Canada's Artificial Intelligence Landscape: Expert opinions

Background

Artificial intelligence technologies such as machine learning, natural language processing, and computer vision are becoming critical building blocks for advanced manufacturing. To better understand how NGen can work with its membership to improve development and adoption of these technologies in Canada, a survey of 30 AI expert members was conducted. This was then followed by more in-depth one on one conversations to explore ideas for new initiatives and collaboration.

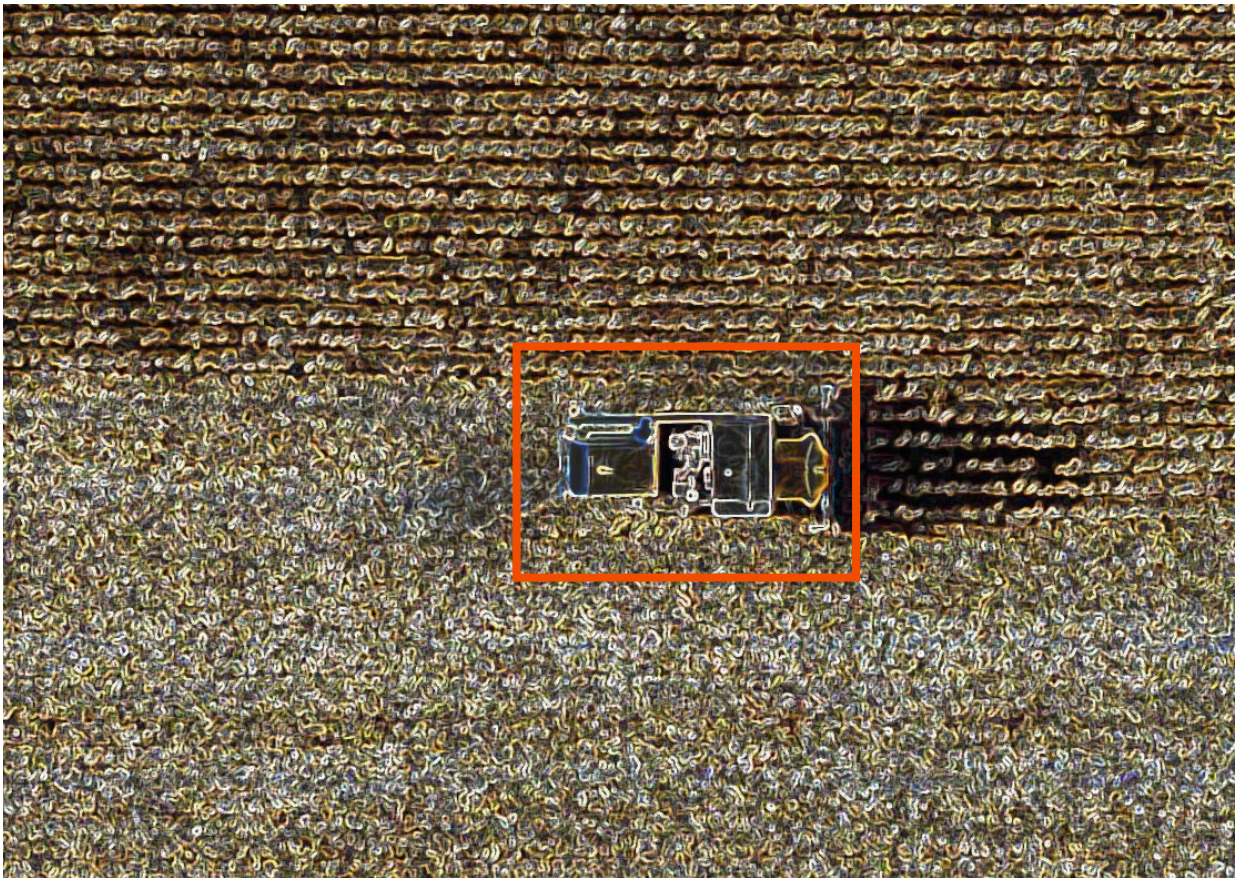


Figure 1 Food scarcity remains a major global issue and it is projected to get worse—the United Nations Food and Agriculture Organization (FAO) estimates that food production will have to nearly double in the next thirty years. In February 2021 the Aspire Food Group announced they would tackle this pressing problem and they began constructing a state-of-the-art cricket farming protein production facility in London, Ontario. With backing from Next Generation Manufacturing Canada (NGen)—Canada's Advanced Manufacturing Supercluster—and with support from several industry-leading partners, the $72M+ project is constructing the smartest indoor protein production facility in the world. Aspire is addressing the issue of high pricing by introducing automation, ASRS, sensors, AI, and densification technologies into their facilities.

Artificial Intelligence– What is it, why is it important, and how does Canada rank?

We all make use of artificial intelligence daily. When we unlock our phone with a thumbprint, or a facial scan. When we ask for navigation instructions on a GPS, or simply get search results on the web. Artificial intelligence is behind all of these tools we now take for granted.

The global AI market size was estimated at USD 62.35 billion in 2020 and is expected to reach USD 93.53 billion in 2021[1]. It is expected to grow at a compound annual growth rate of 40.2% from 2021 to 2028 to reach USD 997.77 billion by 2028. The advertising and media segment led the AI market and accounted for more than an 18.0% share of the global revenue in 2020.

If beauty is in the eye of the beholder, then perhaps artificial intelligence is in the mind of the beholder. It can be a tool for improving efficiency, detecting patterns or anomalies, predicting the future. Artificial intelligence can give a business competitive advantage – imagine a race to an unknown urban destination between two identical vehicles, one with GPS, and one without – which will most likely win?

AI fundamentally enables new digital services like proactive maintenance – "we'll call you" before your equipment breaks down, because we have detected abnormal behaviour by continuously monitoring data from your plant. The business value for this is very high, especially in a country as large and remote as Canada.

Fundamentally artificial intelligence requires data to run – it is the fuel for the software engine. Without the right fuel the engine will run poorly, or not at all. But with the right data artificial intelligence can control processes with more precision, representing billions of dollars of improvement to the bottom line in industries like chemical, oil and gas, and power distribution.

Developing new solutions using AI has to some extent completely levelled the playing field. Large corporations no longer necessarily have an advantage when the required data may simply not exist yet. A small lab in Canada can potentially compete on a global stage.

Another unique characteristic of AI is its ability to solve difficult, narrow problems. This suggests many customised solutions will be needed. If smaller companies armed with the right AI tools can compete on a World stage, then Canada could exploit its economic makeup, delivering customised and profitable digital solutions.

Given the diverse nature of AI technologies, league tables showing Canada's ranking are both rare and likely to provoke debate, but Figure 2 is from a Sept 2021 OECD report showing AI funding for several countries. Unsurprisingly spending in the US, Europe and even Great Britain, appears much higher than in Canada.

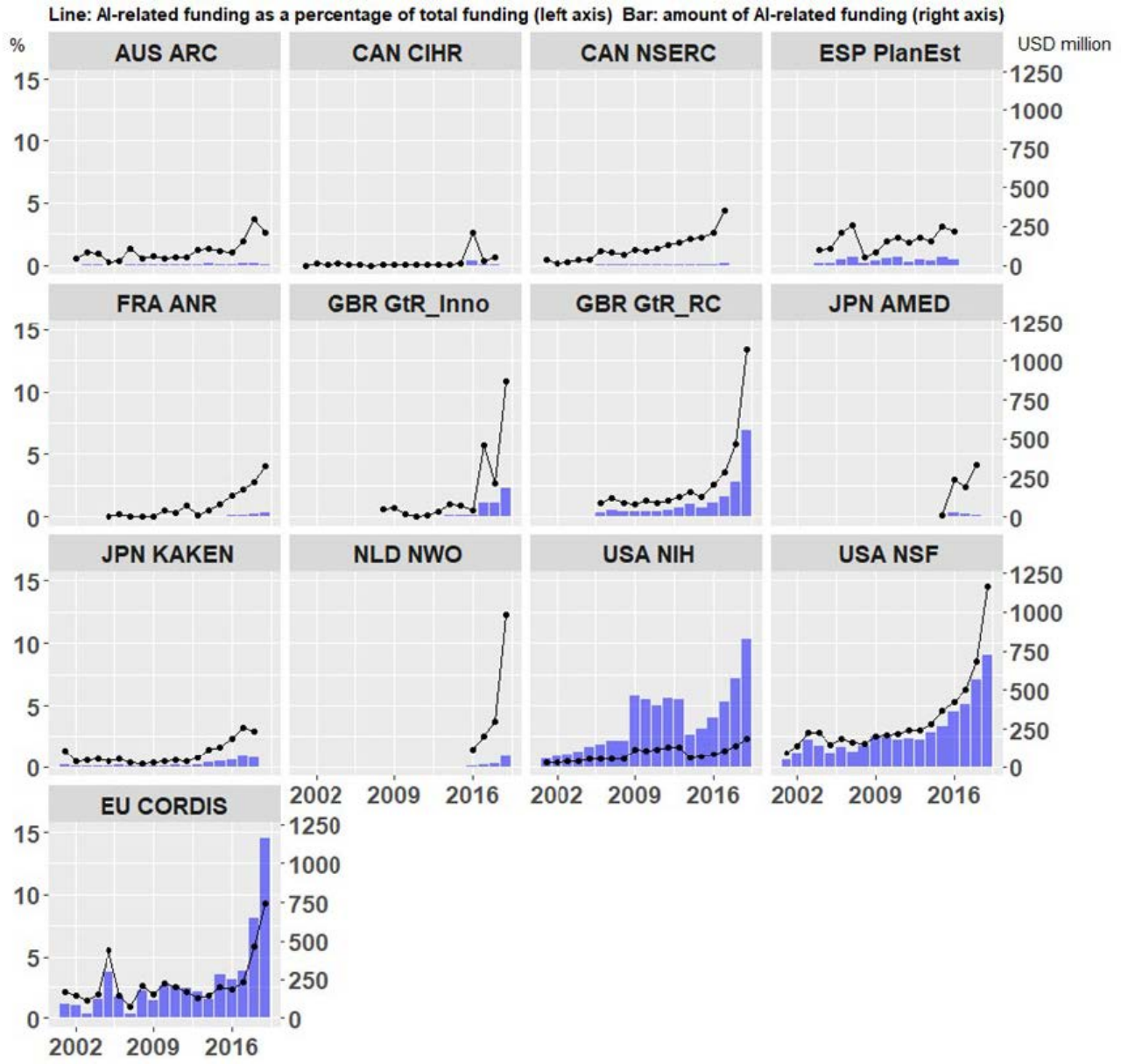


Figure 2 Estimated AI-related R&D funding within selected agencies, 2001-2019 (OECD Report[2])

NGen Artificial Intelligence Advisory Board

To better understand how NGen could help increase adoption of artificial intelligence (AI) across Canada, an advisory board was formed. The initial advisory group consisted of 30 organisations deeply involved in Canada's AI ecosystem, see Table 1.

Accenture – Jim Tsilemos	**JITbase** - Frederic Scherer
AgiLean - Alexandre Dubé	**LabsCubed** - Jeffrey Petracca
Alberta Machine Intelligence Institute - Cam Linke	**Leesta** - Pierre Ayotte
Answer Precision Technologies - Greg Skvortsoff	**Lemay AI** - Ryan Wallace
Augmenta AI - Francesco Iorio	**Maya HTT** - Remi Duquette
Autodesk - Matthew Spremulli	**Microsoft** - Michael Gardiner
Burloak Technologies – Peter Adams	**Moov AI** - Nicholas Morel
Canadian Industrial Hemp Corporation - Robert Ziner	**Nexas Networks Inc.** - Tom Gaasenbeek
Concordia University - Dr. Tsz-Ho Kwok	**NRC** - Dr. Guy Lamouche
Contextere Corp. - Carl Byers	**NRC (Quantum)** - Phil Kaye
Creabox Inc. - Chloé Durand	**NTwist** - Chowdary Meenavilli
Darwin AI - Arif Virani	**Praemo** - Paul Boris
DeepSense - Jennifer LaPlante	**Scale AI** - Clement Bourgogne
FreePoint - Paul Hogendoorn	**UoT** - Padraic Foley
IBM - Fariha Khan	**Vector Institute** - Michiel Vos

Table 1 Members of NGen AI advisory board

An initial meeting was held in June 2021. The advisory group members briefly described focus areas for their organisations. The group generally agreed that more collaboration amongst the smaller Canadian suppliers, as well as promotion by NGen, could help increase industry adoption of AI.

An online survey of the group was conducted, to better understand the issues around AI adoption in Canada, and strengths and weaknesses in the ecosystem. The survey was then followed by one-on-one interviews, typically 30-45 minutes, to explore individual experiences, opinions, and suggestions for action. The survey group is only a sample of Canada's significant AI ecosystem, but common themes still frequently emerged. This report summarises the survey results and discusses the interview findings.

Survey Results

The initial survey questions were designed to give an overview of solutions offered by the respondents, and the specific application areas for artificial intelligence. Nearly half the survey respondents identified themselves as technology providers, with diverse representation from manufacturers to researchers, as shown in Figure 3.

Aerospace and automotive were the largest markets cited, although sectors were quite evenly represented, see Figure 4. "Other sectors" included ocean, biomedical, packaging and construction.

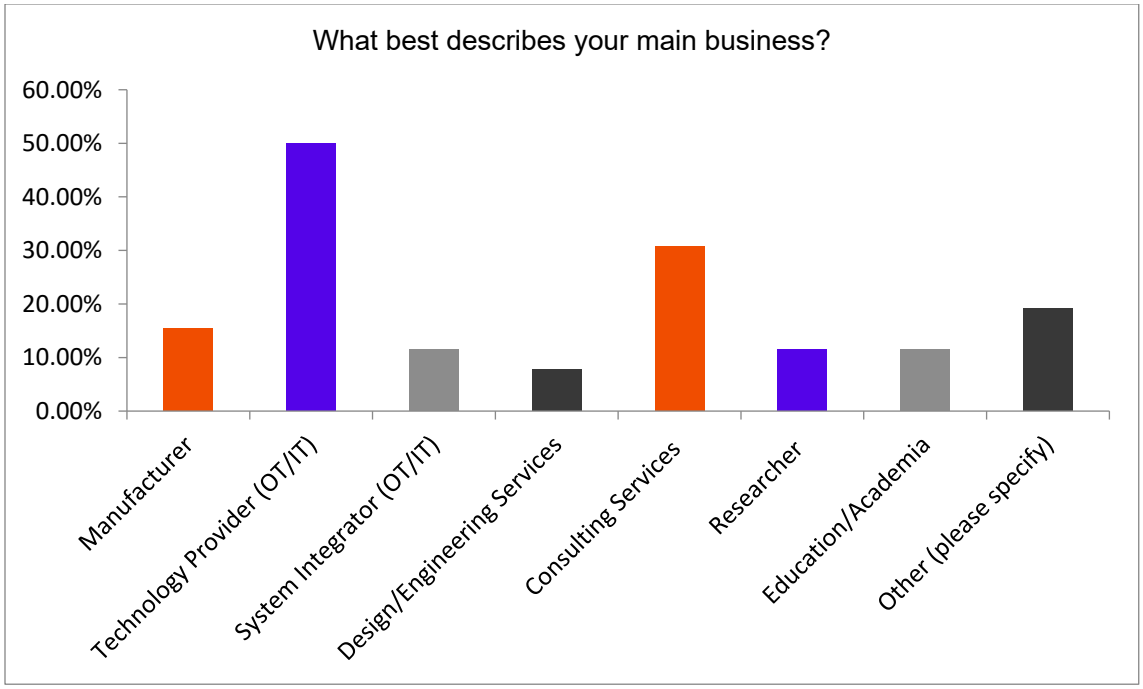


Figure 3

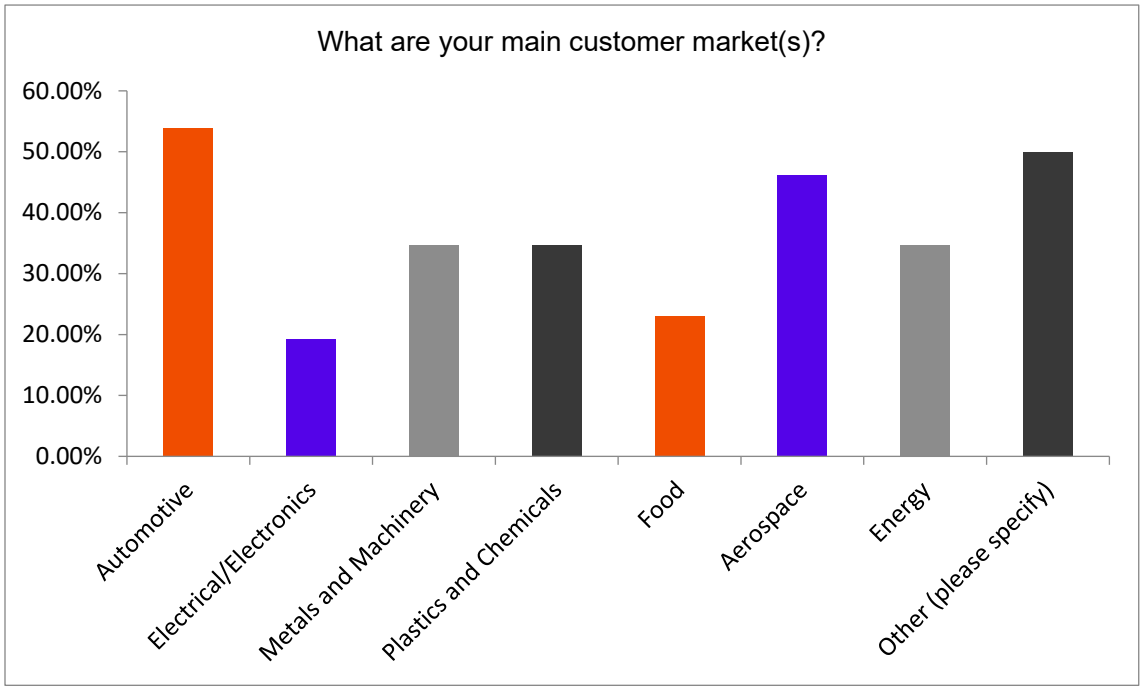


Figure 4

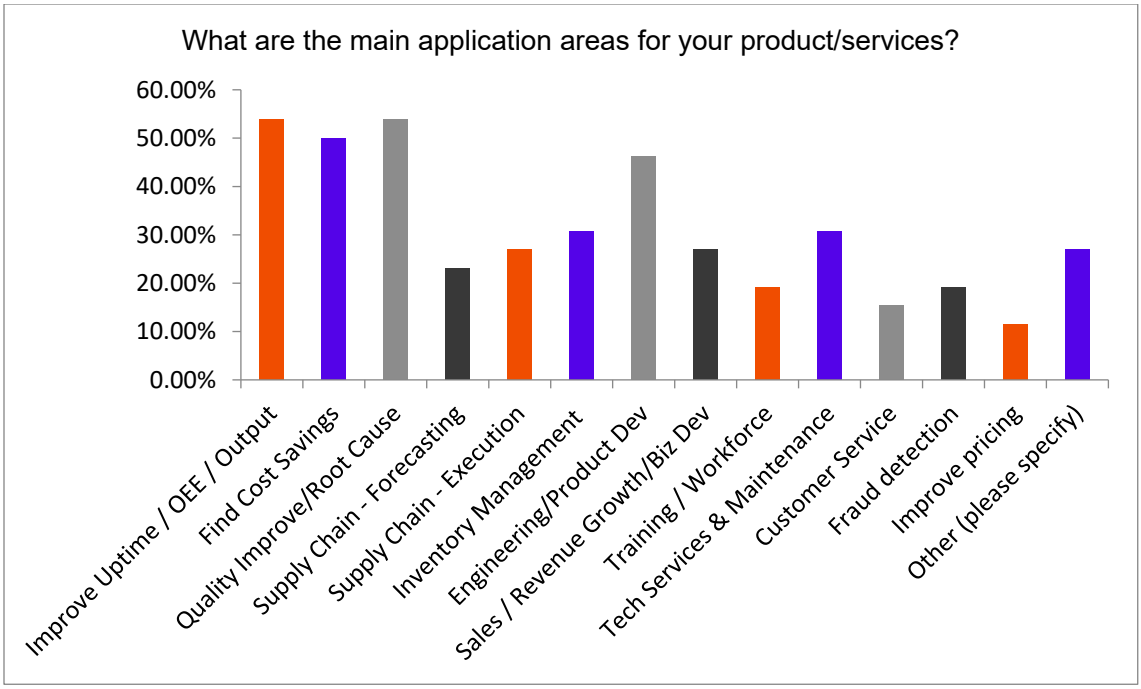


Figure 5

The first sign of the ubiquitous nature of AI came in the very wide range of application areas cited by survey respondents, as shown in Figure 5. Efficiency improvement and cost reduction were stronger themes than new business growth. The majority of business was generated inside Canada (see Figure 6), in contrast to the finding with Automation and Robotics, where the majority of sales were outside Canada.

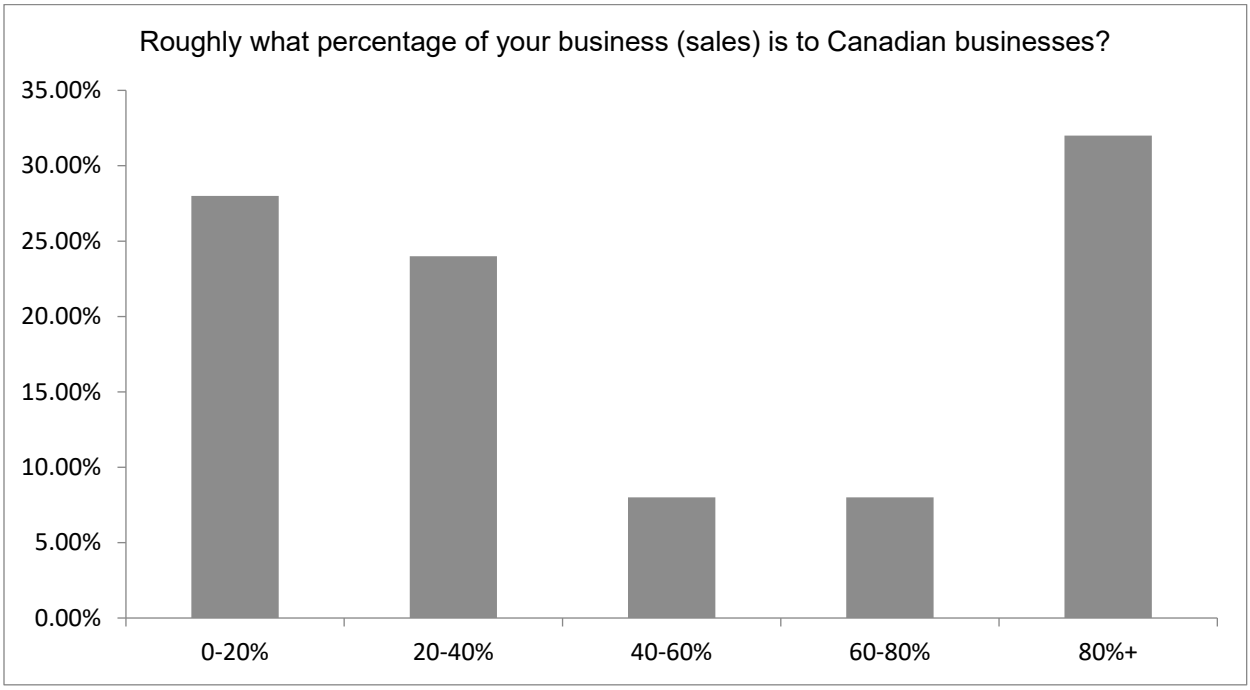


Figure 6

Opinion was consistently negative on whether Canadian companies had a good understanding of the business case for AI (Figure 7), with respondents feeling companies generally were NOT well informed, and this perception is validated by the significant proportion of time most respondents later said they had to spend helping educate their potential customers.

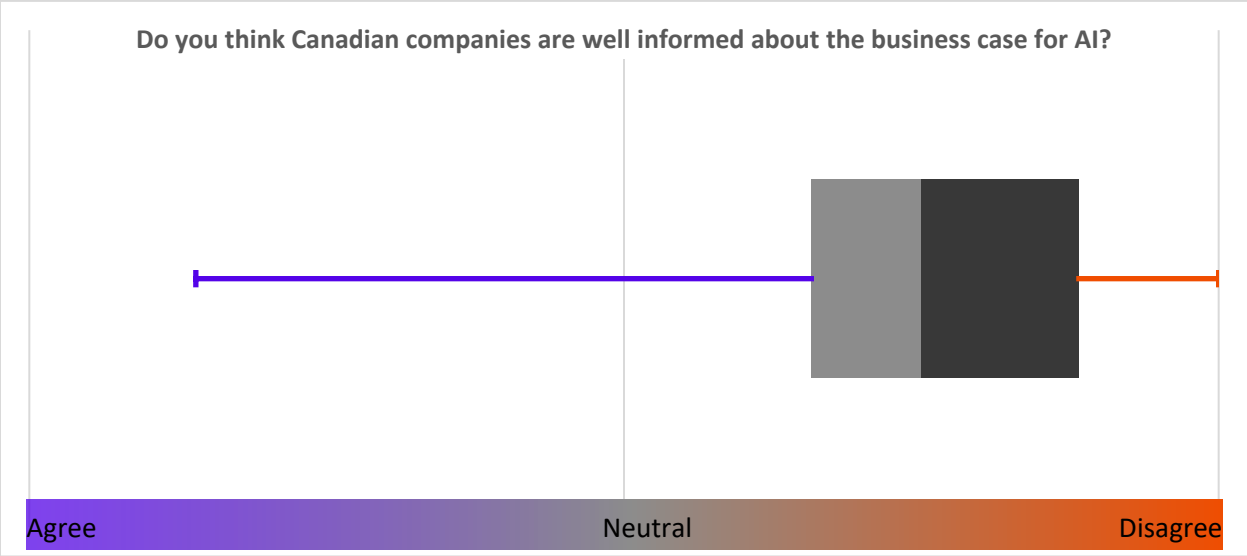


Figure 7

Respondents were then asked "How could awareness about AI be improved in Canada?" and some of the responses are shown in Table 2. A common theme was to share "costed" case studies across multiple sectors and applications.

"Show how AI will impact the bottom line."
"Create tools to develop business cases using the data and systems companies already have."
"Promote and enable better sharing of information between peers (AI success stories)"
"Share practical examples that map to a variety of manufacturing environments/applications and company sizes."
"Are you AI ready series of workshops which are truly helpful to align business challenges and AI tech usage."
"Businesses must understand that AI is an approach to unlocking value and not the actual solution in itself. Until recently, AI was either seen as a magical seasoning that once sprinkled on challenges, magic happened or that AI was still an "internal innovation lab" sponsored by a visionary executive team."
"By showing applications and benefits (real benefits) that speaks to management who are responsible for decision making."

Table 2 "How could awareness about AI be improved in Canada?"

The survey asked for examples of the best use cases for AI deployed (or planned) across Canada. Interestingly only a few specific examples were given, possibly because of confidentiality and/or modesty. Specific examples cited are listed in Table 3. An interesting answer was: ***"If Canada intends to gain competitiveness, it needs to push a different type of "best" - leading edge technology."*** The respondent explained that if (for example) vision systems/applications are regarded as "best examples" right now then a better direction for Canada would be ***"to pioneer AI for use in product/process design aid/automation, connected with intelligent manufacturing."***

New protein manufacturing facility in London, ON with Aspire / NGEN / Telus/ Swift labs
MAPs (Material Acceleration Platforms) are an emerging tech that use automation and AI to greatly accelerate novel material development UofT/NRCan
Mila (Quebec Artificial Intelligence Institute) within Canada. Specifically, the AI-for-Humanity initiatives
IREQ (Institut de recherche d'Hydro-Quebec) - these kinds of projects demonstrate how AI can be used to intelligently deploy high value manufactured assets in the field - optimized for energy collection but also balanced for local ecology

Table 3 Describe the best use case of AI deployed (or planned) in Canada

A follow up question asked respondents to list application areas for artificial intelligence that were most under exploited in Canada. Answers were diverse with no common theme; however, manufacturing and construction were the most mentioned sectors. There were some interesting, specific, suggestions:

"VIA rail. It's mind blowing that they can't (don't) inform passengers waiting for trains, or people waiting to pick up passengers, that a train is late, on time, or when it will arrive. Same with public transit buses. Service can be vastly improved not by running on time, but by giving users accurate to-the-minute info, avoiding the aggravation of missing a bus by 2 minutes, or getting there 20 minutes early and standing in the cold or rain to avoid missing a bus. This is too easy not to do, and would greatly improve the user's ridership experience."

"Architecture, Engineering, and Construction (AEC) is very under-exploited in the use of AI in Canada. Many offices/firms and companies are curious but not sure 'where'/'how' to start exploring this topic. - this topic could be expanded upon further to include:

- ***Architectural design for new spaces (pandemic friendly)***
- ***Engineering for optimal structural design and preventative maintenance***
- ***Construction with data collection for safety planning and site coordination***
- ***Manufacturing (and Product Design)"***

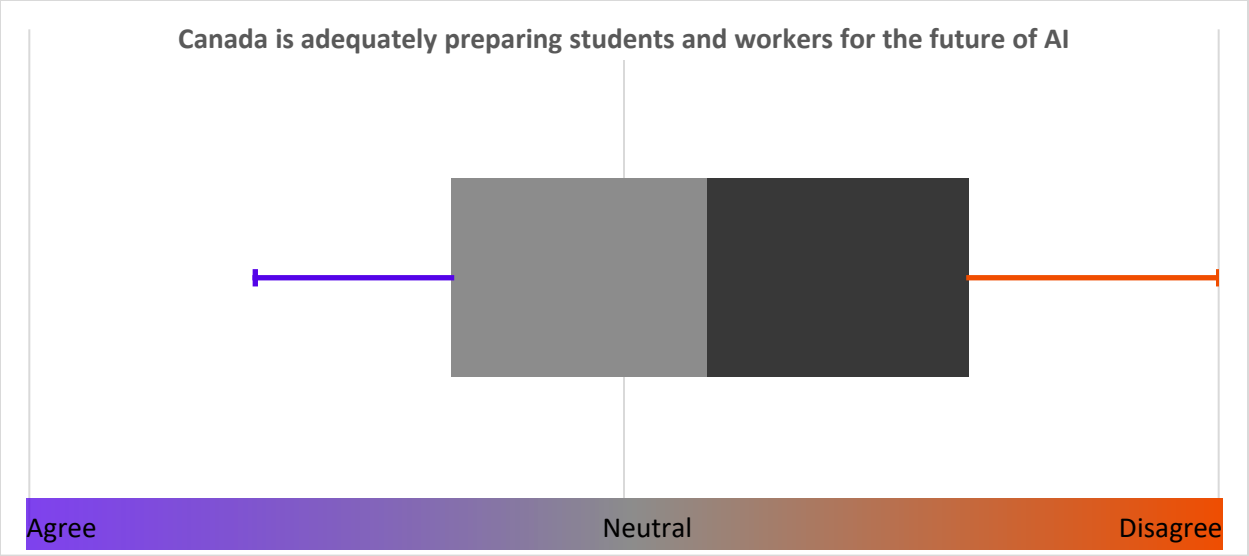


Figure 8

Opinion was neutral on whether students and future workers were being adequately prepared to work with AI (Figure 8).

Skill sets needed for AI adoption by SME's were strongly related to data (capture, analytics, science), and surprisingly the business case was not highlighted as a skill gap (Figure 9) despite many comments elsewhere in the survey that indicate this is a critical factor in adoption.

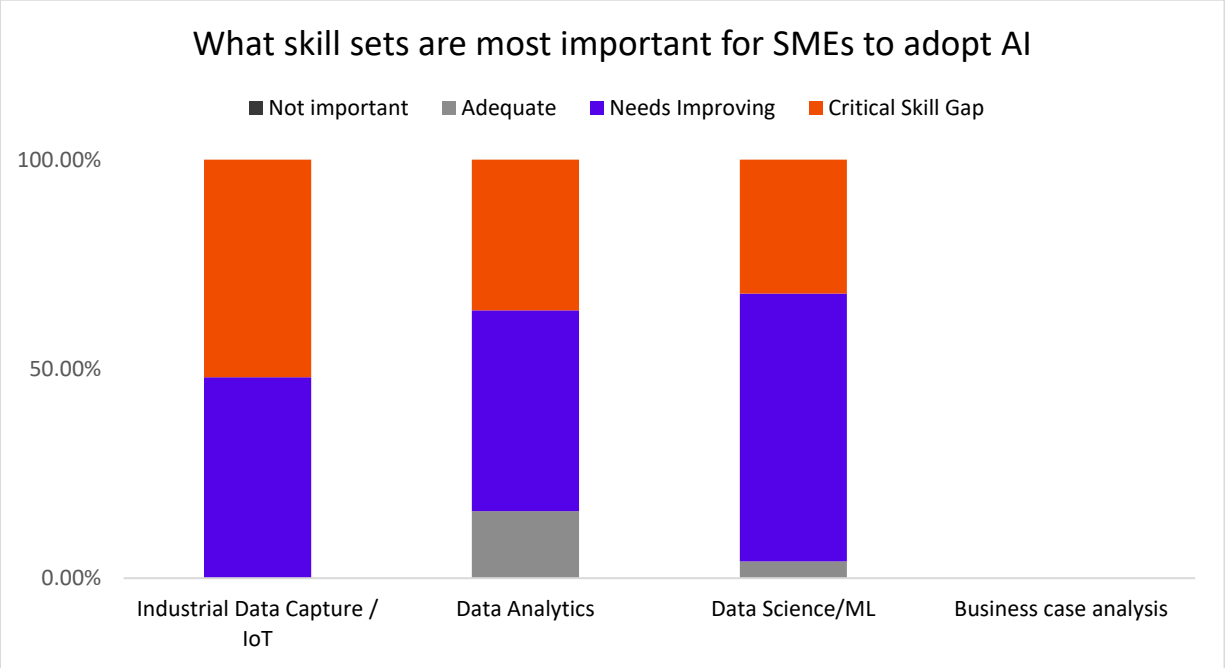


Figure 9

Respondents were asked for examples of AI skills training in Canada. The most common answer was “unsure”, followed by university programmes: ETS, Dawson College, Waterloo, McGill and U of T were mentioned as was MILA, Vector Institute, and AMI Canadian Startup: Korbit AI.

"Cross-training collaborations between AI/ML experts and industry experts can be a useful model to build knowledge and skills on both sides of academics and industry. Autodesk’s AI For Engineering Summer School program was a 2-week long program that tried to bridge the gap between academics and engineering industry interests.” (Video link below)

https://vimeo.com/Autodesk - AI For Engineering Summer School 2019

Asked if NGen can help with AI upskilling, the general sentiment was yes, with respondents evenly divided as to whether this should be via promotion, hosting or funding of activities. The following answers captures most of these elements.

“I believe that NGen can (help) with curating or directing companies to a series of 101 courses with academic partners which can get into the details of AI/ML and work through some real life examples. At a level where decision makers can understand the technology and make a decision on how to create a deeper roadmap on the technology's use. Also to obtain some funding to help with the next level in-depth courses.”

“Yes (NGen can help). Documents/Webinars breaking down AI into its various components in an easy to understand manner. Creating something like a portal/link that easily links additional learning resources, classes and connections, that is very easy, direct, and quick to use.”

The strengths and weaknesses impacting AI adoption in Canada showed positive perception of technology and US customers, as well as interestingly, Canadian competitors. The most negative factors were digital (and data) maturity, AI awareness and the impact of the pandemic (Figure 10).

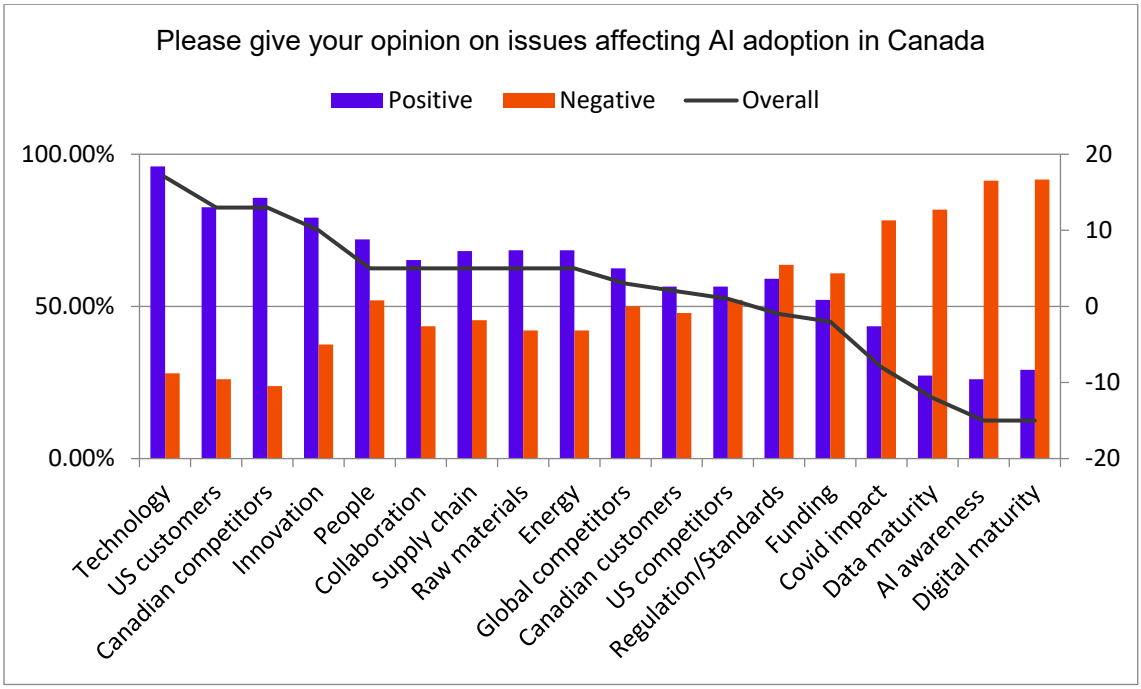


Figure 10

The survey also asked respondents for open ended opinions on Canada's structural advantages and disadvantages. Overwhelmingly the biggest advantage Canada has in AI is academic/research talent, with over two thirds of respondents citing this as a strength.

The conservative/slow pace of investment by Canadian businesses was cited as a weakness by a third of respondents. Also, the small size of Canadian suppliers in the AI ecosystem was often regarded suspiciously here (again reflecting a conservative mindset), whereas in complete contrast the US approach was often to actively outsource innovation to small suppliers! The lack of understanding about AI, and practical applications linking academic research and industry was also often cited as a Canadian failing. Brain drain to the US in particular was also mentioned as a concern.

When asked for actions to improve adoption of AI in Canada, the responses clustered around phrases such as increasing awareness, education and funding, although most responses lacked any detail. What follows is one of the more specific answers.

"Build more cross-training efforts between academia and industry - right now it feels like there is academic groups who hold a lot of knowledge in AI but rarely know how to apply it (at least outside of Fintech and Healthtech) -- we should be promoting more experimental engagements between industries that could benefit from AI - and see

what we get - Build data/AI fluency from a younger age -- take lessons from Dawson College in Montreal (AI for Everyone) and ensure that our next generation of Canadians can engage in AI related conversations (at a bare minimum) - Create tax-incentives for companies to experiment with AI
-- many existing companies do not want to take a risk (money, time, energy) on an AI project or building an AI team -- provide companies with a 'haven' to explore this and recoup money for their innovative attempts"

The survey asked what question(s) would they like to pose to NGen's membership (over 4000 organisations and individuals across Canada). The full list is reproduced in Table 4.

What are the barriers to implementing an AI solution?
What data driven solution do you think would help your operations improve the bottom line
none
Why are companies so slow to adopt? Why are large consultancies the go to providers? How would industrial operators be motivated to move faster?
For manufacturers - where are you currently using AI today? What barriers do you face when implementing AI systems?
Specifically, how have you incorporated AI/ML in your business operations? Where do you place yourself on the TRL-equivalent maturity spectrum with respect to your AI adoption/implementation.
What do you know and understand how AI could help your organization? How are your competitors are using al? How prepare to embed AI into your operations?
What manufacturing field has the deepest need for AI?
What business use cases are you thinking of deploying AI for? What is your industry 4.0 maturity level? What industrial data are you collecting today? What data do you think you should be collecting but know you are not today?
What issues members have faced during adopting or deploying AI and how they overcame those issues.
What are the main hurdles to implementation (from ideation)
Would you be ready for even the most basic use of AI in your process/workflow/business?
What is AI/ML? Do you presently utilize the technology? How do you use it?
What initiatives are you planning to develop in the next year?
What do you feel is the most significant barrier to adoption of AI within your company?
What are the efforts to make AI more popular outside of Fintech and Healthtech that exist today? Or are there plans to do so in the near future? If so ... what are these?
Do you understand the variability in your process? Do you single source of truth of your production (reconcile the quality to raw materials in product) ?
Why would your company NOT do an AI project?
Why haven't you started yet? What's keeping you from taking your first step?
Where AI can be applied to your business.
Do they agree that AI-driven bio-engineering is the next frontier - or .. what will THEY be ...
How much money and time would you comfortably invest in an AI production pilot?

Table 4 What question(s) would you like to ask NGen's membership about AI?

The lack of awareness by Canadian businesses to the benefits of AI was highlighted in the skewed response shown in Figure 11, with nearly 80% responding customers were either "not so aware", or "not at all aware" (of the benefits).

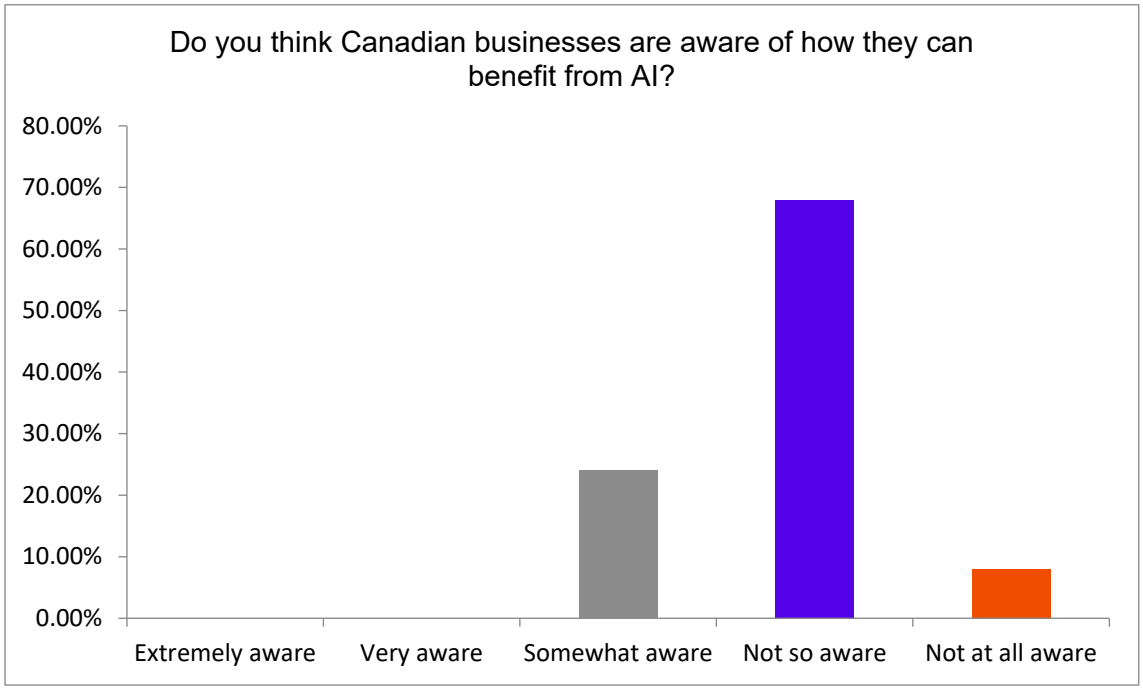


Figure 11

When asked about customer knowledge about AI products and services the responses were quite variable. There seems to be a fuzzy high-level desire to use AI to "improve", often frustrated by a lack of connection with and understanding of the data required. (See the later discussion on the "Data Value Gap" model proposed by DeepSense, and data foundations from Accenture).

"About 10% understand and are ready to adopt AI. The remainder are still exploring potential use cases. In some situations, a use case is identified but a gap exists: data is not available or sufficient to create an AI solution, or the company lacks the skills and tech to be able to create and use AI in operations (they are unique skills beyond current tech operations)"

"Typically the customer think they have a problem AI can help them with. Unfortunately, many do not have the data maturity level and digital operations maturity level to successfully deploy an AI solution. The journey towards AI is always longer due to the wrong initial expectations of what is needed to run an ML-driven industrial operational environment."

"Very knowledgeable at a high level about the kinds of problems AI (traditionally) can be applied to (BI/analytics/forecasting). Quite oblivious to the full spectrum of opportunities (design automation, intelligent manufacturing, fully automated QA, etc.)."

"My typical customer, at the direction or influence level, is looking to make it to the end of their career, deferring such things to the next generation that comes in after they retire. They know its

coming, they know its needed, but they don't think they can do it, so they are deferring it to the next generation that comes in after they've left."

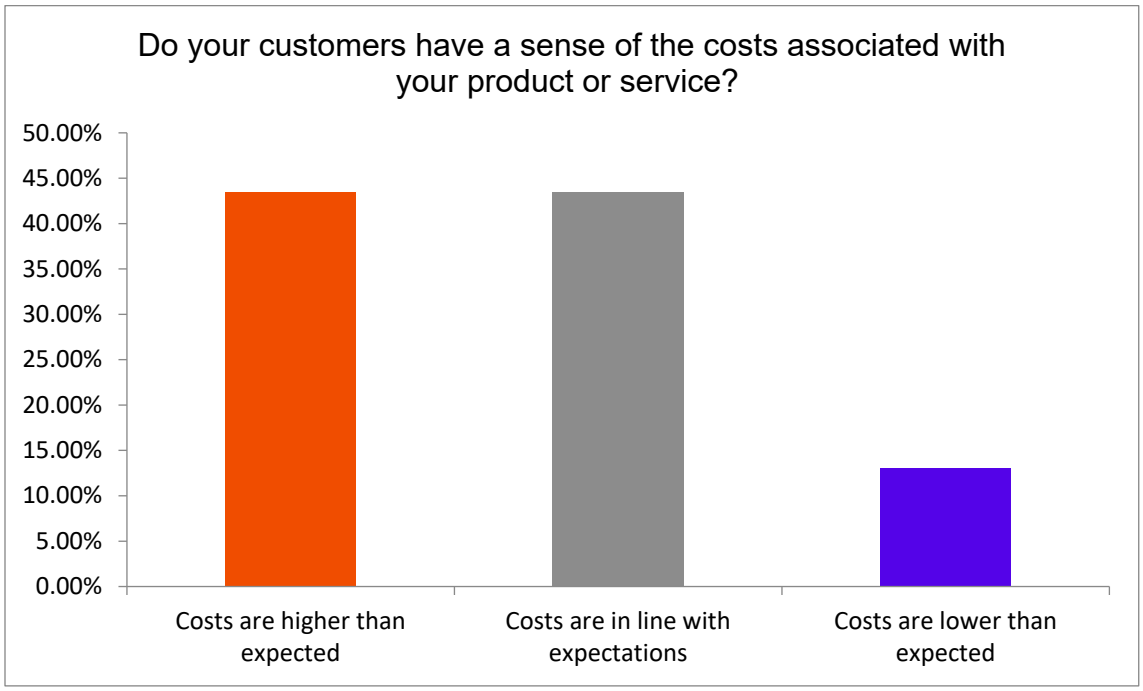


Figure 12

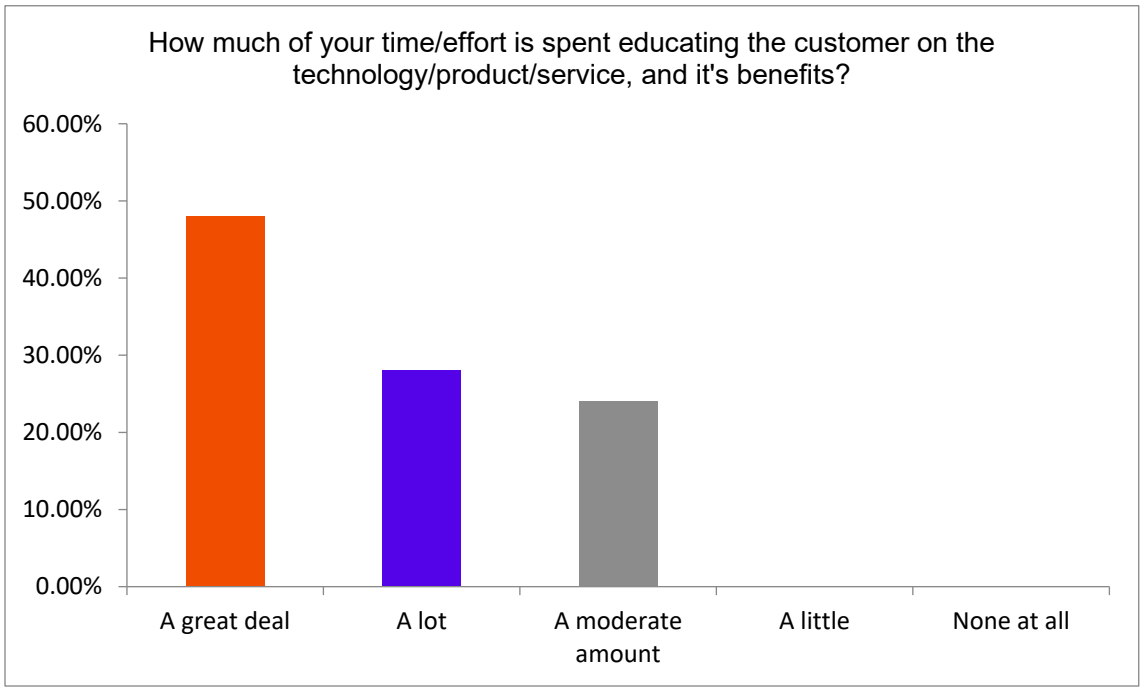


Figure 13

It was clear that expectations about both the capability and implementation costs of AI were often poor, and much effort was spent trying to better educate customers, as shown in Figure 13 and Figure 14.

Creating new AI demonstration resources for Canada was broadly supported, (Figure 14), as the list of existing resources appeared short – MILA, Vector, ScaleAI, IVADO and AMII were mentioned.

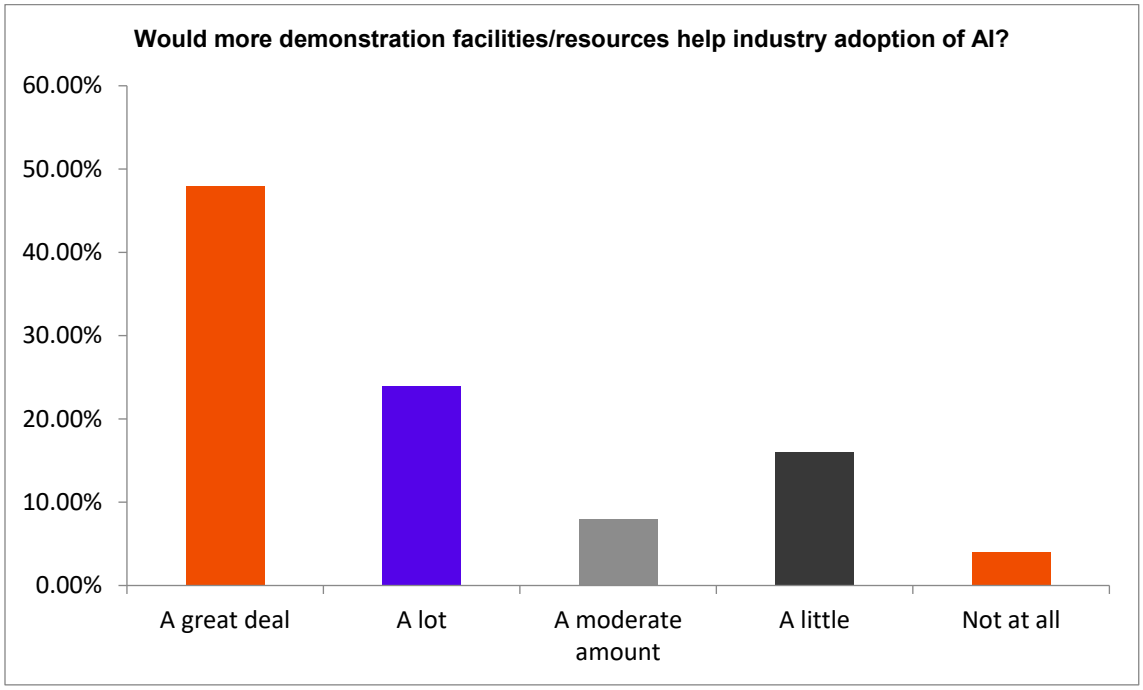


Figure 14

The respondents were very evenly split as to whether any new demo resources should be physical, virtual or both.

"Ideally physical if a lot of hardware is being used. Typically in person events are a lot better for networking."

"Both - virtual for education, demonstrations. Physical for proof"

"Virtual and allow users to filter use cases by the objectives, challenges or opportunities that are relevant to them."

"$10Bn left on the table"

Any process that suffers from drift or disturbance can be better controlled if it is continuously monitored. Often industry/business data is only reviewed periodically by subject matter experts. This is inefficient, and as one respondent noted ***"gut feel is typically used for decision making rather than data. The downside to this is the variability in decision making from gut feel."*** The same respondent continued: ***"A 2% improvement in efficiency, from AI controlled processes, translates to $10Bn that is currently left on the table in the chemical industry."***

The oil and gas industry in Canada has much to gain from artificial intelligence, and the Alberta Machine Intelligence Institute (AMII) has published an useful report on the role machine learning can play.[3]

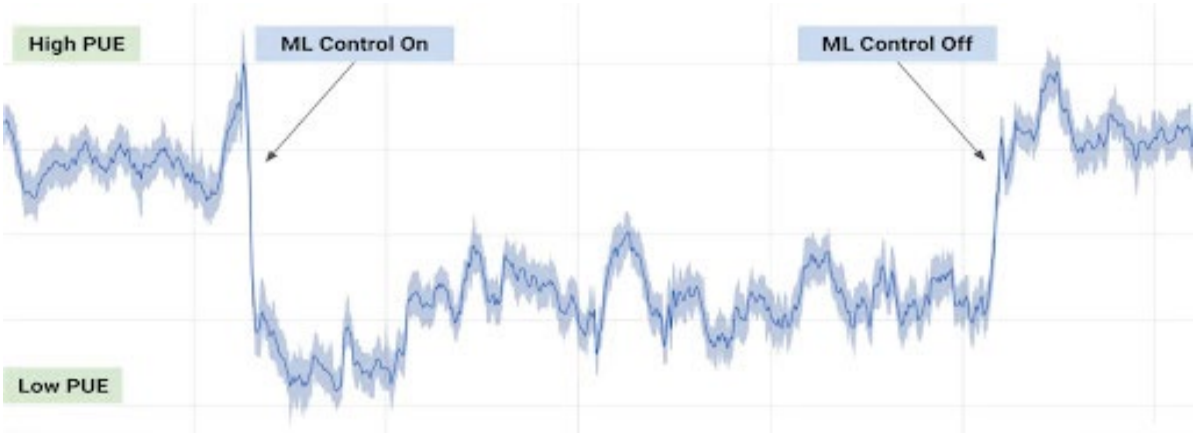


Figure 15 Machine Learning (ML) was able to consistently achieve a 40 percent reduction in the amount of energy used for cooling at Google data centres[4]

A more subtle point regarding process control is that human operators may not be incentivised to experiment with complex control or formula decisions, like how much recycled vs virgin material to add into a process. It may be easier for the operator (less risky) to use only virgin material, but ultimately more costly for the business.

A practical example of how AI can provide proven process improvement was demonstrated by BluWave-ai, who have developed models using data from PEI. Optimizing the renewable energy mix in its grid using BluWave-ai's predictive technology yielded up to a 50% improvement in energy scheduling accuracy for Summerside Electric. This (now) proven solution then led to a recent export agreement for BluWave-ai with Tata Power in India (see sidebar).

Success Story: BluWave-ai

"It is very exciting to see BluWave-ai take ***AI models that were delivered into live systems in Summerside Canada and retrain and deploy with Tata Power in Mumbai India***, leveraging support from our Fund," said Leah Lawrence President of Sustainable Development Technologies Canada (SDTC), "This is an excellent example of Canadian Export focused cleantech innovation, using AI and data to get more efficiency and reduce carbon footprint in electricity smart grids."

“Our team at BluWave-ai has sought out innovative early adopters of complex AI technologies to onboard our products. We have focused on working with leading global energy companies, such as Tata, to build the world’s premier AI cleantech company," said Devashish Paul, CEO of BluWave-ai, “In Canada, our solutions delivered the first real-time AI electric utility dispatch. We were able to take our platform and quickly train it for the Indian market using real-time data from Mumbai to integrate with Tata Power’s utility operations. This technology provides our customers a solution that realizes significant financial benefit from the 35,000+ yearly electricity dispatches.”

BluWave-ai is thrilled to continue to work with Tata Power in this historic Canada-India partnership driving innovation in the global energy transition as the world emerges from the COVID-19 pandemic, into an exciting, more sustainable, and more prosperous future.

Text and image BluWave

While there is often a desire at the top of the organisation to use AI, this can be frustrated by what DeepSense call a "Data Value Gap" between the top and the operational, coal face of the business, as shown in Figure 16.

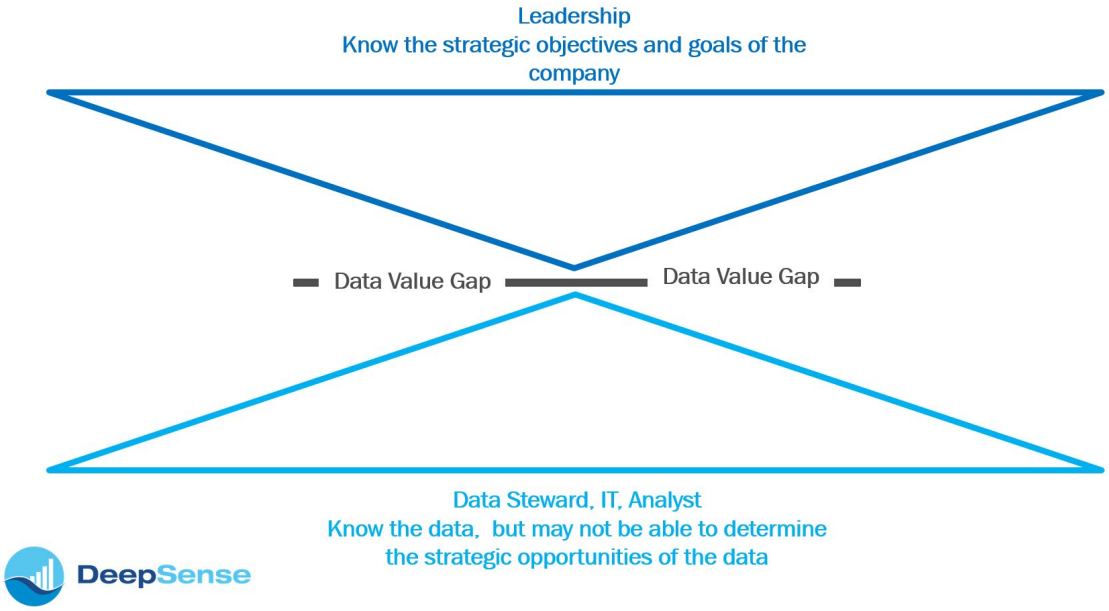


Figure 16 Data Value Gap (Courtesy of DeepSense)

Another common problem identified by most survey respondents is the lack of immediately useful or even usable data in many organisations. While it may be possible to "wrangle" data for a one-off AI project demonstrator, getting to the next level is much harder without the right data foundation in place. A clear vision of upstream (where data originates) and downstream (where and how will data be used) requirements needs to be part of a strategic plan. Fixing legacy applications may be simply uneconomic, but new systems should be properly planned as part of an organisation's data journey (see Figure 17).

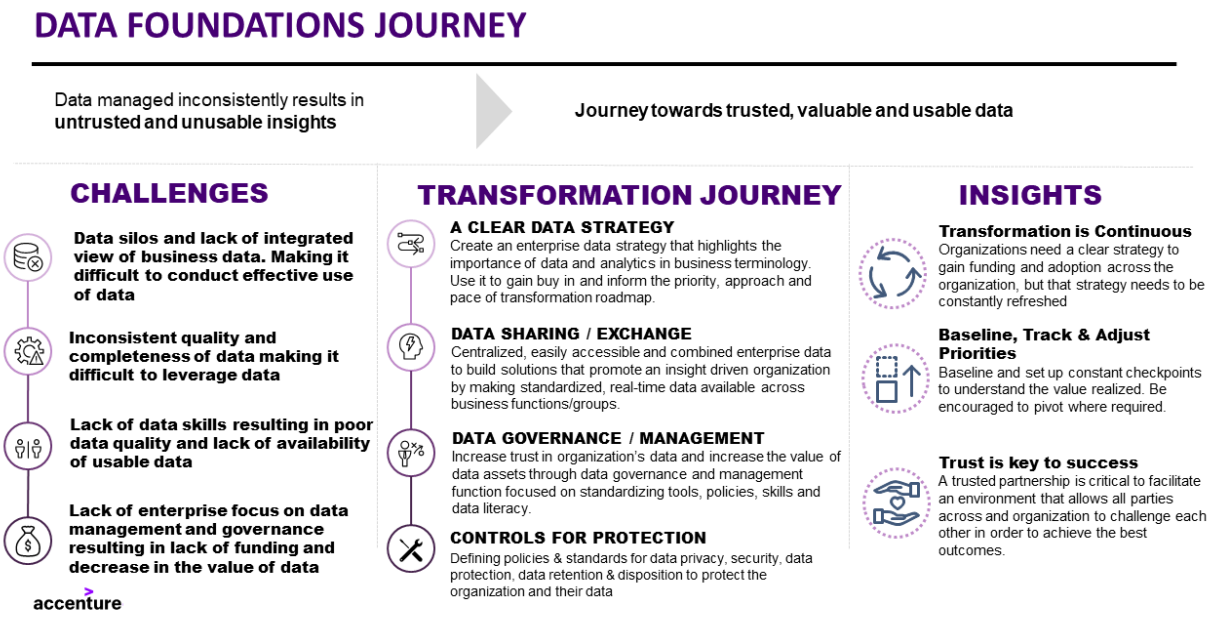


Figure 17 Data Foundations (Courtesy of Accenture)

There are many opportunities for Canada to capitalise on the unique nature of AI. It is sometimes seen as a disadvantage that Canada is not home to many multinational corporations. While large companies may have a disproportionate amount of data, it is a fallacy that they therefore have an advantage, since the data for new endeavors may simply not exist yet. As one respondent wryly noted, "there is fundamentally no reason why a giant like BASF should be able to discover a new material faster than a small lab in Oshawa."

Another respondent noted that recently a student was able to use AI to develop 40 new materials over a weekend in the lab, work that conventionally would have taken 9 months! AI is able to reduce 10 to15 steps in a process to maybe just 6, by novel combinations that were not obvious before.

IBM have published results from their MolGX platform, capable of deciphering patterns in the shape of the molecules claiming this is "the very basis of deciding the material properties. It will accelerate the development by 10 to 100 times – compared with the usual circumstances." [5]

The narrow capability of AI – to do difficult, but niche tasks - may be a tremendous opportunity for Canada, given our business makeup of many smaller organisations. Customised AI solutions, coupled with the higher profit margins afforded by digital services, could be a great economic engine. But clearly this transformation will not just happen by itself, and indeed is hampered by the lack of digital maturity endemic in these small businesses.

There is often a gap that an AI solution could fill between product and customer. For example, a company may manufacture an underwater drone (ROV) with a camera. The customer may use the drone to perform routine inspection of say a pipeline and require someone to monitor camera images to look for unexpected deterioration. Should the ROV manufacturer develop an AI solution to offer as a digital service to highlight anomalies? Alternatively, a new entrant can provide a solution, or the customer can develop in-house capability. Whatever path is taken, ultimately this is a growth opportunity for someone.

Businesses can transition from supplying physical products (parts/machinery) and augment this with new digital services, from simple preventive maintenance to more advanced, proactive monitoring exemplified by "We'll call you (when there's a problem)". The business value can be very high for such proactive solutions when locations are remote, and costs for getting people and equipment to site in an emergency mount quickly, along with the opportunity cost of the downtime.

Another advantage of this digital service (contributing to higher margins) is that it can often be cloud enabled, with no investment in infrastructure, and solutions can be tested and scaled easily, with security built in. An example is shown in Figure 18 where AI is used to enhance training assessment.

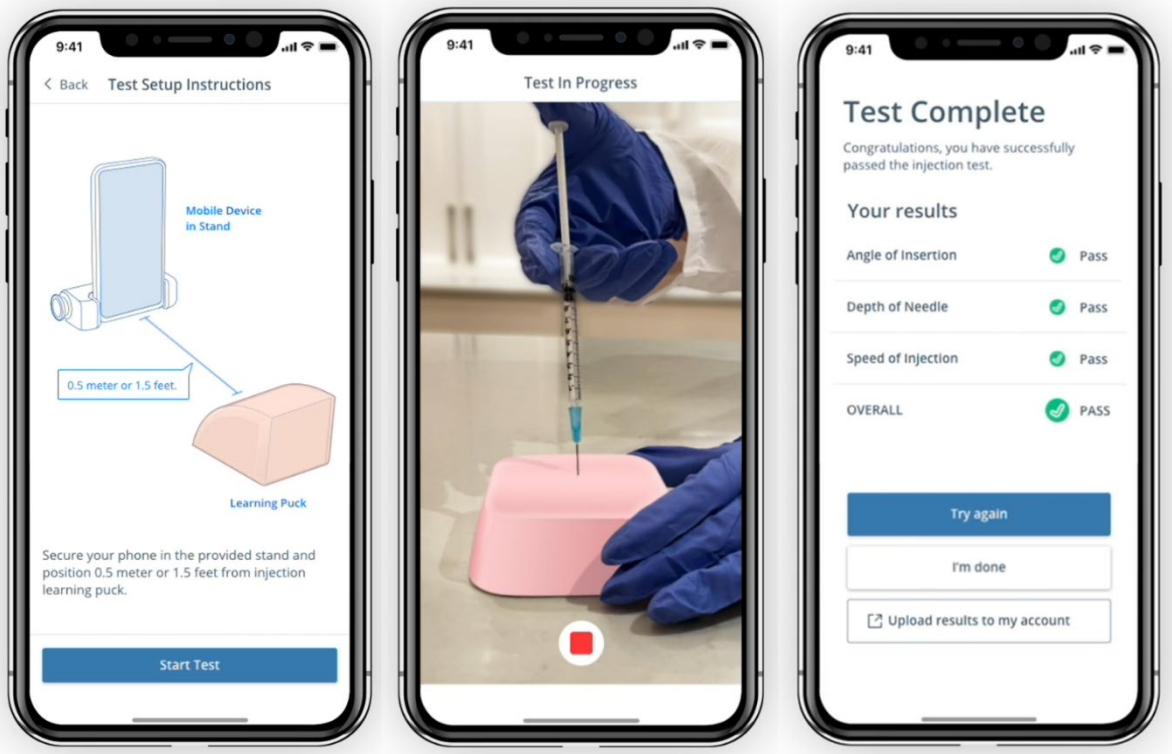


Figure 18 Use of AI and mobile device to provide enhanced training effectiveness (CAE)

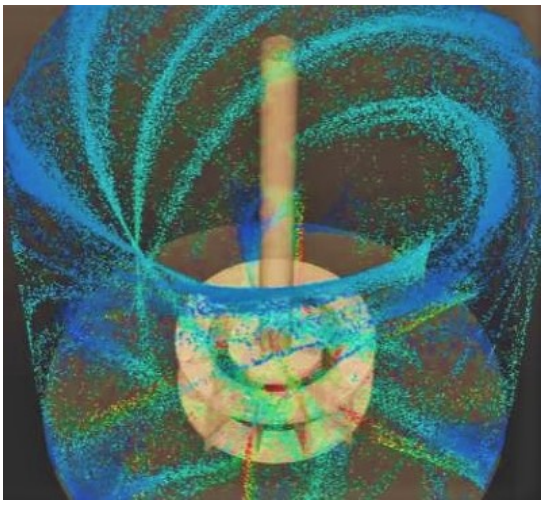
Canada does not appear to be leading in terms of process simulation, judged either by industry digital modelling investment/licenses, or programmes producing students at the same rate as eg Germany. While data science is good in Canada, students are not well connected with manufacturing. There is relentless pressure to improve manufacturing processes, and the global leaders always have world class digital twin/simulation capability. As one respondent noted, "we cannot afford not to be constantly improving, or we won't even be good enough to keep the business we have today."

"AI can participate in spades…."

While there has been much focus on the use of artificial intelligence with images, there has been much less work correlating form and function, specifically to aid design and manufacturing. What is the best shape (and material) to achieve certain functions, eg to absorb noise, or energy in a crash, or even for a factory. It is here that one respondent was convinced "AI can participate in spades", partly because "current tools are obsolete, and new AI solutions do not have to be all encompassing, they just have to solve particular problems."

Deep learning is already helping to produce functional approximation of FEA, where simulation may not be as fast or cheap as a surrogate model. However, simulation is only ever "one-way" (a particular, pre-defined configuration is examined), whereas AI offers the possibility of producing almost infinite solutions to the inverse problem – what shape and materials *could* a solution look like. Some of these solutions will never have been seen before, they are literally beyond the imagination of designers and engineers.

Applying AI in this way for form/function in the design and manufacturing space could be a tip of the spear approach where Canada could compete on the global stage, given strategic leadership. Although massive computational power is required, this can be shared, without the need for huge manufacturing investment. Using a funded "challenge" to drive both advancement and industrial adoption using a DARPA-like structure (project ultimately headed by one individual) was suggested during the interviews.



To illustrate an inverse design problem, imagine a large tank containing fluid that needs to be mixed. AI could estimate the forces needed to mix the fluid, and from this it could suggest the required shapes to create these forces, and in turn the powertrain requirements to drive the mixer.

Reducing machinery power requirements using AI in this way could enable new solutions towards achieving a net zero emissions goal.

Figure 19 Using AI to solve inverse manufacturing and design problems (image courtesy of Altair Canada)

"If you want to know what to do with it, you'll come to Canada…"

Figure 20 R&D in Quantum computing (Image courtesy of Microsoft Canada)

Canada has an active R&D community working in quantum computing. While it is true there are not yet many applications developed, quantum computing can solve some problems much faster than conventional computers, and it can also provide capabilities that are truly unique. In some cases quantum computers may have an exponential speed advantage, and sometimes polynomial (searching a database). Unique capabilities, with as yet unclear applications, include quantum sensing and unbreakable communication protocols.

Since machine learning is closely related to optimisation, quantum computers "should be good at this", said one respondent. Applications may still take 5-10 years to mature. However the respondent was bullish that while Canada could not win a manufacturing hardware race, it could be the place to come once you owned a quantum computer - "if you want to know what to do with it, you'll come to Canada, provided we develop the quantum applications here."

Providing a Pathway for Adoption

A web portal could offer value to NGen's members in a variety of ways. Firstly, it could provide valuable self evaluation tools for a company considering whether artificial intelligence is a viable solution to its problems. This would allow more efficient industry awareness, while simultaneously freeing up resource from the AI supplier base, who spend much of their time "educating the customer on the technology/product/service, and it's benefits."

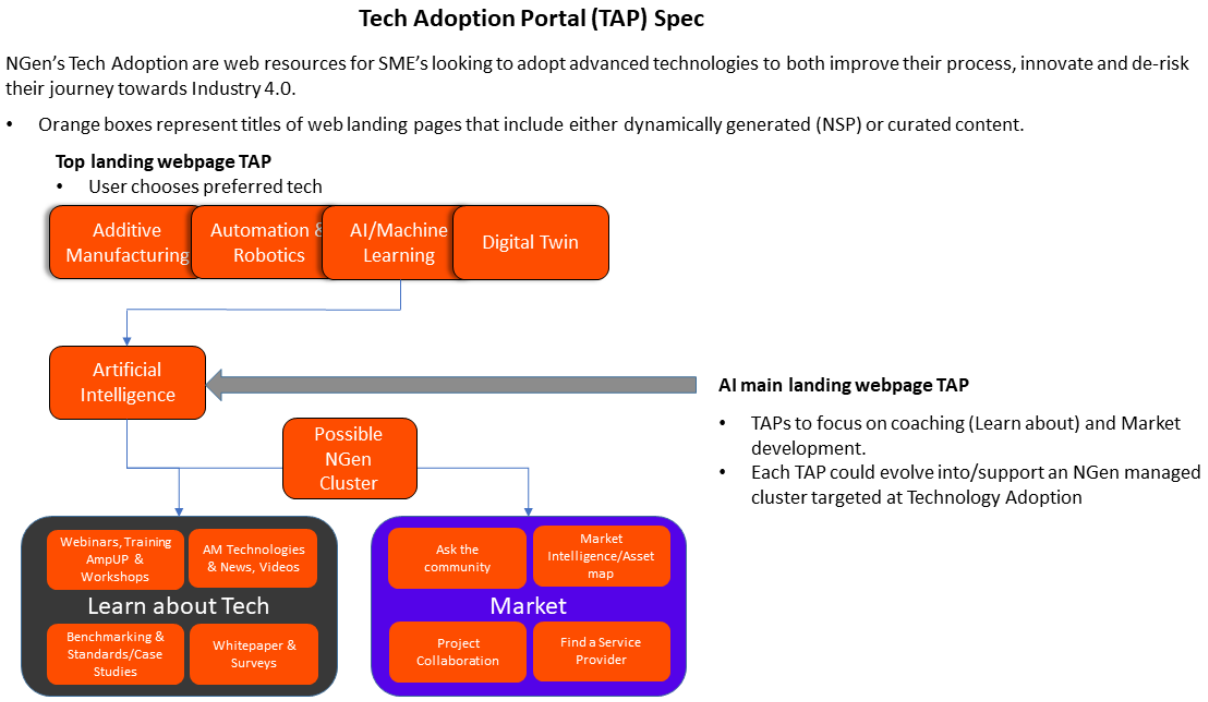


Figure 21 Block diagram for Tech Adoption Portal

A block diagram showing possible elements for a tech adoption portal are shown in Figure 21. The left-hand side contains education and awareness modules to help members learn, and the right-hand side are marketplace modules to stimulate adoption. Additional content ideas are presented in Figure 22.

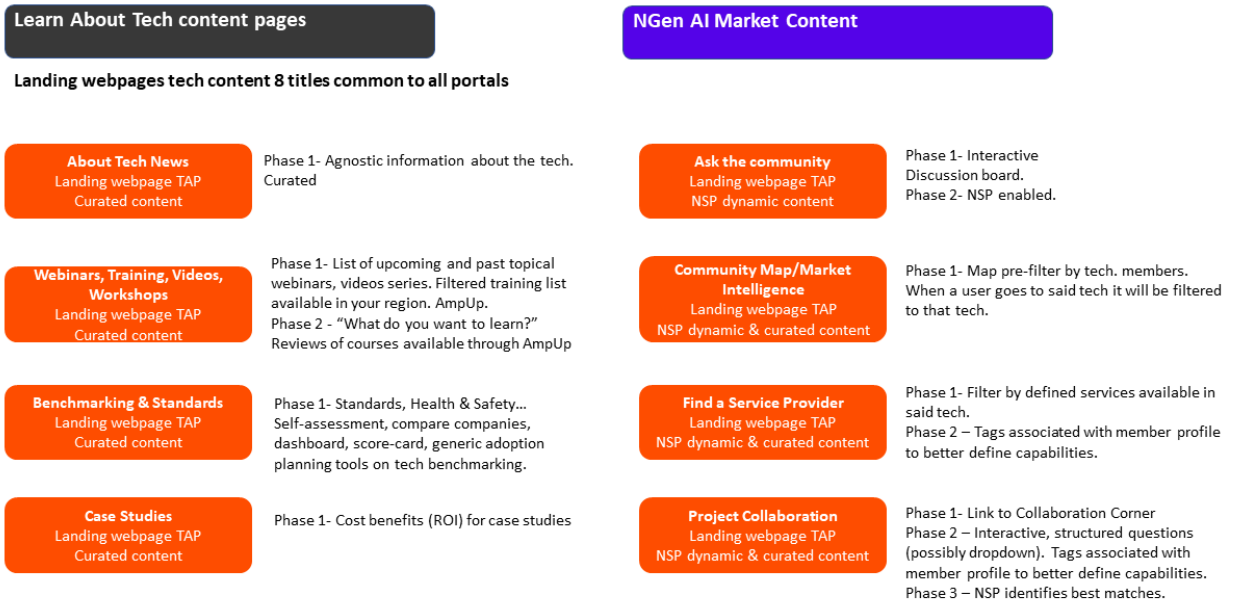


Figure 22 Tech Adoption Content Details

The tool could triage and guide with a series of expert derived, but automated, questions. This would ensure that members are adequately prepared with the necessary business and process information before connecting via the "Ask an Expert" service.

The reason for investigating AI might be growth eg with a new digital service, or the need for quality improvement by reducing human variability, or cost reduction, to name a few (and of course it may be all of these). By providing members with an interactive asset map of AI solutions across Canada, searchable by market and technologies, as well as the business drivers/benefits behind each asset, the portal would ensure Canadian businesses could easily see what others are already doing.

Eventually it might be possible to use machine learning to match the members supplied information to a prescriptive course of engagement. Machine learning is already being used to diagnose and respond to office process automation, with evaluation on ease of implementation and potential for automation.

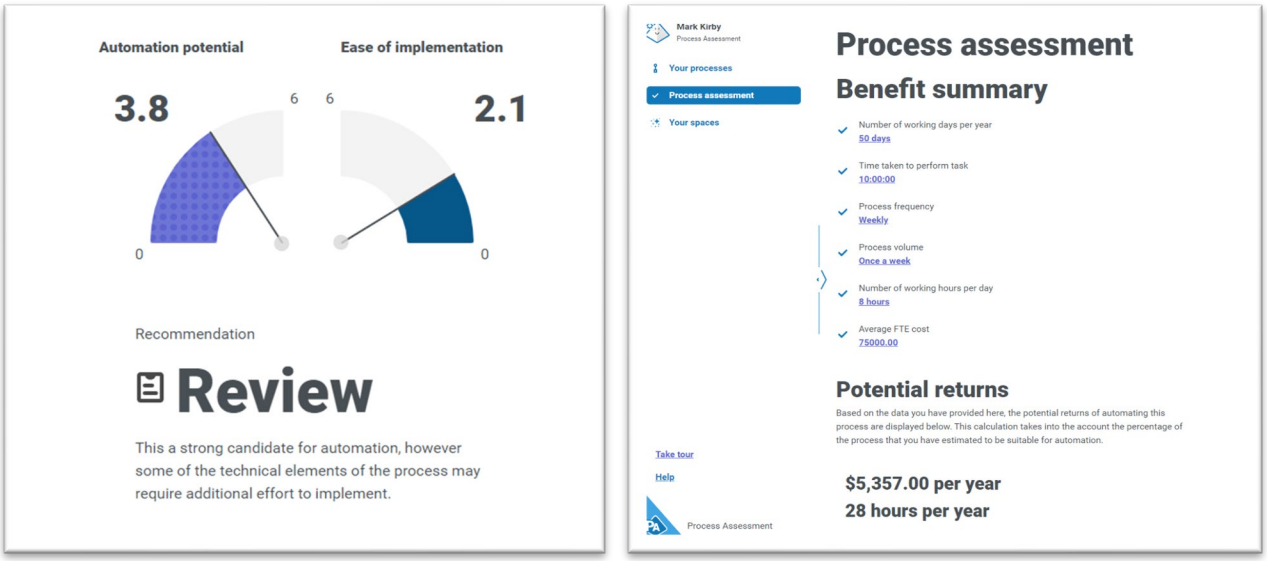


Figure 23 Machine learning example for process assessment (https://www.blueprism.com/resources/ultimate-guide-to-rpa-and-intelligent-automation/)

Key questions on a readiness checklist can help members navigate to the correct portal resources and suppliers. The portal should provide a high level, agnostic framework that sits above more application specific payback and evaluation tools provided by some AI suppliers (for examples see Figure 24 and Figure 25). The checklist could evaluate what response mode a member is in: growth, trouble, even keel or overconfident. Case studies can be presented that resonate with the member.

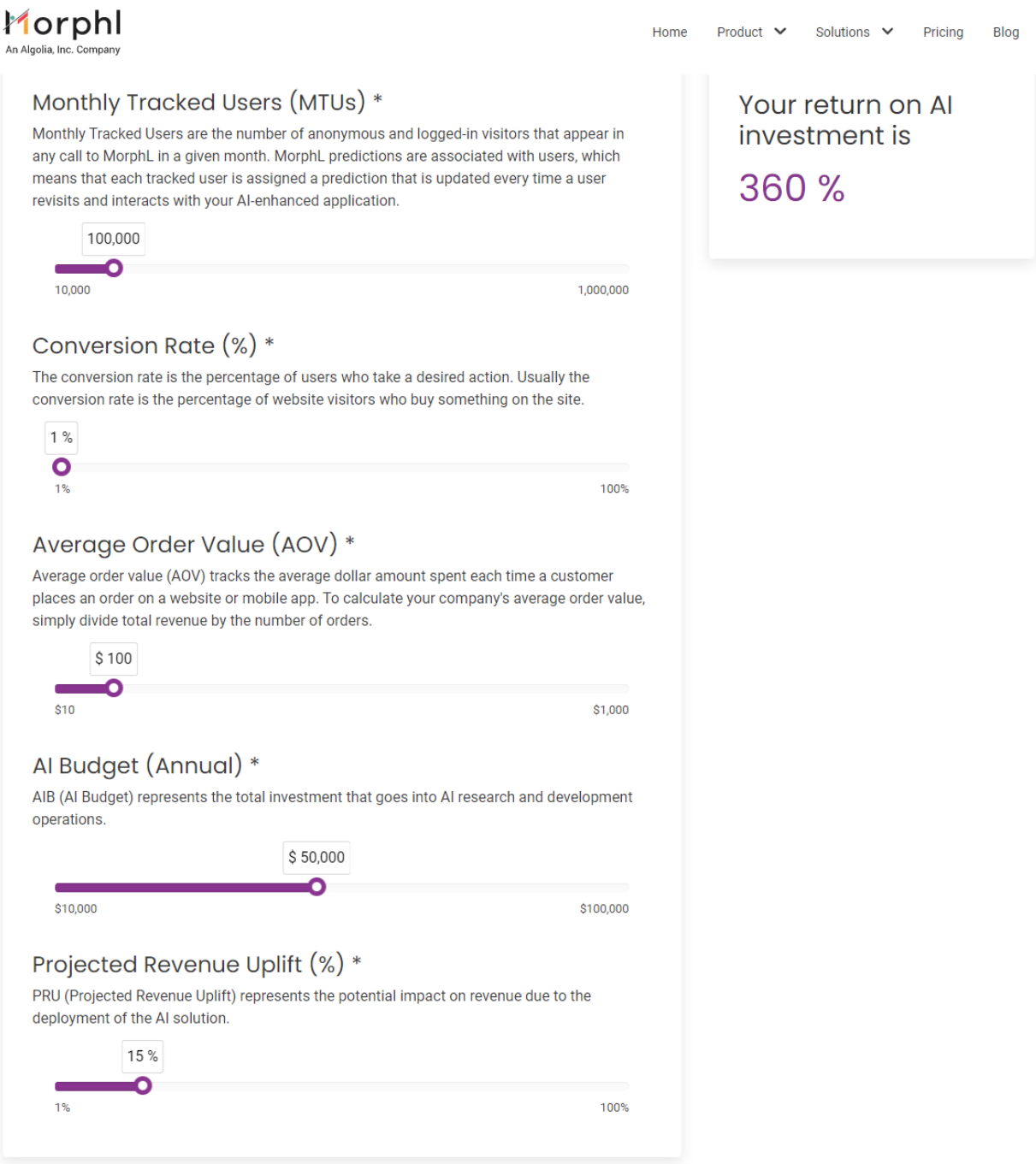


Figure 24 Payback calculators for specific application (https://morphl.io/resources/ai-tools/ai-roi-calculator.html)

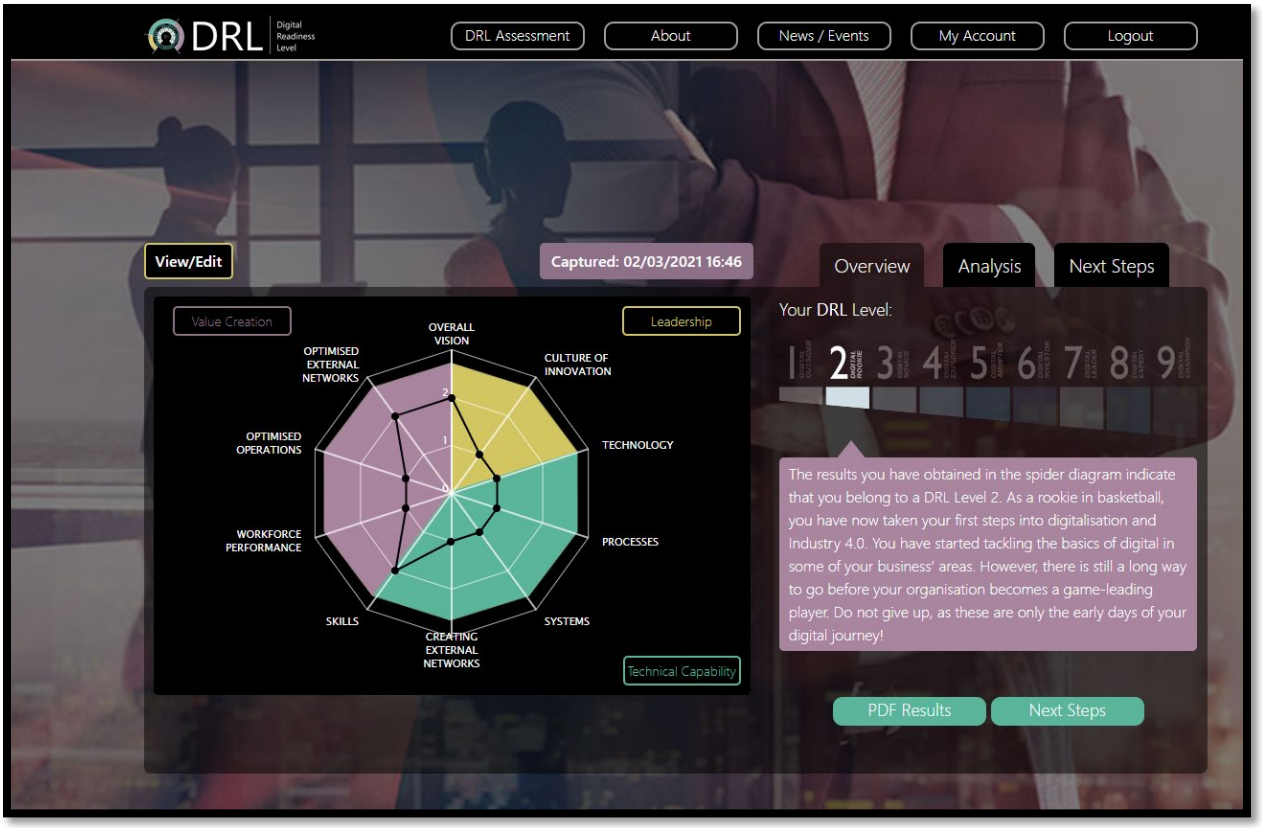


Figure 25 Self assessment Digital Readiness, example (https://drl-tool.org/)

Payback calculators can best help when the application is well defined. It may still be possible to provide useful value via the portal by giving members examples of different budget brackets and what can be accomplished for each cost increment, since the first question is often "How much will it cost?"

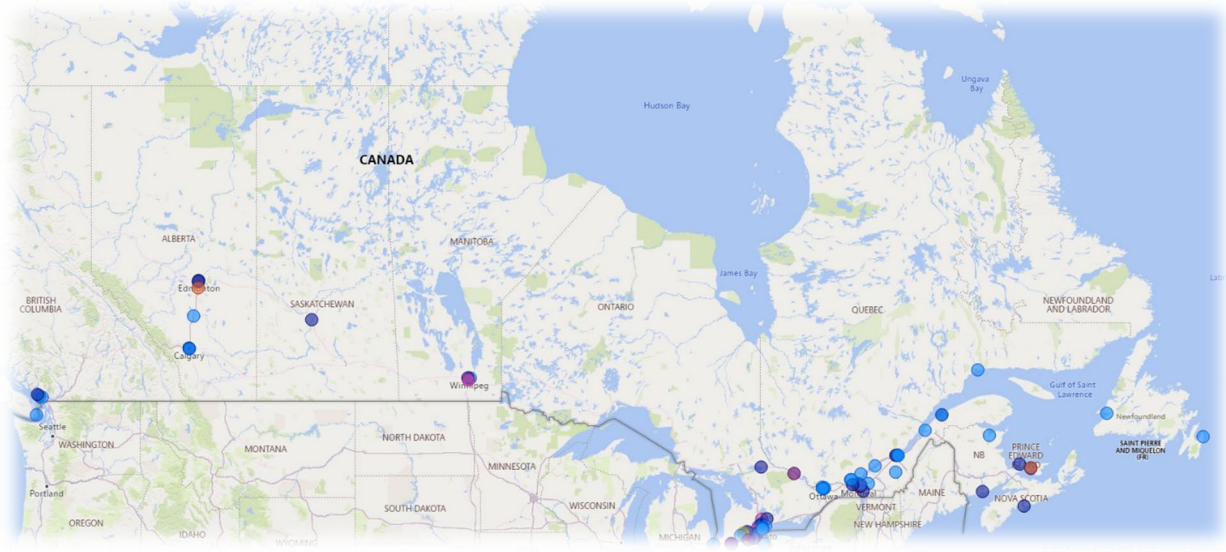


Figure 26 NGen portal could show members AI suppliers, as well as industry installations by market/application, on asset maps

Endnotes

[1] https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-market
[2] https://doi.org/10.1787/7b43b038-en
[3] https://www.amii.ca/latest-from-amii/machine-learning-in-oil-gas/
[4] https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40
[5] https://research.ibm.com/blog/ibm-molecule-generation-experience

"The recipe for success is to bring all your subject matter experts together on day one."