**Breaking Through the Status Quo: Scaling Canada's Innovation Game**
April 10 - 11 2018
National Arts Centre, Elgin Street, Ottawa, ON, Canada

**Day 1 - April 10, 2018**

08:30 - 09:00
**Welcome Address**
JEFFREY CRELINSTEN, Publisher & CEO, RE$EARCH MONEY

Crelinsten began by acknowledging that the conference was taking place on the unceded land of the Algonquin nation. "In my spiritual work I've learned that sentiments are important, words are important, but action is the most important," he added, making a special note that there would be no speakers' gifts at this year's event but instead a donation made in each speaker's name to Indspire, a charity that supports indigenous education.

He began by reviewing the many features of the recent budget, such as measures intended to help grow Canada's business sector, including significantly more funding for the National Research Council's Industrial Research Innovation Program and new money for initiatives aimed at female entrepreneurs, skills development, and helping companies scale up. Crelinsten pointed to the Accelerated Growth Service created to coordinate public sector support for scale up firms and Innovative Solutions Canada, which is being launched by Innovation, Science and Economic Development (ISED) Canada in answer to the private sector's ongoing call for an equivalent to the US government's longstanding Small Business Innovation Research program.

He also praised the Treasury Board of Canada Secretariat's horizontal and departmental reviews, which has led to a consolidation of federal business innovation programs, reducing the total number of these initiatives from 92 to just 35. "An early example is ISED's Strategic Innovation Fund, which consolidates several programs to create a larger pot of funding that's open to a wider range of industry sectors."

He then charged the audience with the responsibility for ensuring these many different measures will make a difference in the lives of Canadians. "You say 'why me'? Quite simply it's because you're part of Canada's innovation ecosystem. It's up to you to make it work effectively." More importantly, he argued that some in the room would be running these government programs while others would be benefiting from those same programs, and everyone has the same goal. Whether that goal will be realized, he added, depends on what key performance indicators (KPIs) are chosen to determine how the money flows.

"We've already seen how our Minister of Science has set KPIs for the government's inclusiveness agenda in the Canada Research Chairs (CRCs) program. Universities must have a certain percentage of women CRCs, or they don't get the money. The

same kind of measure could ensure engagement with indigenous scholars, entrepreneurs, and companies, depending on the specific program in question."

In this respect there will be particular challenges around the high-profile superclusters initiative, which has reached the point where selected participants are negotiating financial arrangements. For Crelinsten, this raises questions about how that money will be distributed. "Will member companies have to prove that they've identified scientific or technological uncertainty and that they've formulated hypotheses to reduce or eliminate that uncertainty?" he asked. "That's what the Canada Revenue Agency insists that they must do to be eligible for SRED [Scientific Research and Experimental Development tax incentive] funding. How many of you knew that?"

Alternatively, he added, it might be sufficient for these member firms to show they have identified a customer need or market opportunity and so they want to co-invest in solutions with the government. "It all comes down to the goal," he argued. "If the goal is to move the GDP needle, then KPIs should be about business opportunities and how to increase the global competitiveness of Canadian firms in the industry sectors covered by the superclusters."

Seen from another perspective, superclusters may be a way of compensating for Canada's low business enterprise expenditure on R&D (BERD), which is much lower than the OECD average. "The flaw in that argument is that if you look at countries that have high BERD, they all have large domestic multinationals in knowledge-based industry sectors," he explained, maintaining that the well-known 80/20 rule continues to apply: 20% of the firms do 80% of the R&D and therefore contribute most of the BERD. "Our problem has been an inability to scale up large firms in knowledge-based sectors of the economy and keep them in Canada. After the demise of Nortel and the downsizing of Blackberry, Canada's knowledge-based sector is comprised almost entirely of small firms."

Crelinsten insisted that the supercluster initiative represents a way out of this problem, but only if they are driven by KPIs that focus on global sales, which will force member firms to keep innovating to serve this international customer base, which will mean conducting R&D.

"By focusing on the right goal the things you want to have happen will happen," he concluded. "If you focus on the wrong metrics, you forget the really important thing, which is the economy."

With that in mind, he promised that the more than 60 speakers at the conference would offer positive examples of people who are breaking new ground in these areas. "We won't be in a complaining mode," he said, indicating that the ultimate aim would be to move everyone forward.

He wrapped up his introduction by describing some of the innovations that have been taking place within RE$EARCH MONEY, which includes new subscription models, the

ongoing publication of *Canadian Innovation News*, and the expansion of the team assembling these products. He turned the floor over to the newsletter's new editor, Veronica Silva Cusi, who shared her enthusiasm for what is in fact her first time at the conference and discussion of the many different themes surrounding research and its funding.

09:00 - 09:30
**Opening Keynote: "New dynamic of open science"**
EUGÉNIE BROUILLET, Vice-President, Research and Innovation, Université Laval

Brouillet began by noting that people engaged in research can become embedded in a world of technology that has become so ubiquitous that we may not notice some of its most obvious features. "We need to connect to our environment, to our social challenges, to be aware of the fantastic capacities that we as scientists are blessed with." She argued that such awareness is essential to ensuring that science is employed in the best possible way for the benefit of humanity and our planet.

Such an outlook has been formalized at Université Laval under the banner Ensemble l'avenir — "together the future" — which is built around three pillars: experience, commitment, and excellence. This initiative is dedicated to helping the university's scholars engage with major social issues and making the institution attractive to others who share in this spirit. "Open science is part of this journey and will pave the way for a more equitable sharing of knowledge for the benefit of communities," she said. "Open science is more than collaborative research, this is more than a platform. It is what we do with it."

By way of example, she pointed out that while most people involved in the processes around innovation would describe their work as appealing and enjoyable, much of it takes place behind closed doors, with collaboration often being restricted to a relatively narrow range of interests. "But isn't innovation about collaboration and idea-sharing to go into areas that one could not develop on one's own?" she asked, noting that an open environment makes this possible. "To innovate, we need to understand challenges. Customers are key; stakeholders, NGOs, cities, hospitals, citizens, are also key. They all need to be part of our innovation enterprise."

Brouillet added that while engineers operate at the forefront of innovation, they cannot function alone, because addressing the problems calls for ideas from the social sciences and humanities, arts, health sciences, and more. "Problems are complex and need interdisciplinary approaches," she argued, pointing to the obvious attraction of technologies such as artificial intelligence, whose impact on our workplaces and our lives must be balanced with knowledge from outside of the field of computer engineering. "What type of society are we building now? Is it sustainable? Are we conscious that some people may be left behind?"

Nor is open science simply a matter of technical interdisciplinarity, she observed; it includes the society of social diversity. Such diversity has practical consequences, as

evidenced by the substantial global economic growth attributed to the increasing participation of women in the workforce since the 1960s. Nevertheless, such gender diversity has not appeared in most areas of science and technology, a shortcoming that may be holding back a great deal of innovation. In light of a coming technological revolution, she added, we cannot afford to let that happen. Brouillet pointed to the Centre hospitalier universitaire (CHU) de Québec-Université Laval and the Centre de Recherche Industrielle du Quebec as two key places where we will begin to see the impact this revolution will have on our lives. “Optimization, customization, advanced automation, robotics, new products for the planet,” she said. “What should we produce here in Canada? We are tops in optics, photonics, and AI. We should capture a greater part of this innovation: the Internet of Things, big data. We are extremely well positioned to do so.”

Even aspects of our society that might appear to be problematic — such as the growing proportion of seniors in the population — could be turned into opportunities, such as leading the way in assistive technologies for the elderly. “As a society, we set our own research and innovation agenda.” She also argued that we are well placed to help those in the developing world who have yet to enjoy some of the benefits of earlier innovations, such as the rise of digital technologies. Even within Canada there are isolated aboriginal communities that can be helped in this way.

Université Laval has a specific focus on sustainable health initiatives, creating an extraordinary collaboration between four hospitals, the community, 13 faculties on campus, and various private sector enterprises. “We are experimenting with the new dynamic of open science,” she said, pointing to the goal of providing sustainable health, research, and innovation to the people and businesses of Quebec and abroad. The resulting open platform represents a new frontier in health care and on behalf of the university she invited all prospective partners to contact her. “We believe that we can all do better with this collaborative vision,” she said. “We can attract more partners to do more research and be more successful — everything a university wants to achieve.”

She also noted a responsibility to the surrounding community of Quebec City, where average life spans can vary as much as seven years from one neighbourhood to another. “The required innovation cannot come from experts working in siloes,” she insisted. “It can only emerge with the recognition that research and data are valuable assets. If properly managed, they can have virtually limitless potential to be re-used in innovative ways.”

With regard to open access to knowledge, she noted that most African universities must cope with the absence of any kind of library on their campuses. “Open science can benefit countries who face unequal access to knowledge,” she suggested. “As such, our contribution should extend beyond Canada’s borders.” Most scholarly knowledge is published commercially, she noted, in journals that are highly profitable for these publishers and increasingly costly for the libraries that house these publications. Maintaining access to scientific knowledge often means cutting back on expenditures elsewhere.

“Universities are one of the most important stakeholders in this debate,” she said. “A significant proportion of the production of knowledge and research is done in universities.” There has been progress made in some parts of the world, premised on mobilization of knowledge, namely moving it into these open, accessible formats. Université Laval’s initiative is an open access platform, called Corpus ULaval. Such measures have also been accompanied by new policies setting standards for research integrity, ethics, and data sharing.

The university has also signed on to an international undertaking drafted by a French group of scholars and publishers on the campus Jussieu in Paris, known as the Jussieu Call for Open Science and Bibliodiversity. Here in Canada the U15, a network of the country’s 15 leading research universities, has issued its own statement on sustainable publishing. “Access to research and scholarly output is essential for scientific discovery, innovation, and education,” she said. “To maximize knowledge transfer and impact, our researchers work must be made readily available around the globe.” This is especially important at research-intensive institutions, she added, where the flow of knowledge is all the more important to develop new ideas and nurture the next generation of researchers.

This life cycle of research depends on what Brouillet called a “healthy communication ecosystem”, based on the principles of open access, public intellects, quality, accountability, and innovation. In addition, the exchange of digital information introduces an even wider array of research outputs. Among the leaders in this regard are the Netherlands and Switzerland, which have committed to making 100% of all their scholarly activity freely available on the Internet by 2024.

“Open science is about the way researchers work, collaborate, interact, share resources and disseminate results,” she concluded. “A systemic change toward open science is driven by new technologies and data, the increasing demand of society to address the challenges of our time, and the readiness of citizens to participate in research. By creating a dynamic of open science in Canada, we will foster innovation and societal advancement. It is up to us now to define what we want to do with open science, how we will generate the most value out of it, and what are our purpose and motivation.”

Jeff Crelinsten led off the questioning by asking how the university’s faculty members have been responding to this initiative in terms of gaining academic recognition for their work with outside agencies. Brouillet responded that her administration encourages faculty members to work with external partners in the public and private sector. “But we have to take this kind of research into account in their academic profile,” she said, noting that promotion decisions are still largely premised on the quantity and quality of academic publications. “We will have to ensure that the research ecosystem in Canada is open to that kind of research.”

That problem was echoed by Doug Ruth, who was dean of engineering at the University of Manitoba for 11 years, during which time he saw people count publications in any

kind of academic decision. Brouillet acknowledged that this was still a problem at Laval, since it is a deep-rooted aspect of scholarly culture.

Steve Alexander, of Fisheries and Oceans Canada, considered how a university could ensure that open access knowledge also includes different ways of knowing, such as aboriginal knowledge. Brouillet pointed to federal budget initiatives dedicated to inclusion and diversity as examples of how to broaden the scope of what counts as a research contribution.

09:30 - 10:15
**Keynote: "Mind the Gap: Budget 2018 and the Innovation and Skills Plan"**
DAVID WATTERS, President and CEO, Global Advantage Consulting Group Inc

Watters was accompanied by his colleague Adam Jarvis, Vice-President of Policy and Research at Global Advantage.

“We really feel we are explorers on your behalf,” Watters began by way of explaining how he and his colleagues probe through the details of each year’s federal budget to understand its full implications, looking for the “story behind the story”. In that respect he regarded the 2018 edition as a special one, especially as it applies to the country’s innovation goals.

“We call this ‘Mind the gap’,” he noted, “because we think there’s a performance gap in linking the innovation system to a trade initiative and a more competitive global aspect that will be important to making this system work.” Nevertheless, he added that the context of the budget is quite positive, as exemplified by factors such as substantial job growth since 2015, the lowest unemployment in a decade, consistent growth in GDP, and the lowest Debt-to-GDP ratio in the G7. At the same time, there are problems expected as interest rates rise, equity markets become volatile, the western pipeline dispute causes internal political tension, and an unpredictable government in the US causes external political tension.

Looking back at budgets of the last few years, Watters recalled the remarkable jump made from the last Conservative government budget in 2015 to the first Liberal government budget in 2016, which marked a 15-fold increase in spending that did have a concrete economic effect. Much of that spending was slated to take place over several years, so the 2017 budget contained essentially no new money. Although the 2018 budget is only about a third of the size of the 2016 budget, it does contain some new spending that represents a 3% increase in R&D and innovation investment. The larger question is whether this is enough to build real progress.

In fact, of the 15 largest expenditures in this budget, the granting councils come in 12$^{th}$ place, while the Canada Foundation for Innovation is 14$^{th}$. Given that most of the other items on the list fall into a range of areas around social spending — including indigenous health (#6), feminist aid (#4), workers benefit (#2), and veterans topping the

list — Watters said many economists have challenged the logic of these efforts. He suggested that there may be a different logic at work.

“I think there may be a new way of achieving economic development,” he said. “We need to put resources into this kind of a structure. Maybe you can grow an economy better by focusing on issues of diversity and trying to change those. There’s something here that may be quite profound, maybe a Canadian way of achieving economic growth.”

Traditional economics would maintain that you cannot made the pie bigger by cutting pieces more equitably, but Watters insisted that this analogy is too limited. “If you can give people an incentive to participate in the economy and to share more equitably in it, you may unleash quite an element of significant growth.”

Jarvis indicated that there are only six funders of R&D in Canada, which includes federal, provincial, not-for-profit firms, post-secondary institutions, foreign investors, and business. While business represents about half of the total, this is actually lower than in many OECD countries, where that proportion can be upward of 80%. Similarly, Canada’s overall expenditures are far less than the OECD average, the result of an ongoing divergence that has been going on since 2004, during which time the average proportion of GDP spent on R&D (GERD) in the OECD rose from 2.11% to 2.35% while for Canada it has dropped from 2.00% to 1.53%. Meanwhile, Germany’s GERD is around 3% of GDP and South Korea and Israel are both over 4%. To make up for this difference and simply reach the average level, Canada would have to spend an additional $10 billion on R&D.

“We’re challenged,” Watters admitted. “But we should look at it as an opportunity. What can we do better? How can we improve?”

In additional charts outlining research leadership in key technological sectors, Canada is not even listed. In that light the real goal is gaining some access to the progress being made elsewhere so it can be put to good economic use here in Canada, an objective that calls for a carefully orchestrated trade agenda.

Watters offered a list of ongoing activities from the 2017 budget, such as the consolidation of business innovation programs, creation of innovation “superclusters”, development of an intellectual property strategy, and a review of tax policy. He cited two areas where no action has been taken: a review of Scientific Research and Experimental Development (SRED) tax incentives and the implementation of a new trade and investment strategy.

In geographic terms, the emergence of superclusters has been targeted in areas across the country. “These really are experiments,” he observed, and while the outcome may not be known, they must all be maintained long enough to learn what kind of economic results they can generate. More significantly, these activities are based on the principal of ongoing collaboration, as opposed to the one-off interactions found in programs such

as the National Research Council's Industrial Research Assistance Program (IRAP). As promising as collaboration may be, it comes with challenges such as information sharing, measuring progress, or agreeing on the allocation of contributions. This makes for profound complexity as to how the results of this interaction will be traded and who is ultimately in charge of directing them.

By way of putting this complexity into perspective, Watters pointed out that the Toronto Regional Cluster, dedicated to Advanced Manufacturing, would qualify this region as the 41st largest economy in the world. At that scale the region's goals must be envisioned differently. "What is its education skills training policy? Who is the minister of trade and direct foreign investment? What about its immigration policy? These clusters really need to think big about how they will develop in the future." He added that they will ultimately have an impact on the country as a whole, bringing specific capability in areas such as manufacturing to specific regions.

Watters and Jarvis then reviewed a centrepiece of the presentation, the intricate map of Canada's R&D and innovation ecosystem. Its colour coding covers seven distinct groups of organizations that engage in various interactions with one another: the federal government, provincial governments, granting councils and government-funded non-profit agencies, post-secondary education institutions, "linking organizations" like the Networks of Centres of Excellence, private sector firms, and global markets.

"Among those distinct organizations you've got a series of flows," Jarvis explained. "And there really are only four things that can flow between any two organizations: people, money, information, and stuff." These items were therefore further distinguished on the map, with the resulting picture pointing to whether the activity was achieving the results that were desired by the budget outlays. Further to the point Watters made at the beginning about diversity and inclusion being a major part of these budget goals, the map for the first time includes this aspect.

Jarvis extracted some components of the map to illustrate the kind of updates it included for 2018, such as money for the granting councils as well as particular provinces and particular institutions, such as the NRC, federal labs, and the Council of Canadian Academies. Watters insisted all of these figures should be far higher, since many of them pale in comparison to what the Toronto Blue Jays pay their players. "The amount of money that we're paying is something that we need to reflect on in terms of the benefits we get from the public sectors investments," he argued.

Watters also considered the issue of government investments in business-funded research, which are not made directly but do occur indirectly through agencies such as IRAP and some college-based R&D programs. Of the 239,000 Canadians who work in some aspect of R&D, 62% are in the private sector, while 30% are in post-secondary institutions and 8% in government.

In looking at the budget's investments in innovation, he cautioned against confusing such funding with the broader support for economic development, through regional

agencies such as FedNor, which focuses on growing businesses in Northern Ontario. Watters also pointed to the accomplishment of the government's horizontal review, which consolidated the number of federal programs supporting business and reduced them from 92 to 35. This process also worked with Innovation, Science and Economic Development Canada to create a number of open data sets that should prove to be useful for many entrepreneurs and their enterprises. Some 24 Centres of Excellence for Commercialization and Research and Business-Led Networks of Centres of Excellence are also moving from administration under NSERC to ISED's Innovative Solutions Canada program. The government continues to support 43 Networks of Centres of Excellence, of which 26 are in the health and life sciences sector while just one deals with manufacturing, which led Watters to refer to the possibility that this mix of themes needed to be better balanced to reflect the country's economic aspirations.

The budget has also set some ambitious aims for economic, social, environmental, and equity/diversity, which raises the question of what kinds of results will actually be achieved. As an example Watters pointed to a recent report by Julie Gelfand, the federal Commissioner of the Environment and Sustainable Development, who argued that despite lofty targets for the reduction of greenhouse gas emissions, very little progress has been made. In fact, Watters listed no fewer than six federal innovation strategies that have been put forward since 2002, which raises the question of what kinds of consultation and collaboration must still be conducted.

The 2018 budget introduced a new, competitive approach to determining who to allocate federal funding to third-party research organizations, such as CANARIE, MITACS, and Genome Canada. "I hope these organizations don't compete with each other," he said. "That would be rather unfortunate in terms of the competitive process." Instead, he would like to see them cooperate within what he called a federal community of practice, linked around common metrics for research, knowledge transfer, and innovation.

In that same vein, the budget identified four flagship programs — IRAP, the Strategic Innovation Fund, the Canadian Trade Commissioner Service, and Regional Development Agencies — that have the ability to help enterprises move from start-up phase to technology development, market entry, and ultimately market expansion. More specifically, he sees great promise in a stronger partnership between IRAP and the country's Trade Commissioners Service. "I think they pretty well bridge the full gamut," he said. "You need to have the technology knowledge that the IRAP ITAs provide and you need the trade commissioners in terms of the outstanding market knowledge in hooking these up together."

Watters pointed out that the budget contains some clearly stated innovation targets for 2025, by which time the government would like to grow the country goods and services exports by 30% and double the number of high-growth companies.

“We have specific innovation targets, such as creating more high-growth firms,” he said. “In the context of global population, however, we are significantly outnumbered, which means we must work hard to stand out.

With regard to the implications of the budget for the business community, Watters indicated that the private sector would have to spend an addition $5 billion to make up for the $10 billion gap between Canada’s GERD and the OECD average. Since innovative enterprises only spend about 3.5% of their revenues on R&D, Canadian firms would therefore have to increase their annual export sales by $143 billion in order to make up this $5 billion shortfall. Currently Canadian exports total $618 billion, so this would represent a 23% jump.

In a global context, Canada has only 0.5% of the world’s population, an unalterable fact with respect to innovation strategy. “We’ve got to be smarter, we’ve got to work harder, we’ve got to form partnerships and collaborations where we are going to be competitive, recognizing the small nature of our population but the terrific asset base that we have,” said Watters.

Some 78% of our exports still go to US, with the next largest trading block being China, at just 5%. The two largest components of this trade are automobiles and crude petroleum, which account for about a quarter of the total. This relatively large proportion poses a challenge in terms of preparing for a post-carbon economy. There are also gaps in terms of where in the world we are trading, with almost nothing in China and only preliminary negotiations taking place with the two most populous countries, China and India.

Watters concluded with a chart showing how dramatically the proportion of the US working population engaged in agriculture had shrunk since the 1850s, especially during the second half of the 20$^{th}$ century. Given that demonstrated possibility of such major transformations, we must prepare for the prospects that will accompany what is being called the fourth industrial revolution, which includes the advent of artificial intelligence, the Internet of Things, robotics, 5G wireless transmission capabilities, regenerative medicine, synthetic biology, quantum computing, and the demands of cybersecurity. “A lot of the research in these areas is now coming to fruition in terms of new technologies,” he said. “The question is: are we ready to deal with the implications of that?”

That question returned him to his initial assertion of “mind the gap”, which starts with an acknowledgement that there is a gap confronting us. “We’ve got to accept where we are and then we can look at the solution,” he said.

Ron Freedman noted that while a huge portion of the Canadian economy now consists of services, Watters’ presentation did not mention this but focused instead on the smaller output of manufactured goods. Watters acknowledged that this distinction needs to be addressed, adding that it is difficult to measure the value of exports in the service sector. “On the issue of financial services, engineering and architectural services,

educational services — these are things that Canada is really terrific at," he said. "And we really don't have strategies for those."

Doug Ruth made a distinction between R&D money dedicated to engineering and the specific need to support engineering design. "NSERC is putting $140 million into the technology side and this year they'll put $2.4 million into engineering design training," he said. Watters acknowledged this very issue and indicated that his firm is working with Irene Sterian, Director of Technology and Innovation at the Toronto-based engineering firm Celestica. She is also the President and CEO of the ReMAP, a national business network focused on advanced manufacturing. "She is focused on looking at the manufacturing plant of the future," he said, noting that in the coming era of "smart" products, the capacity of a plant will be adapted to suit the technology that is being produced.

Crelinsten concluded with an ancient Indian story about how archery was taught to young warriors aiming their bow at a bird. When each was ready to shoot the master asked the warrior what he saw, telling them to stop because they were not focused on the target. Only the warrior who tells the master that all he can see is the eye of the bird was allowed to shoot. "You have to know what your goal is," said Crelinsten. "That's what David was talking about. Always keep the goal in mind."

**Parallel sessions | SESSION A | This Just In: Collaboration is Key**

10:45AM-12:15PM
MODERATOR: MARC LEPAGE, President and CEO, Genome Canada
HELLE BANK JORGENSEN, President, Global Compact Network Canada
ALAIN DUDOIT, Ambassador of Canada (ret.); Interim Senior Vice-President Partnerships, Scale.AI
JAYSON MYERS, CEO, Next Generation Manufacturing Canada
JOY ROMERO, Chair, Clean Resource Innovation Network; VP Technology & Innovation, Canadian Natural Resources Limited
IAIN STEWART, President, National Research Council (NRC)

**Superclusters: Canada's Grand Experiment in Scaling Innovation in Key Sectors**

*Over the years, Canada has invested billions in strategies designed to scale innovation and commercialization in targeted sectors. Before Superclusters, there was the NCE program, then CECRs, followed by BL-NCEs – a gradual progression toward closer engagement with the private sector. The Treasury Board Secretariat's recent review of federal government business innovation support documents over 90 existing program streams delivered by 20 federal departments and agencies, and 28 new initiatives introduced in the 2016 and 2017 federal budgets, including the $950M Innovation Superclusters Initiative (ISI). How did ISI get started and what does it offer that is new? How will we know when and if the ISI has succeeded?*

Dudoit introduced himself as one of the founders of QG100, a privately funded network of CEOs of Quebec-based companies with global capacities, focused on developing knowledge and international business growth. When the supercluster initiative was first being discussed, he was approached by several members asking if QG100 could become part of this initiative, to which he replied that this was a logical step. More significantly, though, he was approached to become part of the initiative, and so he has become part of the executive of Scale.AI, the industry-led supercluster on supply chains and artificial intelligence. At this stage he has three priorities: completing the cooperation agreement with Industry, Science, and Economic Development (ISED) Canada; building the supercluster management team; outlining the supercluster's governance structure.

Jorgensen explained that she joined the board of the Smart Agri-Food Supercluster because she had involved the United Nations Global Compact, a network of responsible businesses. Because of her previous work on Sustainable Development Goals, she found herself drawn into the need for agriculture as a fundamental human need.

Myers described Next Generation Manufacturing Canada as an effort to apply technology to manufacturing in Canada as well as scaling up manufacturing. This work encourages firms to invest more in technology to improve their productivity, which has become a critical strategical element in many industries.

Romero acknowledged that many aspects of clean technology were new to her when she became part of the Clean Resource Innovation Network (CRIN), but she had been a member of the Science and Technology Innovation Council of Canada, so she understood the need for innovation in this area. But she identified networking as an even greater need, since this aspect of the sector was not well developed. "What we saw as an industry — and this is very much industry-led — is that the opportunity was for us to step in and create the industry pull," she said. "Nothing is different if nothing is commercialized. Our goal is that Canada is the global leader in hydrocarbon reduction, and that we are both carbon emission competitive and cost competitive." She indicated that all the people serving as executives for these superclusters were demonstrating the outstanding dedication that is required to bring these ambitious undertakings to fruition.

Stewart recalled his own introduction to the concept of clusters in 1999, when a group of Liberal MPs came up with a plan to enhance innovation in Atlantic Canada, using NRC to create regional clusters for that purpose. When the superclusters concept was being discussed, he presented the NRC as a logical partner in this activity because of its mandate as a national, publicly funded research resource. "To the extent that the superclusters have been interested in us, we have been trying to support them in their success," he said, noting that the NRC was involved in the development of 17 of the 50 proposed superclusters.

Lepage then asked the panelists to describe in more detail what kind of work their respective enterprises would be conducting.

Dudoit pointed out that about $1 billion had now been invested in Scale.AI, which was drawing funding from private and public sources through more than 120 partners. As for what the supercluster will be doing, he explained that while its overarching theme is artificial intelligence, it will focus specifically on applying this technology to the challenges of supply chain management, especially applied to the needs of enterprises in the Windsor to Quebec City corridor. “If you look at the population density, the GDP density, and the trade density of that ecosystem — which we want to build, by the way — it’s in excess of 60 per cent of all of these indicators for Canada,” he said. “The supply chain is also the backbone of the Canadian economy, generating about $1 trillion worth of revenue.” There will be a further focus on three major vertical sectors: retail sales, manufacturing and industry, and the health care system. Two other areas of interest will be transportation and logistics, as well as the AI sector itself. Finally, the supercluster has created a technology roadmap, which coordinates the data that has already been collected and applies this to decision-making on particular projects. “That mapping is already available and actionable,” he said, adding that a revised version of the map was being used to identify projects with the greatest impact on the regional economic system.

Jorgensen said her supercluster was focused on the equivalent of stranded assets, namely the stranded innovations that have not scaled up to commercial levels. This applies to work taking place in small and medium-size enterprises across the country, as well as unlikely places like farms where innovative activities are being employed. “It’s not so much focused on ‘here’s a project’ but rather on bringing all of this together, building a system that makes all of this innovation scalable,” she said.

Myers indicated that there were about 140 investing partners in Next Generation Manufacturing Canada, which has two major priorities: building a national network in this area and creating demand. A broad spectrum of manufacturing interests is represented in this network, from food and wood to automobile parts, aerospace, and steel. “In terms of technology, AI is important but so too are 3D printing, robotics, automation, and Internet of Things data analysis,” he said, referring to a great many assets in the public and private sector that will be brought to the fore by this network. Some private partners, such as Xerox, host their own technology demonstration centres and invite other firms to take part in order to scale up. Myers also made the point that this supercluster is intended to help companies overcome the absence of activities that would help them build up their customer bases, given that only a tiny fraction of Canadian firms do any benchmarking and only a minority of firms working on new technology are able to meet their business objectives. More specifically, there will be three types of projects supported through this supercluster: technology development, technology adoption, and technology diffusion.

Romero referred to the oil and gas industry as a key sector that is preparing for the spread of clean technology and devoting significant R&D resources to that goal. Between 1999 and 2012, for instance, while federal support for R&D was stagnating in real terms, within the oil and gas industry it rose by about 1,400%. “In 2016, of the $2 billion that was invested in clean tech, $1.45 billion of that came from the fossil fuel

industry," she said. "This is a huge amount of money that we want to be sure is driving value and driving results," she said. "What we're focused on in CRIN is six technical theme areas and we're trying to get clear challenge statements that are coming from these areas." She added that the ultimate aim was building up the entire innovation system. "In Canada it's fine to talk about Silicon Valley, because the density is there," she explained, noting that talent and institutions are spread much more thinly in Canada. "You have to have a way to connect geographically dispersed groups. We are focusing on that."

Stewart outlined how the NRC was establishing a program to help each of the superclusters meet their research needs by making available whatever talent and facilities could be of assistance. As these large groups continue to organize themselves and identify what their needs may be, NRC has already identified $32 million of activities in its own annual operating expenditures that might be relevant to the superclusters. The considerable network built through IRAP, which includes some 16,000 Canadian companies, can likely be applied to providing solutions to work within the superclusters. Finally, with 22 laboratories across the country, NRC has been considering ways of bringing their capabilities to the superclusters. "For each supercluster, we're trying to offer value inside that they can tailor to their specific needs," he said.

Lepage then asked the panel to consider what comes after the current supercluster push, given that this round is unlikely to transform the economy in the five years that have been set aside for this initiative. In addition, he asked about the role of disruptive technologies, which do not necessarily emerge from established industries but instead from small start-ups, which suggests that "industry-led" networks may have to integrate these smaller players over the longer term. Finally, he sought a definition of what success would look like for these superclusters, especially in light of pre-existing economic strengths found in particular parts of the country, such as the oil and gas industry in Calgary or the automotive sector in southern Ontario.

Romero responded that success would come from operationalizing the plans for a given supercluster. "Success for us is that in 10 years you don't need us because we've actually created the marketplace," she concluded. "We are very careful in our choice of platforms that they don't require a huge amount of administration on our part. We are creating the means for people to connect in a much more purposeful way." The next step, in other words, must take the work of the superclusters outside the sphere of their participants, so that the larger economic base begins to change.

Jorgensen argued that the impact of particular industries and even countries was not necessarily determined by their scale, as evidenced by the outsized global impact of her native Denmark, but rather by the quality of activity that is being undertaken. In this light she anticipates a natural progression that should emerge from the most successful of the superclusters, which is to say not another round of supercluster activity but simply a well-established network of people across the country working with one another.

Dudoit referred to the $10 billion gap mentioned in David Watters' presentation — the amount necessary to compensate for the gap between Canada's spending on R&D and the OECD average spending on R&D. According to ISED, the superclusters initiative assembled no less than $17 billion worth of investment interest and commitment in R&D. The five superclusters that are proceeding will assemble some $5 billion worth of R&D, but that does not negate the availability of the rest of this $17 billion total, which could be incorporated into a second round of superclusters. And beyond the mere fact of rounding up investment, Dudoit is inspired by the prospect of profound culture change in Canada when it comes to R&D. "Government and the private sector are trying to do things differently," he said. "One of the measures of success will be how much we have changed in becoming more effective at collaboration — collaboration with results." He identified two other factors, accessibility and speed, as being essential to this culture change, which in turn will be essential to the long-term survival of enterprises based on technology.

Myers agreed with Dudoit that the most outstanding feature of this process so far was the remarkable amount of investor interest that has been demonstrated in these R&D activities, which emerge not just from participating firms but also from consortia and other parties representing organizations far beyond the core of the supercluster mandate. "What is key for all of these superclusters is the leadership they provide," said Myers. "Just the ability to identify what the requirements are, talk about skills development. What better way to do that than to talk about these projects? Clearly this isn't going to be done in five years, but we have to look at how to sustain the program on an ongoing basis."

Stewart also made the point that superclusters alone would not necessarily alter the foundation of Canada's R&D framework, but it has already done something far more profound. "It's creating a thing that's missing in the Canadian ecosystem at large scale," he said, referring to the deeper layers of interconnection within the innovation networks found in other countries. "I don't believe the supercluster model is going to be effective at generating disruptive technologies. But in the main what it will do is provide market opportunities for disruptors to connect with the larger companies and bring their products and ideas into our existing clusters." He cited this as the real mark of success: sustained dialogue between innovators within the economy, which ultimately will help determine whether Canada is a good place to do R&D at all.

**Parallel sessions | SESSION B | A Focus on Agility and Growth**

10:45AM-12:15PM
**Demand for Innovative Talent: Employer Perspective**

MODERATOR: NOBINA ROBINSON, CEO, Polytechnics Canada
CARL BYERS, Chief Strategy Officer, Contextere
LAUREN KELLY, Manager, Skills Development, First Nations Technology Council
STEVE NONIS, Principal, Turner Fleischer Architects Inc.

HEATHER SMART, Applied Research Professional, Technology Access Centre for Aerospace & Manufacturing

*Entrepreneurs and business leaders pinpoint talent as one of the key ingredients for success. The federal government's Innovation and Skills Plan attempts to address the talent issue with initiatives that include supporting K-12 students (youth, girls) with coding skills, investing in the Global Talent strategy to attract entrepreneurs and tech talent to Canada, and investing in experiential learning opportunities for postsecondary students through programs like Mitacs or SWILP (Student Work Integrated Learning Program). But industry's talent needs are much broader and deeper. How are Canadian firms working with educational institutions and other innovation intermediaries to prepare the talent we need to scale Canada's innovation game?*

Robinson began by noting that this session was competing with another discussion dealing with the very high-profile introduction of superclusters. "But if you think about talent, who's going to make the superclusters work?" she asked. "It's going to be the talent, and the ingenuity and the creativity of all those who perform R&D in Canada. So let's put a focus on the people needs for innovation."

She cautioned against thinking that the talent associated with scientific input alone will be enough to drive innovation; instead, a different kind of talent will be essential to helping enterprises grow. While the former may take years to develop, Robinson suggested that this other kind of talent is in immediate demand, and she wondered if federal programs are helping to nurture it. "It's very important, as we keep talking about an ecosystem and words like 'diversity', to talk about the diversity of talent needs," she argued. Such diversity includes the talent produced through technical training to provide the people who will work with scientists and firms to bring products to market. However, the panel was not intended to celebrate the supply of such individuals who are being graduated from various programs, but rather to consider the demand for them within the country.

Kelly introduced herself and the issue as it applies to her organization's work on training indigenous people for technical careers. The challenge, as she framed it, is to cultivate skills that are relevant but also advanced enough to be of interest to employers. "We're trying to figure out how to align with academia and industry to bring more meaningful training," she said.

Smart indicated that she has recently begun working in a college setting after many years in the aerospace industry, a transition that she described as giving her a view of these distinctly different worlds and how they perceive the kind of talent required for the immediate needs of business as well as the long term needs of innovation.

Nonis described the significant expansion of the architectural firm where he has worked, a change that he credits to how the business perceives itself. "A lot of the growth is tied to having the mindset of being a growth-based firm: leveraging technology, leveraging the opportunities out there that technology brings, to help prepare better deliverables,"

he said. These efforts have also included a great deal of outreach to educational institutions that provide the talent to drive such growth. He regarded this as both a way of ensuring that what the students are learning is relevant to the firm and showcasing to the students how what they are learning can be put into practice.

Byers outlined his firm's work as that of helping to build companies by facilitating their search for employees who will contribute to that process, as well as helping those prospective employees join a network where they can identify the best opportunities for taking advantage of their skills and experience. He expanded on this description with more detail about how enterprises could bootstrap their growth, rather than seeking third-party funding, an approach that works closely with polytechnical institutes. By way of example he pointed to projects his company conducted with Algonquin College in Ottawa and the Southern Alberta Institute of Technology in Calgary, which were funded through NSERC's ENGAGE program, which has a minimal cost outlay on the part of participating private sector partners. In this way students at the two colleges helped a company develop a prototype product in about three months, a goal that the company had originally estimated would take upward of a year.

Following up on that description, Robinson asked Nonis where his firm turns to obtain the type of talent it needs to keep growing. He observed that because the construction industry was moving ahead rapidly with the adoption of new technologies, agile individuals are needed to respond to this changing work environment. "We really put a lot of emphasis, whether you're a co-op student or a partner, everyone in the team has an opportunity to share their ideas, question a process, because that's the only way we're going to get better," he said. And although the company has certain ways of approaching its business, it has had to keep changing its practices to meet the demands of the marketplace. In such a setting, finding time to do research has been difficult and yet the need is paramount. "This is where we started leveraging some of the research grants with universities and colleges and bringing students in," he recalls. More specifically, they are now on their third federal grant through the Building Information Modelling (BIM) program in collaboration with George Brown College, which allows them to bring in students for up to 18 weeks in order to pursue specific research projects. Depending on the nature of the work and the performance of these students, some of them are hired afterward. "They've actually provided solutions that we've integrated into our database," he noted.

Smart offered another account of a collaboration between a successful firm and a college. In this case the company was StandardAero, which had a strictly defined culture that had enabled it to remain as an independent aircraft engine maintenance, repair, and overhaul business in an extremely competitive environment. In 2009 the company identified opportunities in new types of welding systems for repair purposes, a move that would be expensive but advantageous. By partnering with Red River College to obtain federal and provincial support, they established the Centre for Aerospace Technology and Training (CATT) building on the campus to house new types of welding technology. "The college is able to bring in students and show them examples of this advanced welding technology in a production-ready environment," she said. "Red River

College is now producing not just a journeyman welder who can operate regular tig [tungsten inert gas welding, an industry standard], but they've seen where the future of technology is in welding."

For Kelly, who is approaching such challenges from the perspective of an organization that is providing students to industry, such examples make her all the more eager to establish an ongoing dialogue with business partners. "There can be a lot of knowledge-sharing about how the talent that we're bringing to companies may be different from what's already in those companies and then hearing back what skills and competencies we need to be building into our programs, both on the human side and the technical side."

Robinson then asked Byers how he was able to find out about the opportunities to find new talent through programs such as ENGAGE. "It's our job to find these things, it's not somebody else's job to tell us about them," he said. Nevertheless, he acknowledged the value of consulting the applied research offices found on post-secondary campuses, which have been able to direct them to different kinds of opportunities for support and collaboration. These offices are also able to help them work within the timelines of their business, as opposed to waiting for six months or more simply to find out if a funding decision has been made. None of this is easy, Byers concluded, but it is part of his job and although some government assistance might facilitate it, he assumes full responsibility for making any particular project work.

Nonis, for his part, said his firm does no public sector work and was not seeking any kind of relationship with government agencies. However, through BIM the company president was connected with George Brown, which initiated the subsequent collaboration. When Robinson asked whether federal funding was essential to the process, Nonis said he would probably seek out these students just the same, assuming he knew how to find them. The bottom line with any kind of R&D, he argued, is simply getting a better product to present to clients and the construction industry has lagged in this respect. "We're really trying to push the value of the BIM process," he said.

Smart indicated that innovation talent is where you find it, not necessarily tied to one particular type of educational background but rather something specific to an individual's personality. By way of example she pointed to an individual she had worked with who began as a journeyman welder but has demonstrated an appetite for finding better ways to do everything, advising those with far more credentials on the role of new materials or repair methods. "What companies need to be able to get better at is identifying those individuals," she said. "If you're looking to innovate, you need to find the innovators in situ at your company and give them opportunities to show you the way." Smart now works in the CATT at Red River College, where she oversees projects with other companies that seek out access to this facility, often dramatically accelerating the technical capabilities and market prospects of small enterprises.

12:15 - 13:15
**Lunch and Special Presentation**
MODERATOR: ERIC MESLIN, President and CEO, Council of Canadian Academies (CCA)
MAX BLOUW, Former President and Vice-Chancellor, Wilfrid Laurier University

*Competing in a Global Innovation Economy: The Current State of R&D in Canada is the fourth report from the Council of Canadian Academies (CCA) in a series documenting Canada's S&T and R&D strengths and weaknesses. It assesses the latest evidence on Canada's R&D and innovation performance, combining up-to-date data with expert insights and analyses, and benchmarking against the performance of other countries.*

*The report is free for download at www.scienceadvice.ca*

Meslin noted that the Council of Canadian Academies has regularly examined the topic of Canada's ability to employ technology to create a better economy and society, a goal that from the early 20th century to today has always seemed to be out of reach. The current report, "Competing in a Global Innovation Economy: The Current State of R&D in Canada", represents yet another attempt to address this question. "It's the latest installment providing data on Canada's track record in fundamental research, applied research, and experimental development, industrial R&D, and the relationship of these research efforts to wealth creation and prosperity through innovation," he said. "We actually tried to combine two very large topics into one assessment. We looked at the literature, we looked at the stats, we carried out bibliometric and technometric assessments and we surveyed leaders around the world using a methodology very similar to prior work." All of this was done by an expert panel led by Blouw over the course of a year.

Blouw began by conveying his thanks to these members, some of whom were in the room for this talk. He then stated the comparatively simple set of conclusions that their efforts had reached. "We're doing well in terms of educational attainment. We perform research at a very highly competitive level, considerably beyond what our population would predict. We're an innovative nation — we create many new products, processes, and services. We're good at it. But our investment in research and development has declined and has been doing so for some time. And we're not very good at capitalizing on our strengths to create prosperity."

The panel's work, he noted, was a concerted attempt to understand these apparent contradictions. He illustrated the positive points with graphs showing that Canada has the highest level of educational attainment in the OECD, as well as survey results indicating that a majority of researchers regard the country's research infrastructure as among the best in the world. Meanwhile, as Canada's R&D intensity had declined over the last 15 years to well below the OECD average, the number of people working in industrial R&D dropped by about 20% between 2008 and 2013. "In other words, we have very highly educated people but they are decreasingly employed in the industrial sector," he observed. "The panel felt there was very little question that a significant

erosion of Canada's international competitiveness and capacity to participate in R&D and innovation is likely to occur if this trend continues over time."

In terms of published research, Canada was in the sixth-place position for impact of published research, but Italy and India have recently surpassed the country. Nor is this trend over, he added, as other rapidly developing countries are also starting to increase their published research output. Perhaps more significantly, Canada does not rank highly in most enabling and strategic technologies, such as artificial intelligence and regenerative medicine, where the country has previously been well placed. Those areas of where Canada's publication research strength has persisted include clinical medicine, public health and health services, psychology and cognitive sciences, philosophy, theology, and visual and performing arts.

Further to his earlier observation about industrial R&D, Blouw noted that Canada now ranks 33rd out of 40 countries in terms of growth, intensity, and magnitude of this work, and Canada is one of the few developed countries experiencing negative employment growth in this sector. "This spending and employment decrease reflects Canada's longstanding industrial structure and shifting patterns of economic activity," he said. In contrast to other G7 countries, too, much of this industrial R&D work is taking place in sectors that are not research-intensive, such as resource industries as opposed to high tech. In addition, more than half of this spending occurs in the service sector, as opposed to manufacturing and more of it is taking place in larger firms, although small and medium-size enterprises still account for more R&D than in the US. Similarly, the amount of foreign-controlled R&D is increasing.

Intellectual property represents another area that is declining, as Canada has become a net exporter of patents, and the outflow is increasing. This is a major shift, since as recently as 2003 some 96% of patents invented in Canada were also owned here, yet by 2014 this figure was 74%. All this being said, the four areas of industrial R&D strength are scientific research and development services, computer systems design, communications and equipment manufacturing, and aerospace products and parts. While this activity is distributed across the country, it tends to be located in clusters around major cities.

"Canada is a very highly innovative nation," he concluded. "We're creating a lot of new and exciting products, processes, and services. We have abundant research talent. We have low barriers to business creation. Canada has established itself as a very favourable environment for technology start-ups, however, successful Canadian tech start-ups often struggle to grow to scale, resulting in a loss of economic benefit to the country. Many entrepreneurs sell their firms to foreign buyers rather than scaling them up." Canada's relatively small market could be part of the problem, he noted, along with the complexity of research tax credits for these smaller enterprises and a potential shortage of managerial skill.

By way of summary, Blouw described Canada as still being a leading global contributor to research in a wide range of fields and home to world-leading talent and infrastructure,

yet the country's international standing in this regard may be compromised by the sustained decline in R&D investment, especially in industry. As start-ups struggle to grow and IP is exported, potential economic benefits are being lost. Above all, the trajectory of Canadian R&D capacity is the opposite of what is found in many competing nations; as the country's research momentum and reputation diminish, so too will the attraction of talent and money. "The panel views the situation in Canada as requiring concerted attention," he said. "We're prospering through legacy investment; we can't do that for very much longer."

Ron Freedman pointed out that an earlier review indicated that if Ontario and Quebec were considered alone, their R&D intensity was at or above the OECD average. He also noted that discussion of patent outflow should be balanced by a consideration of the income influx that derives from these exports. And he was critical of the use of a linear model of innovation that sees a straight line from research push to commercialization, as opposed to examining market pull that motivates a research input.

Blouw agreed with these observations, although he did defend ongoing spending on R&D, which has been demonstrated as being vital to the prosperity of nations. Freedman responded that the inverse could just as well be true, that it is those who are better at commerce that can afford to do more research.

Blouw also argued that the terms of reference for this report limited their perspective to the specific trends that were being discussed, nor were they asked to come up with solutions to the problems that have been revealed.

John Solininka, President of Accelerant Health Innovations, recalled that during his years of investing in no fewer than 40 R&D companies, not one of these ventures was aimed at Canada. He blamed this on Canada's preference for doing its own research rather than directing investment through procurement in order to provide a market pull for home-grown Canadian technologies. "One of the reason R&D works in the countries that you're mentioning is that they have great home markets," he said. "Home markets don't matter for big companies; home markets matter a ton for tiny companies."

Another commentator suggested that the measure for R&D investment was tied too closely to participation in the Scientific Research and Experimental Development (SRED) tax incentive program, which many companies shun because of the extensive paperwork that accompanies what might be modest benefits. Blouw acknowledged the problem but suggested that it did not represent a major distortion of how the country's R&D intensity is measured. In addition, the panel's deliberation took into account changes in SRED over the years and the key role of this program in defining research measures.

Louise Earl, a section chief at Statistics Canada, described in detail how SRED was used to characterize R&D intensity from 1997 to 2013. By way of compensating for its limitations as a measure, StatsCan also sampled companies that do not report R&D information to the federal government for tax purposes. She classified R&D as a "rare"

activity that was hard to identify statistically and could therefore be missed, however, she said the methodology for doing so was as clear as practically possible and listed in its entirety on the StatsCan Web site.

Blouw reiterated just how difficult this data could be to collect and analyse. “The panel repeatedly, consistently, ran into challenges with the completeness of data, the representativeness of data, the interpretability of data,” he said. “Data issues are profound when trying to measure some of these very complex human behaviours at the intersection of the business world and the R&D world.”

**Parallel Sessions | SESSION A | This Just In: Collaboration is Key**

13:15 - 14:00
**Working Together: Navigating Academic Culture to Enhance Public-Private Collaboration**
MODERATOR: GAIL BOWKETT, Director of Policy, Mitacs
SUSAN BLUM, Associate Vice-President of Applied Research and Innovation, Saskatchewan Polytechnic
MICHAEL QUINN, Associate Vice President - Research, Scholarship and Community Engagement, Mount Royal University
VALERIE WALKER, Vice President, Talent and Skills, Business Council of Canada

*With university faculty merit and promotion firmly tied to publications in peer-reviewed journals, academics that work with industry and help students pursue entrepreneurial ventures are at a disadvantage. How do professors who engage with industry and entrepreneurs navigate this culture and how can policies enhance university-industry interaction to help grow and scale successful Canadian firms with global customers?*

The discussion began with an overview of both the challenges and opportunities to be found in building bridges between the public and private sector in academic institutions. Quinn made the point that the rigid structures of academic culture make it difficult for administrators to reward innovative efforts that do not fit the conventions of publication and promotion. Even more fundamentally, he explained, faculty members tend to think of their work on the basis of semester-length time cycles, which does not always match up with the time frames of prospective partners, even in terms of scheduling meetings around an individual’s teaching schedule. “The systems just don’t quite mesh,” he said. “It’s not that there’s no interest from both parties to work together. But there’s real logistic barriers in just trying to make it happen and get credit from a faculty member standpoint for all the time and effort it takes to build up those relationships.” For her part, Walker suggested that one of her organization’s mandates was helping members of the business community appreciate the problems facing prospective academic partners and reduce the barriers that crop up.

Bowkett pointed to the fact that academic-industrial collaborations do happen, which raises the question of whether these interactions are changing academic culture in any way. Quinn pointed to the important role of students, who want to gain the kind of

experience that such collaborations provide. Mount Royal has established its own innovation “studio” as an office space where people on campus can get together with people from off campus. “It’s basically a big matchmaking session and we’re starting to see projects evolve out of that just because we’re creating a space to bring people together to break down some of those barriers.” Meanwhile the Business Council mounts its own round table discussions to facilitate these same kinds of interactions and streamline the extensive process that leads from an initial conversation to a formal legal relationship. Walker pointed to a guide produced by her organization that identifies the many steps in this evolution and how they might be streamlined. She recounted a recent trip to Switzerland, which is regarded as successfully promoting these kinds of partnerships, where universities tout three pillars of success for any academic institution: teaching, research, and service. She found the concept of service to be especially useful, as it could apply to projects that benefit teaching or research.

Quinn returned to the challenge of promotion and tenure assessment, which can take the form of elaborate formulas that rank faculty members in a numerical way. “That doesn’t work if you’re trying to do community partnerships or create innovative places where there’s an opportunity to fail,” he said, noting that they are trying to broaden these assessment mechanisms to enable faculty members to convey the sometimes elusive impact of such activities. “How do you measure the ‘so what’ questions,” he asked. “So you did a piece of research — what happened? Was a policy changed? Was a patent created?” By way of example, he pointed to a multinational initiative called Changemaker Campus, where universities work together to pin down these impacts in a meaningful way. Blum pointed to the role of Technology Access Centres, a national network that promotes the role of applied research at colleges to prospective partners in the public and private sectors.

Bowkett suggested that there appears to be a growing interaction between universities and colleges, a perspective that was echoed by Quinn. According to him, over the last decade these institutions have moved from seeing one another as competitors to becoming equal partners in regional research ecosystems. “Having more people around the table, reaching into different kinds of communities at different scales, is really a valuable asset, especially when there’s large-scale partnership funding opportunities out there and it makes sense to pull institutions together across the full spectrum,” he said. “I’m seeing a lot of positive change even in the last two or three years.” Blum made a similar observation, pointing to a growth in mutual interest. “Now we’re seeing many universities reaching out to us, not at the last minute to add our name to applications for funding, but actually in the initial conversations and development,” she said, adding that institutions have extended these efforts to offer cross-appointments to participating faculty members.

Walker agreed with these assessments, but noted that the academic world could still be confusing and counter-productive for many businesses. “Not every opportunity needs to be followed,” she said. “The challenge we’ve been working on is to get leaders to recognize when they should leave, and when they should partner.” This led into a discussion of the role that risk plays in the willingness to engage in these partnerships.

Quinn argued that the difficulties can often outweigh even the most attractive benefits. “It’s easier to take on something by yourself, with one institution to one project,” he said. “There needs to be some sort of external incentive to do more collaboration. There’s a real role here for the provinces and the federal government to incentivize some of this coming together, which is not likely to be generated from within.”

Bowkett concluded by asking how institutions deal with individuals who want to set up their own enterprises, and how this kind of internal collaboration might be established. Quinn pointed to Mount Royal Institute for Innovation and Entrepreneurship, where students can set up their own small and medium size enterprises. “It’s everything from bringing partners to campus for students to work with to a Dragon’s Den-like competition where students address challenges brought to us from the community or industry,” he said. “We also build direct work experience or internships into the degree program, which forces that connection with outside agencies.”

Walker regarded the development of student entrepreneurship as a major priority for post-secondary educators. “Whether the demand for start-ups or a maker space is coming from students or from the industry side, the institutions that respond to that demand, they will succeed,” she said, adding that institutions that cannot adapt to this demand will face a much harder path ahead.

14:00 - 14:45
**Research for Impact: How Focusing on Challenges Changes the Research Game**
MODERATOR: MARC FORTIN , Vice-President, Research Partnerships, NSERC
RODNEY GHALI, Assistant Secretary to the Cabinet (Impact and Innovation Unit), Privy Council Office
PARI JOHNSTON, VP Policy and Public Affairs, Universities Canada
KARLEE SILVER , VP Programs for Grand Challenges Canada

*Successful innovation stems from problems and needs – the proverbial “pain points” – that inspire new solutions. Policy makers, funders and researchers are increasingly recognizing the power of applying research efforts to specific challenges. With the rise of challenge-driven research, new collaborative models and funding mechanisms are emerging to encourage multi-disciplinary research focused on solving specific economic and social problems. This panel will explore some established and newer initiatives in this space and examine how we can scale these efforts.*

Fortin began by emphasizing the value of bringing together people with diverse perspectives on research to consider how they can work together to do more. He noted how important such collaboration could be when seeking the support of a government that wants to know the impact of research and the return on any investment in this work. “One way to generate this impact is by bringing different organizations together, focused on a problem or a challenge,” he said, asking the panel to comment on how to identify appropriate problems or challenges to pursue.

Silver recalled the various topics that established the Grand Challenges program and suggested that they were linked by the fact that in each case the research would break new ground. “You need have to have a greenfield space for challenges to be effective,” she argued. If a desired area is already saturated with many people and projects, it will be harder to obtain the resources and talent necessary to proceed. Her organization’s own experience called for a review of major challenges around the world, such as improving access to care for mental health. This means identifying individuals and institutions that can contribute to this work, as well as setting aside challenge-based funding streams to attract such participants. Johnston agreed, pointing to the latest budget’s emphasis on science-based activities. “There is research capacity across the country in areas where this government has some important public policy challenges,” she observed. “How do we knit together better the new capacity within our tri-councils, the new capacity at the National Research Council?”

A question from the audience raised the matter of increasing the interaction between colleges and universities. Johnston insisted that there is already a lot happening in this regard, citing bodies such as the Business/Higher Education Roundtable, which represents firms and educational bodies across the country. “It’s done some really important work to help catalyse that coalition of interested institution across the private sector, colleges, and universities,” she said. “It’s starting to develop programs and projects for those kinds of problems that matter to the business sector.” Government has driven this activity through initiatives such as the call for superclusters, where even unsuccessful applicants are continuing to collaborate, which she offered as evidence of how well these efforts build new partnerships.

Silver added that Grand Challenges Canada has assembled groups made up of diverse partnerships, which are made stronger by the fact that rather than merely assembling for the purpose of obtaining funds, they are united in a desire to address particular problems. With particular reference to educational partnerships, Johnston underscored the importance of students, whose interest and energy can animate these undertakings. “They’re often the glue to taking that knowledge to an institution or bringing a fresh perspective on the partnership,” she said.

Fortin asked about the role that granting councils play in these relationships. Ghali noted that these agencies are just one aspect of an intricate patchwork of organizations at all levels in the public and private sector that sustain the mandate of universities, and he stressed the importance of considering all of them. “We do think about the government as a big block and you forget about all these pieces,” he said. “So if we have these challenges, these complex public policy issues that we need to address, we can bring the best and the brightest to these challenges, irrespective of where they come from.” Fortin then suggested that clusters are simply a reflection of the way all these different bodies work together.

Another question from the audience returned to the mental health care initiative cited by Silver, asking her specifically about whether the ideas raised by this work have made a concrete difference. “Challenges are best placed where you’re actually living and so a

critical part is that you're actually measuring the impact," responded Silver. "We can say that it has saved more than 11,000 lives and improved more than 1.6 million lives to date. By 2030, when the Sustainable Development Goals are ending, we'll have saved a million lives and have improved about 20 million lives." She pointed to gains in the project's activities in Africa, where it has expanded beyond the role that was initially foreseen to become widely embraced by different communities, including private sector firms operating in the region. By way of example, she pointed to a medical device company in Zimbabwe that embraced this model for dealing with mental health and subsequently struck up a liaison with public health officials in New York City who want to apply it there.

Two final questions dealt with the problem of funding technology practice as opposed to curiosity-driven research and the separate issue of what sort of culture attitude toward research and economics is being passed along to students while they attend university. Johnston suggested that many institutions take seriously their role in enculturing students. "There's a lot of innovative, dynamic change going on at colleges and universities to respond to the needs of students," she insisted, citing the University of Calgary as an example, where the entire curriculum was being designed around an entrepreneurial approach. "Aside from learning outcomes that are related to entrepreneurship, institutions are setting targets to ensure that all their students have a work-integrated learning opportunity in the context of their studies." Ghali concluded by describing his own department's objective to be a "landing spot" for entrepreneurial efforts in post-secondary setting.

**Parallel sessions | SESSION B | A Focus on Agility and Growth**

13:15 - 14:45
**Squaring the Circle: Collaborations among Innovators and Regulators**
MODERATOR: CLAUDIA KRYWIAK, Vice President, Corporate Development, Planning and Strategic Initiatives, Ontario Centres of Excellence
PAUL ALLARD, Co-founder, President and CEO, Impak Finance Inc.
CHRYSTIA CHUDCZAK, Former Executive Director, ISED Innovation Lab
MOAD FAHMI, Director - Fintech and Innovation, Autorité des marchés financiers
TED GRAHAM, Head of Open Innovation, General Motors
ELLIOT SIEMIATYCKI, Special Advisor, Automotive Technology and Innovation, Ontario Investment Office, Ministry of Economic Development & Growth

*The Council for Economic Growth is calling for more flexibility and agility in Canada's regulatory system. Especially in sectors that are evolving rapidly – think financial services and autonomous vehicles for example – outdated regulations are hampering Canadian entrepreneurs in seizing new opportunities. What can we learn from those who are tackling these issues through creative collaborative solutions, such as sandboxes, and other outside-the-box thinking?*

Holding up a smart phone, Krywiak emphasized that in the course of just a decade, this seemingly simple technology has been responsible for disruptions in everything from

the way the taxi industry operates to the conduct of the last American federal election. More specifically, businesses have embraced this same technology in areas such as financial operations for everything from fraud detection to market predictions. The result has been the emergence of a gap between those who develop these technologies and regulators trying to ensure their socially responsible use.

Among the places where such efforts had been evolving was the Innovation Lab established by Innovation, Science and Economic Development (ISED) Canada, which Chudczak formerly directed. She described it as a place that attempted to bring principles of human-centric design into the world of digital technology, work that often led her to deal with regulators in various areas. “I look at innovation as problem solving, both problem solving in the public service for Canadians, with Canadians and Canadian businesses, and solving problems of society,” she said. “If you take that perspective of defining innovation in that way, for the lay person it becomes a lot clearer what the potential is moving forward.”

In a similar way, Siemiatycki described his role in the Ontario government with respect to forthcoming technological challenges such as the introduction of autonomous automobiles. “I’m encouraged by the direction of growth in this kind of technology space,” he observed. “But I do think we have a number of hurdles that we have to overcome and those are the types of conversations that we’re having internally.”

Fahmi represented a financial perspective on these issues from his post in the Quebec government. Similarly, Allard’s role at Impak Financial gives him an intimate overview of the impact that financial technologies are having on everyday life. “There are pressing issues today, such as the United Nations 17 Sustainable Development Goals, which are extraordinary areas of innovation and when you want to help society you want to work with regulators,” he said.

Graham recounted how he gained a direct appreciation of how technology is changing our lives by becoming an Uber X driver so that he could better understand the way people were perceiving this innovation. In this particular case he noted that the role of regulators is crucial, whether they choose to take a hands-off approach or become involved in administering this new mode of transportation.

As an example of how the divide between innovators and regulators can be managed, Fahmi described his department’s work with the “sandbox”, a dedicated portal where innovators can consult regulators. Such access answered the demand for guidance that many entrepreneurs seek from government, so that they can appreciate the rules that govern their business. While this process was clearly of some assistance to the firms, Fahmi suggested that these interactions also had a profound effect on how people in government think about innovation. Speaking as a representative of one of the financial technology firms that the sandbox had targeted, Allard recounted how well this common forum allowed them solve problems and meet the priorities of both regulation and business. “If you want to cheat and try to pay less tax or bring value only for yourself

then you want to avoid regulators," he said. "But if you want to bring something that is valuable for society, then you want to work with regulators who want to be innovative."

In a similar way, ISED's Innovation Lab was intended to create a setting where government departments could consider how best to set up services that would be used by all Canadians. Chudczak regarded this approach as unusual in the public sector, where solutions are generally imposed with little regard for end-user design principles, some of which were deceptively simple. She recounted how some of the most significant progress amounted to little more than a common agreement on terminology, but such steps ended up making significant contributions to the ultimate effectiveness of the end product. Even within the context of the culture that defines regulatory institutions — which is to say highly conservative and risk averse — the laboratory nevertheless opened up unprecedented possibilities for change.

With respect to the need for better collaboration between regulators and businesses with a stake in innovation, Graham argued that the financial crisis of 2008 was transformative for General Motors. From that point forward the company became more open to the prospects being offered by innovative partners, wherever they might be found. For these partners, many of which were ambitious but small start-up companies, GM was able to bring a much more authoritative determination of how to make their products acceptable to the demanding automotive marketplace. Siemiatycki outlined how that same marketplace is being viewed by the Ontario government, which among other innovative activities is the only jurisdiction in Canada that has regulations dealing with the testing of autonomous vehicles on the province's road system. He credits the Ministry of Transportation with anticipating the arrival of this technology well before its public profile had risen; a testing framework that has subsequently emerged from consultations with key industry players and university researchers, leading to the appearance of autonomous vehicles hitting the road sooner than anywhere else in the country but still observing the ministry's high safety standards. Nor is that ministry the only one closely watching the advent of this particular technology, which promises to spread regulatory ripples across everything from insurance to housing. For Siemiatycki, the global research potential of this field alone could ultimately be worth $50 billion, while the entire transportation market amounts to trillions. "You want to bring in some of those innovators early on," he said. "You don't want to get halfway down the path and realize that companies are way ahead of you or going in a different direction. Our job has been to bring in those stakeholders and enable us to have those strategic conversations. We want to be part of the game and we want to make sure that the economic benefits of developing and deploying this technology are realized in Ontario."

Chudczak endorsed the virtues of design thinking as a way of ensuring that such deliberations between regulators and innovators can have the most successful outcome. "When you do bring all those players together, you set aside your perspective, and you actually want to do what's right for Canada," she said. "Once you challenge a group like that, the results are incredible and you do become global leaders and true inventors."

Krywiak suggested that there may be virtue in governments not simply encouraging the development of innovative technologies, but themselves becoming early adopters of those technologies. Chudczak was able to address this question from her own experience in the Innovation Lab, which did just that through The Build in Canada Innovation Program, which places pre-commercial Canadian technologies in an approved pool where organizations like hers could use them. The specific product they chose was a visual collaboration tool called a SMART board, produced by Calgary-based Nureva, which was scaled to become available to markets around the world as well as becoming a core part of the lab's design practice.

Allard endorsed this approach, which he regarded as part of a regulator's role with respect to innovation and a way of overcoming "analysis paralysis", which often prevents governments from taking decisions. "Governments need to give a tone and position themselves, to help regulators take that lead positioning," he said, referring to an example from France, which took a lead in the adoption of block chain technology. "It's a public statement. Are they leaders today? No, but by positioning themselves, they give a signal to international companies that want to deploy there."

Fahmi compared this perspective to Graham's decision to drive an Uber in order to better understand this technology, which can provide information as well as sending a strong message to the public. "If the regulators are not using the technology that the public is using, we are eroding public confidence because the experience they have with the regulator is different from the experience they have elsewhere," he said. For just this reason, Fahmi explained, his department has begun using natural language processing and other machine learning technologies to demonstrate confidence in the AI systems that are making their way into the business and education sectors.

Krywiak suggested that another difficulty facing innovators is the need to harmonize regulations at a global level, something that can pose a challenge for companies as large as GM, which operating in a wide range of jurisdictions around the world. Graham described how complicated this could be, depending on where they might choose to test autonomous vehicles and how the regulations there are framed. In each case, he argued, it is necessary to have a full exchange of ideas about the goals of the testing and how it can be managed. Siemiatycki pointed to the advent of Uber, which caused problems by catching regulators in many different jurisdictions off guard, as an example of why it is important to stay on top of how innovative technologies are making their way into different parts of the world. In contrast, prior planning by the governments of Michigan and Ontario paved the way for an autonomous vehicle test that crossed their border, which he believes was the first such instance of international travel by this kind of car. At the same time he cautioned that this is still early days in testing and many regulatory regimes will have to be satisfied as the work proceeds, such as harmonizing Ontario's rules of the road with the federal government's rules regarding motor vehicle engineering.

A questioner from the audience asked about the seemingly subjective process of striking a balance between when an innovation would be deemed acceptable for market

and when a regulator would then approve it for widespread use. In the case of autonomous vehicles, for example, how many accidents can be tolerated and the technology still is approved? Siemiatycki indicated that evaluations are ongoing and any trends in the behaviour of these vehicles will be closely tracked, but in the end, it is hard to gauge where the balance will finally be struck. Graham noted that the bulk of the testing is in fact virtual in nature, along the lines of elaborate video gaming systems, which is an inherently safer and less expensive way of determining how well the technology is faring. Fahmi stated that a similar methodology is conducted with financial technology in the sandbox, where these powerful tools can be tested in a safe, secure way.

Another questioner raised the issue of handling the data arising from the testing and adoption of new technologies. Allard suggested that public awareness of how information about their behaviour is collected and used is far greater than it was even a few years ago. Graham added that it is essential to think more expansively about data collection, since software applications on a cell phone may be able to use location services to take stock of an individual's driving performance. From a regulatory perspective this may not impinge on GM directly, but it is another example of how regulation needs to be harmonized across all areas the technology can influence. Fahmi said that regulators have focused largely on the issue of cybersecurity — simply safeguarding data — but there is a growing interest in how data is used, which is a separate topic. "At the same time that there's pressure to increase user privacy, there's also a willingness to open it, for sometimes what is a very good reason," he said. "It means asking very tough questions about identity and data. It's something regulators need to collaborate on, because we're not going to solve this in the financial world or the telecom world or the automotive industry. It's more crucial than that; everything's data now."

Chudczak reminded the audience that the human interface remains the critical determinant of how regulation will operate, even though in the adoption of technologies in the automotive or financial world this aspect may not be as obvious. Siemiatycki agreed and predicted that such an interface will start to take shape in the way individuals think about data. For many companies whose ability to pay for and provide "free" services depends on how they use their customers' data, these developments could have significant consequences, as has already been demonstrated by the recent attention to Facebook and the impact of Europe's General Data Protection Regulation, which could have negative implications for innovation, at least in the short term. Krywiak suggested that these trends could be shaped by cultural norms, as in the case of China, which anticipates leading the way in the field of artificial intelligence because that country's population has very different expectations about the nature of privacy. In this way, she concluded, nations as well as innovators and regulators can be pitted against one another in competition.

In this light Chudczak cautioned that the lines of communication between innovators and regulators must remain open, otherwise Canada risks being left behind by others who will race to adopt technologies that we will ultimately also want. For Siemiatycki,

this also means setting goals and determining our expectations. “As we have these conversation and as we try to harmonize, our job is to set out a vision for what we want this technology to do for us,” he said. “Then it’s up to major stakeholders — small companies, big companies, universities, or others — to develop solutions that achieve that.”

Fahmi recounted how his own government’s efforts to monitor the growth of financial technology led his group to expand from 10 employees to its current level of about 70 people. While that growth reflected efforts conducted in the interests of the public, the real effect was an exciting and very positive shift in his organization’s own culture. “While building something for outside,” he said, “the biggest winner was on the inside.” In light of the critical assessment of Canada’s private sector R&D performance that had been offered by Max Blouw’s presentation on the Council of Canadian Academies report, Allard insisted that innovation was possible and more money could be attracted if a vision for its application can be framed in the inspirational way Siemiatycki was suggesting. Graham agreed and expressed his own support for the disruptive efforts of emerging firms, even when they fly in the face of well entrenched and supposedly laudable regulatory mechanisms. “It’s important to have this continual creative destruction,” he said, offering some sympathy for regulators, whom he predicted were going to have to become even better at shaping their work to accommodate an increasingly dynamic technological environment.

**Parallel Sessions | SESSION A | This Just In: Collaboration is Key**

**Stop talking, start walking: EDI should be Canada’s competitive advantage**
3:15PM-4:45PM

MODERATOR: KELLY NOLAN, Founder, TalentStrategy.org
AILISH CAMPBELL, Chief Trade Commissioner of Canada and Assistant Deputy Minister, International Business Development, Global Affairs Canada
MARY JANE LOUSTEL, Co-Founder & Strategist at SHEACCELERATOR Inc.; Former National Indigenous Relations Executive, IBM Canada
MARCELA MANDEVILLE, CEO, Alberta Women Entrepreneurs
LESLEY SHANNON, NSERC Chair for Women in Science and Engineering, BC/Yukon Region , Associate Professor, Department of Engineering Science, Simon Fraser University

*Studies of firms, organizations and communities show a positive correlation between success and effectiveness with Equity, Diversity and Inclusion. Yet cultural and institutional inertia continue to stall the spread of EDI practices in the private, public and non-profit sectors. The Canadian government has made equity, diversity and inclusion hallmarks of Canada’s approach to innovation. This panel looks at some of the exemplary practices and attitudes that are putting Canada at the forefront of the EDI movement.*

Nolan set the stage for discussion that began from the observation that initiatives such as pay equity have not been able to shore up the success of women in key areas such as research ventures and high tech, where in many places their numbers have actually been diminishing. Campbell responded that action to address such problems must come from the highest levels of an organization's management. "Leadership from the top matters," she said. "We know what a difference a good CEO or prime minister can make to setting out the agenda and being relentless in terms of saying it's a priority and maintaining focus." In this way the role of females in all circumstances becomes normalized, including such situations as being pregnant at work or travelling for work. And despite some discouraging statistics, Campbell takes heart from the attitudes that are being voiced. "The commitment that I'm seeing in the public and private sectors in Canada is incredibly positive and heartening," she observed, noting that business people she encounters at international meetings are interested in visiting Canada to see how the role of women is being shaped here. "We have fantastic male allies in this journey and I want to thank them, because this isn't something that's a women's problem, it's a society problem."

Shannon introduced herself as the chair of the computer engineering option at Simon Fraser University, where a priority for her is investing heavily to raise the proportion of female students to 19%, in contrast to a national average of 9% for these programs. She argued that the pipeline for such talent matters if the culture of high tech is ever going to change. "Bluntly, if you aren't inclusively considering women and every other underrepresented group, you aren't trying to hire from the majority of people who live in this country," she said. "If you are unwilling to consider the fact that you are hiring from 40% to 45% of the population and you can't find the employees you want, you're doing something wrong." She emphasized that this observation speaks to more than improving technology development in Canada, but confronts a host of other problems, such as women's poverty levels.

Loustel warned against losing sight of the fact that finance and research are about what these activities can do for the good of society. With regard to the issue of gender equality, she maintained, society does better when women do well. "We know when we look at the experiences of women coast to coast that financially they don't do as well as men," she said. "That's why it's important to create economic opportunities and inclusion for women and to include women in the solution-making we talk about here in research." Speaking also as an indigenous woman, Loustel added that the same principles of inclusion apply to indigenous culture, whose ways of knowing were benefiting these traditional societies long before Europeans showed up in North America.

Mandeville, who also identified herself as being of indigenous extraction, recalled how well entrepreneurship suited her when she realized that this was how she could apply her business school background. Yet she observed that while women start businesses at the same rate as men, but they are not growing them. "That issue of scaling that we've been talking about, the necessity for the success of our economy in an increasingly globalized business environment is really important," she argued, citing this

difference as an inherent equality that must be corrected. “We’re not truly at parity until women can realize their entrepreneurial aspirations, regardless of what those are.” By way of acting on this idea, Mandeville asks business representatives how many women occupy leadership positions within their organization, and how many of the other businesses they deal with are run by women.

Nolan continued this thought by suggesting that progress has not been stymied by a lack of programs that try to achieve goals such as increasing the number of women in engineering, but rather these efforts have been held back by the leadership at the institutions that carry out such initiatives. “It’s the leadership that needs to be trained and have their eyes opened,” she said, adding that these leaders must now confront this challenge by reviewing and revising the governance structures they oversee. She then asked the panelists to comment on the barriers that still exist to progress.

Loustel responded that we tend to be inherently uncomfortable with change, even when it addresses things that are not working well. “Despite the fact that collectively we’re seeing increasing numbers of people marching for rights, how much of that is making its way back into workplaces?” she asked. “The system itself certainly needs to be adjusted, but it’s the people working in the system itself that keep the system the way it is.” At the same time, she concluded that this also means people can be the solution to this very problem. More specifically, in the matter of research that involves indigenous people, they need to be made partners in this effort, or the results will count for very little.

With respect to more general barriers, Mandeville referred to the lack of access to capital experienced by women entrepreneurs. A great many programs have successfully tackled that problem over the last two decades, she acknowledged, but now the challenge for these entrepreneurs is finding the funding to expand, particularly when it comes to the development of service-based businesses that lack traditional forms of assets for lending purposes. Similarly, Mandeville identified access to markets as another barrier. “How do we move effectively into other markets?” she asked, pointing to the need for an effective network to do so. “In certain industries and sectors, the women owning businesses are still facing barriers in terms of connecting with the right people who are making decisions.”

Shannon considered these matters in even more fundamental terms, asking whether organizations were investing in bathrooms that have infant change tables or breast feeding rooms, as well as extensive policies for maternity leave. “The change to a dual-income household has to reflect a sharing of parental responsibilities,” she said. “We have to build that into our systems and organizations.” Such requirements are guaranteed by law, she noted, but it is not always embraced as fully as possible; for example, women routinely take only 70% of their allowed maternity leave. “As a society we have a lot of baggage,” she said. “We have to find a way to protect the next generation and open their opportunities.”

Campbell characterized many work environments as a ubiquitous, all-consuming medium – like water is to fish – so that it is easy to forget that it is there, even when it may be toxic. She therefore advocated for the role of a more sensitive observer who would be willing to indicate to others when something is wrong in the environment. With regards to the problem of child-bearing and parental leave she recommended that men take as much as women, which would offset negative perceptions by some male managers that this benefit holds women back in their careers. Taking stock of such changes in the workplace also requires data, including figures on how much support the government provides to women-owned businesses. Often this data simply does not exist, an oversight that Campbell insisted should be corrected. That being said, she argued that there would be no simple, single program that would address the wide range of problems surrounding gender and diversity. “There is this need to have intentional programming for women, potentially around minority-own businesses, indigenous-owned businesses, so to have those channels,” she said. “What’s very interesting to me are those women who come in and say ‘I don’t want to be in the women’s program, I just want to be in the regular program’. That’s great, too. It’s going to be up to individuals to decide the channels where they want to access your product, your business, your enterprise, your public service.”

Campbell related how heartening it has been to see a continuous improvement mind-set in the Trade Commission Office in Ottawa. “What’s really cool is that we have 160 offices around the world and they can test different things and then bring them back to our central node,” she said. “One of the things I like to do when I meet with the commercial services around the world is say ‘So what are you doing with women in your communities?’” She singled out the New Zealand government’s relationship with the country’s aboriginal population as one example of a model from which Canada can learn. Similarly, she has seen how the automation of some services with digital technology in Australia and Switzerland have made in possible to remove forms of bias from the way these services are delivered. “We’re not there yet in Canada but we’re really happy to share our information,” she said, recalling how her counterparts in other countries have been inspired to initiate their own programs specifically serving women. “I like to say that it’s actually way easier than you think once you get started.”

Shannon described how equity and diversity could be represented in ways that are as practical as health and safety measures; when visitors to an organization are provided with essential information such as the location of fire exits, for example, they might also be told where unisex washrooms can be found. At the same time, she carefully distinguished the value of mentorship from the value of sponsorship. “Mentorship doesn’t move the needle of career progression the way sponsorship does,” she said, pointing to the need for job application reviews where the applicant’s name is removed to ensure a more objective assessment.

Loustel recounted the progress — and often lack of progress — in the place of indigenous people in Canadian society, which takes the place of milestones such as the signing of the Constitutions and reports by various commissions. “If you hold the 1996 Royal Commission on Aboriginal People up against the Truth and Reconciliation

Commission of Canada, which was released in 2015, you're not going to see a lot of different information," she said. "It causes a little bit of concern about what will cause the change that we're after. There's more indigenous people now who are educated, who understand the tools of the system, understand the system biases and are able to work with them, to help change them." Likewise, many non-indigenous people have become much better informed about these issues and care deeply about them.

Mandeville was brought into Alberta Women Entrepreneurs to help build programming for indigenous women, as well as for women to pursue international expansion. "The first year of trying to think of programming and how to work with indigenous women was just listening," she said, recalling many visits to many different communities around the province. "That's where our Next Step program was born; that program continues to evolve because it is delivered with and for indigenous women. And so we're always listening to what it means — that's the best pathway, listening more than we talk." This broader perspective also looks past traditional assessments of entrepreneurial success as individual success. "It's not individual possibilities all the time," she said. "Sometimes its community possibilities; it's social development, it's community-building. And those things sometimes are not as tangible, but they are just as valuable for making the world a place we want to live in."

Nolan held up the laudable goals of organizations that want their workforce to be as diverse as the clientele they serve, but indicated how difficult it can be to move toward such change. "The power of implicit bias can make us believe that we're making rational decisions when we're not," she said. "If you just uncover your blind spots, the way you interact with the world around you changes. It's a great human equalizer: we're all biased. The solution of having a diverse team is great, but if they're not aware of their own biases we're still in the same spot."

A question from the audience asked how the delicate question of privilege should be raised in a formal way. Loustel responded that she continues to marvel at the ongoing privileged conversations that take place in her own organization, conversations that include her as someone privileged enough to have obtained a good higher education and training. She also advocated kindness and some empathy when raising these matters. "I don't know anyone in a true place of privilege that doesn't have challenges that they must face, that perhaps we don't understand," she said. "But it's important to start with that discussion about your own sense of privilege, your own appreciation." Nolan added that assessing one's own privilege need not be a matter of assigning blame but simply accepting a practical reality. "It's not that you caused the pain, but that you benefited from some sort of privileged system that had been in place before you even got you here and so you have a role in making things a little bit more equitable," she said.

Shannon singled out a specific problem in hiring practices aimed at creating more diversity within organizations. "Men do this wonderful thing where they apply for jobs where they have 60% of the qualifications," she said. "I wish women did this, and I'm including myself in the pile when I say this. We want 100% of the qualifications. And

because I do hiring, I know we never get 100% of the qualifications when we hire. So why not change my job ad to actually reflect that I'm never going to get that, that we're looking for some subset of these characteristics and the ability to grow into the rest. We won't hire people if they don't apply and we have to give them that avenue. If you're going to hire someone who doesn't meet 100% of the qualifications, then why are you saying you need that?"

Donna Kirkwood of Natural Resources Canada described how this department launched a gender equality charter on International Women's Day. After posting an article about this development on the internal Web site, she found herself dealing with comments from individuals who feel excluded from the process and feel that fingers are pointing at them. "Quite honestly I had not anticipated such reactions," she said. "So now we're facing the fact that we have to have a more inclusive conversation, because when you say you want gender equality some people feel excluded." Nolan replied that there is no evidence showing that majority groups such as white males face career obstacles when gender diversity programs are introduced, and in fact it can even enhance their prospects if they champion such initiatives. Education and engagement therefore become essential to overcoming these negative perceptions. "You're changing systems, and people are going to be fragile about that," Nolan said, adding that it is vital to address these concerns. "Male allies, without them we're not going to get there. And when they become the sponsors, we all win. I'm going to say congratulations, because if you didn't have that response, you wouldn't have done a good job."

Shannon concluded that the fear factor can be overcome through some thoughtful reasoning. "I would try reframing it differently: we're not taking this pie and cutting it differently, we want a bigger pie," she said. "This isn't about taking away from you to give to somebody else, this is about saying 'we've got this pie, why can't we have more, because I like pie'."

**Parallel sessions | SESSION B | A Focus on Agility and Growth**

**Corporate Drivers of Innovation**
3:15PM-4:45PM

MODERATOR: NEAL HILL, Vice President, Market Development, BDC Capital
JAMES MAWSON, Founder and Editor-in-chief, Global Corporate Venturing
ROBERT SCULLY, Director, Manulife Capital Ventures
PEGGY VAN DE PLASSCHE , Senior Adviser, Portag3 Ventures

*The recently announced Venture Capital Catalyst Initiative (VCCI) has identified a number of funds-of-funds that will invest in start-up and scale-up firms to help grow Canadian companies. In addition, BDC Capital launched a professional development program for fund managers, based on a successful Kauffman Foundation course. Less well-known is BDC's new corporate venturing program to engage Canadian and foreign companies that do not have dedicated venture capital divisions to co-invest in VC*

*rounds for Canadian firms. In this panel, we hear from some of the companies and investors that are driving innovation in Canada.*

Mawson got the discussion under way with a formal presentation about venture capital in the Canadian and global markets, where the 80/20 rule applies, i.e. 80% of the investments are made by 20% of the firms. In addition, the number of corporate deals being completed has gone up in recent years. “What you find is that corporations are involved in about a fifth of the deals by volume, but two-thirds by value,” he said. “So they’re really driving the upper end of the benchmark for disruptive companies.” In some cases, these are massive rounds of investment, worth hundreds of millions of dollars, especially in highly active markets such as Asia. This is a distinct contrast to Canada, which has good economic growth and low unemployment, but where these kinds of huge investments are much rarer. In Asia and Europe, on the other hand, there is an attitude that spending is essential to guarantee growth of new companies.

Globally, then, Mawson estimated the number of venture capital deals conducted annually to be on the order of 12,000, while in Canada the figure is around 50-60, although that might be higher, depending on how many were not publicly announced. He pointed to the high levels of research being conducted at the country’s universities, which were offset by the low levels of commercial ventures that have emerged as a result. “There’s a bit of a disconnect between what IP is available and what has been turned into entrepreneurial companies that are being backed,” he said. In addition, he pointed to the growing number of foreign investors who have moved into the Canadian market, a distinct contrast to other parts of the world where most of a start-up firm’s investors are locally or regionally based. Even those large Canadian corporations that are making significant investments do so in the United States rather than Canada. “It makes sense given the overall climb of the American economy,” he said, “but it’s slightly counter-intuitive given the local edge they might be able to give to some of those entrepreneurs.”

Van de Plassche agreed with most of Mawson’s assessment, although she added that one factor holding back some venture capital investment was the need to pay more to have the right person overseeing the deal. In a similar way, she noted that many university spin-offs must find the right talent to run these firms, as the IP holder — who is often an academic with no interest or business skills — would not be a good choice.

Scully, for his part, also referred to the fact a great deal of investment is a way of gaining access to the talent necessary for success. One example he identified was the rapid expansion of artificial intelligence, a field where talent is essential but hard to find, hence the need to buy it through acquisitions of one sort or another. He also argued that international experience is essential, especially with regard to the United States, and he has no problem with the fact that many companies look there to invest rather than in Canada.

Mawson suggested that among the leading concerns for Canadians is the amount of intellectual property that is leaving the country. It is in keeping with the perception the

country has of itself as hewers of wood and drawers of water, but he also suggests that Canada should be confident enough to see its investors move outside the country as well. Nor was Van de Plassche surprised to see this money leave the country because only there will they find the resources to grow, given how risk averse Canadian institutions tend to be.

Likewise, a booming economy is not necessarily a sign that all is well, according to Mawson, who pointed out that sales of domestic ice peaked during the period when electric refrigerators were developing a mass market. Once these appliances became more or less ubiquitous, however, the ice market collapsed. “The time to be most concerned is when things seem to be going so well,” he said. “High earnings, low unemployment, everything’s great — that was from decisions that happened 10 or 20 years earlier. But what’s going to happen in five years’ time to undercut that, and what areas will be affected?”

Scully quoted Amazon founder Jeff Bezos as saying “your margin is my opportunity”, which he extended to make the point that entrepreneurs are looking everywhere for margins that are too high and might represent an access point for them to enter a particular market, perhaps with some disruptive technology. “Nothing is safe, in my opinion,” he said. “There are some things that are more heavily regulated or require special relationships and unique know-how or skill sets. But entrepreneurs don’t see legacy systems, they don’t see political challenges. They just see a better way of doing it.”

Van de Plassche recounted her own experience with individuals who have emerged with this attitude, which comes with no special agenda other than the desire to make a worthwhile investment. Hill asked about the distinction her company makes between strictly financial investments as opposed to those with a more strategic character. She described the difference in terms of who you would approach, whether it is strictly a venture capital investment or something that called for a company with a wider range of corporate connections.

Hill asked Scully to comment on how Manulife approaches the new venture capital landscape. According to Scully, longevity is a priority. “You drive discipline and longevity by housing it within an investment framework,” he said, noting that the questions that follow deal with how such investments make money and drive returns. “How is this going to become a self-sustaining engine? The spin-off is that you get a lot of internal innovation.”

Returning to the observations of the Council of Canadian Academies report on private sector R&D investment, Hill then made the point that the investments Scully and Van de Plassche were describing would not be identified as research and development activities. “Yet clearly in every sort of organization there’s a mix, even if it’s 90/10 or 95/5, there’s some mix of strategic driver for the attempt to generate strategic return,” he said. “There’s an interesting angle that is often not picked up in these discussions

about declining business R&D." However, Neal added that even by this measure, Canada is not doing as well as the global average.

Mawson built on this observation by pointing out that the reason R&D does not show up in venture capital plays is because the people conducting this work are no longer directly involved with the investors themselves. "Those people have been reallocated to external," he said. "They've just gone to start-ups. They're still involved in innovation, but that's not necessarily tracked by this study. You get what you measure; if you just measure the number of spin-outs at universities, you get a snapshot of one area, but you miss that bigger, more holistic landscape."

Hill recalled how he regularly encounters corporate executives who are surprised by the collaborative funding opportunities that are available through university or federal government granting programs. "If you want to start somewhere easy and cheap, just walk down to your nearest large university and ask about their corporate innovation program," he said. "They probably have one, and they probably have someone there who will take you through the projects that are under way in areas of interest to you, the patents that have been filed by faculty members. A lot of Canadian corporates just haven't thought about that."

Van de Plassche responded that the problem is not necessarily knowing about just prospects, but executing deals based on them. During her time at CIBC she routinely had several technology firms approaching her at any given time, but the potential returns from them were often too limited to make them of interest. Hill countered that major corporate firms should be in a position to help fledgling enterprises scale up through access to a much larger customer base. Mawson suggested that this is an innovation strategy issue, based on the needs of emerging entrepreneurs, whereby government policy can help link up these ventures with larger corporate partners. He outlined how such an approach transformed the way many international companies were approaching Brazil, a place that has been lacking in any kind of formal innovation strategy but where slow and steady interactions have enticed local firms and governments to develop such policy to attract outside investors. He insisted that Canada is even better positioned to do so. "What you have is unique globally," he said. "You have an egalitarian society, you've got an amazing system, a great economy, you've got these large corporations, you've got great entrepreneurs, you're a friendly place, you encourage all these thing," he said, adding that such assets make him wonder why performance here lags so much. "Is it just so comfortable here you don't need to bother?"

Scully commented that part of the challenge Canada faces is the allure of the United States, where for example many high-tech entrepreneurs wind up. Some do return, he noted, and the network and attitude they bring back with them can make their presence here a huge win for Canada.

Ron Freedman asked about the contrast between the rate of return on investments in the United States, which are consistently much higher than in Canada, and why on that

basis anyone would invest here. Hill suggested that Canadian returns have been rising sharply and therefore present an attractive opportunity. “The depth and breadth of the ecosystem over the last five years is totally different,” Hill argued. “In just a few years we have gone from having just a few entrepreneurs who had done anything more than one start-up to now 100 or 150 who are in their second or third company, and they’re coming back for more. Really fundamental metrics are falling into place and seemingly for the long term.”

Mawson acknowledged that some kind of economic downturn could be in the offing, given how well the global economy has performed over the last decade, but he built on Hill’s point that changes in Canada represent a potential for returns that could be even more attractive. Scully also insisted that some Canadian venture capital funds have done exceptionally well.

Freedman reiterated that the risks associated with such investment could still be substantial and questioned whether this was the kind of environment where the Canadian government should be directing taxpayers’ money. Hill suggested that this amounts to no more than a pump-priming exercise, as opposed to some means of making money on behalf of taxpayers. In an ideal world, government participation would not be needed because private capital would abound, but Mawson dismissed the hard-line Reagan era attitude that governments should stay out of this business. He pointed to the example of China as a reminder that strong government intervention can accelerate the pace to well defined economic goals.

Freedman then asked about declining margins as investment continues and whether there comes a point where you are selecting targets on the basis of “least worst” rather than “best”. Van de Plassche said the Canadian market has not disappointed in this way, and in some areas, such as artificial intelligence, the prospects for improvement continue to be strong. Scully agreed. “We continue to see really interesting entrepreneurs doing really interesting things,” he said. “Entrepreneurs are recognizing that certain markets are maturing and they need to move and be ahead of that. I continue to be impressed and amazed by the concepts and ideas that they’re coming up with. I definitely do not see the quality of deal flow declining.”

A second questioner asked about the scale and implications of foreign investors entering the Canadian market. Scully confirmed that this level of activity has been increasing and Canada poses few barriers to this prospect. Hill added that as such players enhance their presence here, more domestic firms are being persuaded that the market is attractive and might be encouraged to ramp up their own levels of investment. Mawson emphasized that many of these investors consider other countries based not only on where they can make the most attractive deals, but also on whether they can get their money out of there afterward. In this respect, he insisted, Canada remains attractive.

16:45 - 17:15
**Keynote: “Helping Canadian Companies Scale-Up Through Standards Setting”**

MICHEL GIRARD , Vice-President - Strategy and Stakeholder Engagement Branch, Standards Council of Canada

Girard introduced the Standards Council of Canada (SCC), a Crown corporation with about 115 staff that reports through Innovation, Science and Economic Development Canada. In addition to coordinating the country's participation in national and international standards organizations, SCC also approves national standards and accredits other bodies that do so. Nine such groups have been accredited by SCC in Canada, including the CSA Group (formerly the Canadian Standards Association), the Canadian General Standards Board, ULC Standards (part of Underwriters Laboratory of Canada), Bureau de normalisation du Québec, the American organization ASTM International, and the Air-Conditioning, Heating and Refrigeration Institute.

"We'd like to see more coming into the fold to support emerging sectors," he said. "If you think about ICT, if you think about AI, if you think about nanotechnology, you've got a core of very strong Canadian companies in the country but they're not organized into sectors like older companies in forestry or electrical. There's a need here for new sectors to coalesce and to think about standardization. We need to engage those emerging sectors a lot more and think through how can we best support the development and implementation of standardization strategies so we access global markets through that means."

In order to ensure that these standards are being used properly, SCC also accredits another 400 organizations that test and certify products in Canada that abide by these standards.

Girard then outlined the entire sector of standardization, which he described as a "parallel universe, mostly invisible to most of you". In spite of the fact that it is seldom discussed publicly, he argued that standards represent a big part of the modern world. "Standards, the technical standards for a product, they're not neutral," he insisted. "They're not objective, they don't reflect the views of everybody. They only reflect the interests of people around a technical committee table. There are some winners and some losers and sometimes, decisions about new technologies or processes are made in those arcane committees by people you've never seen before and you'll never see in your life."

This perspective is especially important for innovative sectors, he added, where other countries may be trying to develop standards to suit products from their own domestic industries. If you are not part of that procedure, then the resulting standards may not cover the features of products from your country's industries.

Girard also characterized standards as a one-way street, where it is very difficult to revisit the subject once a particular framework is in place. "For innovation, the lesson we are learning is that we need to be at the table when it makes sense for us strategically," he said. "But we need to be at the table first and we need to hold the pen. Being the chair of a technical committee is a very powerful position and we don't take advantage

of the fact that we are very well respected internationally as Canadians to lead those processes. We've been behaving like Boy Scouts in many sectors up until now, and we're changing that."

In terms of sheer scale, Girard's office was able to tabulate no fewer than 335,000 international standards that were being maintained as of 2015. There are also about 30,000 new papers coming out every year, an indication that activity in the field is accelerating. That being said, the number of made-in-Canada standards has declined, from upward of 5,000 in 2000 to just under 3,000 in 2016. "The action, when it comes to designing new standards to commercialize new products, is not taking place in Canada," he observed.

Girard acknowledged that participation in standard-setting is a cumbersome responsibility, but it is well worth the trouble. Any product that could have an impact on safety will find itself being regulated in one way or another, he pointed out. At the federal level alone, 18 government departments apply thousands of technical standards on a regular basis, with just over a third of these having been developed in Canada and most of the external standards coming from the United States. At the provincial level, because these governments regulate more traditional products and processes, just over half of the pertinent standards were developing domestically.

Canada has traditionally done well at supporting established enterprises in the resource or manufacturing sector, Girard maintained, but the country is missing opportunities to provide similar support for emerging sectors. This shortcoming revolves around a lack of discussion on the standards that will shape these sectors, a discussion that is being very actively taken up in countries with strong ambitions in these same sectors. China has been especially active in this respect, something he discovered soon after joining SCC when he was approached by a Chinese delegation seeking Canada's support on an international committee that would be responsible for standards around traditional Chinese medicine. Visits by such delegations have been a regular occurrence, to the point that China now chairs more ISO technical committees than any other country except the United States. "In terms of overall membership, you have more Chinese officials populating ISO committees than you have Americans," he said, noting the same trend can be found in standards bodies dealing with telecommunications, and electrical products. "It is the transparent policy of the government of China to become standards-setters in existing, traditional areas but also in emerging, new areas."

Girard cautioned that the scale and implications of this Chinese initiative are not to be underestimated. "We can decide to let them take up the pen and own the committee," he suggested. "Or we can decide to be strategic about this and fight back in areas where we know we have a comparative advantage. It's our decision to make but we can't let others decide for us. If we do, we lose."

As for what this means in concrete, technical terms, Girard offered the example of fine bubble technology, a Japanese invention that uses nanotubes to inject gases into liquids, which has many practical applications in areas such as creating de-icing

products, cosmetics and food processing. After it was developed in 2013, a delegation from Japan approached the SCC for Canadian support to chair the ISO committee that would create standards for this new technology. The resulting standards now govern a market that is expected to be worth $4.3 billion by 2020 and which Japan is expected to dominate. “They’re going to take ownership of this process,” he said. “You’ll get certified, fine-bubble agents. They will be safe; they will do what they’re supposed to do. And they will replace a whole bunch of products that are currently being used in the country.”

This Japanese example therefore serves as a cautionary tale about how standards interact with emerging products and their market. “We’ve got to follow this model,” Girard insisted. He placed this advice in an even more urgent context with figures outlining the fact that although just 3.8% of Canada’s 1.15 million enterprises do any kind of export business, that small proportion accounts for almost one-quarter (23.7%) of the country’s overall GDP. In 2014, those exports were worth $469 billion.

Not surprisingly, the vast majority of these exporters focus exclusively on the US market. Fewer than 1,000 Canadian businesses are active in other countries, yet those alone account for almost 8% of the country’s GDP. “When you interview the folks in these companies and you talk to them about their success, standards certification comes up all the time,” he said. “They’re part of the ecosystem; more often than not they are standard-setters themselves, which allows them to dominate a market.”

Given the integral role that SCC can play in supporting innovative companies through standard-setting, the federal government provided the agency with new funding in last year’s budget. This made it possible to hire sector specialists who have been helping such firms design and implement standardization strategies. The 2018 budget included even more funding through the intellectual property initiative, so more of these specialists will be hired in the coming months and should be working closely in the development of the new superclusters. Not every company can benefit from SCC’s expertise, Girard conceded, so part of the task is determining which enterprises can make the most of standards to succeed.

“It’s about end-to-end support: upstream designing the new standard, designing the new certification program, and then going back to the provinces and federal departments to make sure they know about the existence of the standards so they can incorporate them into regulations,” he said. “It’s to get this concept of one standard across the country, because right now we see a lot of jurisdictions taking different approaches when it comes to regulation.”

Girard cast this standards strategy as intertwined with an intellectual property strategy, something that is already evident in countries where this combination can allow them to “collect the rent” on technologies used worldwide. Many Canadian enterprises are starting to appreciate this prospect; where once it was almost exclusively technical managers who interacted with SCC, now it is CEOs and other key executives who are participating in the process. There is good reason for this, he insisted, offering the case

of the head of a Vancouver firm that manufactures marine sensors; soon after becoming head of a standards committee for this technology, the firm began receiving orders from China, even before the work of the committee was completed. “With the credibility associated with this process,” he concluded, “the doors were opened.”

**Dinner and Conversation: Re-imagining science advice in an innovation economy**
18:30 - 20:30

MODERATOR: PAUL DUFOUR, Senior Fellow, Institute for Science, Society and Policy, University of Ottawa; Principal, PaulicyWorks
ANDREW APPLEJOHN, Senior Science Advisor - Environment and Natural Resoures, Government of NWT
DONNA KIRKWOOD, Chief Scientist, Natural Resources Canada
MONA NEMER, Chief Science Advisor

In an homage to Rick Mercer, who that same evening was broadcasting the final show in his television series’ 15-year run, Dufour engaged in his own mild version of a “rant” on R&D. More specifically, he quoted former federal science advisor Arthur Carty’s comment to a House Committee that was reviewing the reasons for the closure of that same office that Carty had occupied. “I continue to believe that the need for sound, impartial advice to government on national and global issues and developments in knowledge has never been greater,” stated Carty for the official record. Dufour noted that the pessimistic mood that dominated that period about a decade ago has been replaced by a more hopeful outlook, but he asked if this was sustainable. “We have a research community in this country right now that’s finally awakened to the realities of making a better case for why knowledge matters,” he said, pointing to the upcoming March for Science. “The pace of knowledge is outstripping the ability of our governance structure to follow it. Science itself is changing. Pressure is growing from a knowledge-thirsty society to address the wicked problems of climate change, global health, water, food security, and of course, issues of equity.” In the same vein as the Council of Canadian Academies that had been discussed earlier in the day, Dufour charged the panel with reviewing the current state of reliable knowledge advice in Canada today.

Donna Kirkwood, who was standing in for Ontario Chief Scientist Molly Shoichet, described some of the insights she had gleaned from her own position as chief scientist at Natural Resources Canada. “The role of the office of chief scientist is to ensure that we’re connecting all the science within Natural Resources Canada but also that we’re connecting with other federal departments, with colleagues from industry and academia,” she said. “I like to say that we’re the ones providing advice to our deputy minister and to our minister on the current government’s policy directions on science.” As for the challenges she faces in that position, Kirkwood pointed to the system she works within, which often prevents her from making the necessary connections and referring to contemporary topics in science as nimbly as possible.

Applejohn outlined the major turning point of his career, when his tenure as a federally employed scientist changed and he was hired by the government of the Northwest

Territories, so that he was no longer an itinerant researcher visiting the north but a northern resident who became much more cognizant of the priorities of this region. His current role in science policy was shaped by the work of the tri-council funding agencies. “There were some key recommendations about how the territorial governments had to step into the role of determining the path of northern science and articulate what their needs were,” he said. “That’s why my division was created. My primary mandate is to broker some form of agreement between the government of the Northwest Territories departments and agencies as to what our needs are and then communicate them effectively.” The resulting science agenda subsequently became a knowledge agenda, rooted in the impact that climate change and new technologies will have on northern communities. “We really recognized that northerners need to play a greater role in the science that happens around them and the science that will provide answers to our most important questions,” he said. Above all, he underscored just how differently the north is viewed by people who live there compared to people who work in the north but do not live there.

Nemer emphasized that her top priority was one of succession, ensuring that there would be another chief science advisor after her, so that there is a long, uninterrupted line of such science advisors. She briefly identified three pillars of her office: science communication, promotion and enhancement of research, and science advice.

Dufour made the point that unwanted science advice is worse than useless, leading him to ask the panelists how they create, maintain and sustain the demand for such advice.

For Nemer, who had only been on the job for about six months at that point, she is still taking stock of the best way to nurture the government’s attention. Given that scientists regularly top or nearly top surveys ranking Canada’s most respected professions, she argued that they should be the ones making more public appearances. “We have a very important role to play, both in terms of generating the science and the knowledge, but also of communicating it,” she said. “I don’t think this is something you should just learn on the fly. You have to pay attention to it.” By way of example, she suggested that far too many Canadians are unaware of the fact that the federal government has its own scientists. “This raises the question of the openness of the science, which is one of the major issues that we’re tackling right now,” she said. “This is the kind of thing that increases the trust of the population in the science and in the integrity of the whole science process.”

Kirkwood insisted that there is in fact a considerable demand for science advice. “There’s more interest in what we do, what the science is telling us, and what it means for the issues of today,” she maintained. “There’s tremendous opportunity to convey the role of federal science, which is quite different from the science conducted in universities and also in industry.” Nor is it a matter of scientists explaining themselves and their work, but rather topics such as ethics and equality. This is also a self-fulfilling goal, insofar as the more scientists speak about their work, the better everyone will be able to understand it. “It has to be accessible,” she said. “People have to be able to get at it. Accessible also means understandable.”

From that perspective, Applejohn noted that he lives in a jurisdiction with 11 official languages. He also notes that of the many scientists who were hosted by the northern research facility he used to run, not all of them were outstanding communicators. “When you can get on a plane and go to a small, remote rural community, and get off the plane and meet people in the community who are asking for that person to come back, you know you’ve met somebody’s who’s effective,” he said. “We need to create opportunities to put young, early-career scientists into communities to explain why they’re there — not what they’re doing or the rationale that their graduate committee found so compelling about their work, but what it means in the greater context: on the landscape, in the community, or leading to a greater understanding of change.” He also stressed the fact that such interactions would go a long way to bridging the gap between the faith that members of the scientific community have in their own methods and the skepticism of outside observers who do not share that faith. “We have to recognize that there are complementary perspectives on similar issues, whether they’re from the indigenous community or from people who simply practice something,” he said. “They’re the ones that live it, they’re the ones that see it. Don’t try to argue with them that your algorithm is better than 40 or 50 years of experience.”

David Wolfe of the Munk School of Global Affairs recounted his experience advising a student who was curious about why recombinant bovine growth hormone (rbGH) was approved for use in the United States but not Canada, leading her to undertake research that revealed how scientists operating under different social and regulatory conditions could interpret the same scientific data in very different ways. “I haven’t heard any of you talk about how you would take that incredible variation in how the social context influences science,” he asked.

Nemer vividly recalled the debate over rbGH and the scientific arguments that led up to Canada’s rejection of it. She regarded it as an example of the conflicts that have surfaced over genetically modified organisms and public protests over their appearance in our food supply. Similar conversations are also taking place over the use of AI, which could leave us in a place where we do not reap all of the advantages of this powerful technology because they become socially unacceptable. “To your point, I think it’s really important from the beginning to engage in a dialogue with society,” she said. “Social acceptability can change, as we saw with reproductive technologies. But the social conversation should not be adversarial. It’s at the time when we know enough about the application that we should start engaging in dialogue.”

Kirkwood suggested that the apparent paradox of different scientists looking at the same data and coming to different conclusions is a matter of the context in which these analyses take place. The questions being asked of the data pertain to a further goal, which may vary from one jurisdiction to another. Data about sediments can lead to different conclusions if one is examining the environmental impact of developing a piece of coastline. “You open up the whole lens of risk,” she said. “I don’t think we’re comfortable as a society talking about risk and mitigating risk. As well, we’re not comfortable with the fact that in science there are no real truths; we don’t understand

that well enough." She therefore endorsed Nemer's recommendation about engaging the public as soon as enough information is available for discussion.

For his part, Applejohn participated in assembling the scientific component of the Mackenzie Valley gas pipeline debate. "I hope I never do anything like that again," he said. "Not because it was bad science but because everything was done in isolation. Proponents did their work; the federal government did its work; the territorial government did its work; communities struggled to do their work; consultants did their work. Everybody got paid." Nothing was shared beforehand, however, and it became a battle of facts, which ultimately makes the case for the virtues of planning ahead to share work before it gets to the point of finished reports. "A little bit of coordination can go a long way to ensuring that at least we don't argue about the fundamentals," he said.

Mehrdad Hariri of the Canadian Science Policy Centre asked how it might be possible to ensure that the structure of science advice is retained regardless of changes in government. He was also curious if this activity could evolve to become more than an advisory role and have a stronger influence on how politics is perceived in different jurisdictions. A second questioner asked about the scope of "science" in the context of science advice, specifically if it includes the social sciences disciplines that are often highly complementary with those that make up the core disciplines of science and technology.

Nemer suggested that the 2018 federal budget should allay concerns that the social sciences might be neglected, since this plan contains new funding for the Social Sciences and Humanities Research Council (SSHRC). While the fundamental research strength provided in areas such as chemistry and mathematics is essential to any conception of science, she sees the entire field as much broader than that. "We need to keep an eye out and move all disciplines forward," she said. "I see it as one of my very serious responsibilities, to make recommendations that would help move the needle on all sciences and research in Canada." She also referred to the creation of the Canada Research Coordinating Committee, which is intended to help the tri-councils and the Canada Foundation for Innovation harmonize their efforts and respond to a changing research landscape as quickly as possible.

With regard to the question of how to ensure the longevity of science advisory mechanisms, Applejohn recommended an appeal to the integrity that drives the best scientific work. "We can ensure that by encouraging government, encouraging industry, encouraging academia to support a science advisor's position, whether they're coordinating or contributing or providing the hard answers that are required," he said. "It will become more the norm than the exception in jurisdictions across Canada." Nemer added that the more prominent the science advisor's role in government, the more likely there would be public pressure to retain it. She has seen evidence of such support from all walks of Canadian society in the correspondence that passes through her office. She also stated her belief that even if people are not happy with a decision taken by government, they respect the fact that the decision incorporated input from a variety of perspectives, such as those a science advisor would provide.

For Kirkwood, ensuring that the science advisor's role would remain relevant and desirable is inextricably linked with accessibility, a topic she regarded as part of general science literacy in the population. Unfortunately, members of the scientific community regularly mitigate against opportunities to enhance that literacy because of the way they go about their work. "For good reason, we invest public funds because we need data," she said. "But let's not just focus on the data. That's what we can produce quickly, but we need as scientists in governments and academia thinking about the harm we are doing to ourselves as a community by not reflecting and producing those synthesis papers, producing those synthesis reports that we do not have time to do." This kind of "slow" science is what can elevate the level of scientific discourse in society as a whole.

Doug Barber recounted the success of his information technology venture Gennum Corporation, which relied on developing a particular niche where there was little competition. As part of this process he began interacting with customers, which led him to discover that identifying and meeting their needs had little to do with science or technology. Based on this insight, he concluded that science advice alone is not enough to guarantee the success of any undertaking based on science and technology, which benefited from experiential learning as much as any R&D initiative. "Have we in Canada become unbalanced in terms of our emphasis on science, rather than balanced in terms of the emphasis on other learning, subjective, experiential learning?" he asked.

Nemer disagreed, suggested that science advice was far from eclipsing the subjective inputs to major decisions. "The problem has not been too much science advice to government," she insisted. That being said, Applejohn indicated that it was this concern that precipitated a major shift in the science policy of the Northwest Territories government. "We still obviously value science, but we changed the name of our policy from 'science' to 'knowledge', to recognize the fact that there are more than the traditional science methodologies at play when we start to understand complex situations," he said. "The knowledge that's gained through experience, through a community's understanding of their situation — it's hard to develop a scientific method around that level of understanding. Being a highly qualified person doesn't necessarily mean that you went through a university."

Kirkwood observed that the role of government has changed over the course of several decades, from when public institutions were trusted with the expertise to arrive at appropriate decisions on complex matters. "Things have changed drastically," she said. "The population wants to know how decisions are made but even more so, they're involved with decisions." In this context, science becomes a crucial aspect of an evolving approach to making public policy in a much more transparent way. "We don't have all the experience, so we need to reach out and get that experience," she concluded. "And we need to figure out why we're developing a policy or program — what is the need? We haven't come to grips with that. I often tell young scientists or young federal public servants who are being asked to speak at public forums: remember you're there to serve the public and not to serve yourself."

**Day 2 - April 11, 2018**

**Opening Keynote: "Data, Trust and Responsibility: the cutting edges of the world's most valuable asset class"**
08:30 - 09:00

PAUL VALLÉE, Founder, Chairman and CEO, Pythian

Valée was introduced by Ursula Gobel of the Social Sciences and Humanities Research Council of Canada (SSHRC), who emphasized the fundamental role that data plays in ensuring that information technology has a positive effect on our lives. “At SSHRC we’ve always believed that to truly realize the benefits of technology — be they socioeconomic, technological, or cultural — we have to improve a deep understanding of the human skills and knowledge that will help us successfully adopt and adapt it,” she said. “The true value will not be guaranteed solely by how many people use the technology but in fact by the level of foresight and human understanding associated with the development and use of that technology.” Through disciplines such as applied philosophy, she noted, Canada has prove to be well able to cultivate just such an understanding.

Valée subsequently introduced his company as one that works with firms that employ large databases, along with the design of cloud storage, systems architecture, and machine learning. This work has three major aims for their customers: to help them use data to compete in the marketplace, in terms of helping people and machines make better decisions; to improve the velocity of software engineering; and to employ data from a defensive position, in terms of performance, reliability, and security of various systems. “Three-quarters of our team are working in home offices all over the world,” he explained. “Our headquarters are here in Ottawa but the company is really all over the place. And you might imagine that in order to get your customers to give you access to their data, you need to unlock a very elevated level of trust.”

The product on which such trust has been built, he explained, is called Tehama, which addresses the very legitimate concern of clients such as major retailers to allow them to manage their most sensitive and valuable data. Tehama creates a virtual “room”, a software-defined network where interactions can take place between the company’s representatives, Pythian staff, and any other service providers, with a complete record showing what everyone did there. “You have an audit trail across all of the organizations in question, even if there’s a dozen service providers,” he said. “What they did while in the room also has an audit trail, and that generates an enormous amount of unbelievably important data.”

Returning to the topic of his presentation, he focused on the controversial claim in its title, namely that data qualifies as the world’s most valuable asset class. This flies in the face of a common assumption that money is the most valuable asset class, but he argued that even money is merely a form of data. If data is regarded as anything that is an observation about the universe, then a bank account balance is just one such

observation. More importantly, this observation allows to you draw specific conclusions about the current state of the universe as well as ascertain its future state, two features that make data so very valuable.

At the same time, he added, data is also the world's most mobile asset class, being ephemeral in form (electrons organized on a computer chip) and freely traded around the world. Even more significantly, collecting data means we are permitting ourselves to be observed, through information that reveals our decisions, state of mind, and insights into the rationale for our behaviour and the likelihood of future behaviour. "There's very little clarity or precedence for just where that value should end up and who should accumulate it," he said.

While data can increasingly allow businesses to compete more effectively, therefore, this same capability comes with increasingly negative consequences if data is mishandled. "Much like owning a lot of oil, you need to be ready for what happens if you spill it," he observed. "A data spill is at least as consequential as any oil spill." The recent dilemma over the disposition of client information on Facebook reveals just how damaging a data accident can be, a loss of that company's value that has been upward of $70 billion.

Such profound implications have led anyone with an organization responsible for significant amounts of data to look closely at who is managing that data and how they're doing so. When Toronto launched its "smart city" proposal, for example, it chose a model that would have vested ownership of the resulting data in a commercial entity, in contrast to a similar proposal by the Spanish city of Barcelona, which recommended that this data come under public control for the purpose of future public benefits. As such deliberations proceed, they make a case for the sharing of all kinds of data, such as all of our genomes, which could ultimately reduce the publicly borne costs of managing diseases no matter how rare they might be. Campaigns to collect such information must therefore grapple with the question of who owns such data and who can profit from it. A company such as 23 and me, for instance, can provide you with interesting details about your genealogy, but you should be aware that you are then licensing them to use that observation on the universe to their benefit. "It's an interesting business model and there's nothing inherently wrong with it," he acknowledged. "I'm just trying to make sure everybody is thoughtful about who you trust with your data and how you expect them to behave once you trust them."

This leads to the very basic concept of privacy, which speaks to the cornerstone of his company's business, which amounts to being trusted with other people's business. That responsibility means adhering to a very high standard of care around privacy, which has recently been highlighted by the advent of Europe's new General Data Protection Regulation (GDPR), which is being felt around the world. Central to this initiative is the "right to be forgotten", which puts the onus on data managers to justify the continuing presence of some data on open networks. Because the trade in data is so completely integrated, the privacy standards being set by the GDPR are becoming the global standard, since it would be impractical to run separate systems dedicated only to data

exchanges with Europe. This has placed the region at the leading edge of data management practices.

The Facebook scandal points to a much wider crisis of trust surrounding how data is being handled, he argued. What has been most upsetting for the company's clientele has been the realization of just how much data they trusted Facebook to hold and just how untrustworthy Facebook has proved itself to be. Nor is Facebook alone in this regard, as illustrated by similar problems faced by data breaches affecting matchmaking service Ashley Madison and the retailer Target. Those enterprises did not "steal" any data — someone else stole it from them — but the damage to their brands is profound.

All of which leads to a mounting demand for good data security practices, which has become Pythian's stock in trade. Such practices include thorough inventory of data assets, mechanisms to prevent accidental loss, and ongoing monitoring of access to data. He then showed a slide outlining the company's risk register, which assesses the risks facing their business in a highly transparent manner. "There's no such thing as no risk," he insisted. "The likelihood of any given company being hacked is almost guaranteed. It's about mitigating your risks and having a responsible plan for how you're going to react to that situation when it does come."

Another aspect of this challenge is a governance model where someone holds you to account for your data management practices. This features a combination of business analysis and technology, which is profoundly enhanced by the ability of a technology like Tehama to track all interactions that might be associated with any kind of data loss. In contrast, the major loss generated by the hacking efforts of Edward Snowden derived from authorities not knowing exactly what was taken and having to respond based on guessing what might have been taken. Such concerns deal with metadata, which are observations about these observations about the universe that turn out to be no less important than the original observations. "It becomes extremely valuable to have a very clear plan for where your data is coming from, how you're permitted to have it, what happens to it once you've got it, and then how it is permitted to leave your perimeter and how do you know what people did while accessing it," he said.

As our ability to collect more data and more detailed data continues to improve, we will become better at predicting human behaviour with greater efficacy, Valée concluded. This could ultimately eliminate people from many types of jobs where machines can be programmed adequately to perform all the same functions. This activity will also extend to the tasks of encoding algorithms used by these machines, algorithms that will no longer be developed by human operators but by machines themselves. This breakthrough will rapidly accelerate the pace of automation, which will force us to consider the kind of society we want to inhabit, which could be as utopian or dystopian as we decide to make it.

**Parallel Sessions | SESSION A | This Just In: Collaboration is Key**

**Lessons from the North**

9:00AM-10:30AM

MODERATOR: DOMINIQUE BÉRUBÉ, Vice-president, Research Programs, SSHRC
ANDREW APPLEJOHN, Senior Science Advisor - Environment and Natural Resources, Government of NWT
LEAH BRAITHWAITE, Executive Director, ArcticNet Inc.
ALISON PERRIN, Climate Change Education and Project Coordinator, Yukon College
PITSEOLAK PFEIFER, Graduate Student, Northern Studies, Carleton University

*Northern Canadian communities have developed innovative solutions that incorporate local knowledge and practices to complement standard techniques and procedures from the South. This panel looks at some of Canada's northern successes and draws lessons for the rest of country.*

Bérubé began by describing Canada's north as a research frontier that is becoming a growing sphere of activity, which has raised specific challenges such as international governance, community-driven research, and the diversity of communities found in this region. She noted that the panel would reflect some of the many different perspectives on this complex situation.

Braithwaite introduced ArcticNet as a network of centres of excellence made up of investigators in the natural sciences, health sciences, and social sciences. This multidisciplinary approach has helped unify the formerly fragmented groups that were doing all of this different work in the north. ArcticNet was created in 2003 and has focused on the Inuit regions of Canada, known as the Inuit Nunangat. developing partnerships with Inuit organizations, northern communities, and private and public sector bodies operating in the region. There are some 150 researchers working with ArcticNet, along with 34 university partners and other partners in 14 countries with an interest in northern research. "None of this has happened perfectly," she stated. "There are many lessons to be learned along the way in terms of how this rolled out. But we do see this tremendous capacity that has been built in the north as a result of taking this multidisciplinary partnership approach to the arctic in a way that had never been done before in Canada. Certainly from an international perspective, Canada owns the second-largest arctic territory in the world, and the world is looking to us to show real leadership in how we build that capacity." The physical realities of the north make it an expensive place to operate, she concluded, but the insights being gathered there on subjects such as climate change have implications for the entire country.

Applejohn described his work as that of providing science policy to the government of the Northwest Territories, building on the type of science that is needed to make decisions in the administration of a territory that covers 1.2 million square kilometres but has a population of just 42,000. "We deliver information to our government through partnerships," he said. "The keys to the science kingdom got passed to the universities; now without a university we find ourselves in this strange position where we have to broker a new suite of partnerships. We're talking about an evolution over the last 30 or

40 years that saw a transition from Canada providing all of the information and all of the science answers to our government providing all the answers."

Perrin was currently in Ottawa completing her PhD at Carleton University, but she has worked for the Yukon Research Centre for the last five years. "I've seen a big growth in our capacity," she said. "Half of my job is working directly with the Yukon government in a unique partnership, helping them incorporate climate change knowledge and science into their decision-making. It's an unusual opportunity for someone in an academic institution to partner with people in policy in government." In the other half of her job, she has been helping to coordinate a growing suite of research activities that Yukon College is overseeing as part of a steady transition to university status.

Pfeifer explained that he was also currently a graduate student at Carleton University, but he has some 25 years of experience in the north. "I was a career counsellor in the former Northwest Territories, prior to division," he said. "I was the chief executive officer of an economic development corporation. I was an assistant director of land claim implementation for the Inuit Makivik Corporation for the Nunavut land claim agreement. I was a policy advisor to cabinet to the Northwest Territories from 1999, as Nunavut came into existence. I was also a national director at ITK [Inuit Tapiriit Kanatami, a key organization representing Inuit interests] responsible for socioeconomic development issues." Through his career, he explained, he has spent much of his time showing Canadians who the Inuit are and what their potential may be. In this respect he has been opposed to popular characterizations of the north as "young, remote, and challenged", which neglects to say how its youth is being measured, what the region is remote from, or which challenges face it. Rather than regarding this part of Canada as incapable and trying to catch up with the rest of the country, he is intimately acquainted with its capable population. "I've known Inuit hunters to be incredible scientists and researchers," he said. "I know young Inuit that are incredible thinkers in innovation. I know Inuit educators and linguists to be incredible intellectuals. Inuit are also the largest private landholders in the world. Inuit are the third-largest private airline holders in Canada."

Moving on to the panel's goal of showcasing success stories from the north, Perrin began by describing a collaboration with another institution to create a post-doctoral position at Yukon College, ideally with that individual becoming a researcher there. The College has also been able to build the necessary partnerships in mining and renewable energy to create industrial research chairs in these sectors. "These are exciting ways of getting people in the north do to the research on things that are of interest to people in the north," she said.

Braithwaite added that she has seen similar evidence of the development of research institutions in the north, and she built on Pfeifer's comments that northern knowledge and northern expertise are being mobilized and more widely available to the scientific community. By way of example she pointed to Siku, an Inuit knowledge wiki and social mapping platform established by the Arctic Eider Society, a registered Canadian charity working with Inuit and Cree communities on research projects, culturally relevant

education, and innovative tools and technologies. “They’ve developed a platform for hunters to make observations and make them available immediately,” she said. “You can log on to the Siku platform and see what the sea ice conditions are, what the weather conditions are. All of this is to make travel much more safe and to make that information available as rapidly as possible to communities on Hudson Bay.” Braithwaite recalled how she had been directly involved in similar work to monitor sea ice around Nain, Newfoundland and Labrador, where an initiative that was initially driven by community needs eventually became of great important to the shipping community that needed to keep nickel moving out of the Voisey’s Bay mine all year round. She also highlighted the enhanced training capacity that such projects have nurtured. “At this point more than 2,400 students have been through a multidisciplinary training experience with ArcticNet,” she said. “I have researchers who have begun their careers and know no other way of doing research in the arctic than in this multidisciplinary fashion in partnership with these research organizations and community experts.”

For his part, Applejohn referred to the Beaufort Regional Environmental Assessment, a multi-stakeholder research initiative that collected regional environmental and socio-economic information vital to the future management of oil and gas in the Beaufort Sea. “It was a critical piece of understanding in the development of the western arctic,” he said. “It was a success because of its broad base, but it was primarily successful because of the involvement of the Inuvialuit organizations, the Inuvialuit Joint Secretariat and the IRC [Inuvialuit Regional Corporation], the regional corporation. And it brought Canada’s science horsepower to the table to meet requirements that were going to be faced if the Beaufort offshore development was ever going to happen. It involved ArcticNet, it involved industry, it involved the people who lived in the region.” He stressed that the local population had a profound sense of ownership of this work and its results.

Pfeifer built on this concept of enabling residents of the region — specifically indigenous residents — to act as partners in this work. “Typically in the indigenous world ‘research’ is a dirty word,” he said, noting the history of how even well intentioned researchers often mischaracterized these groups and their societies. “What I call a credibility gap is still existing,” he said. “This credibility gap is the belief that Inuit are not capable of being Western-trained researchers. There is a need for two-way capacity building: northerners do not need to become better researchers, researchers need to become better northerners.” By way of example he pointed to the 2017 report by Mary Simon, which revealed how little had changed in arctic governance over the last 40 years, a critique that Pfeifer extended to how northern research is conducted.

Applejohn agreed, suggesting that northern institutions could and should be adapted to reflect the needs of the people they serve. At the most fundamental level, this means money to be spent on northern research should be spent in the region, ideally on researchers who are themselves northerners. He has seen examples where southern researchers do work in areas where the capacity for this work is already in place in the north, such as that of a southern engineer who had worked out the physical behaviour of roads built on permafrost, a topic that was already well understood by northerners

who travel on such roads. Perrin recounted similar experiences, where local expertise is on a par with anything developed by outside experts. “We’ve come to a place where we can see who wants to work with us in a way that is acknowledging what we can bring to the table,” she said. “It’s about finding partners that authentically want to partner with you.”

Doug Ruth described the University of Manitoba’s indigenous engineering access program, which has had about 130 graduates over the last 30 years — more than the rest of the country combined. He suggested this is a key part of bridging the divide with the north by educating northerners in such a way that they can return to the north and make valuable contributions in ways that will be universally recognized. The greatest challenges have not been academic ones, which northern students have demonstrated they can meet, but rather the social challenges of making these individuals comfortable in a setting that is very unusual for them. Ruth wanted to know how the demonstrated value of this approach could be expanded. Pfeifer responded by stressing that there must be more investment in northern education, especially in science subjects, so that students do not experience as much academic disruption should they attend university elsewhere.

Robert Luke, of OCAD University in Toronto, noted that this institution’s priorities include decolonization. “Science is a method, it’s about contingent knowledge, and that means it can change based on what we observe,” he said, noting that the inputs and outputs can better reflect the needs of society. “We have an opportunity to say that there’s a bunch of other things that we do in these institutions that matter, and there are a bunch of other things that we produce that also matter. We need to educate the scientific peer community as to what those things are. My question is: how can we do that and how can we help you, and how can we help the funding agencies to understand that there’s different ways to acknowledge the input, the activities, and the output of science?”

Applejohn responded by noting that the Northwest Territories had recently transformed its science strategy into a knowledge strategy, a move that was accompanied by a policy statement premised on the idea that there are multiple ways of understanding issues. “We have to recognize up front, from a territorial government perspective, that our people and our communities are more than capable of answering questions on their own,” he said. “Science is one of many tools that can be applied to problem solving. I frankly don’t know how to communicate that to the granting councils, but I think SSHRC in particular is listening. How that translates into funding security for community-based organizations or public policies, that’s a question for people in this room.”

Pfeifer added that he appreciates the value of the peer-reviewed scientific process for translating and interpreting data. “We understand the traditional Western research paradigm and the need to do that,” he said. “But presently that knowledge mobilization and dissemination is only available to anyone in the south and around the rest of the world. All of that knowledge extraction process that ultimately benefits the academic community in the south, really there needs to be a shift of that peer review in terms of

co-authorship.” This shift would also extend to other, non-written forms of communication, he noted, to ensure that it becomes part of an indigenous culture that has different ways of expressing knowledge.

For Braithwaite, this discussion highlighted the virtues of a Networks of Centres of Excellence program, where there is far more scope for extensive partnerships and co-authorship. Within ArcticNet this has been reflected in an integrated regional study approach that required projects to be tied to northern communities, which would then be incorporated under a broader regional management, which would also be led by northerners. “These regional studies and the projects that filled them were driven through the communities and through the indigenous and northern organizations,” she said, adding that there was a significant learning curve for everyone involved. Among the key insights that emerged was a realization that stable, long-term funding was crucial to success. She referred to the example of assessing the environmental impact of the Muskrat Falls hydroelectric development in Labrador, which brought together Harvard University, Memorial University of Newfoundland, and representatives of the Nunatsiavut region. ArcticNet supported the collection of baseline data in 2008 that would be crucial to assessing the subject in the years to come. However, the necessary time to make these observations was made possible by the network that drove the work. “Ultimately it was that data from that research project that was used by indigenous peoples to protest against Muskrat Falls,” she said, pointing to the subsequent change in policy by the provincial government to include this information in the assessment of the project. Such support proves useful to level the playing field for northerners confronted by organizations with deep pockets that want to operate in the region.

When asked about the implications that this new outlook on science and knowledge could have from the perspective of agencies that fund research, Perrin observed that many of the major funding initiatives, such as the Canada First Research Excellence Fund, were not directly accessible to an institution like Yukon College. More specifically, she suggested that requirements such as who would be allowed to become the principal investigator on a research grant is important, since it could make the difference as to whether funds are controlled locally. Similarly, she argued that including northern reviewers on funding proposals also makes a significant difference to the extent that the region can take a share in the research process. “That’s something that I feel is not always noticed, that the expertise is there and the capacity is there,” she said.

Further to the subject of funding, Pfeifer observed the substantial trust and responsibility that is placed in academic institutions that oversee large amounts of research funding. “With all due respect to ArcticNet, I’d rather not see an ArcticNet, I would rather see a research network that’s based in the north, based in the territories,” he said. “Let’s give $300 million of research funds managed and run and decided upon in the north. If we don’t see that justice, under the existing paradigm the south continues to benefit. If the mining industry understands that there are impact and benefit agreements needed, we need to think of research as an extractive industry as well.”

**Parallel sessions | SESSION B | A Focus on Agility and Growth**

**New Federal Government Initiatives in Demand-driven innovation**
09:00 - 09:45

MODERATOR: NOBINA ROBINSON, CEO, Polytechnics Canada
CHRISTOPHER BAIRD, A/Director General, Office of Small & Medium Enterprises and Stakeholder Engagement, Public Services and Procurement Canada
AMBER MOUSSEAU, Manager of External Relations, Innovative Solutions Canada, Innovation, Science and Economic Development (ISED)
ROSCOE KLINCK, Portfolio Manager, Innovation for Defence Excellence and Security (IDEaS) Program

*One of the ubiquitous issues Canadian entrepreneurs raise is government procurement. Federal and provincial government rules and culture make it difficult for Canadian SMEs to sell to government, putting them at a disadvantage when they approach global customers who ask: "why isn't your own government a customer?" A new program within ISED, Innovation Solutions Canada, is being modeled after the US SBIR program in which government departments fund companies to provide solutions to in-house challenges. Defence Canada is piloting its own innovation experiment, IDEaS, where companies can work in secure "sandboxes" on potential solutions for the military. How will these new approaches accelerate the growth of Canadian firms that provide products and services to governments in Canada and around the world?*

Robinson began with her firm conviction that the federal government can play a key role in the success of innovative enterprises. "When you look at government policy, especially the federal government policy, we can do better if we harness procurement for innovation," she said, referring to the experience and insights she gained as a member of the panel led by Tom Jenkins that produced the 2011 report "Innovation Canada: A Call to Action". She directly cited the report's recommendation "that the current pilot phase of the Canadian Innovation Commercialization Program (CICP) evolve into a permanent, larger and effective program that provides incentives for solving operational problems identified by federal departments", then observed that this has now become part of the current government policy and the three panelists represent different aspects of its execution.

In this context, Baird's work with Public Services and Procurement Canada marks the oldest expression of such a policy, the Build in Canada Innovation Program (BCIP). "Fundamentally it's an innovation procurement program that provides a first sale for pre-commercial goods that stem from the work that Canadian innovators do, both in the goods and services process space," he said. "You could call it a 'buy-and-try' program. We do use procurement to buy these innovations, so it's revenue to the innovator, it's not a grant or contribution." He added that the program, which is now permanent, recently introduced a demand challenges component, which has further increased the volume of opportunities both for potential suppliers as well as the various government agencies they can serve. In fact, with more than 600 submissions in 2017 and

anticipation that this number will be even higher in 2018, Baird acknowledged that managing the flow had become a challenge, although one he welcomed.

Mousseau then described Innovative Solutions Canada, which was just launched in December 2017 and modelled after the American Small Business Innovative Research program. This demand-driven initiative represents no fewer than 20 different federal government departments, which puts specific innovation challenges out to members of Canada's small and medium-size enterprise community. "We're not looking for existing solutions in the marketplace, we're looking for ideas," she said, referring to the goal of developing new solutions to existing challenges. Participants are then supported through distinct stages, starting with proof of concept for a solution and proceeding to prototype development and ultimately the commercialization of a product, for which the government will be the first buyer. These enterprises can also seek out partners, such as post-secondary institutions, to obtain the necessary expertise or facilities they require for this work.

Klinck described the Innovation for Defence Excellence and Security (IDEaS) program, which had only begun a few days earlier. With a budget of $1.6 billion over 20 years – about $84 million annually – the goal is to seek out innovative answers for some of the country's defence and security problems. The format is similar to the well-known X Prizes, where successful solutions to challenges receive a significant award. The program also features "integrators", Department of National Defence scientists who are responsible for working with the participants in order to ensure that the resulting solutions are appropriate and worth putting into practice.

Robinson then asked the panelists how they measured success with respect to their programs. Baird indicated that BCIP surveys firms a year after their contract is complete, posing questions to reveal the number of jobs that were created by this work, whether the firm's revenue base has gone up, and whether the technology that was developed has been commercialized, ideally for export. So far these surveys have shown 80% of these companies have commercialized their products and some 44 countries have BCIP innovations available to them. Although Innovative Solutions Canada is just getting under way, Mousseau identified some of the same elements that will be used to gauge success, as well as assessments of how well a firm's partnership was conducted and whether underrepresented social groups were able to take part in the process. Robinson noted that the American SBIR has no such focus on underrepresented groups, which makes this a distinctly Canadian aspect of the program. Klinck added that the broadest measure of success for IDEaS would be the emergence of effective solutions for some of Canada's hardest defence and security problems, as well as drawing new players into defence contracts. He noted that expanding the pool of contractors could be as straightforward as couching challenges in the broadest possible terms, so that companies that have never interacted with DND will realize that they have the ability to take part.

Klinck emphasized the importance of building new relationships in the academic sector. "If we can create an effective network where there wasn't one, then we can tap into that

down the road," he said. Robinson then pointed out the implication for academic institutions, namely that IDEaS offers them funding opportunities beyond the usual scope of the federal research granting agencies.

Given the differences between these programs, Robinson asked how prospective participants might be able to determine which one was best suited to them. They acknowledged that companies often moved between different programs to find a good fit; Baird cited the example of IRAP as a place where many firms begin before entering BCIP.

A question from the audience highlighted the need for better mechanisms to promote collaboration in R&D, such that support can be maintained until working solutions and products emerge. Baird suggested that some other jurisdictions were attempting to go beyond the limitations of a specific procurement or funding program to sustain the development of new technologies, and he expressed interesting in seeking some lessons or best practices from these places.

**Scaling Canadian Firms**
09:45 - 10:30

MODERATOR: DAVID WOLFE, Co-Director, Innovation Policy Lab, Munk School of Global Affairs
DANA O'BORN , Director, Strategic Initiatives, Council of Canadian Innovators
ANSHULA CHOWDHURY, CEO, Sametrica
NEIL DESAI, Director, Corporate Affairs, Magnet Forensics
PAUL LEM, CEO, Spartan BioScience

*Canada's start-up ecosystem has enjoyed considerable attention from policy makers, intermediary organizations and investors for many years; but successful, profitable medium-sized and large firms with global customers are still relatively rare. The dearth of Canadian medium and large firms puts our start-ups at a disadvantage in connecting with global supply chains from a domestic base. What lessons can we learn from our small crop of Canadian firms that have scaled successful global businesses headquartered in Canada?*

Wolfe referred to the Council of Canadian Academies report, *Competing in a Global Innovation Economy: The Current State of R&D in Canada*, which identified the ability of Canadian firms to scale up as a critically important factor in the country's R&D performance.

Desai addressed this subject from the perspective of his software firm, whose products are employed to help customers around the world deal with digital security problems. He suggested that the scale-up needs of such an enterprise are quite specific. "The challenges are common when you're first starting a business: the first few employees, registering your business, getting technical talent, especially when you're a technology-

intensive business," he said. "But our challenges become quite specialized as we go forward: the capital challenge, the customer challenge, and the talent challenge."

O'Born explained that the genesis of the Council of Canadian Innovators was to create a common forum for medium-sized Canadian firms that were seeking to grow. "We try to fill that space that is not the start-up ecosystem and certainly not the major multinational space," she said. "The needs of scaling technology companies are very different." She described the council's efforts to create a fertile environment for such companies, such as helping governments tailor their policy initiatives on matters like intellectual property and technical standards.

Lem noted that after his company undertook a great deal of work to successfully bring its product to market, it is faced with takeover offers from larger competitors as well as bids by foreign governments to take their operations out of Canada. He proposed a fairly simple solution for scaling up, which would call for a dedicated line of government funding that would be directed by representatives from firms that have already scaled up, who would then identify "winners" – up and coming enterprises deemed be worthy of support in their own efforts to expand. "It would be fast; you could set it up in a month," he said. "Just set aside the Canadian government as a limited partner and I bet this would return more than anything else, because these guys have a proven track record of taking a dollar and turning it into a million."

Wolfe returned to the question of access to talent, which he identified as a key factor in where firms are located and how well they grow. Desai responded that this was part of a larger suite of challenges that determine entrepreneurial success, which he outlined by referring to an ongoing and inappropriate emphasis on counting jobs. "We keep talking about job creation when a Google or Microsoft builds an office here," he said. "Let's be very clear: they're creating engineering and data science jobs, which is actually not net new jobs in the Canadian economy. What they're doing is job reshuffling, increasing the salaries that other companies have to pay to keep their engineers. When I think about job creation and the skills of tomorrow that we're going to need, no one is talking about the sales, marketing, and operations jobs." He added that post-secondary institutions devote very few resources to nurturing talent in these areas, which puts the onus on firms like his to invest their own resources in such training. "We've spent so much time putting people on pedestals who have engineering and data science degrees, the irony is that we're not adding a zero to the number of them in Canada, and until we do that we're not going to see the competitive side of a lot of these firms go up."

Lem agreed with Desai's assessment and returned to his earlier argument about supporting the experience and insights of successful entrepreneurs. In places such as China, Europe, and Israel, governments have thrown their credibility and clout behind such individuals and their firms, an approach that has enriched national economic ecosystems. "That's how you get international companies headquartered in your country, developing all those jobs so that the profits all go back to you," said Lem. "Otherwise, we'll always be subsidizing someone's R&D, but big companies will scoop it up and we'll never benefit from that."

Desai then suggested that venture capital had also been placed on a pedestal, since the short-term revenue it generates is more easily measured than the less tangible growth in talent and other resources within companies such as his, which have bootstrapped their own growth. “So we take a million dollars of our own money and put it back in our company – a successful business model that generates cash – that is meaningless to the government,” he said. “But if I can find an investor who wants to get into some hot tech and has a portion of their portfolio with a high-risk appetite, the government says ‘let’s throw some good money after bad’. We’ve seen what the outcomes have been in Canadian venture over the last decade. If I were the taxpayer evaluating my government, I would fire them. That’s ridiculous.”

Chowdhury responded that some government programs do in fact respect the internal commercialization efforts of growing enterprises. She finds it even more promising that many post-secondary institutions, which are responsible for training the next generation of talent, are engaged in ongoing efforts to partner with firms such as hers. While she acknowledged some of the difficulties that Desai had identified in how the government chooses to support growing technology firms, she argued that this this is part of a long-term shift away from Canada’s traditional commodity-based economy. “If we were to have this panel 10 years from now, we’d be having a very different discussion,” she said. “These types of policies take decades to produce the type of seasoned operators and managers who will shift the balance.” She also observed that Canada maintains a robust network of publicly funded social services, one that contrasts sharply with the availability of such services in the US and provides a distinct advantage to this country.

Wolfe then asked the panel to weigh in on a perennial challenge faced by Canadian entrepreneurs, namely the relatively small size of the domestic market. Desai praised initiatives such as the Build in Canada Innovation Program, which can provide growing firms with invaluable feedback on their products. At the same time, he insisted that such feedback must come quickly if these firms are to survive and thrive. “Getting that customer reflection and customer feedback has got to be part of the ecosystem here if the government and large industries want to work with companies,” he said. “The competitive landscape for us changes on a day-to-day basis. We change our product road map literally week to week. And I don’t think that’s fundamentally understood in some of these programs.” By way of example, he cited the inability of Canadian law enforcement agencies to provide public quotes about the fact they are using his company’s products, a shortcoming he finds frustrating and counter-productive.

Chowdhury described her company’s experience as one of diversifying its customer base, seeking out different levels of government as well as community organizations. While this approach has been effective in ensuring steady growth, she noted that it poses more work in terms of overseeing a variety of different markets. Lem outlined an altogether different strategy, where his company invested heavily to develop a unique technology – in this case a cutting-edge DNA analyser – and so dominate the market for this product. That has enabled the firm to build a strong presence but does not resolve the more fundamental problem of how growth will proceed, since there are few government programs that would meet such specific needs. Desai then warned that

even where such programs might be applied, they run the risk of building up a company's ability to serve wider markets without actually helping them to open up those markets. He insisted that scaling up a company was a matter of identifying firms that are ready to grow, solving major public challenges, and prepared to operate internationally. "Those have to be intersecting interests for a country of this size," he said. "If you don't get that balance right, you're going to be creating supply through the demand side of the program."

Jeff Crelinsten reminded the panel of Doug Barber's experience in building his company Gennum, which immediately went international but in a highly focused market niche where there would be very little competition. He asked Lem if the fact that his company's product was in an area of intense competition posed an insurmountable obstacle to remaining independent in Canada. Lem said that was true, which is why he advocated for direct government intervention to prevent that from happening and interrupt a cycle of external buy-outs that prevents so many Canadian firms from scaling up. Desai identified the traditional interpretation of "competition" as a dated, industrial era concept that takes on an entirely new meaning in the world of technology-driven enterprise, where companies make products that are uniquely tailored to customer needs. "They don't want competitors, they're trying to create categories," he said, noting that his own firm consciously embraces this tactic. "We're trying to swim away from competition, not into it. When you want to create a category, that's where the opportunities are, and if you don't think it's possible, just look at the Fortune 500 over the last 15 years. Companies at the top of it didn't exist 10 years ago. We have to start thinking about the art of the possible and look at where need it going to be in order to drive some of these competitiveness decisions." Chowdhury agreed and suggested that the best policy choice was that of nurturing technical and entrepreneurial talents, although she reiterated that it could take decades to see the fruit of these efforts.

Another audience question addressed the question of failure, asking the panelists how they regarded it and whether they had personal insights on it. Lem responded that his biggest failure was raising any money from venture capitalists, which led him to become outstanding in his ability to draw angel and strategic investors. Chowdhury recalled that when her company was first beginning to grow significantly, major decisions were falling almost exclusively on her, which led her to a major re-evaluation of how to build up the organization's resilience so that it could function in her absence. Desai, for his part, regards it as a failure when the firm hires people who are not a good fit for the mission, which does nobody any favours. He also raised a much more sweeping point about how the Canadian government could more effectively harness the important role of failure. "We have so many technology failures," he said. "People are starting businesses every day and they're failing all the time, which is fantastic. But there's a lot of public investment going in these things and I find it interesting that in programs like SRED, IRAP, Mitacs – these programs that essentially making starting a business in Canada almost too easy – when they succeed there's almost no return to the taxpayers to pay for all the failures and get more people doing it. Those who are reaping the benefit, if they want to sell out, they should to look at what the public investment was and at least repay that. That would insulate the failure side and allow for more reinvestment and a

higher risk threshold, because the big bets are where we're going to see the biggest payouts."

**Plenary Panel | Using all of our Heads: Getting Government Departments to Connect, Collide and Collaborate**
11:00 - 12:00

MODERATOR: DANA O'BORN , Director, Strategic Initiatives, Council of Canadian Innovators
NEIL BOUWER, Assistant Deputy Minister, Horizontal Reviews, Treasury Board Secretariat of Canada
DONNA KIRKWOOD, Chief Scientist, Natural Resources Canada
MATTHEW MENDELSOHN, Deputy Secretary to the Cabinet (Results & Delivery), Privy Council Office

*Ministerial mandate letters have explicitly charged Ministers to collaborate with other Ministers to develop an all-government approach to Canada's innovation and skills agenda. New structures have been put in place to facilitate this process, including the appointment of a Chief Science Advisor with a mandate to coordinate STI activities across departments, the formation of the Canada Research Coordinating Committee (CRCC) to align the work of the federal granting councils, the Impact Canada Initiative focused on accelerating outcomes-based funding approaches across government and the creation of the Accelerated Growth Service to coordinate federal government departments and other service providers in helping high growth firms accelerate their growth. This panel looks at how these new initiatives will build on existing innovation support programs and create a cohesive and collaborative approach to move the needle on Canada's innovation performance.*

After setting an overarching goal of trying to understand how to help government and industry work together on common goals, O'Born asked Kirkwood to begin by describing how science and research become active elements in such collaboration. Kirkwood recalled this question coming up as soon as she was named Chief Scientist at Natural Resources Canada, where part of her mandate was to provide a more horizontal view of science within the department, as opposed to the siloed views of the traditional resource sectors, such as forestry or mining. These efforts were facilitated by the arrival of a new government in 2015 that was dedicated to putting a fresh emphasis on science that had been lacking for many years. "I really did sense it, travelling around the country speaking with scientists in our labs across Canada, I was welcome for that conversation."

Bouwer presented the concept of collaboration as a motherhood principle, but institutional structures can help it or hold it back. He had just completed a horizontal review of business innovation programs. "We have a high degree of professionalism in the public service across departments and agencies, in academic institutions and think tanks," he said. "People want to collaborate. That's not the issue. The question is whether we're creating the right environment for them.  Nobody is against collaboration

but institutional structures often make it more difficult." His work has involved reviewing the places where this kind of problem occurs.

Mendelsohn agreed that the idea of collaboration remains attractive, but there are incentives, institutional cultures, and other characteristics of departments and agencies that can readily mitigate against sharing. Among other things, there is competition between departments and information hording among people who want their output to be polished before it is shared. He also identified the Prime Minister's high profile endorsement of science as a top down measure that invited changes across government. Among those were horizontal priorities that everyone was responsible for, which made individual ministers and departments feel ownership of a need to contribute to overall horizontal goals, such as improved outcomes for indigenous people, climate change or reducing poverty. This flew counter to the entropy that would otherwise lead toward silos, so that environmental matters stayed with that ministry, for example, and other departments would not feel a need to engage. "There's a deep recognition that the kinds of things that governments around the world are now facing are not ones that any individual minister or department can deal with on their own," he said, adding that this outlook extended to the establishment of processes that go beyond the government itself. In fact, initiatives such as poverty reduction or social innovation are being co-created with external partners such as not-for-profit companies.

O'Born challenged Bouwer on the universal desire for collaboration, which as Mendelsohn pointed out, can be stymied by practical barriers. Bouwer replied that a sense of urgency was useful for overcoming such problems. "Having a deadline helps motivate people to be constructive," he said. And he reiterated that his own experience has reinforced his conviction that people really do want to collaborate, as evidenced by how little resistance he got when he asked for a horizontal review from various departments that they had to pay for. "We asked for an audacious amount of data in a short period of time, and they delivered it over the summer," he recalled. "Data is a place we can all agree to collaborate; analysis is a place we can all agree to collaborate; good program design and effective outcomes is a place we can all agree to collaborate. There are plenty of spaces that are not an affront to people's accountability or business lines, that are fertile ground."

Mendelsohn pointed out that the horizontal review Bouwer was describing had as a major goal an assessment of which government programs were more effective and which were less effective, a distinction that governments often find difficult to make. Starting a program is easy, he observed, but judging its success after a few years has been considerably more elusive. "One of the things that's been really important over the last few years is rebuilding the evidence base and reinvesting in data," he said, adding that this process has led to working more closely with the research community. Bouwer agreed and argued that there is far more data to be shared amongst departments than his department's review assembled. "We have only scratched the surface of admin data," he said. "At Stats Can there's a revolution happening."

From the perspective of a department involved in such a major review, Kirkwood still saw evidence that existing administrative systems are getting in the way of collaboration. More specifically, she argued that however strong the will to share information might be, it can still be difficult to connect with the people who are properly placed to do so. She referred to the Clean Growth Hub, a clearing house created in the 2017 federal budget that served as a focal point on the entire government's resources for clean technology activities. "It's doing fantastic work looking at the needs of industry in accessing funds that the government has made available to work on new technological developments, to accelerate innovation in Canada," she said. "The result of that is that we flattened the organization. Now if we had done that for the climate change science plan for the pan-Canadian framework, we would have arrived at our goal in three months instead of a year. My great hope is that this is the new way to do science or deliver services: from time to time let's flatten the organization."

Mendelsohn provided his own example of such progress through the Atlantic Growth Strategy, which not only intends to cut across government departments, but different levels of government as well. This initiative has very specific goals, such as increasing immigration or the number of high-growth export-oriented firms, but with inputs from across all facets of government and business sectors. This collaboration has driven efforts within the Privy Council Office to build cooperation with outside partners and make outcome-based funding decisions. This approach also spawned the Smart Cities Challenge, which was less about investing government money into municipally-inspired ventures and more about bringing together the partners in proposals for this challenge. "By incenting that collaboration around a shared vision, the projects get funded somewhere else — by the city itself, by the province, by the private sector, by foundations, or elsewhere within the federal government," he said. "There are dozens of things going on right now across the federal government — different structures, different processes that people may not be aware of, which have those shared goals."

O'Born acknowledged the number and diversity of these efforts, but she asked more specifically about how industry observers perceive the wide array of initiatives outlined in the annual federal budget. In this context, she asked the panel how industry can become incorporated into efforts to achieve greater collaboration. Mendelsohn responded that while people in government still spend most of their time meeting the needs of government leaders, the relationship with the private sector has steadily become more important. "There are a lot of different kinds of engagement activities and processes that are under way," he said, pointing to programs such as Innovative Solutions Canada, which is aimed at making the Canadian government serve as the first client for small and medium size businesses, and Impact Canada, which identifies scientific and technical challenges that could be tackled by industry partners. "These will be nimble ways of accelerating existing technologies and refine them to new situations," he said, offering the example of growing food in the north.

Speaking as a scientist, Kirkwood indicated that such programs generated some concern that support for discovery research might fall by the wayside, but those fears were allayed by the 2018 budget. "This last budget was a historic science budget," she

said, “where the government did invest in basic science and basic research. Science advisors like me were very happy to see that we’re not just trying to fix something and forgetting the rest.” She added that the innovation chain relies on these basic inputs, such that investments made decades ago are now coming to fruition in the technical projects that are now under way.

That being said, Bouwer did not regard such projects as being truly effective unless they were generating results in some commercial market, where they generate sales and exports. Because many of the small and medium size enterprises that take part in this work will not have the wherewithal to conduct their own detailed review of this impact, so it is up to the government to ensure that this information is properly tabulated and analysed. “There are some really good management best practices for designing innovation programs for small businesses, which we disseminated to those departments participating in the business innovation review,” he said. “Some of those programs, such as IRAP or NRCan programs, really are best in class.”

Kirkwood regards this approach as an extension of the interactions found in the scientific world, where researchers eagerly share their findings with one another and how that could benefit one’s own work. “I truly believe that by coming together and bringing the best minds together, be it in science or other walks of life, you get the best results and outcome,” she said. “There’s enough money out there for research; if we came together and focused on a problem we want to address and put those resources toward that together, we could make a difference.” Above all, she reiterated, people like her are working for the public, not for themselves. This raises the larger question of how to assess the impact of such collaboration.

Bouwer put the matter more bluntly: “Collaboration, like hierarchy, is your frenemy. Collaboration is your enemy if it waters down accountability on something you need to get done. Collaboration is your friend if you want to be creative and enhance the performance of your team through transparency.”

Mendelsohn added that efforts to make the process of government work better do not necessarily imply that all process should be eliminated. “It is to ensure that the process doesn’t become the end in and of itself,” he said. “Sometimes you can be working on a large project for six or nine months and people don’t agree but no one ever really forces the issue, which is what are we trying to achieve, by when, and let’s get it done and ensure we are measuring the results.”

Alain Dudoit, a former public servant who is now with the supercluster Scale AI, described these collaboration activities as a welcome change from what he was seeing when he left the government a decade earlier. As a result of his current work, he wonders about the implications of collaboration for the adoption of artificial intelligence in many areas, given that this powerful technology raises many concerns about privacy, governance, and security. Nevertheless, this technology is now ready to begin transforming the way government delivers its services. “There is a massive

transformation under way," he said, noting that Canada has yet to take advantage of this change.

Mendelsohn commented that this entire session had avoided the topic of superclusters, which he regarded as an oversight. As for AI specifically, he noted that there are in fact a number of experiments going on in the government to test the value of this technology. "There are many of us who are looking at applying AI to simplify various processes, to digitize various processes, and to help streamline some of the government processes that take enormous amounts of time," he said. "And you will hear more about those over the next year."

When asked by Dudoit if there were a federal AI strategy, Mendelsohn conceded that no such formal policy existed. "But we have been building forums that are working on various things that will lead to an AI strategy," said Mendelsohn, describing a task force that is reviewing the current state of AI applications and how they are performing. As testament to government moves in this direction, Bouwer referred Dudoit to a seminal paper drafted by Michael Karlin of Treasury Board Secretariat and Tara Dunham of Global Affairs Canada, *Responsible Artificial Intelligence in the Government of Canada*.