ARTIFICIAL INTELLIGENCE POLICIES IN EAST ASIA:

AN OVERVIEW FROM THE CANADIAN PERSPECTIVE

ASIA PACIFIC FOUNDATION OF CANADA
FONDATION ASIE PACIFIQUE DU CANADA

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EXECUTIVE SUMMARY

Accelerated advances in computing and greater integration of the internet – along with the proliferation of big data – have enabled significant progress in the field of artificial intelligence (AI) during the past few years, raising the profile of a discipline long relegated to the fringes. Many, especially in Asia, point to the DeepMind AI AlphaGo's victory over Lee Se-dol in the game of Go in 2016 as the watershed moment when the zeitgeist shifted. The possibilities – and therefore fears – tied to advances in AI have started to dominate the public discourse. Tangible progress in a field that blurs the line between science fiction and reality has helped fuel the furor and underscores the urgent need for intervention by policy-makers.

As AI is relatively new lay for people, it is challenging to talk about it, let alone create policies related to it. There are many unknowns and upcoming firsts in the regulation or governance of AI. In China, Japan, and South Korea, however, governments have begun creating AI policies in a comprehensive and committed manner. Thus East Asia provides excellent case studies for Canadian policy-makers as they begin to grapple with the development, deployment, and regulation of artificial intelligence.

Underpinning this report is the fact that all three East Asian nations regard AI as a key factor contributing to their international competitiveness, and that they have all taken nation-wide measures to enhance their AI capabilities. The scope of their national AI strategies is broad, with ambitious goals for everything from AI research and development (R&D) to integration of AI in specific economic sectors. This report provides a nuanced and detailed documentation of East Asia's AI agenda. It is hoped that the report will provide useful case studies for the Government of Canada as it seeks innovative ideas for expanding its own governance of this disruptive technology.

More importantly, this report asserts that the Government of Canada must recognize AI as a space for geopolitical competition and act proactively and strategically. The examination of the AI policies in East Asia paints a familiar picture for Canadians: China is a major influencer in the space of AI, promising opportunities for Canadians, but engagement with China entails risks and difficulties arising from differing values. In a similar vein, Japan and South Korea remain reliable partners for co-operation for Canadians, with the potential for collaboration yet to be fully exploited. Canada punches above its weight in AI research, and China, Japan, and South Korea are looking to Canada to help boost their own talent and research capabilities. Today, AI is a space where Canada can exercise greater influence, with the potential to take a leadership role in shaping norms of international AI governance.

Canada should, therefore, leverage its strengths and engage with these three East Asian countries in a strategic manner. It should participate in discussions on AI ethics and governance to positively contribute to the shaping of international norms, while building partnerships of like-minded nations to gain leverage in promoting uses of AI that align with Canadian values. As the technological becomes intertwined with the political, the perception of China as a threat to the

liberal world order continues to gain traction in the AI space. Western liberal democracies have strengthened their rhetoric and policies to counter China's approach to AI, highlighting liberal values in their ethics guidelines and policies. At the same time, China continues with its AI agenda and seeks to raise its international profile by becoming a norm-setter. Canada could play the role of the traditional "middle power" in facilitating constructive conversations, bridging the gap between China and the West. Meanwhile, Canada has the opportunity to form alliances with like-minded, relevant countries like Japan and South Korea to further increase its profile as a major player in international governance of AI.

As of July 2019, the trade war between China and the United States continues. This is accompanied by the United States' attempts to check the rise of Chinese high-tech firms, as exemplified in the White House and Department of Commerce orders to limit Chinese company Huawei's access to its U.S. vendors. The trade war underscores the greater role that technologies such as AI play in foreign policy today and brings attention to the need for the Canadian government to approach AI governance on the global stage in a strategic and comprehensive manner.

In this context, this report explores the national AI policies of these three East Asian countries to inform Canadian policy-makers and AI practitioners of the challenges and opportunities of a field that will soon intersect with every aspect of our lives. The report first establishes the relevance of AI and AI policies in East Asia for Canadian policy-makers. Then, three subsequent sections investigate AI policies in China, Japan, and South Korea, focusing on the policies, talent management, and ethical, legal, and social implications (ELSI) of the technology. Finally, the last section synthesizes the analysis of AI development in East Asia and concludes with four broad recommendations:

Recommendation 1: Increase Canada's capacity to govern AI in a co-ordinated manner at different levels of government.

Recommendation 2: Leverage Canada's AI talent more effectively as part of "Brand Canada."

Recommendation 3: Proactively address emerging AI issues in trade and investment.

Recommendation 4: Identify Canada's place in emerging AI geopolitics and engage strategically.

INTRODUCTION

It is an exciting time to be in the field of artificial intelligence (AI). Recent research breakthroughs and the transition toward a data-based society and economy have brought forth a golden age for AI. Every day, the media continues to circulate stories – often sensationalized ones – about AI and how it will revolutionize the way we live.

However, contrary to public expectations, AI will not dramatically change the world. Instead, it will make existing products and services faster and more efficient. AI does not exist on its own; as it is used today, AI is a program that is applied in existing hardware or services to maximize their efficiency – more similar to electricity than the T-800 from the film Terminator. But this means that AI, omnipresent like electricity, will influence – and already has influenced – most of what we do today, and this will have policy implications. AI presents the world with challenges and opportunities.

Particularly for Canada, this is a pivotal moment. During the late 1980s and early 1990s, at a time when AI was considered an interesting but impractical field, Canada invested in the field. Some of its institutions are now home to leading AI academics who are thriving in the field and attracting investments from tech giants like Amazon and Google. In the mid-2010s, the federal government invested C$125M on a national AI strategy to further support research and attract talent, which contributed to bringing Canada to the top of the list for investors and companies seeking to leverage AI. However, the upcoming transformations brought by AI pose new challenges to all stakeholders: government, industry, and civil society.

China, Japan, and South Korea's approach to AI provides important insights at this critical juncture for Canadians. Their governments have committed to comprehensive AI strategies that stretch beyond supporting research and development (R&D). These strategies point to opportunities for Canada in both its bilateral relations with these countries and in multilateral settings where Canada could take a leading role in driving the discussion/agenda around AI governance. Further, their strategies underscore the permeability and potential impact of the technology, which prompts us to think about our own approach to AI.

The objective of this study is to provide an overview of Chinese, Japanese, and South Korean AI policies, demonstrating their degree of commitment to not only research, but also commercialization, deployment, and considerations of ethical, legal, and social implications (ELSI). This report also analyzes the differences between Canadian and East Asian policies, drawing out implications for Canada. In order to limit the scope of this study, policy discussions on privacy and data management laws are not included. This report represents an attempt to make sense of the new space and provide the foundation for more in-depth research in specific areas of AI governance.

This report adds to the existing literature by taking a more in-depth look at the national policies in the three countries, with the intent of finding Canadian implications. At the moment, there are

several reports that focus on domestic implications (e.g. future of work) within Canada, or non-Canadian reports that focus specifically on China and threats to security. This report considers the region as a whole and provides comparative overviews while developing a greater analytical perspective on Canada's policy toward East Asia.

Structure and Methodology

The report is based on qualitative analysis of policy documents, reports, and media coverage, supplemented by interviews with relevant academics, policy-makers, and other practitioners in Beijing, Seoul, and Tokyo. These interviews occurred primarily during the spring of 2018 and are complemented by additional conversations.

The first section explains the basics of AI policy. Case studies of China, Japan, and South Korea are then presented. Findings are analyzed in the final section, and policy recommendations are presented. Each case study features an analysis of the broader government policy on AI, the country's attempts to address AI R&D and talent training, and its engagement with AI ELSI through government policy. Based on the analysis of the three cases in East Asia, four policy recommendations for Canada are presented at the end.

AI 101

How do we define *intelligence*? Philosophers have dedicated substantial tomes to this task, but disagreement remains, which leads to even more questions about the nature of intelligence. The definition of *artificial* intelligence becomes even more challenging, particularly when the term is conflated with other closely associated technologies like robotics and 5G, although neither of these constitute an artificial intelligence.

There is no singular definition of AI. Even Stuart Russell and Peter Norvig's leading textbook on AI, *Artificial Intelligence: A Modern Approach*, eschews a singular definition, and instead lists four different definitions: thinking humanly, thinking rationally, acting humanly, and acting rationally.[1] Russell and Norvig also note the interdisciplinary aspect of AI as a field, pointing to philosophy, mathematics, economics, neuroscience, psychology, computer engineering, control theory and cybernetics, and linguistics as the intellectual foundations of the technology, which underscores the point that defining AI could be tantamount to tackling the perennial questions in the discipline of philosophy.[2] Ryan Calo states that AI is "an umbrella term, comprised by many different techniques," and other policy documents on the subject take similar approaches.[3]

For the purposes of this report, AI is simply defined as simulation of human intelligence through computers, mainly referring to machine learning. Put simply, machine learning is a form of data

[1] Russell, Stuart and Peter Norvig. 2010. Artificial intelligence: A modern approach. Upper Saddle River: Prentice Hall, p. 2.

[2] Ibid., p. 5-16.

[3] Calo, Ryan. 2017. Artificial intelligence policy: A primer and roadmap. U.C. Davis Law Review. 51(2): 5.

analysis in which systems identify patterns and make decisions based on data in an automated manner. The theory itself is not new, but it took off in recent years due to the availability of big data and computing hardware capable of running these systems.

It should also be noted that we are still very far from seeing an AI like the T-800 from the Terminator movie franchise or Andrew in Bicentennial Man because current AI programs are limited to performing specific tasks that they were designed for – that is, they are "narrow" AIs. For instance, consider an AI program designed to play chess. A human may not be able to beat this program in chess, but this program will not be able to perform other tasks that we perform daily, such as figuring out the best transit route to work or summarizing the contents of a newspaper article.

The opposite of narrow AI is artificial general intelligence, a system that is able to perform *any* task that a human being can. But experts in the field generally believe that this will not happen in the near future. Martin Ford, an author who has written on AI and robotics, asked 23 leading experts when we should expect to see the first artificial general intelligence, and the average timeline of the 18 who responded is 2099.[4] As such, at least for the near future, the use of AI will mainly *complement*, not *displace*, humans or their intelligence.

This report focuses on the more immediate challenges emerging from greater integration of narrow AI into all aspects of our daily lives rather than issues surrounding artificial general intelligence.

Why an AI Policy?

If we are not concerned about the rise of a self-aware robot army, then why should we worry about AI at the policy level? It is because AI is a disruptive technology that will significantly affect the way businesses operate, as well as the larger society. According to a 2017 PwC report, AI is expected to provide a US$15.7T boost to global gross domestic product (GDP) by 2030, which would be equivalent to adding approximately 10 Canadian economies to the global economy.[5] Especially for high-income, developed countries with technical capabilities, AI promises an opportunity for increased productivity. Today, there is consensus around the world that policy-makers should support their respective AI research and industry to take advantage of the economic opportunity that AI presents.

However, this report argues that investment in AI policies is required not only for economic reasons, but also because of three broader challenges in the rapidly evolving field of AI.

First, most countries lack the necessary infrastructure to further their AI ambitions. There is a worldwide AI talent shortage, and major players in the private sector are racing to hire AI talent, from Silicon Valley to Beijing. According to a Tencent report, there are perhaps 300,000 individuals with AI expertise, while there is an immediate shortage of 800,000 specialists in this field.[6] This challenge will require a government-level response in education and immigration policies. The problem of infrastructure also extends to data, the "fuel" of AI. The greater the amount of data available, the better AI can be engaged. Today, however, most countries have regulations that

[4] Vincent, James. 2018. This is when AI's top researchers think artificial general intelligence will be achieved. The Verge. https://www.theverge.com/2018/11/27/18114362/ai-artificial-general-intelligence-when-achieved-martin-ford-book; and Ford, M. 2018. Architects of intelligence: The truth about AI from the people building it. Birmingham: Packt Publishing.

[5] PricewaterhouseCoopers. 2017. Sizing the prize: What's the real value of AI for your business and how can you capitalise? Boston: PricewaterhouseCoopers.

[6] Tencent Research Institute. 2017. 全球 人工智能人才 白皮书 (Global artificial intelligence talent white paper). Beijing: Tencent Research Institute.

restrict data flow due to privacy concerns. As such, there is a need to reform existing regulations to allow the use of data, while ensuring the privacy rights of individual citizens.

Just as governments needed to create highways and establish rules of the road with the advent of the mass-produced automobile, so too do citizens and industry require the involvement of government to set up the basic infrastructure for an AI-driven economy to take full advantage of the new technology.

Second, AI involves ethical, legal, and social implications that will permeate different sectors. The best publicized example is labour market disruption due to automation. According to McKinsey, as much as 30 percent of human labour could be displaced by AI by 2030.[7] Further, AI involves potential threats to privacy rights, as well as the perpetuation and exacerbation of existing socio-economic biases. Economist Joseph Stiglitz warns that AI could further deepen the gap between the rich and the poor.[8] Experts in the field have raised concerns about the abuse of AI for malicious uses, from new forms of scams to drone attacks.[9] These concerns underscore the need for greater state involvement in proactively adjusting regulations to promote R&D and deployment, but also to prepare citizens for a society where AI is fully integrated.

Finally, AI raises potential challenges for state sovereignty. At the most basic level, integration of AI into weapons and weapon systems could change the nature of warfare. Russian President Vladimir Putin recently said that "whoever leads on AI will rule the world." The policy debates surrounding the technology are now increasingly framed within the language of an AI race, which emphasizes the competition between nations for supremacy on AI technologies, akin to the arms race between the United States and the former Soviet Union during the Cold War.[10] At a more subtle level, AI could also challenge the ability of states to govern effectively. AI, due to its decentralized nature, is a difficult technology to regulate. It has the potential to further undermine states through ELSI, such as mass unemployment or the dissemination of misinformation. As such, AI poses threats to a state's sovereignty at different levels, which warrants a response from policy-makers.

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[7] McKinsey & Company. 2017. Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages. New York City: McKinsey & Company. https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages.

[8] Korinek, Anton, and Joseph E. Stiglitz. 2018. Artificial intelligence and its implications for income distribution and unemployment. NBER Working Paper No. 24174. Cambridge: National Bureau of Economic Research.

[9] Future of Humanity Institute. 2018. The malicious use of artificial intelligence: forecasting, prevention, and mitigation. Oxford: Future of Humanity Institute.

[10] Suder, Katrin. 2018. AI can change the balance of power. Berlin Policy Journal. https://berlinpolicyjournal.com/ai-can-change-the-balance-of-power/.

Policy-makers have become aware of the opportunities and challenges that come with AI, and governments around the world have started announcing their AI strategies.

Where is Canada in the AI Space?

Canada was an early investor in AI research. During the so-called "AI winter," a period during the 1980s and 1990s when decreased interest in AI led to a drop in research funding, Canadian funding agencies continued to support basic AI research, attracting scholars from all over the world. As a result, Canada today is home to world-leading researchers and their teams. At a time when AI talent is in high demand, Canada's research capabilities allow it to punch above its weight.

To further leverage this advantage, the Government of Canada announced in 2017 that it would commit C$125M for the next five years to further Canada's AI R&D and attract top-level talent in the country through the Pan-Canadian Artificial Intelligence Strategy, managed by the Canadian Institute for Advanced Research (CIFAR). The Strategy mainly addresses R&D and talent issues.

Further, there are various initiatives within the government that seek to address the advent of AI. Innovation, Science and Economic Development Canada (ISED) launched the National Digital and Data Consultations to understand the Canadian public perception of data issues. The Standards Council of Canada is working to develop a national standard for ethical uses of AI as well. The Treasury Board of Canada has also been active in the AI space. In February 2018, Canada joined the Digital Seven, a network of governments seeking to further integrate digital technologies in governance, and in July 2018 it created the first-ever Minister of Digital Government. In December 2018, the government also announced that it would collaborate with the French government on the International Panel on Artificial Intelligence, which will convene international AI initiatives.

Why East Asian AI?

There are three key reasons why Canadians should pay attention to East Asia's AI development.

First, China, Japan, and South Korea offer examples of comprehensive and forward-looking AI strategies that could provide lessons for Canadian policy-makers. The three East Asian governments have each formulated comprehensive national plans that promote AI R&D through facilitation of collaboration among policy-makers, academics, and industry stakeholders. Their plans also include strategic integration of AI into their economies and societies with a long-term view.

Second, understanding East Asian AI development is crucial for Canada's future engagement in the region. Economically and politically, the three East Asian countries are important partners for Canada. China is Canada's second largest trading partner. Japan and South Korea are also key trading partners (fifth and seventh largest, respectively). They are also regarded as vital partners in Canada's multilateral dealings and share similar political values. The national policies in East Asian states demonstrate a clear commitment to transforming their economies and societies through AI, which gives rise to new challenges in trade and diplomacy. Canada's continued engagement in Asia should be accompanied by a deeper understanding of the region's AI development.

Third, East Asian AI development underscores the emergence of an AI race and the need for Canada to identify its appropriate role. An examination of AI development in East Asia suggests a global fracture in attitudes toward AI and the subsequent emergence of an AI race or AI geopolitics. The attitude toward AI in East Asia clearly demonstrates that AI development is regarded as a national-

level project with implications in multiple areas of society. China, Japan, and South Korea regard AI development as a continuation of national development.

Combined with the cultural, social, and political factors that contribute to AI development, the consideration of AI as a national endeavour strongly suggests the emergence of AI as a space in foreign policy that could deepen existing splits in contemporary geopolitics. For instance, competition for securing AI talent and infrastructure between China and the United States has already been described as a duopoly – a race between the two – especially as China's use of AI for social surveillance and military application has alarmed liberal, Western states, led by the United States. Also, AI experts and practitioners in Japan and South Korea express concerns about their role "stuck between" China and the United States, sentiments that echo existing anxiety about China's rise in the region.

Canada has research capacities that allow it to perform well in the space of AI. Early investment in basic research has produced world-leading researchers in AI based in institutes at the University of Alberta, University of Toronto, and Université de Montréal, and has drawn investment from global giants such as Google and Amazon to the country. The Government of Canada launched the Pan-Canadian Artificial Intelligence Strategy in 2017 to further develop its existing strengths in research and talent. As the technological becomes increasingly intertwined with the political, these strengths in research and talent provide Canada with a tool to broaden its options in foreign policy, which should be leveraged in a timely manner.

CHINA

Government Policies

The Chinese Communist Party has clearly articulated a concrete vision for the role of AI in its policy documents released since 2015. The latest Five Year Plan (2016-2020), which is China's principal, large economic strategy, released in 2015, articulated China's intent to invest and gain leadership in big data and "intelligent manufacturing." Made in China 2025 consistently emphasized the need for China to upgrade its manufacturing sector by integrating emerging technologies (principally AI). As such, the Party had clearly identified the need to invest in AI for continued economic growth before the release of its AI-specific plans.

In July 2017, the State Council (the equivalent of the federal cabinet) released the Next Generation AI Development Plan, a comprehensive strategy document that outlines China's ambition to become a world leader in both AI development and application by 2030 (see Table 1). The Plan is comprehensive in its scope, addressing issues of talent acquisition, funding allocation, safety frameworks, technology standardization, and ELSI.

Table 1: Short and long-term objectives of China's AI development

Year	Goals	Scale of Core AI Industry	Scale of Related Industries
2020	Catch up to other nations in terms of AI research and application	RMB150B (C$30.5B)	RMB1T (C$203.3B)
2025	Achieve major breakthroughs academically and be world-leading in application	RMB400B (C$81.3B)	RMB5T (C$1.016T)
2030	Become the world's primary AI innovation centre	RMB1T (C$203.3B)	RMB10T (C$2.032T)

The AI Development Plan operates on four guiding principles.[11] First, it should be led by technology, in the sense that the policy-makers should be aware of the need to attain leadership in cutting-edge AI technology. Second, the Plan should be implemented systematically, placing basic research, technological R&D, industrial development, and commercial applications within a single system. It is noted that the "advantages of the socialist system" should be used to support this systematic approach to AI development, which points to greater policy latitude available to the central government. Third, the implementation of the Plan should be driven by the market, leveraging

[11] The author used the translation of the Plan posted in: China Copyright and Media. 2017. A Next Generation Artificial Intelligence Development Plan [translation by New America]. China Copyright and Media. https://chinacopyrightandmedia.wordpress.com/2017/07/20/a-next-generation-artificial-intelligence-development-plan/.

the resources in the private sector. It highlights the need to fully delineate the responsibilities of the government and the private sector to maximize the government's role in planning and guidance, policy support, security, regulation, environmental protection, and formulation of ethical guidelines. Finally, the Plan should follow the concept of open-source sharing and promote collaboration between industry, academia, research, and production units. It highlights the need to promote two-way conversion and application of AI technology for civil and military uses, and the need to continue participating in global research.

Following the release of the Next Generation AI Development Plan, the Ministry of Industry and Information Technology released the Three-Year Action Plan for Promoting Development of a New Generation Artificial Intelligence Industry (2018-2020), which outlines more immediate guidelines for industry, government, and other stakeholders until 2020. The Action Plan highlights the importance of supporting research and entrepreneurship in establishing a foundational AI industry, and specifies target AI products such as autonomous vehicles, medical imaging diagnostic systems, video and voice identification systems, smart home products, and intelligent translation systems. The Action Plan falls in line with and supports the Next Generation AI Development Plan within a narrower time frame.

It is necessary to approach these national policies in a nuanced manner that considers China's unique form of governance. In the West, where there is emphasis on the rule of law, the text of a policy is of utmost importance, and any kind of adjustment in policy requires appropriate process (i.e. legislative procedures). However, this is slightly different in China. The text of a policy is important to some degree, but policies and regulations can be bent following mutual understanding between officials that such action is necessary to achieve greater goals. This can provide greater agility and flexibility in addressing emerging technologies such as AI (this advantage comes with the cost of lack of democratic accountability or predictability, of course).

In this case, the greatest impact of the Next Generation AI Development Plan is the Party's explicit endorsement of the industry and the implicit understanding that it will be followed by policy support. Ultimately, the Plan functions not as a detailed blueprint whose success is measured by congruence to its details, but as a general "wish list," according to Matt Sheehan of MacroPolo, a University of Chicago think tank that analyzes the Chinese economy. Sheehan writes that this wish list signals the relevant players – local government officials, private firms, academics – to deliver the items on it using their resources and ingenuity and promises the necessary policy support.[12]

Since the launch of the Next Generation AI Development Plan, China has made great strides in this area by leveraging its unique policy strengths. In China, these national plans offer an opportunity for ambitious local government officials to make a name for themselves by delivering the items on the wish list. Fifteen out of 34 local governments had announced their own AI strategies as of October 2018. The projected size of the AI industry from the combination of the 15 AI strategies amounts to RMB429B (C$80.17B) by 2020, almost three times the national goal of RMB150B (C$30.5B), which underscores the impact of the national directive upon local policies.[13]

The private sector has followed suit as well. The Chinese startup scene is notoriously competitive, and the nod from the government was quickly understood by ambitious entrepreneurs as an

[12] Sheehan, Matt. 2018. How China's massive AI plan actually works. MacroPolo. https://macropolo.org/chinas-massive-ai-plan-actually-works/.

[13] Ding, Jeffrey. 2018. Latest Policies for AI Industry [Data sourced from Qianzhan Chanye Institute]. https://docs.google.com/document/d/1NQ8kjeKso6mpaQtXyoFu7Tbl44UapdnNt7dOjGwhB8w/edit#.

opportunity to profit. Chinese startups received 48 percent of total global AI funding in 2017.[14] SenseTime, a Beijing-based facial recognition firm, became the world's most valuable startup at US$4.5B, and its success would not have been possible without the government policy support.[15] Chinese AI research is gaining more influence in academia as well, with the number of papers from Chinese researchers accepted by the Association for the Advancement of Artificial Intelligence conferences (the most prestigious in the field) more than doubling – jumping from 10 percent of papers to 23 percent – between 2012 and 2017.[16]

The Party has also taken further measures to maximize the efficiency of the private sector by organizing a National AI Team. More specifically, the Ministry of Science and Technology has designated tech giants such as Baidu, Alibaba, Tencent, and iFlyTek to lead specific sectors of AI. For instance, Baidu is responsible for autonomous driving, Alibaba for smart cities, Tencent for health care, and iFlyTek for voice recognition. The expectation is that the members of the National AI Team develop "open innovation platforms" on these key areas and thereby set the standards for each industry.[17] Further, this has the effect of minimizing competition among large tech firms, which have shown the tendency to compete until they have edged each other out of the market.

AI R&D and Talent

The issue of AI talent is a major policy issue not only in China, but in the rest of the world. This is a murky area for examination, as it is challenging to define "AI talent." For the purpose of this report, AI talent does not merely refer to high-level AI scientists and engineers with graduate degrees, but also workers who are able to function in AI-integrated workplaces (such as smart factories).

That being said, the shortage of talent – as an inclusive term that stretches beyond PhD holders – has been defined as a major challenge in China's AI ambitions. This has been explicitly indicated in China's official AI policy documents, including the Next Generation AI Development Plan, which notes that "cutting-edge talent for AI is far from meeting demand."[18] Tencent has also noted that the AI talent shortage is a major policy issue and that there may be a deficit of up to five million qualified workers within a few years.[19]

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[14] Snow, Jackie. 2018. China's AI startups scored more funding than America's last year. MIT Technology Review. https://www.technologyreview.com/the-download/610271/chinas-ai-startups-scored-more-funding-than-americas-last-year/.

[15] SenseTime has gained access to footage from China's 170 million closed-circuit TV cameras by partnering with government, which in turn uses the technology for social surveillance. See Russell, Jon. 2018. China's SenseTime, the world's highest-valued AI startup, closes $620M follow-on round. TechCrunch. https://techcrunch.com/2018/05/30/even-more-money-for-senstime-ai-china/.

[16] Ding, Jeffrey. 2018. Deciphering China's AI dream: The context, components, capabilities, and consequences of China's strategy to lead the world in AI. Oxford: Future of Humanity Institute.

[17] Goodrich, Jimmy and Paul Triolo. 2018. From riding a wave to full steam ahead. New America. https://www.newamerica.org/cybersecurity-initiative/digichina/blog/riding-wave-full-steam-ahead/.

[18] See the translation of the Next Generation AI Development Plan: https://chinacopyrightandmedia.wordpress.com/2017/07/20/a-next-generation-artificial-intelligence-development-plan/.

[19] Tencent op. cit.

The Chinese government views addressing this talent shortage as a priority. Even before the launch of the AI Development Plan, the Chinese government had been proactive in recruiting international academic talent in science and engineering through the likes of the Thousand Talents Program, which focuses on repatriating Chinese researchers working abroad. Further, since the launch of the Plan, all relevant players involved in China's AI development have been racing to attract talent. For instance, the municipality of Beijing introduced an incentive program for top AI talent in March 2018 that offered RMB1M (C$187,000) in cash prizes and a fast-tracked immigration process as perks.[20]

The private sector plays a key role in this space. Companies such as Baidu, Alibaba, and Tencent have been leveraging their financial resources to compete against other tech giants in the Silicon Valley and elsewhere to attract AI talent from around the world. Nick Zhang, president of the Wuzhen Institute, said experienced AI researchers are being offered a salary of US$1M or more by major companies.[21] The combined efforts of the Chinese in this space seem to be yielding results. According to a Tencent report, the proportion of foreign AI talent in China increased from 5.2 percent to 7 percent between 2015 and 2017.[22] In addition, these companies have also established AI labs outside China, such as Baidu's driverless cars laboratory in the Silicon Valley or Tencent's AI research lab in Seattle.

However, in the long run, China's priority is to strengthen its own AI talent pool, and it has started investing in AI education at the national level. In April 2018, the Ministry of Education issued the AI Innovation Action Plan for Colleges and Universities, which seeks to make Chinese research and academic institutions the leaders of AI innovation and training by 2030, in line with the goals of the Next Generation AI Development Plan.[23] Under this Action Plan, 100 AI specialization programs for specific domains (e.g. AI plus health care, AI plus transportation) would be created by 2020 through the development of 50 sets of world-class teaching materials, 50 national-level, high-quality online courses, and 50 AI institutes. By doing this, the Chinese government addresses the talent shortage in not only academic research, but also in lower-level, technical applications in different sectors that seek to integrate AI.

Further, under this initiative, AI expert and venture capitalist Kai-Fu Lee's Sinovation Ventures, created in 2017 to offer AI talent in Beijing, partnered with the Ministry of Education and Peking University to develop a plan to educate at least 5,000 students and 500 teachers within the next five years. At the pre-university level, 40 high schools have teamed up with SenseTime for the AI high school program, and there are reports of elementary schools introducing basic AI curricula to their students as well.

AI ELSI

For Canadians, China's engagement with AI from the ELSI perspective is a major concern. As a liberal democracy, the use of AI for social surveillance and militarization – especially with the explicit emphasis on civil-military technology transfer in China's official strategies – raises major

[20] Lee, Amanda. 2018. Beijing offers 1 million yuan in cash incentives, long-term visas and 'green card' to attract global talent. South China Morning Post. https://www.scmp.com/tech/china-tech/article/2138630/beijing-offers-1m-yuan-cash-incentives-long-term-visas-and-green.

[21] Cyranoski, David. 2018. China enters the battle for AI talent. Nature. https://www.nature.com/articles/d41586-018-00604-6.

[22] Tencent op. cit.

[23] See the summary of the AI Innovation Action Plan for Colleges and Universities: https://medium.com/syncedreview/china-puts-education-focus-on-ai-plans-50-ai-research-centres-by-2020-5589c35ba701.

concerns. It also seemingly justifies the call to securitize Canada's digital assets with regards to China, as the United States has done by limiting access to U.S. research institutes and funding. This is an especially difficult topic of discussion, as it is layered with cultural and political differences between the two countries, amplifying the sense of anxiety and fear that has characterized the world's response to China's rapid rise to power. In this light, it is important to consider the different ways in which China approaches AI ELSI and identify areas where constructive engagements could be pursued.

First, it is true that China uses AI for social surveillance and military applications. It regards such applications of AI as directly relating to the maintenance of stability ("social harmony") and therefore is unlikely to yield to any compromise in this area. The government plays a clear role as a client in acquiring key AI technologies for social surveillance. Since 2015, the Chinese government has been rolling out the social credit system, which rates citizens based on their behaviours within society. Based on their rating, citizens could be either punished (e.g. banned from public transit, denied loans) or rewarded (e.g. discounts on public bicycle rental fees, access to government loans). The program is expected to be rolled out nationally by 2020, and international experts have expressed concerns about the added surveillance capacity of the Chinese government and the potential implications for democratic institutions abroad as well.[24] In this light, it is difficult to imagine China being receptive to international AI ethics guidelines or standards that emphasize democratic values, such as the Montreal Declaration[25] or the European Commission's Ethics Guidelines for Trustworthy AI.[26]

It is also important to consider other approaches to AI ELSI in China. Indeed, the Party is using AI in a way that does not match the values of liberal democratic societies like Canada's – such as developing tools of social surveillance and allowing companies to access private data and test out AI products and services in a way that may jeopardize citizens' safety from the Canadian perspective. However, this does not mean that China is unaware of or indifferent to the potential dangers of AI, or that the Chinese people are passively accepting these illiberal uses by the Party. Arguably, the opposite is true.

[24] Hoffman, Samantha. 2018. Social credit: Technology-enhanced authoritarian control with global consequences. Canberra: Australian Strategic Policy Institute.

[25] Link to Montréal Declaration: https://www.montrealdeclaration-responsibleai.com/.

[26] Link to Guidelines for Trustworthy AI: https://ec.europa.eu/futurium/en/ai-alliance-consultation.

At the public level, there are concerns about AI ELSI. Chinese citizens are aware of the potential dangers of AI, as shown in a March 2018 poll that indicated 76.3 percent of Chinese people saw AI as a threat to their privacy.[27] Chinese consumers have been pushing back against misuse of private data by raising their concerns online, as well as initiating lawsuits. For the Chinese government, which greatly cares about its legitimacy, this is not an issue that it will merely disregard to meet the economic targets of the Next Generation AI Development Plan; in fact, it regards itself as the key player in protecting the collective well-being of its citizens. For instance, the Ministry of Industry and Information Technology issued warnings to Baidu, news platform Toutiao, and online payment platform Alipay for their misuse of personal data and ordered the companies to address the complaints from concerned citizens.[28]

More broadly, the Next Generation AI Development Plan clearly states the need to develop a "security assessment framework" and adjust the educational system for its citizens in preparation for a more AI-dependent economy and society. The Standardization Administration of China's AI Standardization White Paper (March 2018) points to the government's commitment to addressing ELSI as stated in the Plan. The white paper highlights the importance of safety, ethics, and privacy issues. It also demonstrates an awareness that a standardization process that takes these issues into consideration is important in order for Chinese products to remain competitive in the global market, with an eye to setting the global standards on this technology.[29] In June 2019, the Ministry of Science and Technology issued Governance Principles for the New Generation Artificial Intelligence as well (see Table 2).

Table 2: Governance principles for the new generation artificial intelligence: Developing responsible artificial intelligence[30]

- Harmony and human-friendly
- Fairness and justice
- Inclusion and sharing
- Respect for privacy
- Safety and controllability
- Shared responsibility
- Open and collaboration
- Agile governance

[27] Hersey, Frank. 2018. Almost 80% of Chinese concerned about AI threat to privacy. Technode. https://technode.com/2018/03/02/almost-80-chinese-concerned-ai-threat-privacy-32-already-feel-threat-work/.

[28] Dehua, Chi. 2018. Baidu, Alipay and Toutiao.com ordered to tackle suspected privacy violations. GBTimes. https://gbtimes.com/baidu-alipay-and-toutiaocom-ordered-to-tackle-suspected-privacy-violations.

[29] See the translation of the White Paper: https://www.newamerica.org/cybersecurity-initiative/digichina/blog/translation-excerpts-chinas-white-paper-artificial-intelligence-standardization/.

[30] See the translation of the principles: http://www.chinadaily.com.cn/a/201906/17/WS5d07486ba3103dbf14328ab7.html

Conclusion

The main takeaway of this section is that China regards AI as a key technology for its national competitiveness, and it has been investing substantial resources to achieve its goal of becoming *the* global leader in AI – in both research and application – by 2030. Regardless of the quality of China's AI innovation, the government's announcement of the Next Generation AI Development Plan has made quite a splash among the relevant stakeholders (private sector, academia, local governments) and also outside China. The perceived importance of AI for future national competitiveness, combined with the scale and speed of China's AI agenda, has generated concern and anxiety from the rest of the world, especially regarding China's seemingly illiberal application of the technology.

It is necessary to understand that China's AI ambitions are pursued in a comprehensive manner, one that does not really operate with the same clear demarcation between public and private that Canadians are familiar with. As stated in the Next Generation AI Development Plan, the development of AI in China allows technology transfer between civil and military uses. While it would be imprudent to entirely securitize Canada's research assets or businesses against China and cease engagement, it is necessary to critically approach Chinese investment in Canadian AI research institutes or commercial deals. As such, China's whole-of-the-nation approach must be taken into consideration and addressed commensurately in dealing with it on AI, whether it is on research collaboration or business engagement.

At the same time, the Government of Canada has an opportunity to positively influence China's use of this technology through smart engagement. There are no widely embraced international standards on the R&D and use of AI, and China has the ambition of being a norm-setter in this area. The relationship between China and the United States continues to become more frigid, and the European Union has become increasingly vocal in integrating explicitly liberal values into its digital policies. In this context, there is an opportunity for Canada to play the role of a middle power in finding pragmatic areas of collaboration with China, such as in the development of ethics guidelines on data and AI technologies, eschewing more sensitive topics such as social surveillance or military applications, and addressing non-political yet critical aspects of AI regulation focused on safety. China's recent softening stance on AI development and its call for international collaboration further suggests that there is such an opportunity for Canada.[31]

Overall, Canada must invest more resources in developing and implementing necessary measures to not only manage its domestic technology agenda, but also to manage its relations in the arena of foreign policy where technology and China are increasingly becoming more and more important.

[31] Knight, Will. 2018. China's leaders are softening their stance on AI. MIT Technology Review. https://www.technologyreview.com/s/612141/chinas-leaders-are-calling-for-international-collaboration-on-ai/.

JAPAN

Government Policies

AI is embedded within Japan's overall growth agenda, characterized by the vision of Society 5.0. Prime Minister Abe came to power in 2012 with an aggressive economic policy called Abenomics, characterized by measures designed to tackle economic stagnation, which had been identified as a long-term problem stemming from fundamental issues such as decreasing productivity and an aging population. Prime Minister Abe won by pledging to address these problems.

In this context, the Japanese government coined the concept of Society 5.0. This socio-economic vision aims to use emerging technologies – most notably, AI – to create "a human-centred society that balances economic advancement with the solution of social problems by a system that highly integrates cyberspace and physical space."[32] The concept was first introduced in 2016 through the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) in its fifth Science and Technology Basic Plan, Japan's five-year science and technology strategy.[33] Society 5.0 was further integrated into Japan's greater economic development strategy by the Council on Investments for the Future in June 2017, when it announced the new Growth Strategy that explicitly articulated the goal of realizing the visions of Society 5.0 and selected health care, mobility, distribution, smart cities, and financial technology as priority areas. Further, the Growth Strategy introduced the following objectives:

- Investment of government resources in strategic fields, leveraging Japan's strength;
- Development of data platforms for inter-connected utilization of data across different fields and provision of public data for private sector needs;
- Support for individual-focused adult education and strengthening of IT skills of citizens;
- Introduction of a "regulatory sandbox system"[34] to try out new ideas; and
- Linkage of the aforementioned measures to a wide range of regions, companies, and people.[35]

As part of realizing the visions of Society 5.0, the Cabinet created the Strategic Council for AI Technology to specifically address AI R&D and implementation. In this, the Strategic Council serves as a "control tower" for three main ministries relevant to AI: MEXT, the Ministry of Internal Affairs and Communications (MIC), and the Ministry of Economy, Trade, and Industry (METI).

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[32] Society 5.0. Cabinet Office. https://www8.cao.go.jp/cstp/english/society5_0/index.html.

[33] Ministry of Education, Culture, Sports, Science and Technology – Japan. Japan's 5th Science and Technology Basic Plan. http://www.mext.go.jp/en/policy/science_technology/lawandplan/title01/detail01/1375311.htm.

[34] Regulatory sandboxes refer to testing grounds for new business models that are not protected by current regulation or supervised by regulatory institutions.

[35] 2017. Council on Investments for the Future. Prime Minister of Japan and His Cabinet. https://japan.kantei.go.jp/97_abe/actions/201705/30article6.html.

The Strategic Council co-ordinates policies within these ministries and sometimes others, such as Ministry of Health or Ministry of Agriculture, when relevant. These ministries have also been responsible for national institutes that conduct relevant research on AI, such as the National Institute of Information and Communications Technology (NICT), the National Institute of Physical and Chemical Research (RIKEN), or the National Institute of Advanced Industrial Science and Technology (AIST), which further gives them the ability to facilitate the government-industry-academia collaboration on AI.

The Strategic Council developed the Artificial Intelligence Technology Strategy in 2017, which outlines Japan's AI R&D and industrialization road map, with the objective of developing an AI industrial ecosystem by 2030. The Strategy has assigned three different research sectors for AI application (health care, productivity, and mobility) for each ministry. It has also assigned R&D agencies and private sector companies to pursue research objectives (see Table 3):

Table 3: Structure of the Strategic Council

	MIC	MEXT	METI
R&D Agencies	• National Institute of Information and Communications Technology (NICT)	• National Institute of Physical and Chemical Research (RIKEN) • Japan Science and Technology Agency (JST)	• National Institute of Advanced Industrial Science and Technology (AIST) • New Energy and Industrial Technology Development Organization (NEDO)
AI Research Area	• Natural language processing, speech translation, and brain information communication	• Basic research and infrastructure technology	• Application in industrial sectors
Research Sectors	• Health Care	• Productivity • Mobility • Health Care	• Productivity • Mobility • Health Care

The Japanese government has thus developed a framework that strategically facilitates collaboration between academia, industry, and government that leverages Japan's strengths and resources, with the ultimate objective of delivering the vision of Society 5.0.

AI R&D and Talent

Japan's self-identified weakness in AI is the lack of talent. The White Paper on International Economy and Trade (2017) noted that there is a talent shortage of approximately 50,000 in the technology field, including AI.[36] Professor Mitsuru Ishizuka of the Cognitive Innovation Center (CIC) notes that Japanese researchers are lagging behind in the field of deep neural networks, stating that Japan is a follower when it comes to this technology.

[36] Ministry of Economy, Trade and Industry – Japan. 2017. White Paper on International Economy and Trade. http://www.meti.go.jp/english/report/data/wp2017/wp2017.html.

Major corporations lead AI R&D and talent recruitment in Japan, as they have the financial resources to attract AI talent. According to a Canadian official in Tokyo, while Japanese companies have been reluctant to look outside Japan thus far, the lack of talent in AI has made them more willing to collaborate with international partners. The Perspectives on Artificial Intelligence/Robotics and Work/Employment report by Artificial Intelligence Research for Human (AIR) notes that corporations have started hiring foreign talent to address this gap.[37] The official, however, notes that most Japanese companies are looking for access to foreign AI talent through the purchase of startups abroad or on a consulting basis, as opposed to hiring and bringing them to Japan. The Japanese private sector's interest in accessing Canadian AI talent is reflected in Fujitsu's recent opening of its global AI headquarters in Vancouver, BC, in November 2018.

The government's commitment to promoting AI has had a positive impact on AI education, spurring collaboration between private and public sector entities. MEXT and METI have together created AI-related university programs, convening a national consultative body with post-secondary institutions, the Japan Business Federation, and industry stakeholders to address talent shortages and weaknesses in research.[38] Further, government ministries are collaborating closely with national research institutes and the private sector to advance research and application in the fields that they have been assigned. The Japan Deep Learning Association (JDLA) has launched an AI certificate program, in which engineers and managers go through short-term training on AI fundamentals. Lastly, Japan Science and Technology Agency also offers JPY150M to JPY500M (C$1.8M to C$6M) worth of funding in the area of AI and big data, and PRESTO for Young Researchers provides JPY30M to JPY40M (C$360,000 to C$480,000) for each three-year project for young, rising AI researchers.

AI ELSI

Society 5.0 regards economic growth and solutions for social problems as inseparable. Thus, in addition to R&D and economic growth, Society 5.0 includes Japan's approach to ELSI in relation to AI development. The Cabinet's commitment to ELSI is most notable in the establishment of the Advisory Board on Artificial Intelligence and Human Society.[39] The Advisory Board consists of 12 members from different academic backgrounds (humanities, social sciences, engineering, law, etc.) and is designed to advise the Cabinet on ELSI matters related to AI from an interdisciplinary perspective. The Board's Report on Artificial Intelligence and Human Society (March 2017)

[37] Ministry of Education, Culture, Sports, Science and Technology – Japan. Acceptable Intelligence with Responsibility, Perspectives on Artificial Intelligence/Robotics and Work/Employment. http://www.mext.go.jp/en/policy/science_technology/lawandplan/title01/detail01/1375311.htm.

[38] Harris, Paul. 2017. Research brief: Developments in artificial intelligence (AI) in Japan and implications for Australia. Department of Education and Training. https://internationaleducation.gov.au/International-network/japan/PolicyUpdates-Japan/Documents/AI%20in%20Japan%20research%20brief_07-2017.pdf.

[39] Ema, Arisa. 2017. EADv2 Regional Reports on A/IS Ethics: Japan. The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems. https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/eadv2_regional_report.pdf.

addresses concrete, imminent issues in mobility, manufacturing, personal services, and communication from ethical, legal, economic, educational, social, and R&D perspectives. Further, MIC organized the Conference toward AI Network Society in 2017, which convened approximately 40 members from academia, industry, and civil society. A subcommittee at the conference drafted AI R&D principles, an ethics guideline for researchers. It is clear that the Japanese government is attentive to groups concerned about AI ELSI and provides space for active discussions.

Table 4: AI R&D principles[40]

- Principle of collaboration: Developers should pay attention to the interconnectivity and interoperability of AI systems (principles mainly concerning mitigation of risks associated with AI systems).
- Principle of transparency: Developers should pay attention to the verifiability of inputs/outputs of AI systems and the explainability of their judgments.
- Principle of controllability: Developers should pay attention to the controllability of AI systems.
- Principle of safety: Developers should take it into consideration that AI systems will not harm the life, body, or property of users or third parties through actuators or other devices.
- Principle of security: Developers should pay attention to the security of AI systems.
- Principle of privacy: Developers should take it into consideration that AI systems will not infringe on the privacy of users or third parties.
- Principle of ethics: Developers should respect human dignity and individual autonomy in R&D of AI systems (principles mainly concerning improvements in acceptance by users, etc.).
- Principle of user assistance: Developers should take it into consideration that AI systems will support users and make it possible to give them opportunities for choice in appropriate manners.
- Principle of accountability: Developers should make efforts to fulfil their accountability to stakeholders, including AI systems' users.

Lively discussions on AI ELSI have taken place in academia as well. The Japanese Society of Artificial Intelligence (JSAI) established its Ethics Committee in 2014. The Ethics Committee started drafting a Code of Ethics in early 2016 and published the Japanese Society for Artificial Intelligence Ethical Guidelines in May 2017. The Guidelines, directed at AI researchers, stress the importance of being aware of their social responsibilities and maintaining effective communications with society (see Table 5).

Table 5: JSAI Ethical Guidelines[41]

- Contribution to humanity
- Abidance of laws and regulations
- Respect for the privacy of others
- Principle of fairness
- Principle of security
- Acting with integrity
- Accountability and social responsibility
- Communication with society and self-development
- Abidance of ethics guidelines by AI

[40] Ministry of Education, Culture, Sports, Science and Technology – Japan. Acceptable Intelligence with Responsibility, Perspectives on Artificial Intelligence/Robotics and Work/Employment. http://www.mext.go.jp/en/policy/science_technology/lawandplan/title01/detail01/1375311.htm

[41] Ibid.

There are also other groups, such as the JDLA and AIR. As such, there are forums in Japan for interdisciplinary scholars to raise AI ELSI matters to policy-makers as large-scale domestic policies are formulated. AI ELSI continues to raise concerns around the world. In this context, Japan, a country with a great AI ambition, the technological capability to deliver it, and similar political values as Canadians, stands out as a promising partner in the area of international governance in matters of AI ELSI.

Japan has started mobilizing its resources to play an active role in shaping the international governance of AI. During his policy speech delivered to the National Diet on January 28, 2019, Prime Minister Abe announced that Japan "will take the lead in establishing human-centred ethical principles for AI."[42] His administration has thus far followed through with this pledge. Japan has agreed to collaborate more closely with Canada and the European Union on AI during Prime Minister Abe's trips in April and May, with an emphasis on promoting "human-centric" uses of the technology.

Conclusion

Strong, centralized leadership by the government underscores Japan's AI strategy. The policies that the Japanese government has rolled out thus far make it very clear that it regards increasing its R&D capacities and integrating AI into its economy – particularly the manufacturing sector – a key priority within the national economic agenda. The formation of the Strategic Council – the control tower – underscores the importance of the government support. The Council creates the space for key ministries – MEXT, METI, and MIC – to co-ordinate their AI policies, while also providing a forum for policy-makers, industry, and research to collaborate in creating the foundation for a new economy driven by emerging technologies such as AI.

The emphasis on AI within Japan's greater economic policy has spilled over to the private sector in the area of talent. The government and the industry are keenly aware of Japan's lag in basic AI research, and they are looking at Canada to fill the gap. Japanese companies, known for their conservative attitude toward foreign workers, are now realizing that they need to work with those abroad in order to complement their weakness in AI research. Japan's capital and manufacturing capabilities could be effectively coupled with Canada's strength in AI basic research.

Finally, the Japanese government's proactive movement in AI ELSI again underscores the degree of importance that it has invested in AI. The fact that the government has invested in internal bodies such as the Advisory Board on Artificial Intelligence and Human Society highlights the Japanese government's understanding that AI cannot be confined to the realm of science and technology policy, but that of the greater national development policy. Further, Japanese AI ELSI bodies have been active in producing early and widely distributed AI ethics guidelines, with an eye to the international governance of the technology.

[42] Cabinet Public Relations Office. 2019. Policy Speech by Prime Minister Shinzo Abe to the 198th Session of the Diet. https://japan.kantei.go.jp/98_abe/statement/201801/_00003.html.

Overall, the review of Japan's AI strategy demonstrates that Japan, like China, considers AI and its integration into the economy as a priority within its national economic agenda, and that it has been making use of its powerful government bureaucracy to spur the collaboration between policy-makers, industry, and academia. Japan's strategy is comprehensive and co-ordinated, viewing AI as a key marker of global competitiveness for Japan in the world.

In this context, Japan stands as an attractive partner for collaboration in the space of AI. Canada's strength in basic research complements Japan's strength in manufacturing and application, as well as abundance of capital. Further, the alignment of values between Japan and Canada suggests that the two could also collaborate in the promotion of global AI governance. Being mindful of Japan's substantial commitment to AI, the Government of Canada should look to Japan for a like-minded partner.

SOUTH KOREA

Government Policies

In 2017, the Ministry of Science, ICT, and Future Planning (now the Ministry of Science and ICT) launched the Mid-to-Long-Term Master Plan in Preparation for the Intelligent Information Society: Managing the Fourth Industrial Revolution. The policy document addresses R&D strategies and potential ELSI of greater use of AI and introduces a road map for achieving the following goals:

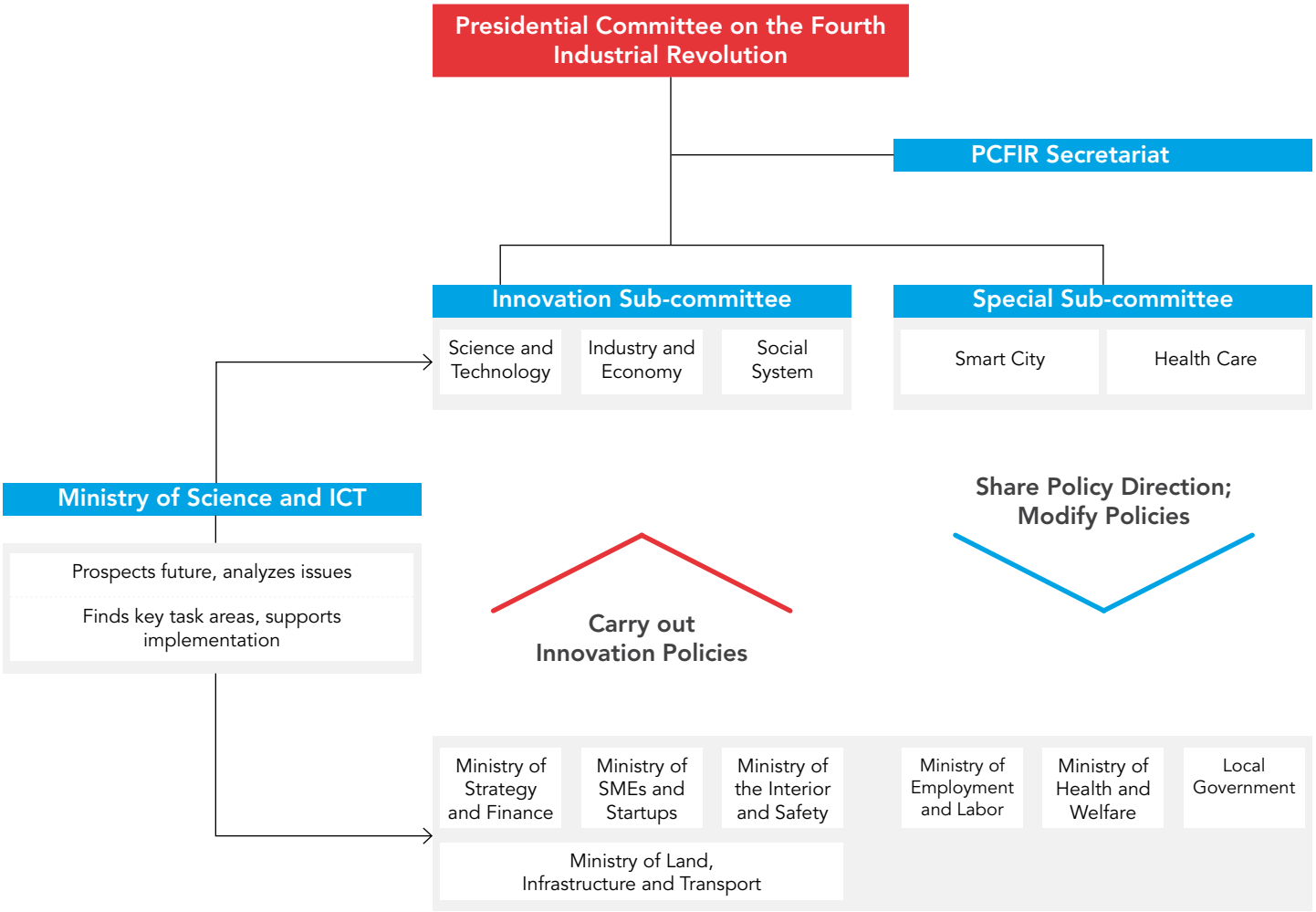
- Build a world-class technological foundation;
- Promote intelligent industry[43]; and
- Revise existing social policies and regulations.

The document provides a framework for collaboration between technology, industry, and civil society with a 30-year time frame. The Ministry of Science, ICT, and Future Planning was re-structured to the Ministry of Science and ICT with the change of power in May 2017, and the Mid-to-Long-Term Master Plan has become outdated. However, the Plan reflects the South Korean government's basic approach to AI, which is re-articulated in more detail through the Presidential Committee on the Fourth Industrial Revolution (PCFIR).

Newly elected President Moon Jae-in established the PCFIR in November 2018. Operating under the motto "led by the private sector, supported by the government," the PCFIR features a roster of private sector leaders and academics alongside five ministers from relevant departments and the science advisor to the President, totalling 25 members (see Table 6). Approximately 30 staff members from the Ministry of Science and ICT support the day-to-day operations of the PCFIR.

[43] When South Korean documents refer to "intelligence" or "intelligent," it often refers to AI in particular.

Table 6: Composition of the PCFIR



Source: PCFIR Website

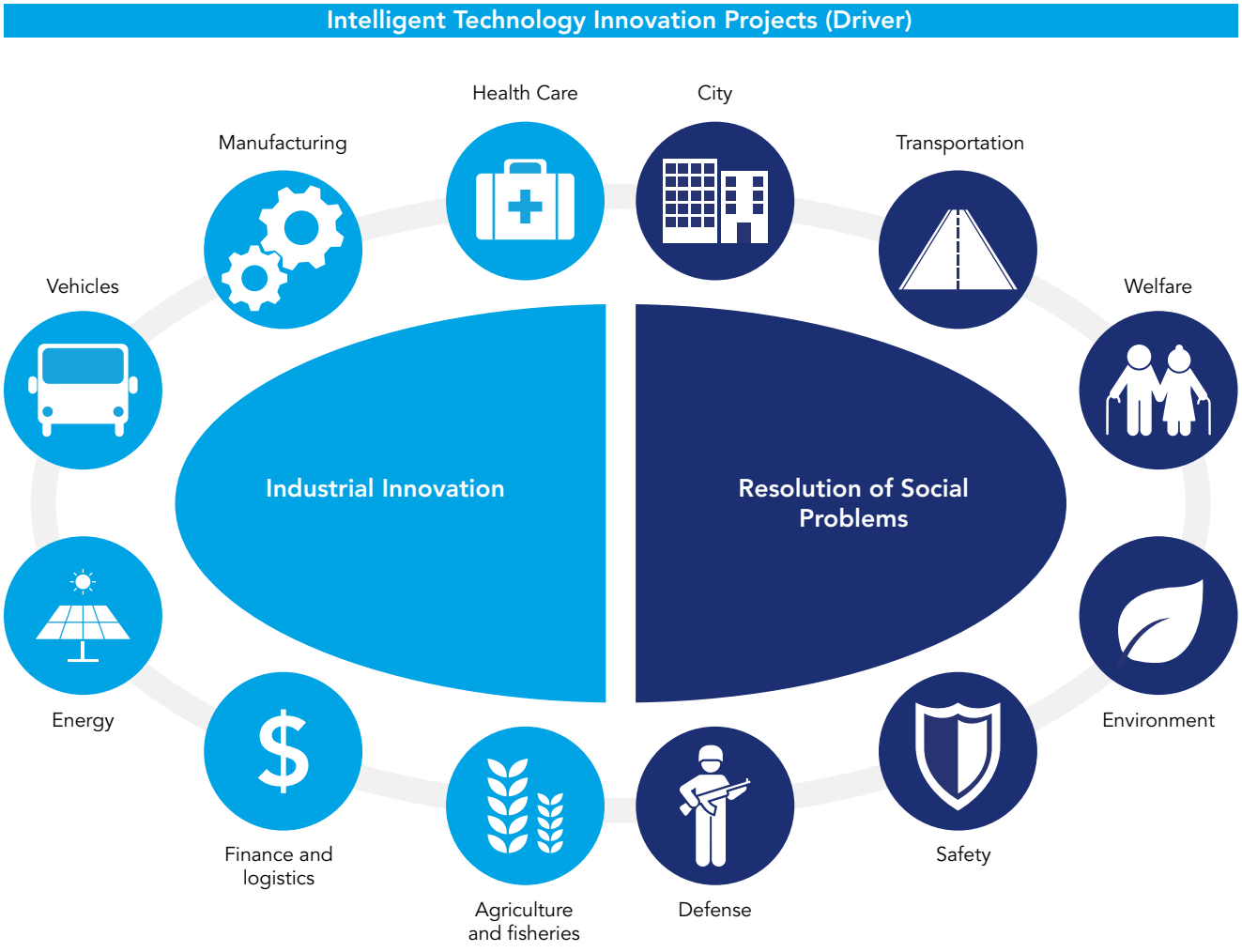
Similar to Japan's Strategic Council for AI Technology, the PCFIR serves as a control tower for co-ordinating the government's policies on AI and other emerging technologies. More specifically, the mandate of the PCFIR is the following:

- Co-ordination of policy measures submitted by various ministries and the committee members;
- Organization of public campaigns related to the fourth industrial revolution and encouraging public participation;
- Preparing the groundwork for regulatory and institutional reforms in support of public-private partnerships; and
- Fostering ecosystems for emerging industries.

The PCFIR's key document is the People-Centered Response Plan for the Fourth Industrial Revolution to Promote Innovative Growth, or I-Korea 4.0 Strategy. The Strategy outlines a comprehensive national strategy that seeks to support R&D and deploy the technologies of the fourth industrial revolution. I-Korea 4.0 parallels Japan's Society 5.0 in that both outline a comprehensive vision in which the technologies of the fourth industrial revolution are developed and deployed to support economic growth and solve social problems.

More specifically, I-Korea 4.0 outlines the plan to promote intelligent technology innovation projects in 12 different sectors (see Table 7); secure growth engine technologies; create industrial infrastructure and ecosystems; and make preparations for future social change entailing the use of disruptive technologies. In I-Korea 4.0, the PCFIR aggregates and co-ordinates proposed policies from relevant ministries, with the Ministry of Science and ICT taking the lead. The time frame for the Strategy is five years, from 2018 to 2022, and the Strategy lists concrete objectives for all 12 sectors.

Table 7: The 12 sectors in I-Korea 4.0



Source: I-Korea 4.0 booklet

In June 2019, President Moon announced a manufacturing renaissance strategy, which will inject KRW8.4T (US$7.1B) in key industries such as non-memory chips, future mobility, and biohealth technologies, as well as upgrade South Korea's manufacturing sector through integration of AI. The manufacturing renaissance strategy echoes Made in China 2025 in many ways, articulating South Korea's ambition to not only maintain, but also enhance, its manufacturing competitiveness, striving to become one of the top four global exporters, as well as increasing the value-added ratio of the manufacturing sector from 25 percent to 30 percent by 2030.

The strategy is not a deviation from I-Korea 4.0; rather, it builds on I-Korea 4.0 as a blueprint and fleshes out the details specifically within the manufacturing sector. In addition to the construction of 30,000 smart factories outlined in I-Korea 4.0, the government will also support the development of 2,000 "AI factories" by 2030. The process will also include the establishment of a data centre for smart factories and revision of existing laws to enhance the business environment for the manufacturing sector. Further, the Ministry of Industry will take a lead in drafting an AI national strategy on manufacturing within 2019.

AI R&D and Talent

South Korean policy-makers and AI practitioners generally believe that their AI R&D sector is underdeveloped. A common refrain in policy documents and conversations held with AI experts in Korea is the fear of falling behind or the need to catch up to the rest of the world. The lack of AI talent is a major policy concern for South Korean policy-makers and the industry, which has prompted the introduction of the national AI R&D Strategy.

The PCFIR launched the AI R&D Strategy in May 2018, investing KRW2.2T (C$2.66B) until 2022 to acquire world-class AI technology, develop AI talent, and become one of the top four AI nations. More specifically, the AI R&D Strategy includes the following initiatives:

- Government-funded AI projects in public sectors (defence, health care, public safety) modelled after DARPA Grand Challenge competitions in the United States;

- Creation of six additional AI graduate programs and five AI R&D institutes for training 5,000 new AI specialists by 2022;
- Promotion of AI application in promising industries (e.g. pharmaceutical research); and
- Creation of an AI hub to provide data relevant to local entrepreneurs and industries.

Adding to the challenge is the disparity in resources between the conglomerates and small and medium-sized enterprises (SMEs). Startups and SMEs currently compete against multinational conglomerates (e.g. Samsung, LG) that are not only acquiring talent from within, but also from the rest of the world.

Table 8: AI research centres of South Korean Multinational Corporations

Corporate AI Research Labs	Year of Establishment
Naver Labs AI	2015
SK Telecom AI	2016
Samsung AI Center	2016
LG AI Lab	2017
SK T-Brain	2017
Kakao Brain	2017
Naver Clova	2017
Samsung SDS AI	2017
Hyundai Motors AI	2017

South Korean conglomerates have started looking abroad to access top AI talent around the world. Naver (often referred to as South Korea's Google) purchased XRCE in France to gain access to 80 top European AI experts. The conglomerates have also been active in Canada. Samsung opened its second North American AI Centre in Toronto in May 2018, following the launch of its AI lab in Montreal in partnership with the Université de Montréal's MILA (one of the three AI clusters) in September 2017. LG also established a partnership with the University of Toronto – home to the Vector Institute, another AI cluster – to set up an AI research lab.

AI ELSI

ELSI is integrated into South Korea's blueprint for its fourth industrial revolution policies. The PCFIR's objective of using cutting-edge technologies to boost economic growth and solve social problems makes it very clear that ELSI is a central concern for South Korea's lawmakers. I-Korea 4.0 specifically points to policies of integrating AI into health care, welfare, the environment, and public safety. One of the PCFIR's three subcommittees is the Social Institutions Subcommittee, which is tasked with innovation of employment and welfare policies, educational reforms to foster creativity, legal and policy reforms to solve real social problems, and international and community relations.

One of the four pillars of I-Korea 4.0 is to make preparations for future society. The PCFIR lists the following policy measures that fall within this pillar:

- Broadening of scope for employment insurance and strengthening of the social safety net for job retraining;
- Reflecting the changing nature of the work environment to ensure that workers in new industries are eligible for workers' compensation;
- Creating an ethics guideline for AI;
- Creating measures to ensure that those negatively impacted by AI have a legal basis for proper compensation; and
- Continuing to hold multi-stakeholder discussions through the PCFIR to create "social consensus" on the government's response to the fourth industrial revolution on labour, education, the social safety net, and ethics.

One of the signature events of the PCFIR is the Regulatory and Institutional Reform Hackathon, which has been held 13 times since the launch of the PCFIR. Modelled after sprint-like, intense work sessions among software engineers in the tech sector, the Hackathon has brought together approximately 30 stakeholders from government, civil society, and the private sector for two-day workshops. The participants discuss multi-stakeholder issues, such as data and privacy rights, the data cloud, or the drone industry in an open manner, curated by professional facilitators. With an emphasis on consensus making, the participants create policy recommendations to the PCFIR, relevant ministries, and the National Assembly. The progress on their recommendations is reported to all participants quarterly. While not all of the discussions touch on AI, these hackathons provide a model for bringing together relevant stakeholders and influencing policy-making in a nimble, democratic manner.

Table 9: Regulatory and Institutional Reform Hackathons

Date	Themes
December 2017	• Right to Self-determination in Financial Information • Improving Location Information Protection Law • Improving Advanced Medical Equipment Regulation
January 2018	• Improving Certification Systems • Harmonizing Use and Protection of Personal Information
April 2018	• Harmonizing Data Use and Protection of Personal Information • Promoting Drone Industry • Promoting Use of Cloud Computing in Public Sectors
September 2018	• Innovation in Transportation Service through ICT • Legalizing Shared Rentals for Korean Citizens in Urban Areas • Improving Regulation of Combined Products in Health Care
March 2019	• Eliminating Regulatory Grey Zones Created by Increase of Personalized Transport • Stimulating Food Industry by Improving Labelling of Nutritional Functionality

On the ethics front, the Ministry of ICT, in collaboration with the National Information Society Agency, released the Ethics Guideline for Intelligent Society in June 2018, as indicated by I-Korea 4.0. The Guideline builds on the principles of Seoul PACT (Publicness, Accountability, Controllability, and Transparency) (see Table 10).

Table 10: Seoul PACT

Publicness: Intelligent information technology should benefit as many people as possible, and the economic benefits produced by the technology should be shared widely for the prosperity of humanity.
Accountability: Clarify the distribution of liabilities entailed to intelligent information technology and related services, and ensure that the distribution of information on safety and protection of user rights and other related social duties is undertaken.
Controllability: Pre-emptively prepare responses to malfunctions of intelligent information technology and services, and ensure that user rights for choices be guaranteed as much as possible.
Transparency: R&D and design should strive to reflect opinions of users, consumers, and citizens; disclose potential dangers while in use; and ensure that personal information is processed appropriately.

Conclusion

South Korea's rapid economic development following the ravages of the Korean War has been referred to as the Miracle on the Han River and became a benchmark for developing nations around the world. The miracle was made possible through economic policies in which the government and private sector entities collaborated closely with each other, taking a whole-of-the-nation approach to economic and social development. The catch-up mindset of the twentieth century is reflected in South Korea's approach to AI and, more broadly, the fourth industrial revolution. Like China and Japan, South Korea regards AI as a key driver of the next generation economy and therefore a national project, closely tied to its global competitiveness. As such, the government has taken measures to ensure that South Korea does not fall behind the rest of the world, clearly articulated in its goal of becoming one of the top four AI nations by 2022. Canada's C$125M investment in its national AI strategy pales in comparison to South Korea's C$2.66B investment in its R&D strategy, and even more so considering other policy measures taken within the PCFIR's greater agenda.

South Korea and Canada have strengths that complement each other. Experts have noted Canada's strength in basic AI research, a product of a long-term investment in its scientists; meanwhile, South Korea excels in implementation and has hardware capacities through its strong manufacturing sector. South Korea's emphasis on upgrading its manufacturing sector through integration of AI is consistent with the objectives of China and Japan, and also highlights the same opportunity for Canada: Canadian AI talent and the East Asian partner's manufacturing capacity. The rush of South Korean conglomerates to Canada is a testament to this potential, and Canada should explore ways of harnessing this opportunity even further.

Finally, the examination of South Korea's approach to AI underscores the potential for collaboration between Canada and South Korea on the issues of AI ethics and broader politics of AI governance. The South Korean government is aware of – and has taken policy measures through the PCFIR to act upon – the potential ELSI of AI. When it comes to values, Canada and South Korea have more in common than not. Further, in light of the growing chasm between China and the United States, Canada and South Korea have the potential to collaborate closely on advocating for the ethical use of AI at the international level.

ANALYSIS & POLICY RECOMMENDATIONS

Analysis

This review of AI policies in East Asia suggests that all three governments regard AI as a transformative technology that is critical to their economic and social development. They regard the state as a key actor in delivering this AI vision, and thus have created comprehensive strategies that stretch beyond R&D and talent development to consider AI's integration into their economy and measures to address associated ELSI.

Accordingly, they have created AI-specific bodies, such as China's AI Plan Promotion Office under the Ministry of Science and Technology; Japan's Strategic Council for AI Technology; and South Korea's Presidential Committee on the Fourth Industrial Revolution, to co-ordinate AI-related endeavours of different ministries and facilitate a coherent, long-term, national-scale plan of action.

These AI strategies create a framework in which a set of goals on AI development are outlined, and the private sector, with the policy support of the state, delivers them. More specifically, these strategies create a space where policy-makers, private enterprises, and academia can collaborate closely. South Korea's strong bureaucracy and co-ordinated policy-making allow the state to play the role of facilitator among different stakeholders. Given that AI requires not only advances in R&D and capital, but also adjustment of existing policies and regulations at the government level, this comprehensive, national approach to AI will facilitate a favourable environment for the East Asian states to move forward in the AI space.

China, Japan, and South Korea believe that they are lagging behind in R&D and talent development, and therefore have prioritized these perceived deficiencies. They have enacted policies to address the shortage of AI talent, by both creating education programs and attracting foreign talent. Their private sectors are also aggressively recruiting and creating research centres abroad to access foreign AI talent. In this, they have shown considerable interest in gaining access to Canada's AI ecosystem and talent.

Further, these government bodies and plans point to their awareness of ELSI resulting from increased deployment of AI. China's Next Generation AI Development Plan and South Korea's I-Korea 4.0 address the need to both adjust social and legal institutions in place and adequately prepare their citizens in the long run. Similarly, the Advisory Board in Japan has made recommendations on ELSI to the Cabinet through its Report on Artificial Intelligence and Human Society. All three East Asian governments display an awareness of the potential dangers of AI and a willingness to engage with the ELSI issues in both development and deployment with a long-term perspective.

AI development in each of the three states is considered a national project. The strategies of each country conform to the developmental state theory, which explains the past success of East Asian states in achieving rapid economic growth by appealing to the nationalist rhetoric that they

are falling behind the rest of the world and thereby justifying significant state involvement in economic planning.[44] With the rise of AI geopolitics, therefore, it is important to understand that AI development is regarded as a national project, and Canada's engagement in this space – whether the objectives are to promote trade or address national security concerns – requires a more comprehensive approach, especially with a technology like AI, which blurs previously set sectoral boundaries.

Finally, on values: it is important to understand that substantive discussion on AI ethics will have to go beyond broad statements featured in respective ethics guidelines. Table 11 demonstrates that ethics guidelines from the three East Asian states and Canada do not deviate much from each other. These guidelines share the idea that AI must be used for some sort of greater good, and that it must be used in a way that is safe, transparent, or responsible. From a broader point of view, the difference lies in the specific social, economic, political, and cultural context in which AI systems are deployed. This difference is an implicit premise of this report.

[44] See Leftwich, Adrian. 1995. Bringing politics back in: Towards a model of developmental state. The Journal of Development Studies. 31(3).

Table 11: Comparison of ethical guidelines

Key Themes	**Canada** (Montreal Declaration)	**China** (Principles of Next Generation AI Governance)	**Japan** (JSAI Ethical Guidelines)	**South Korea** (Seoul Pact)
Privacy	• Privacy and intimacy	• Respect for privacy	• Respect for the privacy of others	
Justice	• Equity	• Fairness and justice	• Principle of fairness	
Safety	• Prudence	• Safety and controllability	• Principle of security	• Controllability • Transparency
Responsibility	• Responsibility	• Shared responsibility	• Acting with integrity • Accountability and social responsibility	• Accountability
Society and Governance	• Solidarity • Democratic participation • Diversity inclusion • Sustainable development	• Inclusion and sharing • Agile governance	• Abidance of laws and regulations • Communication with society and self-development	• Publicness
Human-centric well-being	• Well-being • Respect for autonomy	• Harmony and human-friendly	• Contribution to humanity • Abidance of ethics guidelines by AI	
Other		• Open and collaboration		

This has several important implications. Shared values underline the fact that the concern for responsible AI transcends political differences, and that there is space for constructive, transnational dialogue on AI governance with the three East Asian states, at least in theory.

However, prior experience indicates that beyond shared values articulated in documents, context, which affects their interpretation, implementation, and enforcement, matters more. In this situation, it is important for Canada to continue engaging with its partners on AI, finding common ground in the actual practice of these ethical values through communication and collaboration. It is easier and more expedient to argue for this approach in relation to Japan and South Korea, but not so much with regards to China, which has increasingly become the "other" of the Western, liberal states. But especially for this reason, it is important for states like Canada to continue engaging with China, in order to ensure that important dialogues on AI governance (and beyond) are not siloed along geopolitical fault lines; and to constantly refine and identify areas of dialogue and negotiation, focused on issues of mutual concern.

Policy Recommendations

Recommendation 1: Increase Canada's capacity to govern AI in a co-ordinated manner at different levels of government.

Canada stands to benefit from the Government of Canada's forward-looking investment in academic research in the field of AI. The C$125M investment in the Pan-Canadian Artificial Intelligence Strategy will further boost Canada's excellence in research, striving to maintain its global competitiveness. However, this evaluation of East Asian AI strategies suggests that there is a need for a more comprehensive Canadian AI strategy that stretches beyond R&D and that would harness Canada's capacity to adequately compete with better co-ordinated states in AI like China, Japan, or South Korea.

These countries have recognized that AI is a technology that is not limited within a single domain, and that engagement with it requires a cross-ministerial effort, which requires expertise to govern. Therefore, they have created bodies such as the AI Plan Promotion Office (China), Strategic Council (Japan), and the Presidential Committee on the Fourth Industrial Revolution (South Korea). In May 2019, the Government of Canada created the Advisory Council on Artificial Intelligence to "advise the Government of Canada on how best to build on Canada's AI strengths, identify opportunities to create economic growth that benefits all Canadians and ensure that AI advancements reflect Canadian values."[45] This is a new development and not much information is available, but it is definitely a step to the right direction.

Canada is different from East Asia and the developmental state approach would not be applicable in the context of Canada's system of governance, especially considering different levels of government. It is challenging for the Canadian government to engage with better co-ordinated Asian states, because it does not have the same capacity to centralize its AI agenda as they do. This is a challenge that has no single answer, but the Government of Canada must lead and hold dialogues with lower-level governments to ensure that AI is deployed across the country and to formulate AI policies that balance the need for co-ordination while maintaining the respect for existing relations between different levels of government.

Increasing the state capacity to govern AI starts by creating a space and investing in talent that can facilitate agile discussions and policy implementations in co-ordination with different levels of government and non-governmental stakeholders. While it is difficult to imagine a centralized AI agency with the same capacities as the ones in East Asia, it might be reasonable to create an AI hub for federal and provincial AI R&D and deployment strategies in different sectors, as well as policy guidelines and public engagement.

[45] Innovation, Science and Economic Development Canada. 2019. Government of Canada creates Advisory Council on Artificial Intelligence. News Wire Canada. https://www.newswire.ca/news-releases/government-of-canada-creates-advisory-council-on-artificial-intelligence-838598005.html.

There are great initiatives rolling out in different levels of government in addition to the Pan-Canadian Strategy, such as the federal government's Innovation Superclusters Initiative or the Alberta government's recent decision to invest C$100M to help AI sectors. Also, the federal government has worked with the Council of Chief Information Officers to set standards for use of AI and hosted National Data and Digital Consultations roundtables to address the ELSI issues. The creation of a central AI agency would allow the different levels of government to work together more effectively to maximize the potential of different AI-related programs, ensure that the diffusion and adoption of the technology across the country follow common norms and ethics, and provide the capacity for Canadian policy-makers to lead in AI governance at the international level.

Recommendation 2: Leverage Canada's AI talent more effectively as part of "Brand Canada."

Canada is home to world-class researchers strong in basic AI research. This is an asset particularly important at a time when the global AI talent shortage is the most common, pressing challenge for governments seeking to harness their AI potential. The Pan-Canadian AI Strategy recognizes this strength and seeks to maintain this competitive edge.

However, at least in East Asia, there is a need to highlight the association between these world-class researchers with the Canada brand. While many recognize the names of researchers, they do not necessarily associate them with Canada. Although major corporations from East Asia (e.g. Samsung, Baidu, Fujitsu) are rushing to establish research centres to gain access to Canada's AI talent, more could be done to attract investment to Canada. Canadian governments and AI stakeholders should work together on branding Canadian AI to further stress the association with Canada, thereby creating opportunities for post-secondary universities and local economies that host these world-class researchers.

More specifically, it is necessary for Canada's AI stakeholders – federal and provincial governments, academics, and practitioners – to identify what makes Canadian AI distinct from U.S., Chinese, or any other competitor's AI. Initial conversations have suggested that Canada's diversity and excellence in good governance are some of the qualities that should be stressed, and a policy that combines immigration – a specific policy area that reflects these Canadian values – with AI talent acquisition might be a productive way forward.

Finally, it is necessary to harness the economic benefit of Canadian AI beyond R&D and connect it to its application to different sectors of the Canadian economy. The Innovation Superclusters Initiative is a positive measure that enhances existing areas of strength in Canada's diverse economy and showcases it to the rest of the world. In branding Canadian AI, it is necessary to integrate a broader picture that goes beyond highlighting excellence in R&D.

Recommendation 3: Proactively address emerging AI issues in trade and investment.

Due to the nature of the technology, advances in AI development and deployment will create new issues in trade and investment with China, Japan, and South Korea, which are Canada's second, fifth, and seventh largest trading partners, respectively. As such, Canada's different levels of government should consider emerging AI issues in trade and investment and prepare a future course of action.

Canadian AI entrepreneurs are aware of the market opportunity in China but are apprehensive about the issues of intellectual property regulations and potential transfer of their technology for social surveillance or AI weapons. This apprehension stems from the perception of different

approaches to AI ethics, a problem that will not necessarily be limited to China. Further, cross-border data regulation, which is tied to AI development and deployment, has already been identified as an emerging trade issue. In this context, different governments in Canada – especially the federal government – must harness the capacity to respond to issues related to AI and trade in an efficient and timely manner.

Canadian AI talent and research centres continue to attract investments from major East Asian companies. AI is a permeable technology and could pose threats in different social, economic, and political sectors. This does not mean that Canada should resort to isolationism driven by fear; on the contrary, it is necessary for policy-makers to fully assess the implications of foreign investments in the space of AI and create clear guidelines for all stakeholders.

Finally, it should be noted that when it comes to AI policy, there is no silver bullet that will adequately address all issues at once. The focus should be on creating a space for continuous discussions and devising policy responses in a nimble manner, instead of drafting heavy handed regulations that cannot keep pace with the technology.

Recommendation 4: Identify Canada's place in emerging AI geopolitics and engage strategically.

China's rapid rise in the field of AI has created a sense of anxiety around the world, coupled with the existing fears toward China. Conversations about AI in the Western world increasingly stress points such as democracy and civil rights, which read as a response to China's use of AI for social surveillance. Key discussions on AI ethics and policy occur in forums such as the Organisation for Economic Co-operation and Development (OECD) or the G7, which exclude China. Consequently, a fracture seems to be emerging between China and the Western world, which may prevent constructive dialogue on AI ethics and global governance. This fracture seems to have deepened significantly and become more obvious since September 2018, when the first draft of this report was developed.

Japan and South Korea share apprehension about China's AI leapfrogging, viewing it as a threat to their economic competitiveness. Politically, they are considered to be part of the liberal countries, but there are concerns about an overly Western imposition of AI ethical discussions, stemming from distinct cultural and intellectual traditions. For instance, even though both are liberal democracies, Japan and South Korea's discussions of AI ethics avoid explicit use of liberal language, such as democracy or civil rights. Further, for states like Japan and South Korea, their proximity to and economic dependence on China will increasingly limit their full commitment to causes of the liberal countries.

In this context, Canada is in a position to play a positive role on the international stage as a mediator. It has strong AI researchers and institutions as an asset and the credibility that China, the United States, and European countries lack vis-à-vis each other. Regrettably, Canada's relations with China have deteriorated significantly since the arrest of Huawei CFO Meng Wanzhou, but with the right pivoting in the long run, Canada could be the player that brings these parties to the table to facilitate dialogue on AI ethics and global governance.

In sum, the Government of Canada must embrace AI as a space of international competition among states, an amalgam of the geopolitical and technological. In addition to continuing to harness its AI capacity, it should also actively participate in AI ethics and governance moving forward.

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