ANALYTICS IN
GOVERNMENT QUARTERLY
FOR GOVERNMENT DECISION MAKERS

OUR SYMBIOTIC FUTURE

A little girl is making friends with Robot Peper.

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EDITOR'S NOTE

Welcome to the summer 2021 issue of Analytics in Government Quarterly (AGQ). In this issue we address emerging out of the pandemic into a new normal that might look different for each of us depending on how we have managed during the pandemic. For example, higher education has weathered the storm, but this sector will look very different in the future. I imagine it would be the same for many government organizations depending on the type of work being done and the measures taken to adapt over the past 18 months.

With respect to the use of analytics, many organizations have had to adjust to remote work and in some cases, to the loss of staff. Opportunities exist for further integration of tools such as robotic process automation and artificial intelligence. And so, in this issue, Tara Holland contributes an article called "Climbing the Mountain: Automated Decisions for Government" providing examples of government organizations using advanced analytics and how these organizations build a foundation for these tools. Kevin Kells provides an article on the use of simulations that can be used to prepare for disruptions and the changes organizations might need to embrace for the future. Stéphane Gagnon discusses the use of advanced tools such as knowledge graphs that are helpful in processing unstructured data and multi-agent systems for integration of robotic process automation. He also discusses the ways in which collaboration between universities and organizations seeking to deploy these tools can speed time to results. Alex Ramirez addresses the analytics talent gap that already exists noting that specific types of skills will be needed. And I provide some insights into how analytics and robotics are being used to augment human effort and how this trend might impact government work.

We have travelled through a time of massive change and rapid adaptation. The future suggests that some of these adjustments might be here to stay, others will need to be modified as we adapt to workplaces characterized by partial remote work, extended human-machine interaction and automated decision-making processes that speed up managerial and policy work in organizations.

We hope you find this issue useful and, as usual, if you have any questions or comments, please do send them along.

Take care,

Gregory Richards, Ph.D.
Managing Editor

By Kevin Kells, Ph.D.

Full-stakeholder Pandemic Response Simulation: Analytics and Human Behaviour

Table-top exercises, simulations, wargames, these are all names for realistic practice sessions carried out in the professional realm to find and correct weaknesses in complex human systems, to identify gaps, improve communication, and to learn new and better ways to execute emergency response plans. For analytics, these exercises represent an opportunity to generate observations and data which may be infrequent in real life.

In natural disaster response, these are called tabletop exercises (TTX). In the military, they are called wargames. Key players and the actual decision-makers are brought in for an afternoon or a weekend, and a facilitated scenario is presented to them, to which they need to react. The decision-makers at the simulation exercise are the actual decision-makers who will be in the field or in the command center or at the hospital at the time of a real emergency. One of the main benefits of such exercises is that the decision-makers from different units and different departments get to know each other better and get to learn how they operate with each other. Moreover, they can build up a relationship of trust that will improve the response of the system in the event of an actual emergency.

Public Health systems also perform simulations, and these are highly effective. Hospitals are even mandated to perform periodic exercises to prepare for emergencies precisely so that the key players making decisions have the opportunity to meet and work with each other under the simulated circumstances of an emergency.

Before the pandemic, a full-scale exercise of Canada's pandemic preparedness plan was in the works to test the capacity of health systems across Canada. It was scheduled for 2020, but cancelled because of the pandemic. [1] [2] We did not have a chance to benefit from the scheduled full-scale exercise, but there are some learnings we can take away from the pandemic to help design the next full-scale exercise. I suggest there are three key players whose roles should not be left under-represented in a pandemic exercise. These three roles are 1) the inexpert citizen, 2) the economic citizen, and 3) the political leader.

The assumption made about a rational citizen is that they will mostly obey orders from authority and mostly follow medical guidance from Public Health officials. With representation of what I call the *inexpert citizen* at the pandemic simulation table, we will be able to simulate the role of the non-rational aspect of human behaviour. This includes the role of incorrect medical information communicated through social media and through word-of-mouth—unintentionally as misinformation, or intentionally as disinformation.

We will also be able to factor in other human reactions and behaviours — perhaps non-rational but very real — such as vaccine hesitancy, belief in unproven medicines or practices, unproven fears and rumors, and defiance of public health directives in the name of perceived individual freedom or any given political ideology. It also includes the recognition that we as human beings do not easily comprehend the exponential nature of contagion and pandemics.

The *economic citizen* is a different simulation participant whose role is to represent the behaviours of citizens who face dire economic circumstances and must choose between the risk of contagion and the risk of losing their livelihood, their businesses or jobs, their homes, and even their families due to financial disruption, mental health crises, or domestic disharmony brought on by public health directives to shelter in place for extended periods. Herein is also represented pandemic fatigue.

Finally, our *political leaders* at the national and provincial levels should also not be under-represented in the next pandemic exercise. These are actual elected officials – not stand-ins or representatives – who participate with their real Public Health counterparts in dealing with a simulated outbreak, the spread of disease, the non-pharmaceutical interventions recommended by the medical experts and disliked by the citizenry, the imperfect implementation by the inexpert citizen, the rebellion and simple inability to conform by the economic citizen, pandemic fatigue, and the political pressure from calls to oust the political leaders from their posts in the next elections by the very citizens whom they are trying their best to serve.

Exercises generate simulated data that can be analyzed and

1   Grant Robertson, February 3, 2021, 'We are not prepared': The flaws inside Public Health that hurt Canada's readiness for COVID-19, The Globe and Mail, https://www.theglobeandmail.com/canada/article-we-are-not-prepared-the-flaws-inside-public-health-that-hurt-canadas/
2   Victoria Gibson. April 9, 2020, How Ontario planned for a crisis before COVID-19 hit, iPolitics, https://ipolitics.ca/2020/04/09/how-ontario-planned-for-a-crisis-before-covid-19-hit/

"Of these stakeholders, the one most important not to under-represent in health crisis simulations is the political leadership."

fed back to the participants in real time and in a post-simulation evaluation phase to see how well their decisions resulted in positive outcomes, which gaps and weaknesses in communication, information flow, preparedness, and procedures reduced the effectiveness of even the best decisions. These are the gaps and weaknesses an exercise helps us identify and correct before the next pandemic. Simply getting the political leaders in the same room with the scientists and medical professionals with whom they would later be working during a pandemic will build up rapport and trust that makes organizational work more successful during the stressful times of a crisis. It may also help scientists and experts get important points across in a more impactful and visceral way than even analytics reports or data visualizations would be able to convey.

Of the three stakeholders, the political leadership seems to be the most important not to neglect in health crisis simulations. Despite lacking Public Health training, politicians in a pandemic need to act on guidance they will not fully comprehend from Public Health officials, weighing it against social, economic, and—for them—political consequences. Whereas during

a natural disaster or outbreak of war, the experts are in control and make the important decisions in the arena of their expertise, during a pandemic, the arena is the whole country, and the decision-makers are the political leaders. Thus, they should be part of the simulation exercises.

At the beginning of the pandemic, Dennis Carroll, Director of the Emerging Threats Unit at the U.S. Agency for International Development, commented during an interview on February 28, 2020 on the PBS Newshour, "A month ago, the WHO signaled that this was a public health event of international concern, which should have initiated political leadership to step forward and begin authorizing the use of these plans. And what we have not seen is the execution or the leadership from the political communities."

In the latter part of the pandemic, in a New York Times documentary film from October 28, 2020, Carroll commented on pandemic simulations and the role of political leadership, "In the years that we ran simulations, we imagined every possible scenario of what type of virus, where it might emerge, how it might be transmitted, what would make it challenging to control: civil war, civil disruption... The one

factor we never entered into those simulations as a variable was leadership. And it never occurred to any of us that our political leadership would fail us so miserably."

Through the role of the inexpert citizen and the economic citizen, let us find a way to include realistic behaviour of the citizenry in pandemic simulations. And most importantly, let us expect the physical presence of the actual members of political leadership at these exercises, along with the actual Public Health officials they would work with during a pandemic, so that they can experience the unintuitive, exponential behaviour of pandemic dynamics and be ready to recognize and act quickly when confronted with the spectre of the next pandemic outbreak.

■ About the Author

Kevin Kells, Ph.D., has worked as an R&D Engineer in software systems in the Financial and Semiconductor industries in Switzerland, Silicon Valley, and Ottawa, and currently works with real-time data and news feed systems at a major market news and data company in New York City. He has extensive experience in non-profit management, both in the area of human systems and IT systems.

He received his Ph.D. from the Swiss Federal Institute of Technology (ETH), Zurich in computer simulation of semiconductor devices and holds an MBA with areas of focus in entrepreneurship and business analytics from the University of Ottawa, Telfer School of Management.

CLIMBING THE MOUNTAIN:
AUTOMATED DECISIONS FOR GOVERNMENT

BY TARA HOLLAND

Data analytics and artificial intelligence have long proven their value in terms of impact on business outcomes. There are many concrete examples of in the Canadian public sector.

- The Centre for Addiction and Mental Health (CAMH) uses predictive modeling to co-ordinate 34,000 patients across 90 independent mental health services.

- The Ministry of Alberta Justice and Solicitor General use analytics to comb through silos of data, cross-referencing related people, places, and events, across police, courts and corrections jurisdictions.

- Canada Post is incorporating analytics to drive cost savings, improve marketing campaigns, and improve customer relations.

But most are predictive and pattern modeling efforts which can mean insufficient actions are taken on the data, and the extent of follow through is questionable. There are greater potential benefits when AI and automation have a direct impact on front line decisions.

"By 2024, 60% of government AI and data analytics investments aim to directly impact real-time operational decisions and outcomes," according to research firm Gartner Inc.[1]

Automated decision-making is real-time, at scale, and natively digital. More importantly, it is business-led and is inherent in policy and program design.

Governments must make a fundamental shift for AI and analytics to fuel a post-pandemic rebound, from a technology adoption mindset to a decision impact mindset.

Pivoting to this new paradigm can be daunting, more so for the public sector than private sector — the public sector has many more stakeholders, more complex measures of success, slow uptake on digital solutions, and a more risk averse relationship with changes.

When faced with what feels like a daunting task, perhaps we can draw lessons from another discipline: Mountain-climbing.

Mountain-climbing is a very arduous and risky discipline— there have been an estimated 280 deaths on Everest alone. When climbing the automated decision-making mountain, we can emulate mountain-climbers proper preparation to minimize the risk and increase our likelihood of success.

Mountain climbers prepare for an expedition in three ways: physically, technically and mentally.

Physically. Obviously, you want to be in your best physical condition. It's not just about rock-hard abs and powerful biceps. Multi-stage climbs require acclimatization to altitude, a strong cardiopulmonary system, strength, balance, and coordination. Preparatory climbs

can begin weeding out climbers whose physical constitution aren't up to the task.

For real-time automated decision-making, your data must be physically ready. Ensuring data credibility is the preparatory foundation that your data must pass. "Dirty data"— outdated lists, missing fields, inconsistent formatting—leads to errors, delays, and, in a public sector context, health and safety issues and liability exposure.

There are many dimensions to data quality measurement needed to verify data credibility:

- Accuracy measures the degree to which data values are correct;

- Completeness means all data elements have tangible values;

- Consistency focuses on uniformity of data;

- Timeliness to ensure the most fresh and current data;

- Uniqueness validates that each record or element is represented once within a data set, helping avoid duplicates.

Data quality management identifies data that isn't up

to the task and good data management practices build the physical readiness needed for automated decision-making.

Technically. Sir Edmond Hillary and Sherpa Tenzing Norgay didn't make it to the top of Everest alone. The expedition—two teams of climbers—were supported by 362 porters, 20 Sherpa guides, along with food, shelter, clothing and climbing equipment.

That 10,000 pounds of baggage was necessary because the equipment of the time was primitive by today's standards. Today's climbers have lighter options: parkas with lighter synthetic fill, strong nylon rope, lighter yet more effective shelter, redesigned technical equipment made of lighter metal.

A technical infrastructure for automated decision-making consists of many components. One is responsive and quickly implemented.

- High-volume, high-speed computing power. Just as climbing equipment has evolved so have the ways in which governments can access computing capacity. Cloud providers provide the ability to more easily access and scale the resources needed for AI and automation.

- Low-code and no-code tools. Traditional analytics and AI development that required deep understanding of and the ability to develop using a coding language are too slow to respond to the needs

"A technical infrastructure for automated decision-making consists of many components. One is responsive and quickly implemented."

1   Rick Howard, Bill Finnerty, Ben Kaner, Arthur Mickoleit, Michael Brown, Irma Fabular, Neville Cannon, Alia Mendonsa, Dean Lacheca, Apeksha Kaushik, Katell Thielemann, March 2021, Top Technology Trends in Government for 2021, Gartner

of intelligent decisioning applications. For public sector organizations to take advantage of the decision-making knowledge and skills in their workforce, they must provide the modern tools to enable business users to develop the solutions.

Cloud computing and modern development tools are two of the important "lighter" technologies needed to successfully achieve automated decision-making.

Even if the equipment is lighter, Everest climbers still need Sherpa guides. Government must look to the experience in other industries and the vendor community to provide the subject matter experts who can help guide the way and avoid the dangers. Too often, it's tempting to read the manual and do it yourself. Everest climbers don't carry their own equipment.

Mentally. Climbers spend about two-and-a-half months on Everest. That's a long time to stay focused. Detailed planning, sometimes beginning years in advance, can help keep them focusing on the mountain. Closely related is visualization, attempting to "see" or "feel" themselves performing techniques and strategies.

This focus allows them to avoid "summit fever," an undisciplined rush to the peak that poses a danger to themselves and others.

The trek up your own Everest also requires thorough

planning. Develop a road map to visualize the endeavour, and picture the process needed to make the necessary organizational and cultural commitments to the project.

Integral to the organizational readiness for an automated decision-making strategy are governance and ethics. There are the explicit legal and regulatory responsibilities, but there are also questions like:

- How can data be shared—or not shared?

- What are the security and privacy implications?

- Do we have to collect more data for an accurate decision?

- How do we ensure that this data is unused in a fair, ethical and equitable matter?

Most importantly for governments, AI-driven, automated decision-making needs clear policies on where and how the program authorities oversee and ultimately own responsibility for the decisions.

The federal government's "Directive on Automated Decision-Making"[2] outlines the amount of human intervention required for a decision according to the nature of its impacts and duration of its impacts. You can turn to that for guidance.

The path to automated decision-making can be a long, arduous

trek. But, like summiting a mountain, the reward is well worth the effort—faster, more effective, fairer public services and improved citizen outcomes.

Best of luck on your trek. We'll see you at the summit.[3]

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❚ **About the Author**

Tara Holland has been with SAS for over 20 years focused on supporting public sector customers. As an industry specialist in the Global Government Practice, she brings best practice and proven solutions to government customers and partners around the world. Her role is to connect and collaborate with the leaders from the industry and across business units with in SAS. Her passion is in bridging the gap between business needs and technology solutions and enabling public sector organizations to deliver on the value of data.

Prior to joining SAS, Tara led the Data Mining team at Canada Revenue Agency and lived the real-life challenges faced by organizations wanting to be more data and analytics driven.

2   Government of Canada, Directive on Automated Decision-Making, https://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=32592
3   For more information about the journey to automated decision-making, download the Canadian government e-book Transformational Decision

AI Integration Helps Build the Next Generation of E-Government

By Stéphane Gagnon, Ph.D.

The Next Step for AI Research

Academic research must rely on a clear research agenda leveraging the latest technologies for innovative applications. Hence it is essential to analyze the next research challenge in AI – that is, integrating Machine Learning (ML), Knowledge Graphs (KG), and Multi-Agent Systems (MAS).

Artificial Intelligence and Analytics (AIA) are closely integrated to help automate processes and support decision making in all sectors of the economy. The past five years have witnessed significant investments in pilot projects geared toward transforming key public services, especially at operational levels (e.g., award-winning projects by the AI Labs at Immigration, Refugees, and Citizenship Canada and the Canada Revenue Agency). This has opened the opportunity for renewed partnerships between government business and technology experts, aimed at co-developing the next generation of analytics-driven e-government.

Machine Learning (ML)

Most of the implementation efforts in AI have focused on ML and its applications to extend the Data Science (DS) capabilities of large ministries and agencies. This was spurred by the rapid adoption of and experimentation with open-source development languages (e.g,. R and Python), and increasingly process-oriented big data platforms (e.g., Spark, MLflow, Kubeflow). While most results have been impressive and encouraging, there is a need to develop a broader and more forward-looking AIA strategy which will seek to maximize value for governments and carefully invest IT budgets and learning.
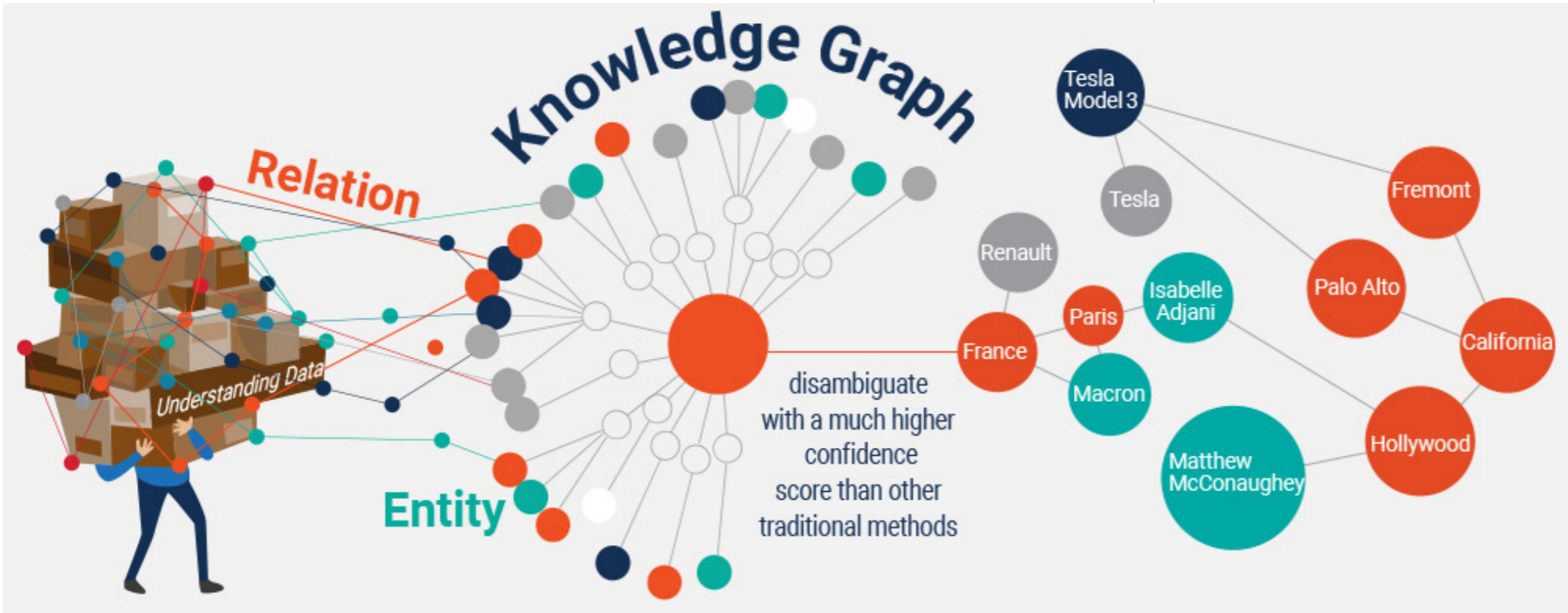
As ML may have been one of the "low-hanging fruits", government DS teams are called upon to learn and integrate more complex AI technologies. Two that are closely linked to ML should be on the radar of all Chief Information Officers (CIOs) and Chief Data Officers (CDOs): KG and MAS.

Knowledge Graphs (KG)

Unstructured information, in both text and multimedia formats, are abundant in all public services. However, Governments have long invested in meta-data and indexing systems but have only scratched the surface of innovative opportunities to leverage this data.

KG technologies (e.g., Resource Description Framework, RDF; RDF Schema; Web Ontology Language, OWL2) are essential for the next step in AIA effectiveness. As one of the many variants of the NoSQL database paradigm, graphs provide more flexibility to represent complex relationships among entities and their data, as well as more versatile query mechanisms and algorithms. Hence, by enabling collaborative development of standard vocabularies and "ontologies", KG technologies integrate several layers of information and contents management platforms, while giving new opportunities for knowledge extraction and decision support.

Multi-Agent Systems (MAS)

Robotic Process Automation (RPA) has been a focus of several governments, especially to better manage performance and risks in high volume processes. The public sector is likely to follow the same evolution as other sectors have followed, for example manufacturing. In the 1990s and 2000s, industrial production and supply chain integration triggered transitions between several generations of RPA: Business Process Reengineering (BPR), Lean Management, Business Process Management (BPM), Holonic Manufacturing, and Industry 4.0 as its most complete architecture.

MAS technologies are key to enabling more real-time RPA and seamless Human-Computer Interaction (HCI) in manufacturing, and public services will surely benefit from such advances. Intelligent Agents, an algorithmic and event-driven component programmed to handle low-level automated decisions, are the next step in RPA as they bring a degree of knowledge-driven autonomy in low-level repetitive decisions where criteria are clear and data is unambiguous (hence, the word "robotic").

Integrated together, agents can be programmed to interact in a multi-agent community where they can query one-another, share resources for punctual tasks, take initiative as per pre-established rules, and especially relieve human intervention from the tedious and error-prone process of performance and risk monitoring.

AIA as an Integrated Architecture

The integration of ML, KG, and MAS technologies is inevitable. As it has been demonstrated in other sectors, DS models create an abundance of decision rules that can be later formalized as part of knowledge repositories. These can further be enhanced in a graph system to enable query and reasoning, helping to automate decision-making. Finally, the inference, rules, and reasoning systems can feed into a multi-agent environment, which in turn can feedback the inference and rules functionality through adversarial learning among agents.

While Industry 4.0 has yielded impressive results, the Government 4.0 movement should by far surpass the level of complexity, innovation, and impact of AIA investments, primarily for the sheer extent of public services, and their greater diversity of operational conditions. It is urgent that CIOs rethink their perception and understanding of the AI wave, and embark a more robustly architected vehicle ready to benefit from the next coming waves.

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▍ About the Author

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Relation
Knowledge Graph
Understanding Data
Entity

disambiguate with a much higher confidence score than other traditional methods

Tesla Model 3
Tesla
Renault
Paris
France
Macron
Isabelle Adjani
Matthew McConaughey
Fremont
Palo Alto
California
Hollywood

OUT OF THE PANDEMIC:
A NEW BLEND OF
HUMANS & MACHINES

BY GREGORY RICHARDS, PH.D.

SoftBank' s social humanoid robot Pepper is able to recognize faces and have conversation with people.

Some industries have thrived during the pandemic. Anything related to communications technology, for example, has seen rapid growth as people find ways to work in physically- distanced (remote) workplaces. Anything industry related to hospitality by contrast, has suffered significant slowdowns and job losses. There is a growing consensus that some of these jobs might never return to be permanently replaced by robotic processes and other technological tools. In addition, workers in some industries who had to adapt during the pandemic might not return, and some have shifted industries all together. Statistics Canada estimates approximately 500,000 Canadian jobs lost since February 2020. Time magazine reports that the US lost 40 million jobs during the pandemic and researchers estimate that 42% of these will be gone forever. All this to say that the post-pandemic labour pools will look a lot different from the past, and the mix of technology and humans in many businesses will be permanently altered.

Although the public sector might be somewhat immune to these labour sector issues, given the significant deficits governments have incurred to manage the pandemic, a hiring freeze or downsizing is not out of the question. And arguably, the work of public servants has increased over the pandemic (i.e.,

someone needs to implement the rollout of the various subsidy programs) with many working remotely. Therefore, automation might help as we emerge from the pandemic with more work and fewer people available.

Public sector work includes many tasks that could be automated. Although agencies are in early stages of digital transformation and are preoccupied with initial steps to solidify data governance, advances such as AI robotic process automation have already begun to bear fruit. This paper will examine shifting dynamics in labour markets that are partially triggered by the pandemic. These dynamics will lead to a symbiotic future: a new blend of humans and technology in the workplace.

Shifting Dynamics

US labour market data indicates that 40% of small businesses surveyed this past February reported that they had jobs they could not fill. Furthermore, there are more job openings this past spring than people in the labour market. This is especially true in the technology sector where job postings are up 30% in

Canada for example relative to 5% in non-tech jobs. In the hospitality industry (hotels, restaurants etc.), workers who left during the pandemic to take on roles for Amazon and other growing firms do not plan to return post pandemic. In some cases, these dynamics will lead to higher labour costs for organizations who need staff. As a result, given the shift to AI and robotics during the pandemic to preserve physical distancing, these labour market realities will likely encourage many organizations to continue altering the mix of humans and technological tools in the workplace.

Shifting the Mix of Technology and Humans

By now, we have become used to technology replacing humans: toll booths, parking lots, airport check-ins and of course ATMs are now commonplace. This trend has accelerated during the pandemic to extend to restaurants and hotels. A leading food industry company Picnic for example, has developed a robotic pizza maker that takes over some of the tasks in pizzerias. Humans still work on the more complex areas, but the programmable tasks involved in making the pizzas are now done by the robot. Similarly, Sally, a salad making robot developed by tech firm Chowbotics, is replacing humans in hospital and university cafeterias. Chatbots

Café In Tokyo uses Robot Waiters controlled By paralyzed people

Jarvis the robotic butler on duty at the Grand Hotel in Sunnyvale
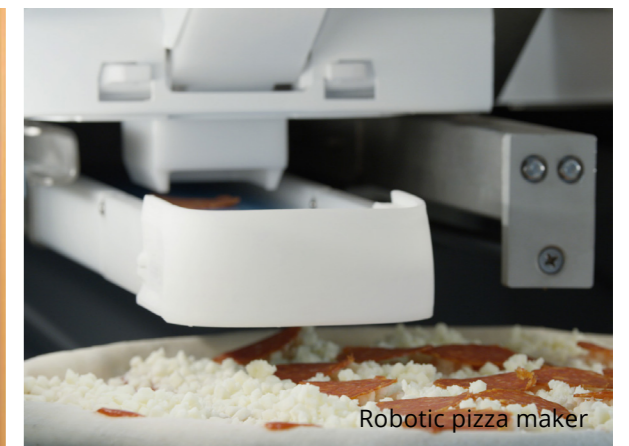
Robotic pizza maker

Salad making robot Sally

created by LivePerson and by IBM are replacing humans in call centres. The mechanical butler Savioke is being deployed in some hotels to deliver toiletries to guests. But robotics and AI extend beyond the hospitality

industry. Robotics company AMP Robotics has seen a marked increase in demand for its assembly line robots. AI tools are being used in finance and legal industries to review loan agreements and in the publishing industry to

gather and collate information. Microsoft for example, laid off several journalists at its news services opting to use instead AI tools that review and organize information. This trend continues into the music industry where

iHeartMedia has replaced disc jockeys with AI tools. Areas such as translation and transcription have also seen marked increases in the use of automated tools that replaces or reduces the human head count.

Our Symbiotic Future

Public sector work includes a significant amount of document processing, policy development and frontline client service. As noted above, all these areas are ripe for the integration of technologies. Robotic Process Automation (RPA) is already being used to process invoices faster and more accurately in some government organizations, and the opportunities for applying automation in areas where workers might not be available are emerging. Research by Ernst and Young suggests that in addition to RPA tools, technologies such as natural language processing can be used to interact with citizens, and "virtual thinkers" that include machine learning algorithms can help with complex decisions. E&Y suggests that RPA is an easy place to start since it is often regarded as inexpensive and relatively low risk. McKinsey suggest that 80% of the processes in HR, finance, and processing of applications for various government programs can be automated with a potential reduction of operating costs of 30%. More importantly perhaps, they suggest that most of machine-enabled

"Any task that is rules-driven and repetitive that requires high levels of data manipulation can be automated in government."

processes can be created using existing technology available in government organizations.

Research by Deloitte provides guidance on the types of tasks that can be automated in government: Any task that is rules-driven and repetitive that requires high levels of data manipulation. This assessment is consistent with the McKiCnsey findings that a large percentage of the tasks involved in areas such as finance and HR could be enabled with automation. The objective is not to replace humans, but to offload the repetitive tasks permitting humans to deal with more complex issues. This will become important since we fully expect that the volume and complexity of public sector work will likely increase post-pandemic.

In summary, examples from the food and hospitality industries demonstrate that in the face of labour shortages, advanced AI and robotics

technologies can help to support operational processes in ways not possible in the past. Current innovations in the public sector such as robotic process automation in financial and human resource management, improved citizen service delivery through the use of chatbots, and rules-driven application processing, can pave the way for additional exploration of human-machine symbiosis.

▍ About the Author

Gregory Richards, MBA, Ph.D., FCMC, is currently the Director, Executive MBA & Interim Vice-Dean, Undergraduate and Professional Graduate Programs at the Telfer School of Management. He was a visiting professor at the Western Management Development Centre in Denver, Colorado and a member of Peter Senge's Society for Organizational Learning based at MIT. His research focuses on the use of analytics to generate usable organizational knowledge.

80%

Of the processes in HR, finance, and processing of applications for various government programs can be automated.

Filling the GAP[1]

The High Expectations for Analytics Professionals

If it is still true that "data scientist is the sexiest job of the 21st Century" as Joshua Crawford, a data science, data engineering and artificial intelligence recruiter and the managing director at Proprius Search insists[2], it has come with very high expectations for any analytics professional. The profession includes a range of denominations going from basic to advanced, and from

area of expertise in public service, business/public administration, statistics, technology, and data science. The analytics profession includes a multidisciplinary body of knowledge. Even though we have argued that any analytics project needs a team, some of the expectations placed on individual analytics professionals are that they must know about data and its organizational flow, areas of application for a given project, computer science, statistical methods, model interpretation, storytelling,

security, privacy and ethics. In other words, a new Renaissance Individual.

The demand for analytics professionals is still very high and many universities have increased their offerings of programs at various levels, preparing these types of professionals. Their curricula are designed to give them a dose of technical, analytical, and soft skills. Generally, these programs are offered as Bachelor or Master programs in computer science, information technology, or information systems

1   GAP – Government Analytics Projects
2   Weldon, D. (2020). What ever happened to the Sexiest Job of the 21st Century? CMS Wire, https://www.cmswire.com/analytics/what-ever-happened-to-the-sexiest-job-of-the-21st-century

specializing in analytics. In any case, they have a technology or business background. They need to learn about statistics, programming, data bases, distributed systems, while learning about how to build different types of models, how to make sense of data, how to write reports, how to tell a story, and how to communicate their results.

Most likely they will have many opportunities to have hands-on knowledge of different tools, most will learn Python, R, and machine learning algorithms, how to use SAS® Miner, Forecast Studio, or Viya; and/or SPSS® Modeler, Tableau® or other visualization tools as well as big data technologies such as Hadoop, MapReduce, Spark, etc.. Furthermore, they are expected to be able to quickly learn a new tool if the ones they know are not available.

Analytics Professionals also need to have a strong mathematical and statistical foundation, be good problem solvers and critical thinkers, ask the right questions, explore, clean, transform, and manipulate data, build models that are transparent, non-biased, easily explainable, and implemented. Moreover, they should be capable of translating their results into business language, seeing the big picture, allow for what-if scenarios, and being ready to go back to square-one and start all over again.

They also must be able to work in teams, play different roles, sometimes mentor new members, sometimes learn from senior members, understand and anticipate the threats of network and data security, data privacy, data ethics.

Implications for Government Analytics Projects

Even though it seems that finding people with all those skills is difficult, we have not even mentioned the additional body of knowledge needed to engage in analytics projects within the different levels of government. For each level of government, municipal, provincial, federal, the type of applied projects is completely different. Their mandates, scope, and timespan are all different. In a federated constitutional monarchy, like ours, the federal government deals with policies that affect all Canadians and are developed by the party in power. This means every time that there is a federal election some ongoing projects are on the line. Similarly, the provincial party in power determines the programs and policies for their citizens and some projects are terminated if there is a change in colours after a provincial election.

The top 25 datasets downloaded by departments (May 2021)

Department/Agency	Downloads
Employment and Social Development Canada	14.22%
Environment and Climate Change Canada	4.84%
Immigration, Refugees and Citizenship Canada	26.72%
Natural Resources Canada	44.25%
Treasury Board of Canada Secretariat	9.97%
Grand Total	**100.00%**

The top 10 departments by number of data sets available to the public

Department/Agency	Number of datasets
Natural Resources Canada	69,531
Statistics Canada	7,801
Government of Alberta	2,274
Government and Municipalities of Québec	1,211
Environment and Climate Change Canada	984
Government of Ontario	726
Public Health Agency of Canada	569
Government of British Columbia	565
Health Canada	565
Parks Canada	483

Municipal projects are more stable but can also be affected if new ward members enter the city council.

Access to the data at each level depends on clearance and other regulations. Data governance is a new concept for many departments and agencies. Data ownership is rarely explained. There is a push to move to Open Data as part of the open government initiative. The question is, will data be more available also within departments? Open government is an initiative to make government more accessible to everyone, meaning Canadians and the business community.

The good news is that there is an Open Government Analytics site[3] which includes access to several datasets. For those analytics professionals who want to acquire expertise working with government data projects this is a good resource.

All levels of government should lobby universities

"All levels of government should lobby universities preparing analytics professionals to include some projects where students can explore the data available in the Open Government Site."

preparing analytics professionals to include some projects where students can explore the data available in the Open Government Site, even though it looks like adding to an already crowded curricula. That way, students will be graduating with some basic understanding of the type of data available to work in government analytics projects. Some may even consider taking a couple of Public Administration courses, as electives.

About the Author

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3   https://open.canada.ca/en/content/open-government-analytics

Helping Governments Lead the Digital Transformation and Implement Innovative AI Technologies

By Stéphane Gagnon, Ph.D.

Université du Québec en Outaouais (UQO) is a founding member of the Government Analytics Research Institute (GARI) / Institut de recherche en analytique gouvernementale (IRAG). The university has implemented multiple research projects dealing with innovative applications of Artificial Intelligence (AI) in the public sector. The following projects are being implemented through several ongoing doctoral theses supervised in both management and technology programs of the university. [1]

Leading the Digital Transformation

Business Technology Management (BTM) is an emerging profession dedicated to leading the Digital Transformation of organizations in all sectors. Given their evolving roles and competency profile, one of the priorities has been to study how Chief Information Officers (CIOs) and other IT executives address the tasks of mobilizing peers, employees, resources, technologies, and partners in leveraging IT for innovative projects.

One thesis is focused on comparative case studies of CIOs in the public sector, analyzing how they have managed major digital transitions. Another thesis has focused on surveying mid- and low-level Project Management (PM) experts to analyze how their careers have been linked to digital transformation projects, to what extent their roles and capabilities have evolved, and what factors influenced them. Data Science (DS) and other AI-related case studies are featured prominently in our findings.

The results of these studies will build upon Organizational Project Management (OPM) research to enrich BTM and DS project leadership with a new competency model for executives. This may lead to a new set of tools to support CIOs in preparing the next generation of digital and DS leaders and facilitate career planning in times of profound flux throughout the IT profession.

Knowledge Extraction and Decision Automation

One priority at UQO is presently to launch the second phase of the BTM Body of Knowledge (BOK), a project jointly funded by TechNation Canada and MITACS (http://btmforum.org/standards/bok).

This is an attempt to unify the professions of IS/IT management, which remains excessively diverse with competing specializations, creating a complex landscape for IT professionals. DS and AI capabilities are at the core of this framework, represented among others by the Team Data Science Process (TDSP) and AI Procurement Toolbox, both open-source references that fit well with other BTM assets for DS and AI.

BTM BOK does not reinvent the wheel, but instead intends to connect readily existing industry certifications and standards. We focus on specifications covering the whole range of Digital Transformation roles and tasks.

To facilitate the open-source development, reuse, and derivatives, it is delivered in a single Eclipse Process Framework (EPF) Method Library and Wiki. It also reuses primarily 100+ CC BY-SA, EPL 1.0, & EUPL 1.2 references, with some under freer licenses such as CC-BY, Apache, and MIT (https://gitlab.com/BTMprof/btmbok).

BOK assets published in XMI

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[1]   The names and links to author profiles of our doctoral students, along with titles and abstracts of their respective theses, are on our web site: https://gagnontech.org/index.php/en/supervisions-en

are presently being converted into various Knowledge Graph (KG) standards, both property graphs and Resource Description Framework (RDF) formats. The resulting ontology of IT roles and management processes will then be integrated within a knowledge extraction engine previously developed by one of our graduates, named Adaptive Rules-Driven Architecture for Knowledge Extraction (ARDAKE) (https://gagnontech.org/ardake/).

One thesis is using this tool to facilitate knowledge extraction from unstructured sources, linking entities and their data to complex relationships throughout the BTM BOK graph. This could help government IT units to facilitate teamwork in cross-functional projects and help configure complex roles and tasks in agile project structures, without losing

touch with the strict and rigorous requirements of IT management standards. Another thesis is applying the same tool, reusing an ontology of IT risks and management, to help simplify the identification of project risks and possibly its prediction.

These research projects offer the potential of providing significant value to governments undertaking vast and complex digital transformation project portfolios, especially those involving complex AI technologies, where significant unknown factors may impact performance. Because regulatory compliance and risk management are key to these efforts, BTM BOK assets and KG technologies, along with ARDAKE, can help enable a new generation of knowledge extraction and decision automation in IT project leadership.

Team Capabilities for Cybersecurity and Data Science

Relying on similar tools, we are attempting to apply KG technologies to help pinpoint team capabilities in highly strategic IT areas, namely Cybersecurity and DS. One thesis developed an ontology of cybersecurity roles, tasks, knowledge, and abilities, and demonstrated how it can be leveraged to pinpoint the right team capabilities and position staffing. Another thesis performs the same analysis for DS projects, where more complex Human Resources Management (HRM) and curriculum vitae ontologies are integrated, helping to optimize personnel e-recruitment for DS projects.

These research results may help governments leverage rule-based AI technologies to bring more rigor to IT management. Digital

transformation projects may also greatly benefit from better team composition based on a more reliable matching of capabilities to requirements.

Internet of Rules and Multi-Agent Reasoning Systems

As rules-based AI is being implemented in more distributed and collaborative processes, new challenges are emerging. One thesis is addressing a key issue, namely open rules exchange among decision agents, hence the term an Internet of Rules, leading to the creation of a new open standard (https://xalgorithms.org). Another thesis is focused on rules execution among agents and ensuring their conformance to semantic and formal interdependencies.

These projects, while more technical than others, open tremendous opportunities for

governments. As we discuss elsewhere in this journal, the next research challenge in AI will focus on integrating Machine Learning (ML), Knowledge Graphs (KG), and Multi-Agent Systems (MAS). Seamless rules exchange and agent reasoning are first steps toward this integration, and the potential for government implementations are primarily for Robotic Process Automation (RPA) in high volume processes.

Research Partnerships

Governments at all levels are invited to create new research partnerships to serve their specific needs for innovative AI technologies. As UQO offers both management and technology masters and doctorates, the applied and scientific research opportunities are numerous. Several faculty have experience in the public sector, and transdisciplinary teams can rapidly be configured to meet the needs of partners, while creating learning and research opportunities for highly

qualified graduate students.

We are "one-email-away" from helping governments lead the digital transformation and implement innovative AI technologies.

▌ About the Author

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