Canada's 'Inclusive' Innovation and Skills Plan in the Face of the Employment Threat of Automation

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Abstract

This paper addresses the following question: does Canada's 'inclusive' Innovation and Skills Plan outlined in the 2017 Budget also constitute an 'automation plan'? To this end, this paper has engaged in a benchmarking of the Trudeau Government's Innovation and Skills Plan as outlined in the 2017 Budget against the three pillars of an 'automation plan', as collated from the global literature on automation. At the outset, David Ticoll's labour obsolescence analysis is deemed the most appropriate methodology to guide policymakers' assessments the threat of automation. The three pillars of an 'automation plan' include initiatives aimed at creating new jobs via innovation policy, supporting skills modernization via training and education policies, and supporting the displaced via transforming the social safety net. The first pillar is only partially fulfilled, as measuring the true extent of the threat of automation through labour obsolescence analysis is missing from the 2017 Budget's considerable focus on creating new jobs via innovation policy. The second pillar is also only partially fulfilled, as the Budget's prioritization of skills modernization did not include efforts to bridge the private-public sector data gap on the diffusion/impact of automation technology. The third pillar - policies aimed at supporting the displaced via transforming the social safety net - was the least fulfilled in the Budget, as transformative initiatives such as universal basic income were largely ignored. This exercise yields the conclusion that Canada's 'inclusive' Innovation and Skills Plan as outlined by Budget 2017 presents a policy package more in line with an 'Innovation and Skills Plan' aimed at capitalizing on the upside of innovation, while only partially constituting an 'automation plan' designed to manage the disruption of automation.

In the lead up to the 2017 Budget, the chair of the Trudeau Government's Advisory Council on Economic Growth Dominic Barton made headlines by warning that 40 percent of Canadian jobs are at risk of automation over the next decade or two (Martin, 2017). This speaks to the following question addressed in this paper: does Canada's 'inclusive' Innovation and Skills Plan outlined in the 2017 Budget also constitute an 'automation plan'? The renewed concern over the employment effects of technological change spawned by high profile studies such as Brynjolfsson and McAfee's 'Second Machine Age' has sparked a global discussion as to what policy recommendations are needed in response to the latest wave of disruptive technologies such as artificial intelligence (AI) and robotics. This article generates a typology of policy responses based on this literature with the goal of situating Canada's 'inclusive' Innovation and Skills Plan within this larger conversation. This exercise will benchmark the current status of Canadian policy areas against the backdrop of the global literature's discussion of their role in mitigating the employment impact of the latest wave of disruptive technological change. Accordingly, part I of this paper will examine the difficulty in assessing the true extent of the employment threat posed by automation. In light of conflicting recent empirical accounts of the extent of the automation employment threat faced by Canada, part I will advocate basing policy decisions off of David Ticoll's focus on labour obsolescence - with its emphasis on job creation, destruction, and displacement – rather than conceptualizing the threat as one of simple labour substitution (machines replacing humans). Part II will benchmark the Trudeau Government's 'Inclusive' Innovation and Skills Plan against the notion of an 'automation plan' - a policy mix derived from the global literature's depiction of appropriate policy responses to disruptive technological change. The three categories of policy interventions comprising an 'automation plan' are policies aimed at creating new jobs via innovation policy, supporting skills modernization via training and education policies, and supporting the displaced via transforming the social safety net. In sum, this paper contends that Canada's 'inclusive' Innovation and Skills Plan only partially addresses automation in that it lacks elements in each of the three policy categories that comprise a robust 'automation plan.' First, despite the 2017 Budget's considerable focus on creating new jobs via innovation policy, discussions on the sector-specific approach and focus on AI did not signal intentions of imbedding labour obsolescence analysis into the innovation policy process. Secondly, while supporting skills modernization via training and education policies was certainly prioritized, efforts to bridge the private-public sector data

gap on the diffusion/impact of technology on the labour market were not addressed. Finally, the least-reflected of the three pillars of an 'automation plan' in the 2017 Budget are policies aimed at supporting the displaced via transforming the social safety net, as transformative initiatives such as universal basic income were largely ignored. Thus, Budget 2017 presents a policy package more in line with an 'Innovation and Skills Plan' aimed at capitalizing on the upside of innovation than an 'automation plan' designed to manage the disruption of automation.

Part I – Assessing the Threat of Automation

This section explores the difficulty in assessing the true extent of the employment threat posed by automation. There has been an emerging literature examining how digital transformation of the global economy is threatening to exacerbate inequality in developed economies and automate certain jobs in sectors such as manufacturing that have traditionally driven middle class prosperity (Brynjolfsson and McAfee 2012, 2014; Frey et al. 2013). Persistently high unemployment rates and the decoupling of productivity rates and employment rates have caused researchers such as Brynjolfsson and McAfee (Brynjolfsson and McAfee 2012, 2014) to claim that computer controlled equipment and artificial intelligence (AI) is driving jobless growth in sectors traditionally impacted by automation (such as manufacturing) as well as more white collar professions. The literature on the loss of jobs due to technological change (technological unemployment) is divided, with a growing minority of economists predicting that advances in AI, robotics, and Information Communication Technologies (ICTs) will eliminate more jobs than are created. The empirical literature on industrial automation supports the notion of technological unemployment primarily as it applies to low-skill workers and (to a lesser extent) medium-skilled workers (Graetz and Michaels 2015). With regards to the effects of ICTs, the empirical literature supports the notion of technological unemployment leading to 'polarization' in the form of disappearing middle-skilled workers (Autor, Dorn, and Hanson, 2014)(Michaels, Natraj, and Van Reenen, 2014).

Researchers have devised various approaches to estimating the future impact that automation will have on employment. First is the occupation-based method. Indeed, while the debate on technological unemployment is divided, a consensus is emerging on a relationship

between a job's routine task content and it's risk for computerization (Acemoglu & Autor, 2011; Autor, 2015; Frey & Osborne, 2013). In terms of methodology, Frey and Osborne estimated the proportion of US occupations that can be automated over the next 10 to 20 years by analyzing 2010 U.S. Department of Labor's O*Net information on 702 U.S Standard Occupation Classification (SOC) codes by applying a classification of task structures (automatable or not) derived from machine learning experts. Their finding was that "47 percent of total US employment is in the high risk category, meaning that associated occupations are potentially automatable over some unspecified number of years, perhaps a decade or two" (Frey & Osborne, 2013 p. 38). The other major methodology for assessing the threat of automation is task-based. Management consulting firm McKinsey & Company have asserted the need to measure automation of work activities rather than whole occupations, as showcased in their January 2017 report *A Future that Works: Automation, Employment, and Productivity* (McKinsey Global Institute, 2017). This report "consider[s] work activities a more relevant and useful measure since occupations are made up of a range of activities with different potential for automation. For example, a retail salesperson will spend some time interacting with customers, stocking shelves, or ringing up sales" (McKinsey Global Institute, 2017, p. 5). Using this methodology, the report estimates that "50 percent of the activities that people are paid to do in the global economy have the potential to be automated by adapting currently demonstrated technology" and that "while less than 5 percent of occupations can be fully automated, about 60 percent have at least 30 percent of activities that can technically be automated" (McKinsey Global Institute, 2017, p. 5). As illustrated in Figure 1, this task-based analysis has found that 47 percent of work activities in Canada could be automated by adapting current technology.

Figure 1: Percentage of Work Activities that Could Be Automated by Adapting Current Technology

AFRICA		ASIA/AUSTRALIA		EUROPE		NORTH AMERICA		SOUTH AMERICA	
Kenya	51.9%	Japan	55.7	Czech Rep.	52.2	Mexico	51.8	Peru	53.2
Morocco	50.5	Thailand	54.6	Turkey	50.4	Costa Rica	51.7	Colombia	53.0
Egypt	48.7	Qatar	52.0	Italy	50.3	Barbados	48.7	Brazil	50.1
Nigeria	45.7	South Korea	51.9	Poland	49.5	Canada	47.0	Chile	48.9
South Africa	41.0	Indonesia	51.8	Spain	48.5	U.S.	45.8	Argentina	48.2
		India	51.8	Germany	47.9				
		Malaysia	51.4	Greece	47.8				
		China	51.2	Austria	47.4				
		Russia	50.3	Switzerland	46.7				
		Philippines	47.9	Sweden	46.0				
		U.A.E.	47.3	Netherlands	45.4				
		Oman	46.8	France	43.1				
		Bahrain	46.1	U.K.	42.8				
		Saudi Arabia	46.0	Norway	42.4				
		Australia	44.9						
		Singapore	44.2						
		Kuwait	41.1						

Source: Chui et al., 2017, in Harvard Business Review

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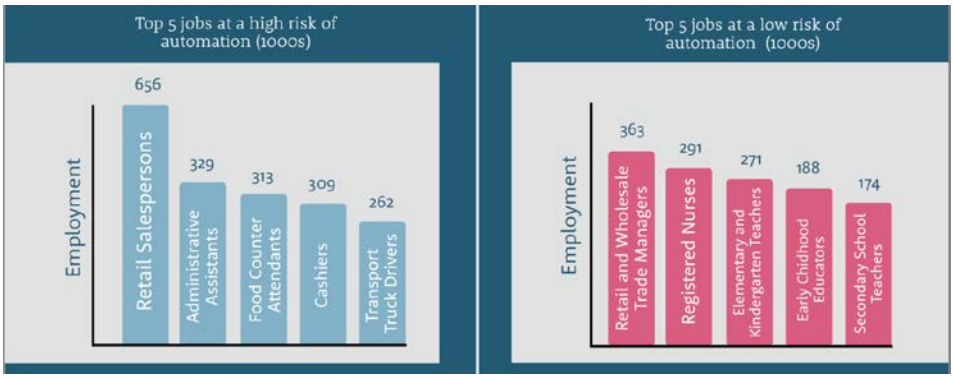
The Canadian labour market has been recently analyzed through the lens of automation. This section will compare these recent empirical accounts of the extent of the automation employment threat faced by Canada with David Ticoll's focus on labour obsolescence - with its emphasis on job creation, destruction, and displacement – rather than conceptualizing the threat as one of simple labour substitution (machines replacing humans) vis-à-vis tasks or occupations.

The first major analysis of Canada using the contemporary methodologies for assessing automation is the Brookfield Institute's 2016 report titled *The Talented Mr. Robot: The impact of automation on Canada's workforce.* This report was the first to apply the occupation-based methodology from Oxford professors Carl Benedikt Frey and Michael A. Osborne and the task-based methodology from management consulting firm McKinsey & Company to Canadian data (2011 National Household Survey). Their occupation-based results shown in Figure 2 illustrate the top five high and low risk occupations.

Figure 2: Top 5 High-Risk and Low-Risk Occupations at Risk of Automation



Source: Brookfield Institute (2016), p. 1.

Using the task-based method, the report estimated that nearly 42 percent of Canadian work activities could be automated using current technologies, and that nearly 18 percent of Canada's labour force could have 70 percent or more of their work activities automated (Brookfield Institute, 2016).

These two methodologies speak to the phenomenon of labour substitution – the substitution of human labour with capital (machines) in a given task or occupation. A third approach to assessing the threat of automation comes from David Ticoll, distinguished senior fellow at the Innovation Policy Lab, Munk School of Global Affairs, University of Toronto. Ticoll notes that "there is an elephant in the room that no one is talking about. The focus on labour substitution in Canada and everywhere else vastly underestimates the breadth and numbers of at-risk jobs" (Ticoll, 2017). Labour substitution is the replacement of humans by machines. Ticoll asserts that "rather than look exclusively at labour substitution to understand the impact of technology on jobs, we must define and analyze changes that affect changing labour demand in the extended ecosystem (or the business web), inside and outside a core sector. The result of this analysis is often a combination of job creation, job destruction and job displacement" (Ticoll, 2017). To illustrate an example of labour obsolescence analysis, Ticoll draws on his prior research on automated vehicles (Ticoll, 2015):

> "business models built around self-driving vehicles will pose big job risks for 1.1 million Canadians over the coming decades. Half a million of these…are professional drivers who face the prospect of labour substitution. They include transport truck drivers; delivery, courier and mail workers; and taxi/limousine drivers. (On-demand drivers for Uber and the like were not counted in the 2011 census.) For the remaining majority (600,000 jobs — police; and insurance, auto service/body shop, dealership/distribution/rental/leasing, manufacturing and gas

> station workers), the main challenge isn't labour substitution, it's functional obsolescence" (Ticoll, 2017).

As this example illustrates, labour obsolescence analysis augments task-based and occupation-based methodologies for assessing the threat of automation. A central difference is in the focus on specific business ecosystems, and how specific technological changes will alter specific business models and business webs. Ticoll illustrates some of the core analytical questions that labour obsolescence methodology focuses on:

> "Changes that will result in labour obsolescence include:
> **Core technologies**: Vehicle hardware will shift from steel to electronics and lightweight materials. Will this further erode the jobs in Canada's already reduced auto sector? Also, demand for oil and gasoline will decline. Electric vehicles will need less routine maintenance (no oil changes!). All this means more jobs for information technologists and fewer jobs for oil workers, gas station attendants and car mechanics.
> **Disintermediation:** Mobility services will use their own fleets and deal directly with consumers via mobile apps. This will have an impact on car dealers and car rental firms.
> **Externalities:** A major benefit of automation will be improved vehicle safety and traffic self-management. This will mean fewer jobs in auto body repair, policing, and accident-related medical services" (Ticoll, 2017).

Returning to the Brookfield Institute's analysis further illustrates how incorporating a labour obsolescence approach can yield different results on the magnitude of threat posed by automation. Using the occupation-based approach, the report identified the top occupation at a low risk of being affected by automation with the most employees was Retail and wholesale trade managers, with a 20.5 percent probability of automation and more than 363,000 employees (Brookfield Institute, 2016, p. 12). Simultaneously, the top occupation that was at high risk of being affected by automation with the most employees is Retail sales persons, with a 92 percent probability of automation and more than 656,000 employees. Although these occupations are in the same sector, the report explains the difference in automation risk as follows:

> "All of these findings suggest that over the next 10 to 20 years, automation will occur most significantly in occupations that are administrative, routine, or oriented toward sales and service…The occupations least at risk appear to rely on humans' cognitive advantage over technology and require more job-specific skills, complex problem solving, as well as people management and oversight" (Brookfield Institute, 2016, p. 12).

These results and the accompanying explanation are in line with the dominant task and occupation-based methodologies currently employed to assess the threat of automation.

However, a labour obsolescence approach may call into question the stability of the occupation of Retail and wholesale trade managers. According to the 2011 NOC description, "retail and wholesale trade managers plan, organize, direct, control and evaluate the operations of establishments that sell merchandise or services on a retail or wholesale basis. Retail and wholesale trade managers are employed by retail and wholesale sales establishments or they may own and operate their own store" (Statistics Canada, 2016). While this occupation may not involve tasks that are routine, the existence of the occupation itself is predicated on the continued success of the retail business model. Rapid advancements in technology such as AI as applied to e-commerce and distribution could conceivably challenge the current retail business ecosystem in the medium term, while long term viability could conceivably be challenged by advances in personal-use 3D printing. In sum, the shortcomings of existing methodologies for assessing the threat of automation highlight the importance of adding a sector-level focus on how technology will impact specific business ecosystems, thus assessing both labour substitution and labour obsolescence. As the next section will illustrate, failing to incorporate labour obsolescence analysis into the policy making process can underestimate the threat posed by automation and thus jeopardize the fulfilment the three pillars of an 'automation plan.' Specifically, policies aimed at creating new jobs via innovation policy, supporting skills modernization via training and education policies, and supporting the displaced via transforming the social safety net all must be grounded in an understanding of the threat of automation that reflects the labour obsolescence approach's holistic emphasis on job creation, job destruction, and job displacement.

Part II - The Policy Response to Automation: Benchmarking Canada's Inclusive Innovation and Skills Plan Against the Three Pillars of an 'Automation Plan'

Figure 3: Benchmarking Canada's Innovation and Skills Plan Against the Three Pillars of an 'Automation Plan

	Three Pillars of an 'Automation Plan'		
	Creating New Jobs Via Innovation Policy	Supporting Skills Modernization Via Training and Education Policies	Supporting the Displaced Via Transforming the Social Safety Net
Best Practice Derived From Global Literature	-Support development of automation technology -Imbed labour obsolescence analysis into innovation policymaking	- Invest in training and education - Coordinate private/public data sharing on automation technology diffusion and employment impact to better inform skills modernization initiatives	- 'Flexicurity' policies to enable portable benefits -Taxing capital, ex: 'robot tax' -Basic Income Guarantee
Canada's 'inclusive' Innovation and Skills Plan as Outlined in Budget 2017	Sector-specific 'supercluster' and AI strategies do not mention incorporation of labour obsolescence analysis	-Investments in education and training -Unclear if skills organization will collect private/public automation-specific labour market data	Adjusting EI to widen eligibility for training programs
Fulfilment of 'Automation Plan' Requirement?	**Partial**: Focus on creating new jobs via innovation policy does not evaluate the automation impact from these new technologies	**Partial**: Investments in Supporting Skills Modernization Via Training and Education Policies do not include mention of automation-specific labour market data	**Minimal**: Lack of commitment to transform the social safety net to support workers displaced by automation

Creating New Jobs Via Innovation Policy

There is an emerging consensus in the automation literature that policymakers should continue to foster the development of disruptive technology such as AI and robotics, regardless of the dislocations in the labour market caused by any automation that may result (Brynjolfsson and McAfee, 2014; 2016; McKinsey Global Institute, 2017). The McKinsey Global Institute report begins its section on policy recommendations by noting that "for policymakers, an embrace of automation could go hand in hand with measures to support labour development"

(McKinsey Global Institute, 2017, p. 112). The rationale for this approach is "the pressing need for productivity acceleration to compensate for demographic aging shifts in order to enable GDP per capita growth" (McKinsey Global Institute, 2017, p. 112). This 'hand in hand' approach calls for two broad categories of issues for policy-makers to consider, which constitute the first two pillars of an 'automation plan': "first, how can we accelerate the development and deployment of automation to generate greater growth in productivity? Second, how can we support the redeployment to other productive activities of workers whose activities are automated?" (McKinsey Global Institute, 2017, p. 112). Reflecting this hand in hand approach is the Dec. 2016 report by the Obama White House titled "Artificial Intelligence, Automation, and the Economy" which discussed policy responses to automation. The report reflected the three pillars of an 'automation strategy' as conceptualized by this paper: "invest in and develop AI for its many benefits," "educate and train Americans for jobs of the future," and "aid workers in the transition and empower workers to ensure broadly shared growth" (White House, 2016, p. 3). The first pillar of automation plan advises policy makers to assist in accelerating early development and adoption of automation technologies. The goal is to increase productivity, innovation and competitiveness, and thus increase wages and employment. The McKinsey report notes that "this support could include investments in developing the technologies themselves, including funding basic research and support for commercialization, as well as supporting investments in digitally enabled infrastructure for automation" (McKinsey Global Institute, 2017, p. 112).

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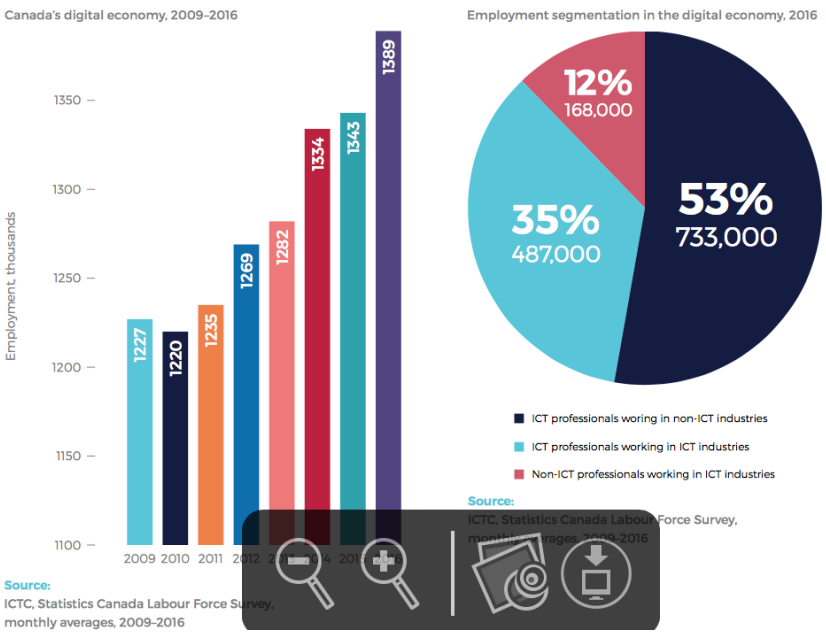
Innovation policies targeted at incentivizing the development and diffusion/adoption of automation technology such as AI and robotics are central to Canada's Innovation and Skills Plan. This focus on maximizing the employment upside of the digital revolution reflects the fact that the employment in the digital economy has grown significantly in recent years (figure 4).

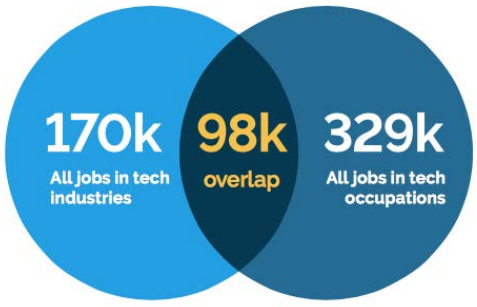
Figure 4: Employment in Canada's Digital Economy



Source: Information and Communications Technology Council (2017, p. 6)

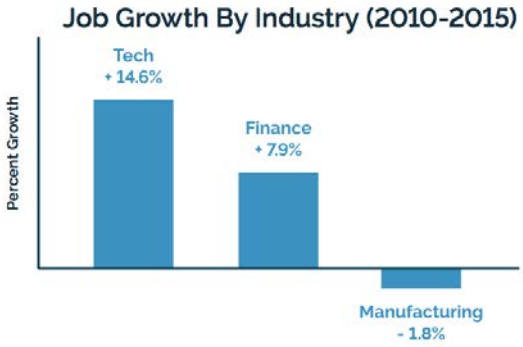
This discussion is augmented by recent data compiled by TechToronto/PWC/Munk School's Innovation Policy Lab showing accelerated job growth within Toronto's tech sector (TechToronto, 2016). This serves a case study of the job creation potential of technology within Canada. The TechToronto report finds that jobs in the tech sector comprise 15 percent of all jobs in the city of Toronto (TechToronto, 2016, p. 5). As figure 5 and 6 illustrate, there is tremendous job growth potential both within the digital sector and in sectors harnessing digital technologies.

Figure 5: Toronto's Tech Sector



Source: TechToronto (2015, p. 5)

Figure 6: Growth of Toronto's Tech Sector



Going forward, policymakers should continue to invest in supporting the growth of the digital economy. The Information and Communications Technology Council (ICTC) estimates that by 2021, approximately 216,000 new jobs will be added to the 1,220,000 ICT professionals currently working in Canada's digital economy (Information and Communications Technology Council, 2017). ICTC attributes much of this growing demand for ICT professionals to transformative and rapid advancements of technology in five key emerging technologies: virtual reality, 3D printing, blockchain, AI, and 5G mobile technology (Information and Communications Technology Council, 2017). Importantly, as these technologies diffuse across the entire economy, Canada's digital workforce will increasingly encompass all industrial sectors. While as of 2016, 53% of ICT professionals were working in non-ICT industries, the ICTC predicts that by 2021, the proportion of ICT workers who are working in non-ICT industries will increase to 84 percent (Information and Communications Technology Council, 2017). Therefore, Canadian policymakers aiming to generate employment through innovation policy will increasingly have to combine a sector-level approach as well as trace how technologies developed in particular subsectors of the digital economy impact more traditional sectors that are quickly being digitally transformed.

Reflecting this, the Brookfield Institute's automation report concluded with a call to respond to automation with a 'focus on Canadian strengths': "to offset any potential negative effects on employment, efforts should also be taken to identify Canada's domestic technological strengths and ensure that the innovators and entrepreneurs behind them, have the financing, talent and supports needed to innovate and scale up. This can help create new jobs that are not only at a low risk of being affected by automation, but are using new technology to grow" (Brookfield Institute, 2017, p. 22). The Advisory Council on Economic Growth's second report echoed this call to focus on Canada's core strengths by advocating a sector approach to fostering innovation (Advisory Council on Economic Growth, 2017a).

Significantly, the 2017 Budget included a strong focus on supporting innovation by targeting specific sectors, both within ICT and in more traditional sectors. Budget 2017 proposes to invest up to $950 million over five years, starting in 2017–18 in 'superclusters' that will "be provided on a competitive basis in support of a small number of business-led innovation "superclusters" that have the greatest potential to accelerate economic growth" (Department of Finance Canada, 2017, p. 79). The competition will launch in 2017 and "focus on superclusters

that enhance Canada's global competitiveness by focusing on highly innovative industries such as advanced manufacturing, agri-food, clean technology, digital technology, health/bio-sciences and clean resources, as well as infrastructure and transportation" (Department of Finance Canada, 2017, p. 79). This marks a meaningful break with the historical tendency for Canadian innovation policy to emphasize sector-agnostic approaches such as SR&ED tax credits, motivated by a desire to not appear to be 'picking winners' (The Council of Canadian Academies 2013). The focus on the 'digital technology' sector features a $125 million investment to launch a Pan- Canadian Artificial Intelligence Strategy. This strategy "will promote collaboration between Canada's main centres of expertise in Montréal, Toronto-Waterloo and Edmonton and position Canada as a world- leading destination for companies seeking to invest in artificial intelligence and innovation" (Department of Finance Canada, 2017, p. 104). These investments reflect the spirit of the first pillar of an 'automation plan' in that they harness innovation policy towards creating new jobs.

Where the Innovation and Skills Plan in the 2017 Budget falls short in fulfilling the first pillar of an 'automation plan' is the absence of labour obsolescence analysis. This absence functions to detach the Government's efforts to create new innovative jobs from an analysis of the potential job displacement caused by these very technologies. The Budget appears to conceive of AI's role in the economy as primarily a cross-sector job-creator: "It has the potential to drive strong economic growth, by improving the way we produce goods, deliver services and tackle challenges like climate change. Artificial intelligence opens up possibilities across many sectors, from agriculture to financial services, creating opportunities for companies of all sizes, whether technology start-ups or Canada's largest financial institutions" (Department of Finance Canada, 2017, p. 104). Importantly however, the Budget does not signal an intention to embed labour substitution and obsolescence analysis into the policymaking process in the funding and operation of 'superclusters'. This is a missed opportunity because the sector-level focus is particularly amenable to the type of business ecosystem labour obsolescence analysis proposed by David Ticoll (Ticoll, 2017). For example, supercluster proposals in AI could embed analysis of the potential automation impacts of new applications that are developed. Similarly, superclusters aimed at introducing digital innovation to more traditional sectors like manufacturing and agri-food could also include analysis as to how certain technologies could alter those business ecosystems leading to unforeseen labour obsolescence. This analysis could

then be fed into the Government's skills strategy to inform trends in demand for training and education policies. In a world where disruptive digital innovations can emerge quickly and blindside labour market policymakers, it is logical to at least prepare for the automation impact of technologies the government itself is assisting to develop. It is important to note however that the absence of any mention of labour obsolescence analysis in the 2017 Budget document does not preclude the possibility that it is/will be incorporated in the policy rollout. In sum, the 2017 Budget's focus on creating new jobs via innovation policy only partially fulfils the first pillar of an 'automation plan.'

Supporting Skills Modernization Via Training and Education Policies

Training and education policy is a commonly cited area for policy change in response to automation. The Obama Whitehouse AI report advocates increased commitments to ensuring secondary and post-secondary education enrolment, while also "expanding the availability of job-driven training and opportunities for lifelong learning, as well as providing workers with improved guidance to navigate job transitions" (Whitehouse, 2016, p. 3). The issue of addressing labor market mismatches is also echoed by the McKinsey report (McKinsey Global Institute, 2017). The issue however is that it is difficult to help workers make informed choices due to the underlying difficulty in assessing the threat of automation. This is reflected by Tom Mitchell and Erik Brynjolfsson, who co-authored a report on automation for the National Academies of Sciences, Engineering, and Medicine (2017). Reflecting on the findings of this report Mitchell and Brynjolfsson recently concluded that a lack of data places policy makers in a precarious position:

> "policymakers are flying blind into what has been called the fourth industrial revolution or the second machine age. There is a remarkable lack of data available on basic questions, such as: what is the scope and rate of change of the key technologies, especially artificial intelligence (AI)? Which technologies are already eliminating, augmenting or transforming which types of jobs? What new work opportunities are emerging, and which policy options might create jobs in this context" (Mitchell & Brynjolfsson, 2017, p. 290)?

This lack of data stems from a lack of data sharing and coordination among private and public sector organizations. The issue for policymakers is that the traditional labour market data they rely on from surveys and the census does not capture indicators of the current state of technology

diffusion and its impact on the labour market. Mitchell and Brynjolfsson summarize the problem as follows:

> "websites for job-seekers contain data about millions of posts, the skills they require and where the jobs are. Universities have detailed information about how many students are taking which courses, when they will graduate and with which skills. Robotics companies have customer data showing demand for different types of automated assembly system. Technology-platform companies have data about how many freelance workers they employ, the hours they work and where. These sorts of information, if connected and made accessible in the right way, could give us a radically better picture of the current state of employment. But hardly any such data are being shared now between organizations, and so we fail to capture their societal value" (Mitchell & Brynjolfsson, 2017, p. 291).

Having access to this type of collaboratively-sourced data would enable policy makers to make informed choices with regards to education and training policy. Specifically, Mitchell & Brynjolfsson note that "a comprehensive index of AI would provide objective data on the pace and breadth of developments" and that "mapping such an index to a taxonomy of skills and tasks in various occupations would help educators to design programmes for the workforce of the future" (Mitchell & Brynjolfsson, 2017, p. 291). In sum, the global literature on automation calls for not only investments in training and education, but also collaborative private-public data sharing initiatives to better inform skills modernization policies.

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A prominent policy area discussed in Canada as a response to automation is education and training. The Brookfield Institute reflected this, noting that "concerted efforts from industry, governments and educational institutions are vital to ensure that these individuals are able to upgrade their skills through education, providing the technical and soft skills for the jobs of tomorrow" (Brookfield Institute, 2017, p. 22). Budget 2017 proposes the Innovation and Skills Plan, which addresses many of these issues. Figure 5 is an overview from the 2017 Budget that lays out the approach to skills, education and training policies under the Innovation and Skills Plan.

Figure 5: Summary of Skills Initiatives from the 2017 Budget

The Innovation and Skills Plan—Helping Canadians Succeed in the New Economy

Skills	Most Skilled, Talented, Creative and Diverse Workforce in the World
Innovation is changing the way Canadians work. Keeping pace with these changes means equipping Canadians with the tools, skills and experience they need to succeed in the workforce, now and into the future. It also means attracting more top talent from around the world to help grow our economy. The Government's Innovation and Skills Plan must ensure that all Canadians have the opportunity to participate and thrive in the new economy.	• Help young Canadians get the skills and experience they need to kick-start their careers. • Make training opportunities more accessible to working Canadians. • Increase the number of Canadians participating in work-integrated learning. • Increase business investments in training. • Improve access to global talent through accelerated processing times. • Grow the number of Canadians equipped with science, technology, engineering and mathematics (STEM), coding and digital skills, especially among underrepresented groups.

Source: Department of Finance Canada, 2017, p. 46

Indeed, investments in training and education feature prominently in the Trudeau government's approach to innovation more generally. The 2017 Budget makes the following commitment to 'inclusive' innovation:

> "Innovation on its own does not ensure that all Canadians have an opportunity to be a part of the changing economy. We have to give all Canadians a real and fair chance to succeed. Canada's future success depends on building an economy that is as inclusive as it is innovative. The Government's long-term plan to grow the economy will only succeed when everyone benefits from the opportunities that result. We will invest in helping Canadians gain the new skills and experience they need to get ahead" (Department of Finance Canada, 2017, p. 19).

The Budget focused on Initiatives aimed at preparing youth to enter the digital economy. In addition to funding digital literacy initiatives aimed at young children, the Budget promotes young adults entering the digital sector by establishing new co-op placements and work-integrated learning opportunities for post-secondary students, allocating $73 million over four years for job-creating partnerships between employers and interested post-secondary institutions (Department of Finance Canada. 2017 p. 60). The budget also focused on continuing education and retraining. To increase access to retraining, the Government proposes to amend the *Employment Insurance Act* and provide $132.4 million over four years, beginning in 2018–19, and $37.9 million per year thereafter, to "allow unemployed Canadians to pursue self-funded training while receiving EI benefits" (Department of Finance Canada, 2017, p. 56). The Budget also includes provisions to make it easier for adult workers to attain post-secondary education through a 50 per cent increase in Canada Student Grants available for part-time students as well

as a new flat-rate contribution model to determine eligibility under the Canada Student Loans Program (Department of Finance Canada, 2017, p. 54). These investments are in line with fulfilling part of the second pillar of an 'automation plan.'

Another central feature of the education and training pillar of an 'automation plan' involves the need to make investments that are informed by better labour market data. In the Canadian context, this has been linked to the need for the Federal government to take the lead:

> "The federal government should take the lead on developing and implementing a National Skills Strategy in conjunction with provinces, post-secondary institutions, the private sector, unions and other relevant stakeholders…While we cannot with certainty know which skills and competencies will be most highly valued in the labour market of 2025, not even attempting to assess and remediate the areas where Canada could improve is difficult to justify" (Mowat Centre, p. 50).

Budget 2017 reflects this in the government's commitment to "undertake a significant reform…in collaboration with the provinces and territories" of the $3 billion per year Labour Market Transfer Agreements (Department of Finance Canada, 2017, p. 52). The Budget notes that "this reform will ensure that more Canadians get the assistance they need to find and keep good jobs in the new economy, and build better lives for themselves and their families" (Department of Finance Canada, 2017, p. 52). In addition to this collaborative reform, Budget 2017 proposes to invest an additional $1.8 billion over six years, starting in 2017–18, to expand the Labour Market Development Agreements. This is aimed at providing "more opportunities to upgrade their skills, gain experience or get help to start their own business. It also means more support, like employment counselling, to help them plan their career" (Department of Finance Canada, 2017, p. 52).

Enhancing labour market data is a feature of the Advisory Council on Economic Growth's advocacy for the establishment of a Futureskills Lab in their second report (Advisory Council on Economic Growth, 2017b). This is reflected in Budget 2017, which proposes to provide $225 million over four years, starting in 2018–19, and $75 million per year thereafter, "to establish a new organization to support skills development and measurement in Canada" (Department of Finance Canada, 2017, p. 57). Working in partnership with willing provinces and territories, the private sector, educational institutions and not-for-profit organizations, this organization will "identify the skills sought and required by Canadian employers, explore new and innovative approaches to skills development, [and] share information and analysis to help inform future skills investments and programming" (Department of Finance Canada, 2017, p.

57). Although the Budget notes that more details are forthcoming, it is not clear whether this skills development and measurement organization will engage in the type of automation-specific, collaborative private/public data sharing advocated for by the report from the US National Academies of Sciences, Engineering, and Medicine (2017). In sum, while the 2017 Budget makes investments in education and training, it only partially fulfils the requirement of the second pillar of an automation plan in terms of enhancing an automation-specific labour market data.

Supporting the Displaced Via Transforming the Social Safety Net

Brynjolfsson and McAfee stress that policymakers should be guided by two main principles: "allow flexibility and experimentation instead of imposing constraints, and directly encourage work instead of planning for its obsolescence" (2016). To this end, some authors have advocated the 'flexicurity' mode, which focuses on separating the provision of benefits from jobs. Colin and Palier note that "if the government can guarantee citizens access to health care, housing, education and training, and the like on a universal basis without regard to their employment status, the argument runs, people won't be so terrified of switching jobs or losing a job" (Colin & Palier, 2015, p. 32-33). This would foster greater flexibility in labour market regulations, resulting in "greater efficiency, dynamism, and productivity, all built around workers' needs rather than on their backs" (Colin & Palier, 2015, p. 32-33).

A popular reform to the tax system in response to automation is the notion of shifting the tax burden away from labour towards capital. While there are many options for this, the notion of introducing a tax on robots has been advocated for by influential figures like Bill Gates and Nobel-prize winning US eeconomist Robert Shiller (Shiller, 2017). The Obama Whitehouse AI report acknowledges that "advanced AI systems could reinforce trends of national income shifting from labor to capital" (2016, p. 41). The report notes that failing to adjust for this scenario "could significantly exacerbate the rise in income inequality seen over the past few decades, absent an appropriate policy response" and that "taxing capital can be a highly progressive form of taxation" (2016, p. 41). However, the report did not go as far as to advocate anything resembling a robot tax. Instead, it advocated higher taxes on estates and dividends.

Basic Income Guarantee is one of the more popular policy responses to the threat of automation (McKinsey Global Institute, 2017). Martin Ford advocates for this as the "most effective policy solution" based on accepting that "ever more investment in education and training is unlikely to solve our problems, while calls to somehow halt the rise of job automation are unrealistic" (Ford, 2015, p. 257). The logic of this proposal is as follows: "if we look further into the future and assume that machines will eventually replace human labor to a substantial degree, then I think some form of direct redistribution of purchasing power becomes essential if economic growth is to continue" (Ford, 2015, p. 265). A basic income guarantee can be implemented in two ways, either in a universal fashion or as a means-tested payment. Ford advocates for the former, or at least a high threshold, so as to avoid perverse incentives to avoid earning more income (Ford, 2015). Several observers have sided against the notion of universal basic income. The Obama Whitehouse AI report contends that "we should not advance a policy that is premised on giving up on the possibility of workers' remaining employed. Instead, our goal should be first and foremost to foster the skills, training, job search assistance, and other labor market institutions to make sure people can get into jobs" (2016, p. 38). Brynjolfsson and McAfee note that "a universal basic income has obvious appeal in a job-light future where a great many people can't earn a living from their labor, but it would be prohibitively expensive to provide even a small universal income to a population as large as that of the United States" (2016). Brynjolfsson and McAfee instead advocate for other redistributive policies that will support the disrupted while still incentivizing work, such as the negative income tax. The logic of a negative income tax is that "if we need human labor working alongside automation to achieve economic growth, social assistance programs should incentivize work, such as negative income taxes" (McKinsey Global Institute, 2017, p. 115). Notwithstanding the debate on specific mechanisms, the need to enhance redistribution policies in light of the threat of automation is a central feature in the global discussions around appropriate policy responses to automation.

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Echoing the automation literature's focus on flexible labour markets, the Mowat Centre's report advocates for the Danish model of "flexicurity," where workers retain a large percent of

their income after they lose a job, and are given access to more training and skills support (Mowat Centre, 2016). The report also suggests the notion of "portable benefits" so that workers in the gig economy "can benefit from flexibility but not be unduly harmed by the absence of a standard employment relationship" (Mowat Centre, 2016, p. 48). The Mowat Centre report also considered the idea of a basic income. However, echoing Brynjolfsson and McAfee (2016), the report concluded that a basic income for all would be "prohibitively" expensive, costing $500 billion annually if it was set at $15,000 per person, "or nearly double all federal government expenditures" (Mowat Centre, 2016, p. 49).

In the lead up to the 2017 Budget, observers predicted that the types of transformative shifts in tax and redistributive policies discussed in the global literature on automation would not be reflected in the Trudeau Government's 'inclusive' Innovation and Skills Plan. Noting that "automation will be given short shrift in the budget," Lawrence Martin reported that "the word from insiders is that while the projected scary numbers of job losses have to be taken seriously, 'there isn't an appetite to hold back the tide' of technology. There is no pickup, for example, on Microsoft founder Bill Gates's idea of taxing robots that do the work of humans and using the revenues for social needs" (Martin, 2017). Indeed, the Innovation and Skills Plan as described in the 2017 Budget is largely missing discussion of one of the crucial pillars of an automation plan: dramatic changes to the social safety net to support the disrupted. However, the Budget does make changes to Employment Insurance to enhance applicability of the social safety net. Specifically, in addition to allowing unemployed Canadians to pursue self-funded training while receiving EI benefits (discussed above), the Budget also proposes to invest an additional $900 million over six years, starting in 2017–18, for new Workforce Development Agreements (Finance Department Canada, 2017). This is aimed at make transfers to the provinces and territories simpler and more flexible to further expand access to EI-funded training programs. The 2017 Budget does not mention more transformative reforms like robot taxes or basic income strategies. However, Ontario's spring 2017 pilot project on basic income will provide useful case study to inform future federal proposals (Ontario, 2017). In sum, while the Budget did mention changes to Employment Insurance to widen eligibility to retraining programs, this does not speak to the more transformative changes discussed in the global literature that comprise the third pillar of an 'automation plan.'

Conclusion

Dominic Barton's pre-budget warning about the risk of automation for 40 percent of Canadian jobs reflected a tension that was later present in the 2017 Budget. Specifically, what policies are required to ensure that an Innovation and Skills Plan is an 'inclusive' Innovation and Skills Plan in light of the employment threat posed by automation? This tension reflects the fundamentally political nature of contemporary innovation policy. Prior to the Budget, Lawrence Martin reflected on Barton's automation comment by noting that "strangely the torrid pace of automation is hardly even being debated in Parliament or elsewhere. Joe Populist is more worried about having his job displaced by innovative technologies than seeing the country becoming more adept at creating new ones" (Martin, 2017). Reflecting this political dynamic, Ryan Avent has asserted that in relation to the current digital revolution, "the question we ought to be worried about now is not simply what policies need to be adopted to make life better in this technological future, but how to manage the fierce social battle, only just beginning, that will determine who gets what and by what mechanism" (Avent, 2016, p. 16-17). This political sentiment was echoed in the Canadian context: "when people can't meet their basic needs through gainful employment, they will naturally express their dissatisfaction at the ballot box...The opportunity and the imperative to reassess and transform Canada's social architecture is looming and much more politically relevant than ever before" (Mowat Centre, 2016, p. 53). Taken together, these quotations illustrate the inherently political nature of the automation debate and the policy response to it. Furthermore, comparative research by Mark Zachary Taylor illustrates that domestic resistance to technology erodes consensus needed to support tax dollars going to innovation efforts, ultimately causing certain nations to fall behind in innovation (Taylor, 2016).

This suggests that going forward, unless Canada's 'inclusive' Innovation and Skills Plan is complemented by a robust 'automation plan', the political support needed to make the necessary investments to position Canada as a leader in the emerging digital economy may erode. To this end, this paper has engaged in a benchmarking of the 2017 Budget against the three pillars of an 'automation plan', as collated from the global literature on automation. These three pillars of an 'automation plan' are policies aimed at creating new jobs via innovation policy, supporting skills modernization via training and education policies, and supporting the

displaced via transforming the social safety net. First, measuring the true extent of the threat of automation through labour obsolescence analysis is missing from the 2017 Budget's considerable focus on creating new jobs via innovation policy. Secondly, the Budget's prioritization of supporting skills modernization did not include efforts to bridge the private-public sector data gap on the diffusion/impact of automation technology. Finally, policies aimed at supporting the displaced via transforming the social safety net were the most absent in the Budget, as transformative initiatives such as universal basic income were largely ignored. Thus, Canada's 'inclusive' Innovation and Skills Plan as outlined by Budget 2017 presents a policy package more in line with an 'Innovation and Skills Plan' aimed at capitalizing on the upside of innovation, while only partially constituting an 'automation plan' designed to manage the disruption of automation. Hopefully this paper will contribute towards setting the stage for future research on how Canada's policies fit into the emerging dialogue on appropriate policy responses to the employment disruptions caused by rapid-technological change.

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