017-federal-budget-616953004.html

Brennan, Zachary. 2017. "FDA to Create Digital Health Unit." Regulatory Affairs Professional Society Blog Posting. Accessed at: http://raps.org/Regulatory-Focus/News/2017/05/04/27484/FDA-to-Create-Digital-Health-Unit/

Brunsden, Jim. 2017. "Brussels seeks tighter vetting of foreign takeovers - Moves to strengthen EU screening process after rise in Chinese investment." *Financial Times*, August 13, 2017. Accessed at: https://www.ft.com/content/04fa752c-7dda-11e7-ab01-a13271d1ee9c

Business Council of Canada. 2017. "NAFTA Consultations - Submission on the renegotiation and modernization of the North American Free Trade Agreement." Accessed at: http://thebusinesscouncil.ca/wp-content/uploads/2017/07/NAFTA-Consultations-GAC.pdf

Canada. 2004. "Smart Regulation: A Regulatory Strategy for Canada." Final report of the External Advisory Committee on Smart Regulation. http://publications.gc.ca/collections/Collection/CP22-78-2004E.pdf

Canada. 2006. "Order Issuing a Direction to the CRTC on Implementing the Canadian Telecommunications Policy Objectives." P.C. 2006-1534 December 14, 2006. Accessed at: http://publications.gc.ca/gazette/archives/p2/2006/2006-12-27/pdf/g2-14026.pdf

Canada. 2008. "Compete to Win." Final Report of the Competition Policy Review Panel. Accessed at: https://www.ic.gc.ca/eic/site/cprp-gepmc.nsf/vwapj/Compete_to_Win.pdf/$FILE/Compete_to_Win.pdf

Canada. 2012. "Cabinet Directive on Regulatory Management." http://www.tbs-sct.gc.ca/hgw-cgf/priorities-priorites/rtrap-parfa/guides/cdrm-dcgr-eng.asp

Canada. 2015. "Modernizing regulation in the Canadian taxi industry." Competition Bureau Technical Guidance Document. Accessed at: http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04007.html

Canada. 2015a. "Pathways: Connecting Canada's Transportation System to the World." Volume 1, Canada Transportation Act Review. Accessed at: http://www.tc.gc.ca/eng/ctareview2014/CTAR_Vol1_EN.pdf

Canada, 2016. "Competition Bureau statement regarding its investigation into alleged anti-competitive conduct by Google." Competition Bureau, April 19, 2016. Accessed at: http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04066.html

Canada. 2016a. "Energy Efficiency Regulations, 2016." *Canada Gazette* Part I Vol. 150, No. 18 Accessed at: http://www.gazette.gc.ca/rp-pr/p1/2016/2016-04-30/pdf/g1-15018.pdf

Canada. 2016b. "Growing the Middle Class." Budget 2016. Accessed at: http://www.budget.gc.ca/2016/docs/plan/budget2016-en.pdf

Canada. 2016c. "Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy." Accessed at: https://www.canada.ca/content/dam/themes/environment/documents/weather1/20170125-en.pdf

Canada. 2016d. "Unlocking Innovation to Drive Scale and Growth." Advisory Council on Economic Growth. Accessed at: http://www.budget.gc.ca/aceg-ccce/pdf/innovation-2-eng.pdf

Canada. 2017. "Building a Strong Middle Class." Federal Budget 2017. Accessed at: http://www.budget.gc.ca/2017/docs/plan/budget-2017-en.pdf

Canada. 2017a. "Building Common Ground – A New Vision for Impact Assessment in Canada." The Final Report of the Expert Panel for the Review of Environmental Assessment Processes. Accessed at: https://www.canada.ca/content/dam/themes/environment/conservation/environmental-reviews/building-common-ground/building-common-ground.pdf

Canada. 2017b. "Clean fuel standard regulatory framework." Environment and Climate Change Canada, December 14, 2017. Accessed at: https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/clean-fuel-standard-regulatory-framework.html

Canada. 2017c. "Consultation on the draft Cabinet Directive on Regulation." Treasury Board of Canada. Accessed at: http://open.canada.ca/en/public-consultation-draft-cabinet-directive-regulation

Canada. 2017d."Consultation on the Spectrum Outlook 2018-2022." Innovation, Science and Economic Development Canada, Spectrum Management and Telecommunications, SLPB-006-17. Accessed at: http://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/Consultation-Outlook-2017-eng.pdf/$file/Consultation-Outlook-2017-eng.pdf

Canada. 2017e. "Environmental and Regulatory Reviews Discussion Paper." Accessed at: https://www.canada.ca/content/dam/themes/environment/conservation/environmental-reviews/share-your-views/proposed-approach/discussion-paper-june-2017-eng.pdf

Canada. 2017f. "Forward, Together – Enabling Canada's Clean, Safe, and Security Energy Future." Report of the Expert Panel on the Modernization of the National Energy Board. Accessed at: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/pdf/NEB-Modernization-Report-EN-WebReady.pdf

Canada. 2017g. "Government of Canada to develop a national Zero-Emissions Vehicle Strategy by 2018." Transport Canada News Release, May 26, 2017. Accessed at: https://www.canada.ca/en/transport-canada/news/2017/05/government_of_canadatodevelopanationalzero-emissionsvehiclestrat.html

Canada. 2017h. "Investing in a Resilient Canadian Economy." Advisory Council on Economic Growth, December 2017. Accessed at: https://www.budget.gc.ca/aceg-ccce/pdf/investing-in-a-resilient-canadian-economy-eng.pdf

Canada. 2017i. "Notice of intent to improve the energy efficiency of appliances and equipment through Amendment 15 to the Energy Efficiency Regulations." *Canada Gazette* Part I, Vol. 151, No. 9. Accessed at: http://www.gazette.gc.ca/rp-pr/p1/2017/2017-03-04/pdf/g1-15109.pdf

Canada. 2017j. "Regulations Amending the Canadian Aviation Regulations (Unmanned Aircraft Systems)." *Canada Gazette* Part 1, Vol. 151, No. 28. Accessed at: http://www.gazette.gc.ca/rp-pr/p1/2017/2017-07-15/html/reg2-eng.html

Canada. 2017k. "Regulations Amending the Patented Medicines Regulations." *Canada Gazette* Part 1. Vol. 151, No. 48. Accessed at: http://www.gazette.gc.ca/rp-pr/p1/2017/2017-12-02/pdf/g1-15148.pdf

Canada. 2017l. "Safe Food for Canadians Regulations." *Canada Gazette* Part I, Vol. 151, No. 3. Accessed at: http://www.gazette.gc.ca/rp-pr/p1/2017/2017-01-21/pdf/g1-15103.pdf

Canada. 2017m. "Technology-led Innovation in the Canadian Financial Services Sector." Competition Bureau of Canada. Accessed at: http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/vwapj/FinTech-MarketStudy-December2017-Eng.pdf/$FILE/FinTech-MarketStudy-December2017-Eng.pdf

Canada. 2017n. "Canada's New Intellectual Property Strategy – Consultation." Innovation, Science and Economic Development Canada. Accessed at: https://www.ic.gc.ca/eic/site/693.nsf/eng/00157.html

Canada. 2017o. "Frequently Asked Questions - Biotechnology and Genetically Modified Foods." Health Canada website. Accessed at: https://www.canada.ca/en/health-canada/services/food-nutrition/genetically-modified-foods-other-novel-foods/factsheets-frequently-asked-questions/part-1-regulation-novel-foods.html

Canada. 2018. "Benefits for Companies – Better rules to protect Canada's environment and grow the economy." Accessed at: https://www.canada.ca/en/services/environment/conservation/assessments/environmental-reviews/environmental-assessment-processes/benefits-canadians.html

Canada. 2018a. "Equality + Growth — A Strong Middle Class." Budget Plan 2018. Accessed at: https://www.budget.gc.ca/2018/docs/plan/budget-2018-en.pdf

Canada. 2018b. "Government of Canada takes steps to ensure a clean environment and strong economy." News Release, Environment and Climate Change Canada, February 8, 2018. Accessed at: https://www.canada.ca/en/environment-climate-change/news/2018/02/government_of_canadatakesstepstoensureacleanenvironmentandstrong.html

Canadian Council of Chief Executives, 2014. "Made in the world: Defragmenting rules of origin for more efficient global trade." A report to the Canadian Council of Chief Executives by Brian Staples and Laura Dawson. Accessed at: http://thebusinesscouncil.ca/wp-content/uploads/2014/06/Made-in-the-world-Dawson-and-Staples-June-2014.pdf

CAPP. 2017. "A competitive policy and regulatory framework for Alberta's upstream oil and natural gas industry." Canadian Association of Petroleum Producers, Report 2017-0035. Accessed at: http://www.capp.ca/~/media/capp/customer-portal/publications/304673.pdf

Carney, Mark. 2016. "Enabling the FinTech transformation: Revolution, Restoration, or Reformation?" Speech prepared for the Lord Mayor's Banquet for Bankers and Merchants of the City of London at the Mansion House, London, June 16 2016. Accessed at: http://www.bankofengland.co.uk/publications/Documents/speeches/2016/speech914.pdf

Carney, Mark. 2017. "The Promise of FinTech – Something New Under the Sun?" Speech to the Deutsche Bundesbank G20 conference on Digitising Finance, Financial Inclusion and Financial Literacy. Accessed at: https://www.bis.org/review/r170126b.pdf

CCC. 2016. "Canada's Next Top Trade Barrier: Taking International Regulatory Co-operation Seriously." Canadian Chamber of Commerce. Accessed at: http://www.chamber.ca/download.aspx?t=0&pid=35943b7b-da00-e611-a280-005056a00b05

CETA. 2016. "Canada-European Union Comprehensive Economic and Trade Agreement." Accessed at: http://www.international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/ceta-aecg/text-texte/toc-tdm.aspx?lang=eng

CFIA. 2014."Incorporation by Reference: Discussion Document." Accessed at: http://www.inspection.gc.ca/DAM/DAM-aboutcfia-sujetacia/STAGING/text-texte/food_actionplan_incorp_ref_discuss_1401723700118_eng.pdf

CFIA. 2017. "Food Labelling Modernization Initiative Phase III Discussion Paper and Questionnaire: Engaging on Key Proposals to Modernize the Food Labelling System." Accessed at: http://www.inspection.gc.ca/DAM/DAM-food-aliments/STAGING/text-texte/survey_food-labelling-modernization_1479501771195_eng.pdf

CFIA. 2017a. "Proposed Safe Food for Canadians Regulations: Update on the public consultation (January to April 2017). Accessed at: http://inspection.gc.ca/about-the-cfia/acts-and-regulations/regulatory-initiatives/sfca/proposed-sfcr/eng/1426531180176/1426531265317

CFTA. 2017. "Canadian Free Trade Agreement Consolidated Version." Accessed at: https://www.cfta-alec.ca/wp-content/uploads/2017/06/CFTA-Consolidated-Text-Final-Print-Text-English.pdf

Chanjaroen, Chanyaporn. 2017. "Singapore Regulator Would Consider Trialing Certain ICOS." BloombergMarkets, November 14, 2017. Accessed at: https://www.bloomberg.com/news/articles/2017-11-15/singapore-regulator-would-consider-certain-icos-for-a-sandbox

CHBA. 2016. "Submission to the Minister of Families, Children and Social Development: Toward a Comprehensive, Sustainable National Housing Strategy." Canadian Home Builders' Association. Accessed at: http://www.chba.ca/CHBADocs/CHBA/HousingCanada/Government-Role/2016-10-18-CHBA-Submission-to-the-Minister-of-Families-Children-and-Social-Development-National-Housing-Strategy.pdf

Chennakeshu, Sandeep. 2017. Testimony before the Senate Standing Committee on Transportation and Communications, June 6, 2017, 42nd Parliament, 1st Session. Accessed at: https://sencanada.ca/en/Content/Sen/Committee/421/TRCM/53397-e

CIIT. 2017. "Priorities of Canadian Stakeholders having an interest in Bilateral and Trilateral Trade in North America, between Canada, the United States and Mexico." Report of the Standing Committee on International Trade. December 2017, 42nd Parliament, 1st Session. Accessed at: http://www.ourcommons.ca/Content/Committee/421/CIIT/Reports/RP9326406/ciitrp08/ciitrp08-e.pdf

CIRS. 2016. "The impact of the evolving regulatory environment on the approval of new medicines across six major authorities 2006-2015." R&D Briefing 59. Accessed at: http://www.cirsci.org/wp-content/uploads/2016/05/CIRS_RD_-Briefing_59_23052016.pdf

CIRS. 2017. "Median approval time for new active substances approved by ICH agencies by approval year – May 2017 slide of the month." Accessed at: http://www.cirsci.org/may-2017-slide-month/

Committee on Internal Trade. 2017. "Regulatory Reconciliation Backgrounder," Accessed at: https://www.cfta-alec.ca/regulatory-reconciliation-cooperation/

Cooper, Diana Marina. 2014. “Commercial drone regulations: Canada vs. US.” Robohub.org. Accessed at: http://robohub.org/commercial-drone-regulations-canada-vs-us/

Craig, Carys J. 2013. "Technological Neutrality: (Pre)Serving the Purposes of Copyright Law." Articles & Book Chapters. Paper 1599. Accessed at: http://digitalcommons.osgoode.yorku.ca/scholarly_works/1599

Cruikshank, Ken. 1991. Close Ties: Railways, Government and the Board of Railway Commissioners. Montreal: McGill-Queen’s University Press.

Cortez, Nathan. 2014. “Regulating Disruptive Innovation.” *Berkeley Technology Law Journal*, 20(1): pp. 175-228. Accessed at: http://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=2021&context=btlj

CSA. 2015. “Start-up Crowdfunding Registration and Prospectus Exemptions.” Canadian Securities Administrations Multilateral CSA Notice 45-316. Accessed at: https://www.bcsc.bc.ca/Securities_Law/Policies/Policy4/PDF/45-316__Multilateral_CSA_Notice___May_14__2015/

CSA. 2017. “CSA Regulatory Sandbox: fast and flexible process for innovative business models.” Accessed at: http://pmprb-cepmb.gc.ca/CMFiles/Consultations/scoping_paper/pmprb_scoping_paper_e.pdf

CSA. 2017a. “CSA Staff Notice 46-307 Cryptocurrency Offerings.” Canadian Securities Administrators, August 24, 2017. Accessed at: http://www.osc.gov.on.ca/en/SecuritiesLaw_csa_20170824_cryptocurrency-offerings.htm

Curtis, John M. 2017. “Maximizing Canada's Innovation and Trade Gains from the Next Generation of Trade Deals.” Forthcoming paper, Conference Board of Canada.

Defence IQ. 2016. “Additive Manufacturing - Aerospace, Defence & Space: Trends and Analysis 2016.” Accessed at: https://defencesummits.files.wordpress.com/2016/02/additive-manufacturing-in-defence-and-aerospace-analysis-and-trends-20161.pdf

Duesterberg, Thomas J. 2017. “5G: China’s dream to dominate world technology.” *The Japan Times*, December 22, 2017, online edition. Accessed at: https://www.japantimes.co.jp/opinion/2017/12/22/commentary/world-commentary/5g-chinas-dream-dominate-world-technology/

EASA. 2016. Presentation to the European Aviation Safety Agency Workshop on Additive Manufacturing.” Presented by S. Waite, Senior Expert – Material Certification Directorate, EASA. September 2016. Accessed at: https://www.easa.europa.eu/system/files/dfu/WORKSHOP%20Additive%20Manufacturing%20-%20Presentations.zip

Environics. 2016. “Canadian Public Opinion on Governance 2016.” Accessed at: http://www.environicsinstitute.org/uploads/institute-projects/canadian%20public%20opinion%20on%20governance%202016%20-%20final%20report%20-%20june%2017-2016.pdf

Estevadeordal, Antoni, Juan Blyde, Jeremy Harris and Christian Volpe. 2014. “Global Value Chains and Rules of Origin.” International Centre for Trade and Sustainable Development and the World Economic Forum E15 Initiative. Accessed at: http://e15initiative.org/wp-content/uploads/2015/09/E15-GVCs-Estevadeordal-Blyde-Harris-Volpe-Final.pdf

European Commission. 2014. "Precision Agriculture: An Opportunity for EU Farmers – Potential Support with the CAP 2014-2020." Joint Research Centre (JRC) of the European Commission. IP/B/AGRI/IC/2013_153. Accessed at: http://www.europarl.europa.eu/RegData/etudes/note/join/2014/529049/IPOL-AGRI_NT(2014)529049_EN.pdf

European Commission. 2016. "Disruptive Innovation – Considerations for Health and Health Care in Europe." Expert Panel on Effective Ways of Investing in Health. Accessed at: http://ec.europa.eu/health/expert_panel/sites/expertpanel/files/012_disruptive_innovation_en.pdf

European Commission. 2017. "Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service." Press release, 27 June 2017. Accessed at: http://europa.eu/rapid/press-release_IP-17-1784_en.htm

European Commission. 2017a. "Quantum Technologies Flagship Final Report." High-Level Steering Committee, June 28, 2017. Accessed at: http://ec.europa.eu/newsroom/document.cfm?doc_id=46979

Farrell, Erin D. and Josh Hanet. "Cybersecurity and Medical Devices: Electronic Medical Data increases Product Liability Risk for Medical Device Manufacturers." Gowling WLF. Accessed at: https://gowlingwlg.com/en/global/insights-resources/cybersecurity-and-medical-devices-electronic-medical-data-increases-product-liability-risk-for-medical-device-manufacturers

FCA. 2017. "Regulatory sandbox." UK Financial Conduct Authority web site. Accessed at: https://www.fca.org.uk/firms/project-innovate-innovation-hub/regulatory-sandbox

FCA. 2017a. "Regulatory sandbox lessons learned report." UK Financial Conduct Authority. Accessed at: https://www.fca.org.uk/publication/research-and-data/regulatory-sandbox-lessons-learned-report.pdf

Flyvbjerg, Bent. 2009. "Survival of the unfittest: why the worst infrastructure gets built—and what we can do about it," *Oxford Review of Economic Policy*, 25(3), 344–367. Accessed at: https://academic.oup.com/oxrep/article-abstract/25/3/344/424009

Freeland, Chrystia. 2017. Address to the House of Commons, 1st Session, 42nd Parliament, June 6, 2017. Accessed at: http://www.ourcommons.ca/Content/House/421/Debates/188/HAN188-E.PDF#page=5

Frost and Sullivan. 2016. "Transforming Healthcare through Artificial Intelligence Systems." Accessed at: http://ai-healthandlifesciences.com/hypfiles/uploads/2016/08/AI-Healthcare-Research-Insights-KisacoResearch.pdf

Geist, Michael. 2016. "The Trouble with the TPP, Day 13: Ban on Data Transfer Restrictions." Accessed at: http://www.michaelgeist.ca/2016/01/the-trouble-with-the-tpp-day-13-ban-on-data-transfer-restrictions/

Gratwick, John. 2001. "The Evolution of Canadian Transportation Policy." Research report for the Canada Transportation Act Review. http://www.eskema.eu/DownloadFile.aspx?tableName=tblSubjectArticles&field=PDF%20Filename&idField=subjectArticleID&id=204

GSMA Intelligence and China Academy of Information and Communications Technology. 2017. "5G in China: Outlook and regional comparisons." Accessed at: https://www.gsmaintelligence.com/research/?file=67a750f6114580b86045a6a0f9587ea0&download

Guerin, Kevin. 2003. "Encouraging Quality Regulation: Theories and Tools." Government of New Zealand Treasury Working Paper 03/24. Accessed at: http://www.treasury.govt.nz/publications/research-policy/wp/2003/03-24/twp03-24.pdf

Haldane, Andrew G. 2012. "The Dog and the Frisbee." Speech to the Federal Reserve Bank of Kansas City's 366th Economic Policy Symposium, August 31, 2012. Accessed at: https://www.bis.org/review/r120905a.pdf

Hall, Wendy and Jérôme Pesenti. 2017. "Growing the Artificial Intelligence Industry in the UK." Report to the UK Business Secretary land Culture Secretary. Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/652097/Growing_the_artificial_intelligence_industry_in_the_UK.pdf

Hanebury, Judith. 2014. "Smart Regulation – Rhetoric or Reality." *Alberta Law Review* 44 (1): pp. 33-62. Accessed at: https://www.albertalawreview.com/index.php/ALR/article/viewFile/348/345

Haber, Hana and Eva Heims. 2016. "Regulating the voiceless? Putting participatory regulation on the research agenda," in "Regulation Scholarship in Crisis?" Ed. M. Lodge, Centre for Analysis of Risk and Regulation, London School of Economics and Political Science, Discussion Paper No. 84. Accessed at: http://www.lse.ac.uk/accounting/CARR/pdf/DPs/CARR_DP84-Martin-Lodge.pdf

Higgens, Catherine, Kim Benjamin, Craig Hutton, and Ryan Klomp. 2017. Testimony before the Standing Senate Committee on Transport and Communications." Study on regulatory and technical issues related to the deployment of connected and automated vehicles. February 8, 2017, 42nd Parliament, 1st Session. Accessed at: https://sencanada.ca/en/Content/Sen/Committee/421/TRCM/53062-e

Hollis, Aidan and Ali Shajarizadeh. 2015. "Delays in the submission of new drugs in Canada." *Canadian Medical Association Journal*, 187(1), pp. E47-E5. Accessed at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4284192/

HPC, 2018. "Home Performance Coalition Calls on Congress to Support Federal Energy Efficiency Programs." Media Release, February 12, 2018." Accessed at: http://www.homeperformance.org/news-and-resources/press-releases/home-performance-coalition-calls-congress-support-federal-energy

Hui, Liu and Carl F. Cargill. 2017. "Comparing the Emerging Chinese Standardization System and the Current US System," East-West Centre Policy Study No. 75. Accessed at: https://www.eastwestcenter.org/system/tdf/private/ps075.pdf?file=1&type=node&id=36156

IBM and CRS. 2017. "Accelerate Oil and Gas Transformation With Advanced Technologies." *Daily Oil Bulletin*, December 19, 2017. Accessed at: http://www.dailyoilbulletin.com/article/2017/12/19/sponsored-content-accelerate-oil-and-gas-transform/

ICDPPC. 2016. "Artificial Intelligence, Robotics, Privacy and Data Protection." Room document for the 38th International Conference of Data Protection and Privacy Commissioners, October 2016. Accessed at: https://secure.edps.europa.eu/EDPSWEB/webdav/site/mySite/shared/Documents/Cooperation/Conference_int/16-10-19_Marrakesh_AI_paper_EN.pdf

IISD. 2017. "Clean Fuel Standard: Summary of stakeholder written comments on the discussion paper." November 2017 Report to Environment and Climate Change Canada by the International Institute for Sustainable Development." Accessed at: http://www.iisd.org/sites/default/files/publications/clean-fuel-standard-summary-comments-en.pdf

Jaffe, Gregory. 2016. "Genetically Engineered Foods and their Regulation: the Way Forward after Twenty Years of Adoption." *Regulatory Focus*, August 2016. Regulatory Affairs Professionals Society. Accessed at: https://cspinet.org/sites/default/files/attachment/Jaffe%20RF%202016%2008%20GE%20Foods%20FINAL.pdf

Johal, Sunil and Michael Crawford Urban. 2017. "Regulating Disruption: Governing in an era of rapid technological change." Mowat Centre Research Paper No. 147. Accessed at: https://mowatcentre.ca/wp-content/uploads/publications/147_regulating_disruption.pdf

Kavanagh, Jennifer and Michael D. Rich. 2018. "Truth Decay: An Initial Exploration of the Diminishing Role of Facts and Analysis in American Public Life." RAND Corporation. Accessed at: https://www.rand.org/content/dam/rand/pubs/research_reports/RR2300/RR2314/RAND_RR2314.pdf

King, Michael R. 2016. "Is fintech a disruptor or enabler for Canada's big banks?" *The Globe and Mail*, December 31, 2016. Accessed at: https://www.theglobeandmail.com/report-on-business/rob-commentary/is-fintech-a-disruptor-or-enabler-for-canadas-big-banks/article33457066/

King, Michael R. and Young, Amelia. 2016. "Towards a FinTech Strategy for Canada – Background Briefing." Accessed at: https://www.ivey.uwo.ca/cmsmedia/3775235/briefingnote_king_young_final_161118.pdf

Kramer, Daniel B. and Kevin Fu. 2017. "Cybersecurity Concerns and Medical Devices: Lessons from Pacemaker Advisory." *Journal of the American Medical Association (JAMA),* December 2017. Accessed at: https://jamanetwork.com/journals/jama/article-abstract/2659246?utm_source=silverchair&utm_medium=email&utm_campaign=article_alert-jama&utm_content=etoc&utm_term=120517

Lee-Anderson, Selina. 2017. "Paving the Way for Lower Carbon Fuels: Federal Government Releases Regulatory Frame-work for Clean Fuel Standard." Blog Post, December 18, 2017, *Canadian ERA Perspectives*, McCarthy Tetrault. Accessed at: http://www.canadianeraperspectives.com/2017/12/paving-the-way-for-lower-carbon-fuels-federal-government-releases-regulatory-framework-for-clean-fuel-standard/#page=1

Lewis, David and Ian Currie. 2018 (forthcoming). "A New Role for Cost-Benefit Analysis in Transportation Infrastructure Investment." *Journal of Transportation Economics and Policy*.

LSISB. 2017. "Life Sciences Industrial Strategy – A report to the Government from the life sciences sector." Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/640696/life-sciences-industrial-strategy.pdf

Mandel, Gregory N. 2009. "Regulating Emerging Technologies." Temple University, Beasley School of Law, Research Paper No. 2009-18. Accessed at: https://papers.ssrn.com/sol3/Delivery.cfm?abstractid=1355674

Marsh, James H. and Tabitha Marshall. 2009. "Railway History." The Canadian Encyclopedia, online edition. Accessed at: http://www.thecanadianencyclopedia.ca/en/article/railway-history/

Masters, Jonathan. 2014. "What is Internet Governance?" Backgrounder, Council on Foreign Relations, April 23, 2014. Accessed at: https://www.cfr.org/backgrounder/what-internet-governance

McCarthy, Shawn. 2016. "Builders urge Ottawa to gradually implement 'net zero' building code." The *Globe and Mail* online edition, October 19, 2016. Accessed at: http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/builders-urge-ottawa-to-gradually-implement-net-zero-building-code/article32447398/

McKenna, Catherine. 2016. "Canada's Strategy for a Clean Growth Century." Address to the Toronto Board of Trade, November 24, 2016. Accessed at: https://www.bot.com/Portals/0/NewsDocuments/11252016Canada%E2%80%99s%20Strategy%20for%20a%20Clean%20Growth%20Century.pdf

McLean, Iain. 2002. "The origin and strange history of regulation in the UK: three case studies in search of a theory." Paper for ESF/SCSS Exploratory Workshop: The Politics of Regulation, Barcelona, November 2002. https://www.nuffield.ox.ac.uk/politics/papers/2002/w29/The%20origin%20and%20strange%20history%20of%20regulation%20in%20the%20UK.pdf

Mohanty, Sopnendu. 2016. Intervention in a Panel Discussion on Regulation and Innovation. 2016 Institute of International Finance Annual Membership Meeting. Accessed at: https://www.youtube.com/watch?v=w0dK2wHgzvg

Mohanty, Sopnendu. 2017. Interview "Regulating Fintech in Singapore." Federal Reserve Bank of San Francisco Podcast Transcription, October 2017. Accessed at: https://www.frbsf.org/banking/asia-program/pacific-exchanges-podcast/regulating-fintech-singapore/

Molteni, Megan. 2017. "Medicine is Going Digital. The FDA is Racing to Catch Up." *Wired*, online edition, May 22, 2017. Accessed at; https://www.wired.com/2017/05/medicine-going-digital-fda-racing-catch/

Nou, Jennifer. 2007 "Regulating the Rulemakers: A Proposal for Deliberative Cost-Benefit Analysis," *Yale Law & Policy Review* 26(2), pp. 601-644, available online at: http://digitalcommons.law.yale.edu/cgi/viewcontent.cgi?article=1561&context=ylpr

Odlyzko, Andrew. 2010. "Collective hallucinations and inefficient markets: The British Railway Mania of the 1840s." School of Mathematics and Digital Technology Center, University of Minnesota. http://www.dtc.umn.edu/~odlyzko/doc/hallucinations.pdf

OECD. 2012. "Recommendation of the Council on Regulatory Policy and Governance." Accessed at: http://www.oecd.org/governance/regulatory-policy/49990817.pdf

OECD. 2015. "Case Study on Crowdfunding." Working Party on SMEs and Entrepreneurship." OECD, CFE/SME(2013)7/ANN1/FINAL. Accessed at: http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=CFE/SME(2013)7/ANN1/FINAL&docLanguage=En

OECD. 2015a. "OECD Regulatory Policy Outlook 2015." Accessed at https://www.oecd.org/publications/oecd-regulatory-policy-outlook-2015-9789264238770-en.htm

OECD. 2015b. "Regulatory Policy in Perspective – A Reader's Companion to the OECD Regulatory Policy Outlook 2015." Accessed at http://www.oecd.org/publications/regulatory-policy-in-perspective-9789264241800-en.htm

OECD. 2015c. "The Policy Landscape for International Investment by Government-controlled Investors: A Fact Finding Survey." OECD Working Paper on International Investment, Yuri Shima, 2015/01, OECD Publishing. http://dx.doi.org/10.1787/5js7svp0jkns-en

OECD. 2017. "New Health Technologies: Managing Access, Value and Sustainability." OECD Publishing. Accessed at: http://dx.doi.org/10.1787/9789264266438-en

OECD. 2017a. "Trust and Public Policy." OECD Publishing. Accessed at: http://www.oecd.org/gov/trust-and-public-policy-9789264268920-en.htm

O'Reilly, Tim. 2013. "Open Data and Algorithmic Regulation," in Eds. Brett Goldstein and Lauren Dyson, Beyond Transparency: Open Data and the Future of Civic Innovation, Code for America Press: San Francisco. Accessed at: http://beyondtransparency.org/pdf/BeyondTransparency.pdf

OSC. 2016. "Decision. In the Matter of the Securities Legislation of Ontario and in the Matter of AngelList, LLC and AngelList Advisors, LLC." Ontario Securities Commission, October 24, 2016. Accessed at: http://www.osc.gov.on.ca/en/SecuritiesLaw_ord_20161024_angellist.htm

OSC. 2017. "2017 Ontario Exempt Market Report." OSC Staff Notice 45-715. Accessed at: http://www.osc.gov.on.ca/documents/en/Securities-Category4/rule_20170615_45-715_exempt-market.pdf

OSC. 2017a. "Form 33-109F5 requirement for registered firms that establish, manage, advise and/or trade in securities of cryptocurrency investment funds." December 8, 2017. Accessed at: http://www.osc.gov.on.ca/en/Dealers_reports-staff-notices_index.htm

Parkouda, M. and Marcovitch, I. 2017. "Speaking the Same Technical Language: The Trade Impact of Canada's Participation in Regional Standardization Organizations." Standards Council of Canada. Accessed at: https://www.scc.ca/sites/default/files/publications/SCC_RPT_Speaking-The-Same-Technical-Language_2017-04-25.pdf

Piketty, Thomas. 2014. Capital in the 21st Century, Translated by Arthur Goldhammer. Cambridge: Belknap Press.

PMPRB. 2017. "PMPRB Guidelines Scoping Paper: High Level Overview of Potential New Framework, CGI Consultation Phase, December 2017. Patented Medicine Prices Review Board. Accessed at: http://pmprb-cepmb.gc.ca/CMFiles/Consultations/scoping_paper/pmprb_scoping_paper_e.pdf

Powles, Julia and Hal Hodson. 2017. "Google DeepMind and healthcare in an age of algorithms." *Health Technology*. Accessed online at: http://link.springer.com/content/pdf/10.1007%2Fs12553-017-0179-1.pdf

PRC. 2015."China issues guideline to deepen reform of standardization system." The State Council of the People's Republic of China. Accessed at: http://english.gov.cn/policies/latest_releases/2015/03/26/content_281475078008940.htm

PWC. 2015. "The Sharing Economy." Accessed at: https://www.pwc.com/us/en/technology/publications/assets/pwc-consumer-intelligence-series-the-sharing-economy.pdf

RCC. 2016. "Canada-United States Regulatory Co-operation Council E-Newsletter." March 2016. Accessed at: https://www.canada.ca/en/treasury-board-secretariat/corporate/transparency/acts-regulations/canada-us-regulatory-cooperation-council/e-newsletter-march-2016.html#toc1

Redutskiy, Yury. 2017. "Conceptualization of smart solutions in oil and gas industry." *Precdia Computer Science* 109C (2017) pp. 745-753. Accessed at: https://www.sciencedirect.com/science/article/pii/S1877050917311171/pdf?md5=8033a12a3043a29709e178718abc5fed&pid=1-s2.0-S1877050917311171-main.pdf&_valck=1

Renda, Andrea. 2016. "From Impact Assessment to the Policy Cycle: Drawing Lessons from the EU's Better-Regulation Agenda." University of Calgary School of Public Policy Technical Paper 9(33). http://www.policyschool.ca/wp-content/uploads/2016/10/Financial-Regulation-Renda2.pdf

Roca, Jaime Bonnin, Parth Vaishnav, Erica R.H. Fuchs and M. Granger Morgan. 2016. "Additive Manufacturing: Policy Needed." *Nature Materials*, 15: pp. 815-818. Accessed at: http://www.nature.com/nmat/journal/v15/n8/full/nmat4658.html

Rodger, Mark J. 2014. "Looking Back: 5 Years under Ontario's Green Energy Act." *Energy Regulation Quarterly*, Volume 2, Spring 2014. Accessed at: http://www.energyregulationquarterly.ca/articles/looking-back-5-years-under-ontarios-green-energy-act#sthash.dPZTfFQR.dpbs

Samuels, Kelly and Ian van den Dolder. 2017. "Regtech to Transform Regulatory Compliance," Fintech Blog, Edwards, Kenny & Bray LLP. Accessed at: http://www.ekb.com/regtech-transform-regulatory-compliance/

Satya, Laxman D. 2008. "British Imperial Railways in Nineteenth Century South Asia." *Economic and Political Weekly*, Vol. 43, No. 47, pp. 69-77. https://www.jstor.org/stable/40278213?seq=1#page_scan_tab_contents

SCAA. 2016. "Genetically Modified Animals for Human Consumption." Report of the Standing Committee on Agriculture and Agrifood, December 2016, 42nd Parliament, 1st Session. Accessed at: http://www.parl.gc.ca/content/hoc/Committee/421/AGRI/Reports/RP8674228/agrirp04/agrirp04-e.pdf

SCAA. 2017. "A Food Policy for Canada." Report of the Standing Committee on Agriculture and Agrifood, December 2017, 42nd Parliament, 1st Session. Accessed at: http://www.ourcommons.ca/Content/Committee/421/AGRI/Reports/RP9324012/agrirp10/agrirp10-e.pdf

Science-Metrix. 2015. "Evaluation Report: Evaluation of the Office of Energy Efficiency." Prepared for Natural Resources Canada, Strategic Evaluation Division. Accessed at: http://www.nrcan.gc.ca/evaluation/reports/2015/17155

SCNR. 2017. "De-Risking the Adoption of Clean Tech Technology in Canada's Natural Resources Sector." Report of the Standing Committee on Natural Resources, June 2017, 42nd Parliament, 1st Session. Accessed at: http://www.ourcommons.ca/Content/Committee/421/RNNR/Reports/RP9016888/rnnrrp06/rnnrrp06-e.pdf

Scott, Ryan B., Tyler A. Scott and Richard Zerbe. 2016. "Bureaucratic Cost-Benefit Analysis and Public Controversy." *Journal of Benefit-Cost Analysis* 7(2), pp. 350 -371. https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/div-classtitlebureaucratic-benefit-cost-analysis-and-policy-controversydiv/4BE15D614CB9B9ECD9108743932D64AD

SCSST. 2017. "Challenge Ahead: Integrating Robotics, Artificial Intelligence and 3D Printing Technologies into Canada's Healthcare Systems." Standing Senate Committee on Social Affairs, Science and Technology, October 2017, 42nd Parliament, 1st Session. Accessed at: https://sencanada.ca/content/sen/committee/421/SOCI/reports/RoboticsAI3DFinal_Web_e.pdf

SCTC. 2018. "Driving Change: Technology and the future of the automated vehicle." Standing Senate Committee on Transport and Communications, January 2018, 42nd Parliament, 1st Session. Accessed at: https://sencanada.ca/content/sen/committee/421/TRCM/Reports/COM_RPT_TRCM_AutomatedVehicles_e.pdf

Simpson, James. 2015. "Steam Trains Were 19th Century Super-Weapons: Europe and America pioneered war-trains – Britain perfected them." Blog post, accessed at: https://warisboring.com/steam-trains-were-19th-century-super-weapons-f4899564ee6d

Smyth, Jamie. 2018. "Australia to tighten foreign investment rules amid China concerns." *Financial Times*, January 31, 2018. Accessed at: https://www.ft.com/content/308ca8d6-06f6-11e8-9650-9c0ad2d7c5b5

Standards Australia. 2017. "Roadmap for block chain standards." Accessed at: http://www.standards.org.au/OurOrganisation/News/Documents/Roadmap_for_Blockchain_Standards_report.pdf

Stern, Jon. 2003. "Regulation and Contracts for Utility Services: Substitutes or Complements? Lessons from UK Railway and Electricity History." *The Journal of Policy Reform*, 6 (4): pp. 193-215. Accessed at: http://www.tandfonline.com/doi/abs/10.1080/13484128041000169897 8

Ticoll, David. 2017. "Harnessing the mobility revolution to build the Canada that we want." Submission to the Standing Senate Committee on Transport & Communications, April 11, 2017. Accessed at: https://sencanada.ca/content/sen/committee/421/TRCM/Briefs/BriefDavidTicoll_e.pdf

UK. 2016. "Online Platforms and the Digital Single Market." House of Lords Select Committee on European Union, 10th Report of Session 2015–16. Accessed at: https://publications.parliament.uk/pa/ld201516/ldselect/ldeucom/129/129.pdf

UK. 2016a."The Quantum Age: technological opportunities." UK Government Office for Science. Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/564946/gs-16-18-quantum-technologies-report.pdf

UK. 2017. "Autumn Budget 2017." HM Treasury. Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/661583/autumn_budget_2017_print.pdf

UK. 2017a. "Industrial Strategy: Building a Britain fit for the future." Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf

UK. 2017b "Industrial Strategy: Life Sciences Sector Deal." Government of the United Kingdom. Accessed at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/666359/171206_Industrial_Strategy_Life_Sciences_SD_Accessible_PDF_DPS.pdf

UK. 2017c. "Royal Free - Google DeepMind trial failed to comply with data protection law." New Release, UK Information Commissioner's Office. Accessed at: https://ico.org.uk/about-the-ico/news-and-events/news-and-blogs/2017/07/royal-free-google-deepmind-trial-failed-to-comply-with-data-protection-law/

UK. 2018. "House of Commons Science and Technology Committee Oral Evidence: Algorithms in decision-making." HC 351, Tuesday 16 January 2018. Accessed at: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee/algorithms-in-decisionmaking/oral/76942.pdf

UN. 2005. "Report of the Working Group on Internet Governance." Accessed at: https://2001-2009.state.gov/e/eeb/rls/rpts/othr/49653.htm#I

UN. 2015. "Best Policy Practices for Promoting Energy Efficiency." United Nations Economic Commission for Europe. Accessed at: http://www.un-expo.org/wp-content/uploads/2017/06/ECE_Best_Practices_in_EE_publication.pdf

Ungar, Lowell. 2018. "The proposed federal budget: Friday the 13th Part 2." Blog Post, February 12, 2018, American Council for an Energy Efficient Economy. Accessed at: https://aceee.org/blog/2018/02/proposed-federal-budget-friday-13th

US. 2013." Statement of the Federal Trade Commission Regarding Google's Search Practices In the Matter of Google Inc." US Federal Trade Commission, January 3, 2013, FTC File Number 111-0163. Accessed at: https://www.ftc.gov/system/files/documents/public_statements/295971/130103googlesearchstmtofcomm.pdf

US. 2016. "Postmarket Management of Cybersecurity in Medical Devices." US Food and Drug Administration. Accessed at: https://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm482022.pdf

US. 2016a. "Summary Report: Joint Federal Aviation Administration–Air Force Workshop on Qualification/Certification of Additively Manufactured Parts" Federal Aviation Administration, DOT/FAA/TC-16/15. Accessed at: http://www.tc.faa.gov/its/worldpac/techrpt/tc16-15.pdf

US. 2017. "Department of the Interior, Environment, and Related Agencies Appropriations Bill, Report." US House of Representatives Committee on Appropriations. July 18, 2017. Accessed at: https://appropriations.house.gov/uploadedfiles/23918.pdf

US. 2017a. "Major Savings and Reforms – Budget of the U.S. Government Fiscal Year 2018." Accessed at: https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/msar.pdf

US. 2017b. "President Donald J. Trump: Buy American and Hire American for the United States Automobile Industry." The White House, Office of the Press Secretary, March 15, 2017. Accessed at: https://www.whitehouse.gov/the-press-office/2017/03/15/president-donald-j-trump-buy-american-and-hire-american-united-states

US. 2017c. “Presidential Executive Order on Reducing Regulation and Controlling Regulatory Costs.” January 30, 2017. Accessed at: https://www.whitehouse.gov/the-press-office/2017/01/30/presidential-executive-order-reducing-regulation-and-controlling

US, 2017d. “Public Input on Bioengineered Food Disclosure Questions.” United States Department of Agriculture, Agriculture Marketing Services Website. Accessed at: https://www.ams.usda.gov/rules-regulations/public-input-bioengineered-food-disclosure-questions

US. 2017e. “Regulations for Emissions from Vehicles and Engines: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas (GHG) Emissions Standards for Model Years 2022-2025”. US Environmental Protection Agency. Accessed at: https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas-ghg

US. 2018. “Efficient, Effective and Accountable: An American Budget Fiscal Year 2019.” Accessed at: https://www.whitehouse.gov/wp-content/uploads/2018/02/budget-fy2019.pdf

US Library of Congress. 2016. “Regulation of Drones.” Accessed at: https://www.loc.gov/law/help/regulation-of-drones/regulation-of-drones.pdf

Van Es, Harold and Joshua Woodard. 2017. “Innovation in Agriculture and Food Systems in the Digital Age,” in “The Global Innovation Index 2017: Innovation Feeding the World.” 10th Edition, SC Johnson College of Business, Cornell University, INSEAD, and the World Intellectual Property Organization, pp. 97-103. Accessed at: https://www.globalinnovationindex.org/gii-2017-report

Vestager, Margrethe. 2017. Cited by David Herszenhorn in: “The transatlantic guns that didn’t fire over Google,” Politico.eu Accessed at: http://www.politico.eu/article/the-transatlantic-guns-that-didnt-fire-over-google/

Viswanathan, Sowmya Viand and Tania Bubela. 2015. “Current practices and reform proposals for the regulation of advanced medicinal products in Canada.” *Regenerative Medicine* 10(5): 647–663. http://ccrm.ca/sites/default/files/cdn_regulation_of_RM_Sowmya_Tania.pdf

Wilkins, Carolyn and Gerry Gaetz. 2015. “Could DLT underpin an entire wholesale payment system?” The *Globe and Mail*, May 25, 2017. Accessed at: https://www.theglobeandmail.com/report-on-business/rob-commentary/could-dlt-underpin-an-entire-wholesale-payment-system/article35106771/

Williams, Anthony D. 2016. “Accelerating Canada’s Clean Growth Economy.” Centre for Digital Entrepreneurship and Economic Performance (DEEP Centre). Accessed at: http://deepcentre.com/wordpress/wp-content/uploads/2016/11/DEEP_Centre_Clean_Growth_Economy.pdf

Winfield, Mark, Nageen Rheman, Mariana Eret, Dawn Srifler and Paul Cockburn. 2013. “Understanding the Economic Impact of Renewable Energy Initiatives: Assessing Ontario’s Experience in a Comparative Context.” Sustainable Energy Initiative, Faculty of Environmental Studies, York University. Accessed at: http://sei.info.yorku.ca/files/2013/10/greenjobs-web-oct10-1.pdf

WGCT. 2016. “Final Report.” Federal-Provincial-Territorial Working Group on Clean Technology, Innovation and Jobs. Accessed at: http://www.climatechange.gc.ca

Yeung, Karen. 2017._“Algorithmic Regulation: A Critical Interrogation,” King’s College London Dickson Poon School of Law, Legal Studies Research Paper No. 2017.17. Accessed at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2972505&download=yes

ANNEXES

Macro Drivers of Whole-of-Government Federal Regulatory Reform Initiatives 1970 — 2016

PERIOD	MACRO-DRIVERS	WHOLE-OF-GOVERNMENT REGULATORY REFORM MILESTONES
1970s	Economic nationalism Stagflation and economic malaise (oil price shocks) "Regulatory inflation" in economic and social areas	1977. Treasury Board Secretariat (TBS) requires evaluation of all federal regulatory and expenditure programs at least once every three to five years. 1978. Federal and Provincial First Ministers agree to refer "whole matter of regulation" to the Economic Council of Canada. 1978. TBS issues Government of Canada Regulatory Policy. 1979. Office of the Co-ordinator of Regulatory Reform established within the TBS.
1980s	Oil Price shock Constitutional debates Neo-liberal economic thinking (e.g., privatization and de-regulation) Trade and investment liberalization (MacDonald Royal Commission) Sustainable development policy paradigm (1987 Bundtland Report)	1980. House of Commons Special Committee on Regulatory Reform issues report (Peterson). 1981. Economic Council of Canada's Final Report on Reforming Regulation issued. 1985. Ministerial Task Force on Program Review (Neilson) identifies federal provincial "regulatory overlap" as a significant issue. 1986. TBS Office of the Coordinator of Regulatory Reform abolished and replaced by Privy Council Office on Privatization, Regulatory Affairs and Operations (PRAO). In August 1986 PRAO replaced by Regulatory Affairs Branch (RAB) under a Minister of Privatization and Regulatory Affairs. RAB issues Regulatory Process Action Plan for: an annual Federal Regulatory Plan; a Regulatory Impact Analysis Statement; public consultation; cyclical reviews of regulatory statutes & regulations; and evaluation of all regulatory programs at least once every seven years.
1990s	Federal debt and deficit management pressures Extension & deepening of international trade agreements	1994. Federal Regulatory Reform Agenda issued for: improving regulatory efficiency in six sectors; a business impact test; paper burden of regulation initiatives; and regulatory management standards. Legislative and regulatory reform program to bring Canada into conformity with commitments under Canada-US FTA, NAFTA, and WTO agreements.
2000 - 2016	Increasing global competitive pressures (rise of China) Internet and other technologies disrupt industries & business models Commodities "Super Cycle"; global financial crisis and recession Paris Climate Agreement Erosion of trust in traditional sources of authority; and concerns over income distribution	2003. Privy Council Office issues *A Framework for the Application of Precaution in science- based decision making about risk.* 2004. External Advisory Committee on Smart Regulation delivers report. 2005. Paperwork Burden Reduction Initiative launched. 2007. Cabinet Directive on Streamlining Regulation is issued, including a lifecycle approach for regulatory management. 2011. Small Business Lens introduced as part of a revised Cabinet Directive on Regulatory Management. US and Canadian leaders commit to establish a United States-Canada Regulatory Cooperation Council (RCC). 2012. Implementation of "One-for-One" Rule; the small business lens; and service standards for high volume regulatory authorizations. 2015. *Red Tape Reduction Act* passed. 2016. Launch of multiple public consultations in regulation-intensive areas; and review of the Cabinet Directive on Regulatory Management.

Best Practice Lists in Regulating for Innovation

1. Deloitte's Shah, Brody and Olson (2015)

- **Rethinking outreach**. (e.g., use online platforms to connect regulators with citizens in a timely way; make sure you have regulatory capacity to respond to influx of comments received online);

- **Sensing**. (e.g., understand the emerging technologies; build networks to stay on top of technologies);

- **Guidelines and statements versus regulations.** (e.g., provide industry innovators with a clear set of guidelines for developing new offerings, allow industry entities to come up with their own set of standards and principles, which could be adopted by a regulator as the base standard);

- **Tomorrow's talent** (e.g., consider alterative regulatory hiring channels to bring in tech-savy talent);

- **Consultation 2.0** (e.g., take a more strategic approach to soliciting citizen comments, such as facilitated deliberative processes);

- **Collaborative Regulation** (e.g., when disruptive new technologies cut across formal regulatory agencies, consider: identifying and drawing analytical strength and insight from other regulatory agencies; explore new inter-agency collaboration models and mechanisms);

- **Correlate to predict.** (e.g., up your data IQ to ensure you have the capacity to successfully analyze large and complex data sets relevant to the regulatory mandate; experiment and explore new data sets; identify data gaps);

- **Citizen as regulator**. (e.g., crowdsource data from citizens, but with attention to data availability, verification processes; and privacy and data security);

- **Open data.** (e.g., make regulatory data more open to citizens, companies and non-profits in order to draw in expertise and insights to regulatory decision-making);

- **Collaborative Enforcement.** (e.g., seek out potential new regulatory partners at home and abroad); and,

- **Retrospective Review.** (e.g., quantify the burden of regulations along with oversight and enforcement costs as a starting point for review and modifying and removing ineffective or duplicative regulations).

2. The Australian Productivity Commission's 2016 research paper, *Digital Disruption: What do governments need to do*? (APC, 2016)

The pace of change has implications for how governments undertake regulatory functions. Some regulations and regulatory approaches are explicitly preventing the development and efficient adoption of technologies. In principle, governments should:

- adopt a 'wait and see' approach to new business models and products rather than reacting quickly to regulate what may be unrealized risks
- where relevant regulations already exist
  - adopt fixed-term regulatory exemptions for innovative entrants that maintain overarching regulatory objectives (as recommended by the Business Set-up, Transfer and Closure inquiry)
  - use the opportunity of disruption to reform markets where there have been undue regulatory restrictions by removing restrictions that impose a competitive disadvantage on incumbents rather than extend existing restrictions to new business models
- where regulation is needed to manage negative externalities, take a proportionate approach (that is, balance the benefits and costs) and regulate outcomes not technologies
- take an evidence-based approach drawing on Australia's scientific agencies in making assessments of the risks to the community from new technologies
- regularly review regulations affected by digital technologies, especially where an increasing share of activity is mediated through digital platforms
- assign the responsibility for reporting to the parties best able to comply at least cost, and design transparent mechanisms for dealing with complaints.

Source: APC (2016: 101)

3. Recommendations from the Mowat Centre (Regulating Disruption Governing in an era of rapid technological change (Johal and Crawford Urban, 2017)

<u>Skills</u>

- Governments must invest in attracting, retaining and training top-quality staff for key regulatory departments and agencies.

- Greater emphasis should be placed on lifelong learning for regulatory staff, including greater incentives and support for educational leaves – particularly for frontline staff.

- The potential for new tools – such as the "microcredentials" and "nanodegrees" that online educational providers are now offering – to enable more targeted and cost-effective training for workers that is less disruptive to daily operations should be explored.

- Explore opportunities for strategic, structured, short-term secondments and assignments to digital technology firms and research and development labs (and vice versa) to give public and private sector workers improved understandings of how each other's organizations operate.

- Incentivize secondments and other similar assignments by making them an important consideration in performance appraisals and internal competitions for advancement.

- Renew commitments to hire and train data specialists within government who will be able to understand and challenge regulated, expert actors who are operating in data-rich environments.

- Target educational outcomes in priority areas, such as numeracy, critical to the careers in science, technology, engineering and mathematics that drive technological innovation.

- Improve the quality and accessibility of re-training programs for individuals looking to or in need of upgrading their skills. Programs such as Denmark's "flexicurity" system, Britain's UnionLearn and Singapore's SkillsFuture should serve as models for further exploration.

- Make employment insurance rules more flexible and supportive of re-training or pursuing further education for workers. This could include relaxing the restrictions on pursuing additional education in a specific set of "in-demand" trades and areas while on employment insurance.

Structures

- Create an Innovation Advocate to challenge established thinking in the regulatory space and identify opportunities for innovation.

- Expand formal pathways between regulators at all levels of government to enhance coordinated and collaborative solutions to cross-jurisdictional challenges.

- Create a Federal-Provincial-Municipal forum to develop harmonized responses to technological innovations. This forum should serve as the focal point for a broader system of engagement, coordination and support for this effort.

- Work with national and international standards development organizations to identify, where appropriate, alternative governance instruments to legislation and regulation capable of responding more quickly and dynamically to rapidly changing technological innovations.

- The federal government should take the lead in convening Canadian regulators and policymakers in support of proactive engagement at the international level to ensure that international governance of global commerce aligns with Canadian government priorities as closely as possible.

- The federal government should continue to pursue regulatory harmonization as a priority in its multilateral and bilateral trade negotiations and as part of its ongoing diplomatic activities.

- Canadian governments should always investigate whether the adoption of existing international standards or regulatory instruments would serve their purposes before creating new national or sub-national ones.

- Canadian governments should ensure that international considerations and issues are emphasized in the training and recruitment of regulatory staff, to ensure that Canadian perspectives are informed by the increasingly global nature of regulatory issues.

Strategies

- Governments across Canada should conduct a baseline assessment of their regulatory frameworks and the burdens they impose. Governments undertaking such an assessment should employ a standardized and transparent methodology for calculating the cost of these burdens.

- Periodic reports to legislatures, cabinets or heads of government on the status of these regulatory updates and reviews should be developed and implemented.

- Following the example set by Estonia, governments should set a date, through legislation, by which governments are required to only ask citizens and firms for a piece of information once. Using this date as a deadline, governments should build a plan for putting in place the necessary legislative reforms and building the necessary technological and administrative systems necessary to deliver a "tell us once" approach.

- Regulators should streamline inspections and enforcement activity through coordination with each other to minimize burdens on businesses.

- Governments should seek out opportunities for increased co-regulation and self-regulation of industries in sectors where they can be assured of strong levels of quality control through robust data-sharing agreements, spot audits and broad oversight of market operations.

- Re-think how existing consultation approaches can become more user-friendly, relevant and timely. Possible approaches include:

  - Building a Centre of Excellence for Consultations within government to support departments and regulators when they are designing and conducting their consultations.

  - Making greater use of Innovation Labs that bring stakeholders from a host of different backgrounds and perspectives together over the course of regulatory or policy development and piloting exercises.

  - Involving participants in consultative exercises in the design of the consultation itself to ensure that participants feel that they have had a chance to not only answer the questions that government is interested in but to also communicate to government their understanding of the issue and their priorities and concerns.

  - Increasing the use of service standards and client-satisfaction as a key performance indicator for consultations.

- Explore new ways of encouraging competition in the digital economy. For example, requiring companies to make their customers' data more portable so that they can more easily switch between platforms and other online services.

- Examine ways to build-out emergent digital government initiatives, such as online tax filing, into a more comprehensive online identity verification system capable of supporting citizen interactions with government across the whole range of its responsibilities.

- Sunset clauses or periodic regulatory reviews should be a regular feature of any legislation or regulation that risks obsolescence due to technological progress.

- The potential use of standards-based solutions — either instead of or in conjunction with regulation and legislation — should be explored as a matter of course, particularly for technical areas and for sectors that are changing at a rapid pace.

- Where possible, governments and regulators should adopt more risk-based approaches to inspection and other regulatory enforcement activities. Leveraging internal data and data available from firms to enable a focus on high- risk and repeat violators will ensure limited public resources are appropriately targeted.

Main Recommendations from the Competition Bureau of Canada Market Study on Technology-led Innovation in the Canadian Financial Services Sector (December 2017)

1. **Regulation should be technology-neutral and device-agnostic**. Rules that can accommodate and encourage new and yet-to-be developed technologies open the door to more innovative offers today and down the road.

2. **To the extent possible, regulation should be principles-based.** Instead of prescribing exactly *how* a service must be carried out, a principles-based approach will allow regulators to be more flexible in their approach to enforcement as technology changes.

3. **Regulation should be based on the function an entity carries out.** This will ensure that all entities that perform the same function carry the same regulatory burden and consumers have the same protections when dealing with competing service providers.

4. **Regulation should be proportional to risk.** This requires a tiered approach: functions whose failure poses lower risks to the financial system should not necessarily face the same strict oversight as those whose failure poses higher risks. This will give smaller players a level playing field to innovate.

5. **Regulators should continue their efforts to harmonize regulation across geographic boundaries.** Differences in regulations across provinces can lead to increased compliance burden. Consistency, on the other hand, can facilitate entry and expansion of FinTech across Canada and abroad.

6. **Policymakers should encourage collaboration throughout the sector**. Mechanisms for doing so include the use of regulatory sandboxes and innovation hubs. Greater collaboration will enable a clear and unified approach to risk, innovation and competition.

7. **Policymakers should identify a FinTech policy lead for Canada to facilitate FinTech development.** This would give FinTech firms a one-stop resource for information and encourage greater investment in innovative businesses.

8. **Regulators should promote greater access to core infrastructure and services**. This includes access to the payments system (under the appropriate risk-management framework) and banking services to facilitate the development of innovative new FinTech services.

9. **Policymakers should embrace broader "open" access to systems and data through application programming interfaces.** With better access to consumer data (obtained through informed consent), FinTech can help Canadians overcome their inability or unwillingness to shop around and switch between service providers.

10. **Industry participants and regulators should explore the potential of digital identification verification**. This would reduce customer acquisition costs for service providers, ultimately reducing the costs of switching for consumers and facilitating regulatory compliance where identity verification is needed.

11. **Policymakers should continue to review their regulatory frameworks frequently.** Doing so will ensure that these frameworks remain relevant in the context of future innovation and can achieve their objectives in a way that does not unnecessarily inhibit competition.

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