Public Sector Future podcast -- Episode 16 – AI for Sustainability

Olivia Neal [host]
Vik Pant, [guest]

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OLIVIA NEAL: Hello and welcome to Public Sector Future. This is a show for anyone who cares about using digital approaches in the public sector to deliver better outcomes. I'm your host, Oliva Neal, and together we explore stories from around the world, where public servants have been successful at delivering change. We meet the people behind the stories, hear their firsthand experiences and their lessons learned. Throughout the series, we discuss technology and trends, as well as the cultural aspects of how to make change happen.

I'm joined today by Dr. Vik Pant. Vik is the chief scientist and chief science advisor for Natural Resources Canada, a department in the Federal Canadian Government. Vik is responsible for providing strategic direction to build capacity within the department's scientific community and for accelerating the application of innovative digital technologies, including artificial intelligence. Before joining the department, Vik held a number of private sector roles and most recently was a senior technical advisor of applied artificial intelligence at the Mars Discovery District, which is a technology startup accelerator in Toronto.

Today, we're going to talk about how Natural Resources Canada are working to implement new technologies to deliver on their objectives, the role of Vik and his teams, and particularly to focus on some of the areas relating to sustainability. Vik, welcome to the show.

VIK PANT: Thank you, Olivia. It's my pleasure to be here. I'm very much looking forward to a rich and rewarding exchange of ideas. Thank you for having me.

OLIVIA NEAL: Absolute pleasure, thank you. So, let's start right at the top. We have people who are tuning into this from around the world who won't know what Natural Resources Canada is. So, could you give us a sense of what is the department, what are you there to do, and what types of people work in Natural Resources?

VIK PANT: Natural Resources Canada is a ministry of the federal government where I'm employed, whose focus is to improve the quality of life for all Canadians by ensuring that our country's abundant natural resources are developed sustainably, competitively and inclusively. And this is important because when we think about natural resources within the Canadian context, we are really referring to some pretty staggering numbers.

Approximately 17% of Canada's nominal GDP can be attributed to – directly or indirectly to the natural resources sector. It is directly or indirectly responsible for around 1.7, 1.8 million jobs, and also the exports accruing to the natural resources sector are estimated in the range of around a quarter-trillion dollars, comprising about 50% of our total merchandised exports. So, really, our mission of ensuring that natural resources are developed sustainably, competitively and inclusively – you can understand what kind of a force multiplier it can have on boosting the Canadian economy, to the benefit of all Canadians.

OLIVIA NEAL: Within the department, how many people are there in Natural Resources Canada? Is this a very large department or is it more of a focused team?

VIK PANT: In Natural Resources Canada, we have approximately 5,000 colleagues, very interestingly, Natural Resources Canada has a very large science complement. In fact, almost half of our expenditures and half of our workforce is in fact science and technology, research and development related. Science is at the heart of NR Canada, and that's why we think of ourselves as a science-based economic department.

OLIVIA NEAL: Okay, so when you joined the department in your role as chief scientist, how did you think about setting your priorities, and what are your priorities now? What are you focusing on for the next few years?

VIK PANT: When I joined the department, I was given three main priorities. The first objective, the first high-level goal that I have is to ensure what we call the horizontality of science across our enterprise. One role which I as the chief scientist and chief science advisor have is to ensure that there is a lot of collaborative learning that is going on, because indeed, we have some of the world's leading scientific experts in many of the fields. The second priority that I was asked to look into was the notion of what we call horizontal science, holistic science. And the holistic science is very often, when we think about science, we think about Western science. We think about the scientific method.

Increasingly, there has been an appreciation, and increasingly there has been a consideration to also look at other viewpoints, other worldviews of science, and a good example of this is indigenous ways of knowing and learning. We know that there is much wisdom in indigenous ways of knowing and learning, so if our science cadre, if our scientists, our technologists are aware of what those learnings are, what that wisdom is, then their own practices and their own methods can be better informed, and vice versa.

And what this means in a concrete sense is to ensure that we have relationships with communities that are knowledge holders, for instance, with indigenous knowledge and indigenous learning. It's to ensure that our practices and our processes within the department are respectful of their intentions, their concerns, their goals and objectives as well, and also

making sure that there are training programs and to ensure that there are knowledge-sharing programs available to our scientists.

And the third goal that I have been focused on, which really maps to my core competency most naturally, was to accelerate the creative application of innovative digital technologies to maximize the impact of software, of technology, in our department, and this means working with technology such as artificial intelligence, data science, blockchain, Internet of Things, 3D printing.

There's lots of interesting, advanced technologies out there. Traditionally, they were used in a fairly ad hoc and experimental basis in our department. How do we set up a technology launchpad where we can not only benefit from that micro scale experimentation, but do so with a pathway to production? So, those would be my three main goals. It's horizontal science, holistic science and the digital acceleration of science.

OLIVIA NEAL: Wow, okay. So, three quite meaty priorities that you've got there. I'd like to explore the last one a little bit more. How to move from an ad hoc, enthusiastic experimental approach to something which really cedes results, and can be scaled and implemented? We see in many public sector organizations around the world, there are people who are hungry for change, who want to push things forward, who want to try things out, and you often get these pockets of innovation. But I think what is often a challenge for many public sector organizations is really thinking about, how do you make that part of the system and how do you make sure that the system supports those new ideas. So, I'm interested in learning how you're tackling that challenge, and what you'd set up and put in place.

VIK PANT: By way of background, my own training is in Information Science. I have a PhD in the field, and so I think of myself as a modeler at my heart. So, what my team and I have worked out is, there are really five main elements to a successful technology launchpad in a public sector setting. This has been our experience. We've validated it for two years and happy to say that our funding got renewed based on our track record and our results, So, the first one, Olivia, I'd like to say, is it all starts with capability. It all starts with talent. It all starts with competence. A lot of organizations have great ideas. The problem is right now that the talent market is very scarce.

So, the first thing to do is to build this pathway into this high-quality pool of extremely talented and qualified individuals so that we can build capacity. When I came into the department, I reached into my networks and connections and created value propositions that I knew would resonate with the types of folks that we were targeting. Once we had the team, we wanted to make sure that the mission was laser focused on value realization. We wanted to make sure that the scientist and our data scientist, our digital solution architects, our software technologists came together and they collectively worked to co-create value. The third thing we really focused on also was that while not everybody wants to become a data scientist, the level of

conversation in the department needs to be sophisticated where folks have a general understanding of the value of data, how to think about data as a resource with opportunities for value creation.

And so, knowledge sharing and this notion of what we call the digital acumen, became very important for us as the accelerator– we wanted to make sure we created ample learning opportunities for colleagues from across our department to learn about data science. The fourth thing is this notion of strategic partnerships. And what I want to emphasize here is, Olivia, that in the past, a lot of times, we hear the work partnership used but in fact, it's being used to refer to what I call transactional interactions.

It's not truly a strategic, complementarity-boosting, supplementarity-enhancing(sic) type of an alliance or a joint venture.So, one of the things that I did and my team did was, we looked around for like-minded organizations, primary case being Microsoft, where we wanted to focus on not just the topic of software, but we wanted to look at what else could Microsoft bring to the table, and in return, what we could bring to the table in a way that led to win/win, mutually-beneficial outcomes.

So, I'll give you a concrete example. We know in working with Microsoft that Microsoft employs not just extremely smart computer programmers and data scientists, but Microsoft also employs extremely smart meteorologists, and climatologists, and weather forecasters, and climate modelers. They employ geologists, geophysicists, geochemists, geobiologists. So, when we realize that there are so many areas of intersecting and overlapping complementarity, looking at Microsoft simply as a software vendor would leave potentially a lot of opportunity missed in terms of value for us.

So, now, for instance, in the relationships we have with Microsoft, we focus on goals not just in terms of software but in terms of higher order objectives, sustainability, net zero, climate change mitigation, adaptation, remediation. What else can NR Canada bring to the table, what can Microsoft bring to the table, and how can we really tackle some of these big global problems that both of our organization leaderships have committed behind.

So, that would be the fourth piece to the five pieces, I would say, and the fifth element of the way that we've calibrated and optimized our digital accelerator, Olivia has to do with this notion of how do you go from pilot to production? The nature of advanced technology is inherently experimental. It's inherently exploratory.

So, you want to give data scientists and all the stakeholders that are involved in that design and development process a lot of latitude. But at the same time, at a macro level, from a portfolio perspective, we are the government. We are accountable. We are responsible.

So, the word is governance. We still have to make sure that we're following all the rules, we're abiding by all the regulations, that we do have the overarching rubric applied to the work that we do. So, this notion of governance as the fifth pillar also enabled us for success to go from pilots to production.

So, these are the five main things I would say have been truly helpful for us in the accelerator, and by focusing on them and then finding the interconnections between them, has been truly beneficial. So, talent would be one. This notion of value co-creation, value realization, value delivery with the clients would be number two. This idea of nurturing a digital first, data-aware culture. The fourth one would be partnerships, innovative partnerships, But also, then I mentioned doing all of this in a way that abides by the rules and complies with all the regulations that Canadians have come to trust the Canadian government for doing the right thing.

OLIVIA NEAL: Well, I think there's so much there to really dive into, and I really appreciate that very clear framing in the way that you're thinking about those five things, because I think there are lots of other organizations around the world who are looking at setting up these types of approaches or maybe have done with varying degrees of success. So, hearing your lessons learned is very valuable as part of our conversation.

I'd like to delve in a bit more to the strategic partnerships piece, and I promise I did not pay Vik to speak so positively about Microsoft. In fact, we gave him free reign, and you chose to talk about that all by yourself, which is fantastic. I'm really delighted to hear how well that relationship is working. But we'll come back to that strategic partnerships piece in a moment. Before we do that, I'd like to just talk a little bit more about some of the specifics of what this has been delivering. could you give us an example of what's the type of current projects that you've got going on?

VIK PANT: Yes, absolutely, and I'll share a composite example, because I think this really illustrates our thinking at a portfolio level of how we select projects with an emphasis on reuse and with an emphasis on sort of a long-term value realization.

The Canadian Center for Mapping and Earth Observation is internationally recognized as one of the world's leading centers for cartography, remote space-based earth observation and remote sensing. Now, we have access through the Canadian Space Agency to satellite imagery, so when satellite imagery of Canada's land cover, water cover comes in, we are able to analyze this and as you can imagine in the past, historically this was a completely manual exercise. So, there were people who would pore over these plates or these slides, and really painstakingly try to understand features by looking at them through microscopes or other types of magnifying equipment.

Now, with the advent of machine vision technology, we all know how common and how popular nowadays it is to do image recognition using artificial intelligence, so naturally for us, a very relevant use case would be to take satellite imagery as it comes in off of the satellites and then use advanced artificial intelligence techniques and technologies to analyze those images with a view to understanding, down to the pixel level, what that pixel represents.

So, if you think about a pixel as representing the top of a tree versus the top of a road versus the top of a building versus the top of a body of water, you can imagine that now when you have raw pixels overlaid with artificial intelligence derived semantic layer, and semantic layer meaning that sort of not just the color of the pixel that you're seeing, but actually what that pixel corresponds to in a conceptual sense, then you could really make all types of very interesting decisions from a planning perspective, from a policy perspective, from a forecasting perspective.

So, one of the things that our team in the digital accelerator did was, we partnered with the Canadian Center for Mapping and Earth Observation, and they had already been doing some excellent work on training an ensemble of artificial neural networks so that you could now have satellite images coming in, they were annotated in the beginning with some human input experts who could say, this pixel means this, this pixel means that.

And once you had a sufficiently large dataset of expert annotated satellite images, now we could train a machine learning model, and once that model is trained, as you can imagine, in the future when new satellite images come in, you can run those satellite images through the trained model and the model can now pretty much give you an extra layer on top of your image, and now that layer can be used for all types of interesting downstream applications.

So, what those applications are, let me give you a few examples. Think about flood mapping. That's one of the obligations that Natural Resources Canada has is to prepare flood maps, and when you think about the destructive nature of floods, where floods can destroy property and it can hurt and harm life and livestock, this is something we want to get better and better at being able to predict, better and better at being able to respond to, and better and better at being able to address.

So, now using this kind of technology to generate flood maps and then actually augmenting them with the flood maps that are being generated by subject matter experts, now you have a collective intelligence built around flood mapping that is superior to or is certainly complimentary to the understanding that you would have had, had you not had this kind of artificial intelligence bolstering the set of insights that you can now leverage to make decisions. Another good example is wildland and forest fires where you can think about, again, the destruction to the economy, the ecology, the environment.

So, the better and better that we can get at being able to understand what the contours are, what the topology is, what the sort of various cover is on a certain piece of ground where we're concerned about wildland fires and forest fires, we can take some of the world-leading expert work that is done in the Canadian Forest Service, in this specific area, take those models and then pair those models up with some of the models that could be built using this kind of technology. Now you can have a good understanding of how to respond to wildland fires and forest fires, and even perhaps predict them.

One very interesting project in the same vein, that we're doing in partnership with Microsoft, has to do with what we call mining risk mitigation. Now, when you think about it, Canada has, according to some good estimates, somewhere in the range of about 10,000 mine sites. And you can imagine, a mine is a fairly large, sprawling operation. You have emissions ponds, tailings lakes, rock piles and rock structures, and if the mine is in active operation, it's a full-time function to ensure that ecological hazards and environmental harms are mitigated as much as possible. When you think about abandoned mines, this can certainly be a problem because now you have a situation where you have the possibility of it just going out of control at some point and creating destruction and harm to the environment or the ecology.

Now, when you think about it, going out to all of the typical locations where mines are normally sited, it's a fairly expensive enterprise from not just financial expenses, but time and risk, and labor involved to do this. But the other part of this is that 10,000 is a fairly large number. How do you keep this up on an ongoing basis to ensure that the catalog of the conditions of these abandoned mine sites are inventoried, through time and over time, in the right way?

But this is where this type of technology that I just mentioned comes into play, because if we have satellites doing passes over the Canadian terra firma, then we can use this type of machine learning modelling not just to identify where those mines are, but over time we can do some difference analysis and to see how some of those are changing over time, see if some rock pile is degrading or see whether some kind of tailings lake is draining or some kind of emissions pond is leeching.

So, to the best that we can with satellite imagery – there are of course limits to this, because it is top-down and there's quite a bit of distance, but nonetheless, we can make some good approximations about the quality of the mine site and also then make decisions downstream about what type of actions to take to remediate it.

Now, this is a project where our scientists working closely with the Geological Survey, working with Canadian Center for Mapping and Earth Observation, Office of Chief Scientists partnered up with Microsoft, who also has some of the world's leading machine vision experts, computer vision experts. So, our teams got together. This is an ongoing project. We've been teaming very successfully, using our datasets, Microsoft's dataset, our expertise and knowledge in subject

matter, domain knowledge, as well as Microsoft's expertise in the domain, but also in terms of software, and really just bringing our ideas together, and trying and testing different approaches to see what really works.

OLIVIA NEAL: Well, I think that's great to hear those very tangible applications and how those are developing over time. One of the things that struck me as you were talking about the flood mapping, wildland fires and mining risk as well is that these are challenges that many countries are facing, and I wondered whether when you're developing these models, whether there's the opportunity to share those with other countries, to make those open and reusable, and if that's something that you think about or if you equally borrow things from other countries and use them in Canada?

VIK PANT: Certainly we have a commitment to open innovation and to open science. So, certainly when you look at Geo-Deep-Learning, which is the Canadian Center for Mapping and Earth Observation artificial neural network ensemble that we talked about, which is used for assigning these layers – features, land cover pixels down to the land cover classes, down to the pixel level, this is actually already on GitHub, which is a publicly-accessible code repository.

And indeed, we know that there are lots of public and private sector, and academic researchers who are using that code base to not only use it for their purposes but also then to recommend changes or improvements, or submit, if you will, a code request. So, that is one element to it, that as much as possible, we are focused on open innovation and open science. Another element to this is, you can have the best models, but then what about the data? So, similarly, the Canadian Center for Mapping and Earth Observation also has a publicly accessible catalog.

OLIVIA NEAL: Okay, thank you, and I think that the more that we talk about this, the clearer it is that none of these problems are issues that can be solved by one team or one agency, or even one entity alone. They're things where you have to have people with a range of knowledge bringing different datasets, different experiences, different expertise to the table, and that together becomes more than the sum of its individual parts.

It's really exciting to hear about the work that you're doing. Earlier in this conversation – when you talked about the five elements of success, you talked about this idea of strategic partnerships, which are really core to how you're delivering. And you've made a lot of progress within your team and in moving that forward, and I'm interested in if you have reflections on that for people in other countries who are wondering about how to go about this type of approach.

I think that often, when you're in a public service environment, particularly if you haven't ever worked in the private sector, there seem to be a lot of barriers to creating those types of partnerships. There's sometimes nervousness around whether you can go out there and talk to private sector companies, is that allowed, is that okay? And I'm just wondering on your

experiences, whether you have any reflections that would be valuable for other public servants as they go forward?

VIK PANT: That's something that we dealt with and continue to deal with as well. And what I would say is, there's a few things that one can keep in mind that would help to make this happen. So, the first thing is transparency. I think at any level, the way we build trust within the enterprise is by being fully open and transparent, and letting executives, letting leaders know what we're trying to do. Second thing is to really engage in what we would call allocentric thinking or outside-in thinking, which is try to imagine what the motivations of those potential partners those prospective collaborators would be.. Then the third piece I would definitely say, is the transparency that I mentioned internally, that same type of transparency and openness with the partner.

So, I like to say avoiding mutual mystification, because in many cases, when you're starting a new partnership model, it's never been done before. So, there also, ensuring that not only do you understand what the other side perceives as their goals and then you align –at every step of the game, because in the long run, that also then builds trust and confidence in the external relationship the same way that it does inside our department with the executive cadre at the senior leadership table.

OLIVIA NEAL: Absolutely. I think those are three very practical lessons for people to implement as they're taking these types of approaches forward, so thank you for sharing those. So, one final question from me, throughout this series, we really want to highlight and celebrate the work of public servants who are doing fantastic things. So, I'm interested to know, you're involved in lots of different projects in different areas. Are there any pieces of work that you've seen from other public servants which have inspired you or really impressed you, and you would recommend other people go and take a look at?

VIK PANT: So, if you would indulge me, I'd like to give you two examples in the government of Canada, and I'd say that they're actually quite complementary and related. So, one certainly I would say is Mr. Anil Arora, the chief statistician of Canada. Mr. Arora heads up our Statistics Canada, and he really has brought a sense of rigor and discipline to this notion of data science. I mean, statistics is certainly a very well-established field, but really what data science offers in terms of new techniques and computation, new algorithms, new ways of actually getting them down on silicone so you can actually crunch massive datasets, he has really calibrated and optimized the entire Statistics Canada enterprise with his leadership to be able to do this at scale.

A second one that I'd like to also refer to is a colleague in the Privy Council Office, Rodney Ghali, and he has been doing some phenomenal work in behavioral economics. When you think about behavioral science, behavioral economics, this has been a field that's been around for quite some time, But what data science has now enabled has brought the power of that massive

scale, going from information to insights capability, and applying them to behavioral science type problems. So, when you look at the work that Rodney is doing in partnership with Health Canada and the Public Health Agency of Canada on analyzing not just the notion of vaccine hesitancy or misinformation related to COVID, but also what would be some reasonable interventions to steer public policy in the right direction.

And these are connected examples because when you think about it, Statistics Canada is responsible for collecting data, and for curating, and sorting, and circulating data across the government and across our ecosystem. But then you also need beyond the horizon thinkers, to make sure that then those data are leveraged in very creative ways to make innovative findings which can ultimately advance the work of the government.

OLIVIA NEAL: Great. Thank you for sharing both of those. We will be sure to go and check those out, it sounds like there's fantastic work going on across the government of Canada, which is wonderful to hear. Well, that is all we have time for. Thank you so much for joining us, Vik, and sharing those very practical lessons, those insights, and for telling us more about the projects that you've got going on. It was a really great and insightful conversation, so thank you so much for joining us.

VIK PANT: Likewise. Thank you, Olivia, it's my pleasure. Thank you for having me.

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OLIVIA NEAL: Thank you to our guest, Dr. Vik Pant, and thank you to you for joining me today on Public Sector Future. Our goal is for you to learn something new and to be inspired to think differently about your own journey. If you enjoyed today's episode and want to help others find it, please share, rate and review the show.

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