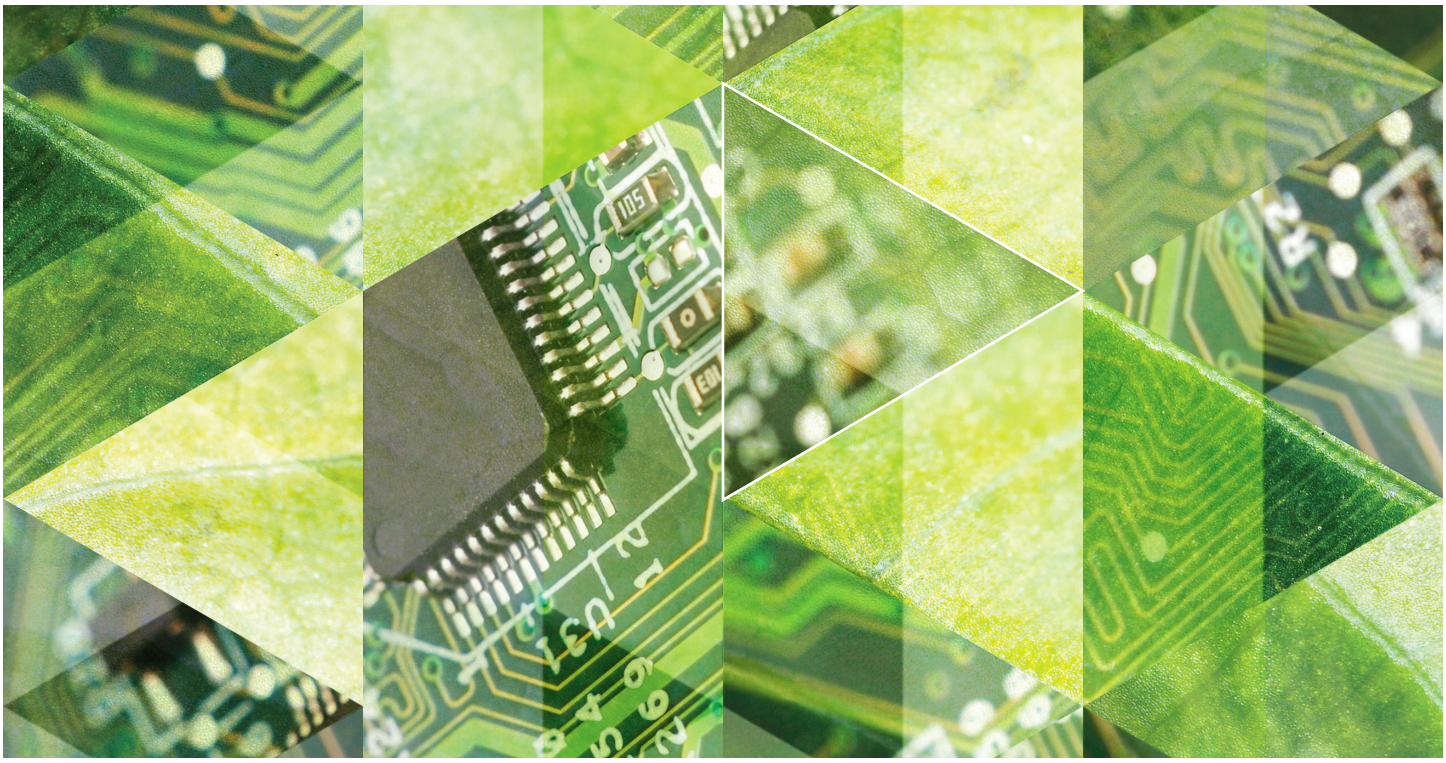
SUSTAINABLE FUTURES

AI, TECHNOLOGY, INNOVATION, SUSTAINABILITY, RESILIENCY AND FUTURE READINESS

Thought Leadership Report 2018

RSI
RETHINK
SUSTAINABILITY INITIATIVES



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RETHINKING BUSINESS AS USUAL
FOR A SUSTAINABLE AND RESILIENT FUTURE

From the RSI Chairman, Troy Wright

New global realities are impacting the economic, social and environmental foundation of our existence everywhere, with profound implications on our future sustainability and resiliency.

At the same time, the emergence of faster, complex and broad-reaching change drivers – including demographic shifts, extreme weather and disruptive innovations—such as ICT, AI, Internet of Everything and machine learning – are transforming the landscape; and redefining 'business as usual'.

In alignment with our RSI mission, we are constantly rethinking and exploring actionable strategies and solutions that are designed to enhance the resiliency and sustainability of business and society – for a better future. We achieve this by connecting leaders with other recognized leaders and experts, across diverse sectors, to accelerate the discovery of proven best practices and innovations that enhance the future readiness of existing and next generation organizations, communities and society. The 'connections' take several formats: leadership summits, knowledge exchanges, private and public workshops, public presentations and publications.

This *'Sustainable Futures Thought Leadership Report'* represents the views of several recognized leaders – many of whom participated in our March 2018 Summit of the same name – supplemented with insights from other respected experts. They include futurists, economists, social, data and environmental scientists, entrepreneurs, academia, and corporate leaders. They all share a common passion and vision for creating and sustaining a better future for humanity – within and outside the context of business.

In my own ongoing quest, as a former corporate executive, current head of a progressive North American fintech company, I believe it's essential to constantly invest in connecting with other leaders and experts – to better understand new realities impacting our existence; and, discover innovative approaches, tools and skills for predicting and being prepared for what's possible and what's up ahead.

I also believe the best thinking is not about seeing the world as it is, but as it could be for all generations – starting today.

We hope you enjoy this report and we welcome your thoughts and ideas too.

Thank you.

Troy Wright

Troy Wright, RSI Chair

IN BRIEF – RETHINK BUSINESS AS USUAL

Exponential change is being driven by climate change, demographic shifts, innovation, both technical and organizational, and other key change catalysts. Leaders in business, communities, government, and academe need to rethink business as usual to prepare for a more sustainable and resilient future.

This thought-leadership report focuses on key changes, intertwined with AI and other disruptive innovations, that are transforming business and society exponentially. The document highlights key insights and actionable take-aways, including case studies, strategies and proven solutions.

As importantly, the report asks, "So what?" "How will AI affect my business, organization, or enterprise, and why should I care?"

WHAT, IN GENERAL, IS AI?

Stated simply, AI is automated, augmented and artificial decision-making. AI is built upon sequenced sets of instructions or functions programmed for computer processing through detailed logarithms. The computer then can decide as a human would decide. It replicates the process of how humans choose a course to bring about a desired result.

THERE ARE TWO TYPES OF AI: NARROW AI AND GENERAL AI.

Narrow AI is what we see all around us in computers today: intelligent systems that have been taught or learned how to carry out specific tasks without being explicitly programmed how to do so. This is evident in the speech and language recognition of the Siri virtual assistant on the Apple iPhone, in the vision-recognition systems on self-driving cars, in the recommendation engines that suggest products you might like based on what you bought in the past. Unlike humans, these systems can only learn or be taught how to do specific tasks, which is why they are called narrow AI.

Artificial general intelligence is very different. It is a type of adaptable intellect only found in humans. A flexible form of intelligence capable of learning how to carry out vastly different tasks, anything from haircutting to building spreadsheets.

WHAT WILL READERS WILL SEE IN THIS REPORT?

This report provides a multi-discipline and cross sector explanation of both the promise and the limits of AI: how it will make our lives better off materially, socially, and, to a degree, personally. To connect the dots between AI and the larger goal of sustainability, this report focuses on five inter-connected "grand challenges:"

- **Food and Agriculture;**
- **Work and Learning;**
- **Finance and Technology;**
- **Transportation and Energy; and**
- **Cities and Urban Communities.**

The purpose is to introduce new and interesting applications of AI. The list is not comprehensive, neither is the discussion exhaustive. The goal is to provide a tour d'horizon through select examples.

Here are a few examples in order to give some sense of the whole report's scope.

- **AI has become critical in the drive to raise agricultural productivity through better soil analysis. This in turn suggests how AI may influence the meta-issues such as Climate Change.**
- **AI is transmuting labour practices as more and more functions become automated. Yes, the result is lost jobs in some fields, but the same forces lead to increased opportunities in more skilled, personal, and engaging positions.**
- **Take the finance industry and its coextensive loan approval processes: AI has created the means**

to speed up routine approvals, while at the same time freeing up time for trained personnel to make the kind of decisions which call for personal judgment.

- **In the energy sector, utilities are now using AI and machine learning to analyse real time sensors, weather patterns, and historical data to discover usage patterns and develop targeted products for customers to improve overall grid efficiencies – an essential approach in the face of wider Electric Vehicle adoption.**
- **As the pace of urbanization increases, AI has become an important tool in helping planners and politicians to change how they adapt to change. The idea of the "Smart City" is not new, but how smart and how quick urban leaders need to be had certainly advanced rapidly.**

Chances are that you work in one of the industries discussed. When literally millions of people may be affected, the highest standards of decision-making are demanded. Take the time and check out what may be already influencing your business, community and how else the insights in this report apply to you. . you live in a city, or know people who do, take a quick look at what may be influencing your neighbourhood, or how you get to work. From getting a mortgage to buy your house to turning on a light switch, AI is now involved.

John Lennon said once, "Life is what happens to you while you are making other plans." As you learn more about AI and its adoption and application, you may get a better understanding of a twist on Beatle wisdom: the future is what happens to you while you are making plans for a fleeting present.

The majority of insights in this report are primarily based on expert knowledge shared at the RSI, AI Sustainable Futures Summit in Toronto on March 28th, 2018. Over 150 multi-generational and cross sector leaders, scientists, entrepreneurs and subject matter experts from Europe, USA and Canada explored how AI technology is being used to transform "business as usual" – advancing the sustainability and resiliency of humanity to thrive into the future.

INNOVATIVE, SCALABLE, ACTIONABLE AND PROFITABLE SOLUTIONS TO ADDRESSING KEY SUSTAINABILITY CHALLENGES FACING OUR WORLD–WITH A FOCUS ON ADVANCING THE RESILIENCY OF BUSINESS AND SOCIETY TO THRIVE INTO THE FUTURE.

To further deepen the discussion and usability of this report, we supplemented the core content with additional thought leadership, referenced sources; plus, a future outlook of what's up ahead.

SETTING THE STAGE

Yasmin Glanville
RSI Founder and Past Chair

Imagine it's the year 2021 – three years into the future. From this future vantage point, you may better appreciate what the speakers, partners and contributors to this report have to say about the changes they see for their organizations and communities. Explore with them why empathy, creativity, continuous learning, inclusiveness and collaborative leadership are critical. Learn how they are tapping into new tools and the power of AI to accelerate discovery and execute solutions to specific grand challenges.

HOW DO WE MAKE THE RIGHT CHOICES?

To broaden our worldview, we start by rethinking business as usual. Einstein said: "We cannot solve problems with the same thinking used to create them."

The great physicist and social thinker also said, "If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask. For once I know the proper question, I could solve the problem in less than five minutes."

Einstein's observations suggest that we need to think harder and clearer, and ask more questions

WE ARE IN THE MIDST OF THE 4TH INDUSTRIAL REVOLUTION

Microsoft CEO, Satya Nadella, says "AI powers every experience augmenting human capability with insights and predictive power that would be impossible to achieve on our own." If understood, used and properly managed, AI can help create incredible opportunities for business and society, and solve huge problems such as disease, food security, and impacts of extreme weather.

"AI powers every experience augmenting human capability with insights and predictive power that would be impossible to achieve on our own."

As with other game-changing inventions such as electricity or jet travel, the impacts of these new AI technologies will be both exciting and disruptive – even, to some, threatening. They seem likely to redefine most of our "normal" day-to-day activities, including how we conduct business, how we design, develop and finance products and services, and how we work, travel, communicate, grow food,

manage natural resources, support our elders and care for our children. Yes, there will be winners and losers. However, the future will belong to those who can use new tools responsibly in order to optimize their value for creating sustainable, inclusive and resilient futures for all.

Thus, leaders and influencers everywhere are being asked to be responsible to fully understand what it is, and how it's being used as a force for good and not so good. Making the correct choices comes from seeing the question clearly, as Einstein suggested.

The future will belong to those who can use new tools responsibly in order to optimize their value for creating sustainable, inclusive and resilient futures for all.

CONNECTING THE DOTS – AI AND SUSTAINABLE FUTURES

Artificial intelligence is already here. It will continue to gain in complexity and sophistication. It presents excellent opportunities for efficiencies and innovation, many of which were unthinkable just a few years ago. Many of these innovations will allow us to make significant progress on the most difficult environmental and social problems facing humans.

– Connor Riffle, "What artificial intelligence means for sustainability"

HACKING SUSTAINABILITY FOR PEOPLE AND PLANET

Yannick Beaudoin, PhD

Director General, The David Suzuki Foundation, Ontario & Northern Canada

As global environmentalism and environmental policy-making has moved into the 21st century, it has not significantly addressed a critical blind spot: the fundamental human system that lies at the root of our ecological and social challenges. As our core interface with nature, and primary social operating system, omitting to update our 'economic software' to match the changing reality of our planetary hardware is akin to deciding to refuse to update your computer or smartphone when prompted and then wondering why the whole system eventually stops running.

Whether advocating environmental or social justice, there remains a propensity to perpetuate divides between how we as people perceive the function of our economic system with respect to our relationship with the planet (i.e. the ecological divide), with those around us (i.e. the social divide) and how we relate and see ourselves (i.e. the spiritual divide). Our core societal construct, the economy, does not reflect the most basic relationships that define a purpose-filled existence that would unleash humankind's full potential. In other words, we are stopping ourselves from achieving our fullest potential at emerging generative, respectful and naturally harmonious societies.

WE ARE IN THE MIDST OF THE FOURTH INDUSTRIAL REVOLUTION.

THIS TIME, PRODUCTIVITY, ECONOMIC PURPOSE AND EQUITY ARE ALL INTERCONNECTED.

Only in the last five years have we been able to identify, on a global scale, nine planetary boundaries using big data. These developments may point to better ways to steward the planet. However, there are downsides. For the first time in history it is statistically likely that the current generation will have a worse quality of life than the previous generation.

The implications for policy are in a way quite simple. If we are truly committed to achieving the sustainable development that provides increased well-being within nature's limits, then demanding that our economics evolves is a prerequisite. Just as we demand innovation and creativity from our

technologies, our other sciences, our businesses and our governments, is a prerequisite. Global environmental policy-making alone cannot keep up with the conventional economy's ability to outpace ecological limits and conservation attempts. Environmental policy making is constrained by a hindsight approach (i.e. reactive to things that have happened) while our powerful economic policy is constantly looking to, and borrowing from, the future in order to maximize value-poor financial goals.

Our growth-first approach encourages disruption of perverse efficiencies while our environmental policies try their best to find a balance and equilibrium. This duality, with the planet on the losing end, is not conducive to a goal of real sustainability. We are missing out on the real progress and creative potential that a post-growth policy shift could deliver. At its core, the economic transition and transformation need to truly address environmental and social failures requiring the adoption of entirely new sets of objectives to inform economic pursuit. Objectives should recognize ecological constraints and social needs instead of relentless growth-first objectives.

With novel technologies such as AI, Blockchain, big data and others, we may create new a new analytic capacity (as illustrated in Exhibit 1) to encompass complexity of the planet and people and inform policy and actions that inform how well we are doing as a society with respect to real progress and well-being.

HOW CAN BUSINESS LEADERS, POLICYMAKERS AND CHANGE-MAKERS TRANSLATE THIS NEW ECONOMIC INSIGHT INTO ACTION?

AND HOW, IF PROPERLY USED, CAN AI OR BIG DATA SPEED UP THE TRANSFORMATION?

Leaders across all sectors can come together to create a new generation of well-being metrics underpinned by novel technologies. These metrics would serve to support a purpose-driven national set of goals to take Canada beyond the constraints of simplistic growth-first thinking.

AI, underpinned by diverse Big Data sources, can be applied to deeply analyse where societal challenges exist and how best to deploy progress-driven investment to address those challenges and enable solutions. AI represents a game changing innovation for government to embrace genuine progress and real well-being as national goals in a manner that evolves us away from an overreliance on GDP.

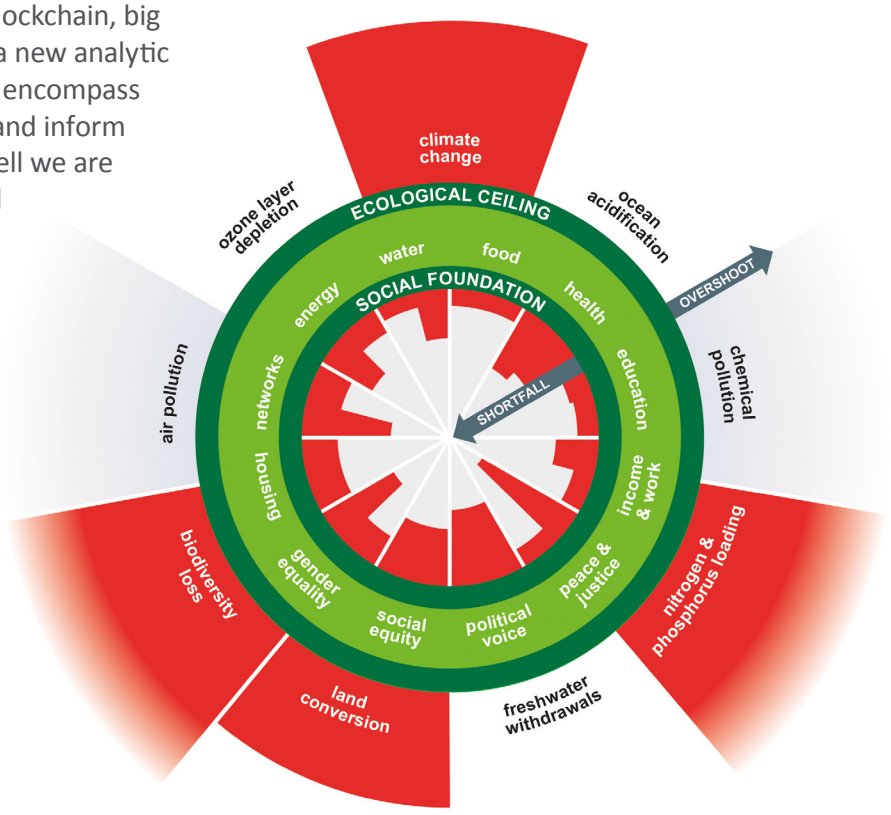


Exhibit 1: New economic model, Kate Raworth 2017)

Beyond the boundary
Boundary not quantified

DISRUPTIVE TECHNOLOGIES AND INFRASTRUCTURE, INNOVATING IN AN AGE OF EXPONENTIAL CHANGE

Terry Stuart
Partner & Chief Innovation Officer, DELOITTE

According to The Innovator's Dilemma author, Clayton Christensen, *"Disruption is a process by which a product or a service takes root initially in simple applications at the bottom of a market and then relentlessly moves up market, eventually displacing established competitors."*

Think back to Blockbuster. Blockbuster LLC, an American-based provider of home movie and video game rental services. Remember the Friday ritual, picking up a handful of videos and popcorn after work for family movie night with the kids. Blockbuster was revolutionary in its day. It was replaced by Netflix – with 24-hour access to movies for real time viewing or downloading from anywhere with an internet connection.

WHAT ARE TODAY'S CHANGE CATALYSTS AND ENABLERS? WHAT'S THEIR IMPACT?

We believe *effective innovators replace myths with methods on a large scale*.

Some of the change enablers are Artificial Intelligence, Networks and Sensors, agri-tech, Solar/ Cleantech, FinTech, Biotech and Energy Storage. They are propelling advancements across all sectors and industries.

SO, WHAT'S HAPPENING HERE? WHAT'S CAUSING ALL THIS CHANGE?

There's a powerful idea in here: when you take a business and essentially digitize it – when you power it with information technology – its price-performance doubles at a very steady rate of roughly every two years.

That's powerful. It's huge. Because when you apply that principle to all these technologies, they are able to hop on that same doubling curve.

Linear vs. Exponential Growth

Our Blind Spot comes from the fact that we have lived in a linear world. But today's changes are exponential.

However, exponential changes like these can be dangerous because they are hard to predict. They are almost counter-intuitive. They go against everything we know about the world.

If I tell you I'm going to walk 30 linear steps forward, you have a pretty good idea of where I'll end up. And you'll also be able to picture what it will look like when I'm halfway there.

But if I take 30 exponential steps, it's hard to know intuitively that I'll end up going around the planet 26 times. Even after I take five or six steps it would hard to just get that right.

That's what's happening with exponential technologies.

When you start with a performance of 0.01, you can double three, four, five times and still be disappointed. It still looks linear. But then you hit the "knee of the curve" and all hell breaks loose. People say it was impossible to predict.

It's not impossible. It's just hard. You must know how to see the rate of change.

If you *can* detect exponential growth, then you have an enormous advantage.

WHAT ABOUT ENERGY?

A USER CASE: OPOWER – PUTTING IT ALL TOGETHER

We all know that not everyone uses energy the same way. Some of us shut off all the lights when we leave in the morning until we get home at 6 p.m., others crank up the AC in the mid-afternoon.

With cheap and advanced sensors, smart meters, real time information and *machine learning* you can start finding signals in the noise by combining detailed energy data along multiple dimensions — such as time, geography, and weather — you can then tease out key similarities and differences among types of energy users.

IMAGINE THE OPPORTUNITIES

Imagine, for example, targeted messages for Electric Vehicle owners with a special rate plan that incentivize car charging after midnight, eventually leading to better accurate forecasts. Opower ingests more than 100 billion meter reads globally from homes and businesses every year – the largest stream of energy customer data on earth. They work with a global network of 95+ utilities, including Enbridge, Hydro Ottawa, Washington Gas, etc.

To date, Opower clients have saved over 11 billion kWh, abated nearly 13 billion lbs. of C02, and **saved over $1.1 billion** on energy bills.

SUMMARY SECTION

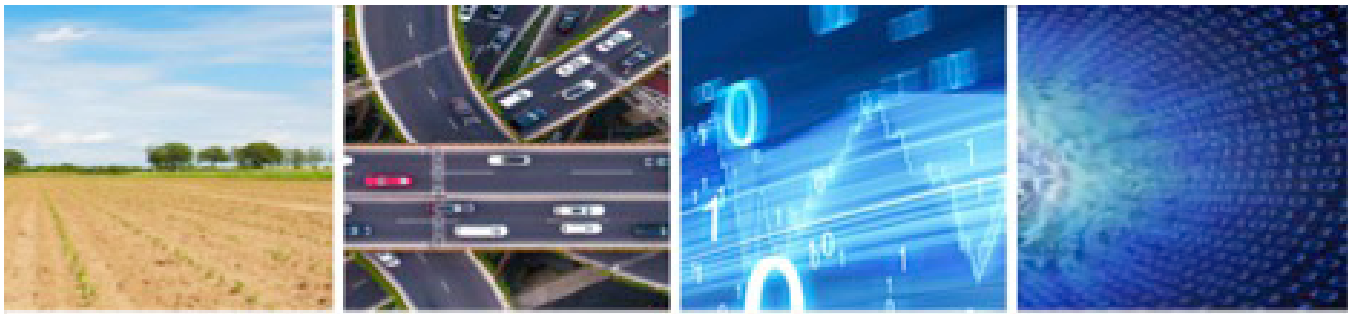
KEY TAKEAWAYS

- **Failing to update our 'economic software' to reflect our changing 'planetary hardware' is no different than ignoring a smart phone update and wondering why the system keeps crashing. Economic objectives must fundamentally shift from 'growth-first' to environmental and sociological in order to right the course towards a sustainable future.**
- **By harnessing new technologies, like AI, global leaders can be empowered to set actionable metrics, to promote well-being economics to their broader communities.**
- **Predicting where the future is going and planning accordingly is critical to stakeholders across all sectors. While we've developed techniques for anticipating linear growth, AI will drive exponential growth demanding a multi-dimensional understanding of where our future is heading.**
- **Take the Energy sector for example. Utilities using machine learning to analyze real time sensors, weather patterns, and historical data can discover usage patterns and develop targeted products for customers to improve overall grid efficiencies – an essential approach in the face of wider Electric Vehicle adoption.**

LOOKING AHEAD

Over the next five years, organizations and communities using innovative technologies to discover digital solutions will fast-track unforeseen exponential global growth. Understanding the possibilities of our near future today is a key opportunity to rethink our economical, ecological, and sociological status quos and envision a holistic system for a more sustainable tomorrow.

RETHINK BUSINESS AS USUAL



This section provides a summary of five meta-challenges impacting our future, and proven strategies for accelerating the discovery, development and execution of solutions for advancing our ability to thrive. The content is mostly based on the AI Summit speaker presentations, supplemented with insights by other recognized experts and innovators from around the world. Collectively forms one meta-narrative of change catalysts transforming the landscape and pushing humanity further into a new world era.

To harness the power of these innovations for intended uses and users, it is important to know what they are and how to use them. How are AI and other innovative technologies already working well and for what? How can they be used to advance the readiness of our own organizations and communities specific to one or more solution goals?

THIS PAGE SEEMS SUPERFLUOUS

REDEFINING **SMART** FOR OUR FUTURE CITIES

Bill Hutchison, P.Eng.

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How will new thinking, risks and opportunities create smarter, greener, more connected communities? What are the key risks and looking ahead, what's next?

An estimated one million people migrate to cities each week. This population boom puts increasing pressure on cities, including their resources and infrastructure. As a result, there is a tremendous need to find innovative solutions that allow our cities to function 'smarter' to accommodate this growth.

RSI asked some of the foremost thinkers in urban and building design to describe what a "Smart City looks like."

RETHINKING SMART CITIES

BILL HUTCHISON, P.ENG., FCIPS, FWAPS

There are at least 20 reasonably credible definitions for a "Smart City." In addition, Sustainable, Resilient, Investable, Interconnected, Convenient, Best and Future City descriptors are used. As Bill Hutchison notes, no wonder mayors, city councillors and even city staff are confused. What makes sense for our city and our citizens and where do we start?

The good news is that all these approaches share a common thread: they leverage new communications infrastructures and technologies such as cloud computing, sensors and the Internet of Things (IoT) along with new forms of open data to enable urban transformation and facilitate timely and informed decisions.

Hutchison has been leading the design and implementation of Smart Cities and Innovation Districts for 25 years. He is Founding Chair of the I-CANADA Alliance of 70 cities and towns eager to become Intelligent Communities, a member of the Board of Directors of the I-VALLEY Intelligent Community Association and a Distinguished

Research Fellow of the Munk School for Global Policy at the University of Toronto. A long-time entrepreneur and consultant, he has also served as Vice-Chair of Canada's National Advisory Board for Science and Technology chaired by Canada's Prime Minister and at the present time he is an Advisory Partner on two future city related research programs at the University of Toronto. He has just finished a five-year term as Board Chair of a federally funded national research program with 10 Canadian universities focused on the future of cloud architectures and edge communications in support of the future IoT.

Urbanization is driving the need for Smart Communities. By 2050, seven out of ten people will be living in cities. The top 750 cities generate two-thirds of global GDP. We need to leverage technology to make our communities smarter. It is crucial to understand the various stakeholders that need to be satisfied in the design of smart communities: industry, government and the communities they serve.

By 2050, seven out of ten people will be living in cities.

Industry players are principally interested in answering the questions "How will we make a return on our investment?" and "Who will own the data?" Government needs to take the lead on smart community initiatives and govern the rules of engagement for industry, so they improve quality of life for communities, as well as satisfying industry's need for ROI. The community must be the ultimate beneficiary of smart city initiatives.

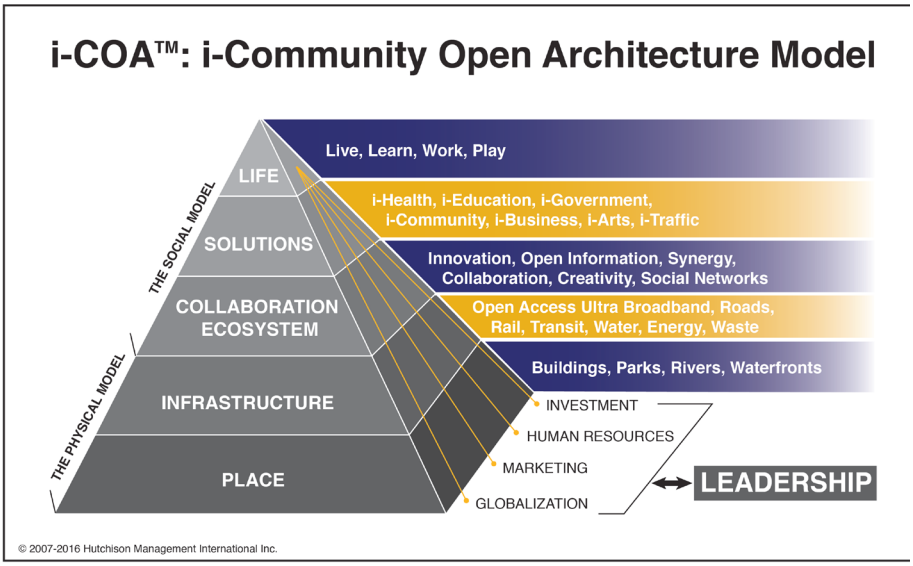
"The creation of smart cities began twenty-five years ago and for the last five years we have had a tsunami-like acceleration occurring with predictions for increased speed during the next 15 years at least. Early on, many "Smart City" initiatives were all about technology. Now there is increasing focus on convenience and quality of life. In the United Arab Emirates, Dubai is focusing on citizens' happiness as its prime objective although every city will evolve differently, based on their locations, cultures, advantages and future opportunities," said Hutchison.

THE ROAD TO CREATING A SMART CITY

"We love to focus on the technologies of the future when discussing our future Smart Cities. But the real challenge — when working to create one of the world's prize-winning Smart Cities — is to intensely engage collaborate with the city's citizens, along with relevant experts in all themes of future importance," said Hutchison. The citizens and local or regional experts must first identify 'Big Ideas and Outcomes for the Future', followed by a ranking of outcomes in priority order of importance for their future Smart City. The next step is to identify the actions that citizens and experts believe are necessary to achieve the outcomes.

The movement is really about "My Future City. We have to change the way we change"

– Bill Hutchison, 2018



"Success in achieving the ideas and outcomes for an award-winning Smart City will then depend on **Rethinking** city governance, organizational structures and the redesign of relevant processes. The Intelligent Innovation Community Open Architecture (I-COA) provides the framework for all implementation initiatives that follow. The elements of the model are shown in the Figure.

There is then a final ranking across all the prior rankings of the priorities from theme-based workshops and citizen outreach and this final ranking is best done by a specially created forty-person Smart City Advisory Council or Task Force that oversees the entire smart city strategic priority development. The Task Force should be chaired by the Mayor with a senior Councillor as Vice-Chair. The Task Force is comprised of seven active citizens and thirty-three senior experts and leaders from all relevant themes like health, environment, industry, social, cultural and a range of other themes. The senior leaders are not necessarily from the city, rather they are recognized leaders in their themes," said Hutchison. "This ultimate ranking of priorities then goes to City Council for their approval. We have used this proven process for twenty-five years because it establishes a lot of credibility with City Council, senior staff and the citizens," said Hutchison. The result is Council is on board with the program and future requests for investment are rarely delayed."

"Our future success in Smart Cities will depend a great deal on community engagement, relevant education and training, inclusion and diversity, new employment and decent job creation all of which require more attention when planning our Smart Cities," said Hutchison. "Rethinking is about 'Changing the Way We Change' and when it comes to creating Smart Cities, it means new processes, governance and organizational structures. Cities that succeed will achieve new levels of prosperity and convenience for their citizens and they will be attractive places to live, learn, work and play."

SIMPLE IS THE NEW SMART

PAUL DOWSETT, ARCHITECT, FOUNDER, SUSTAINABLE.TO

As one of Canada's foremost thinkers and practitioners of sustainable architecture, Dowsett's guiding philosophy is that "Simple is the new Smart."

The key to sustainable design is putting an emphasis on proper planning in the design phase to ensure the "right amount of the right material is used in the right place." This means using the latest computer-driven technology, including Artificial Intelligence (AI), at the front-end of the design process—versus at the end—to fix the problems caused by poorly-considered design. It is more expensive to retrofit environmental or other benefits after the fact.

Therefore, builders and property owners should invest extra planning time to ensure their designs are carefully thought through. This yields more cost-effective and resilient buildings with lower total life-cycle costs.

"The essence of resilience is having materials, and building assemblies and forms, that do their job without the injection of energy."

Use smart design to simplify your buildings and reduce reliance on mechanization.

BUILDINGS TYPICALLY FOLLOW THE 80/20 RULE

Twenty percent of the cost of a new building is the initial capital expenditure; 80% is spent on operating and maintaining the building over its lifetime. Consequently, increased emphasis should be placed on reducing operations and maintenance (O&M) costs. This can be achieved through proper passive-design techniques that reduce the need for mechanization. Mechanized systems are costly

energy consumers and run the risk of breaking down. The more you can minimize the need for mechanical systems, the better.

SUSTAINABLY-DESIGNED BUILDINGS ARE ALSO MORE RESILIENT TO THEIR NATURAL ENVIRONMENT.

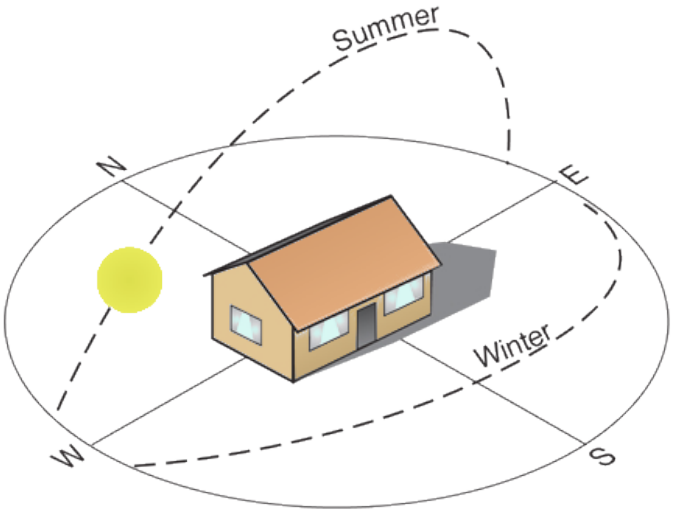
One significant impact of climate change is the increasing number of extreme weather events. Sustainable buildings are well-sealed and naturally-insulated, so they do not require as much energy in the event of emergency.

TESTED AND PROVEN

This theory has been tested using examples from four different disasters: the 2003 blackout in the northeastern seaboard; Hurricane Katrina in New Orleans; Hurricane Sandy in New York; and Toronto's 2013 Ice Storm. In all four of these crises, buildings designed using sustainable practices proved more resilient.

FIVE SUSTAINABLE BUILDINGS STRATEGIES

There are five principal strategies for achieving sustainable buildings: Site Optimization, Passive Solar Design, Exterior Insulation, Durable and Healthy Materials, and Efficient Mechanical Systems.



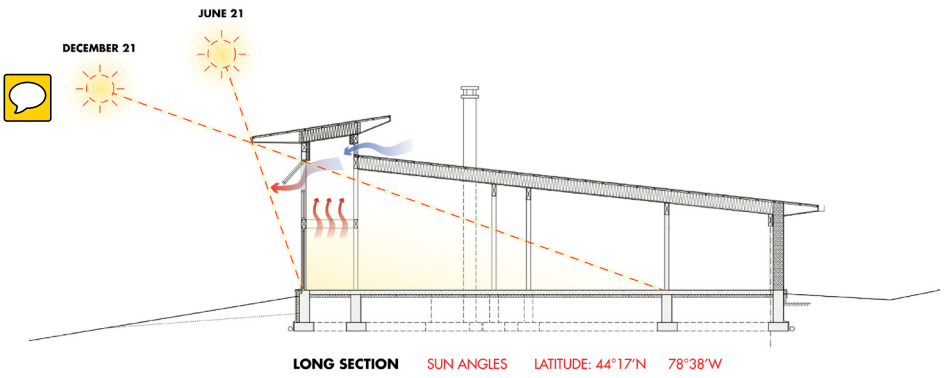
1. **Site Optimization: Careful consideration of a building site will minimize the impact on the land, protect vegetation, mitigate the need for additional infrastructure, and provide opportunities for desired solar heat gain, and natural shading and ventilation.**

2. **Passive Solar Design techniques allow for buildings to benefit from heat gain in winter and reducing the need for mechanical cooling in summer. In this approach, the building itself, or some element of it, takes advantage of natural properties of materials and air created by exposure to the sun. Examples include operable windows placed for optimal heat gain in winter, shading devices and solar chimneys for the summer, and thermal mass for both seasons. In Peterborough, Ontario, the Hunter House designed in 2002 with these techniques has achieved energy savings of 54%. Today, Dowsett's firm is achieving numbers between 80% and 90% energy savings.**

3. **Well-Insulated Buildings are essential in reducing the need for mechanization. Insulation placed on the exterior of the structure is much more efficient. Thermal Mass is the property of a material's ability to absorb, store, and release heat. Thermally-massive building materials such as stone and concrete have a high capacity to absorb and to store excess heat, often from the sun, which is absorbed when the ambient temperature of the space rises above that of the**

Thermal Mass; and is released into the occupied space when the ambient temperature falls below that of the Thermal Mass. This also reduces the need for mechanical temperature regulation.

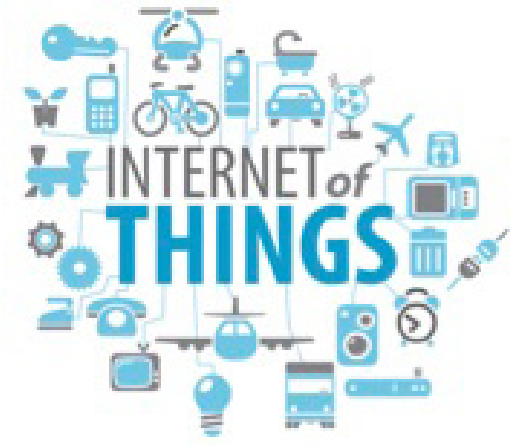
vign principles will require supplementary mechanical equipment to air-condition the building. It is important that this equipment be efficient and properly sized for its purpose. This can be achieved through energy-modelling using the latest software, and by inputting data gathered by AI from the greatest possible number of comparable sources.



PEOPLE AND INFRASTRUCTURE FIRST IN SMART CITIES

JULIE MORIN, GLOBAL IOT SPECIALIST, MICROSOFT

Key to incorporating innovative technologies into future Smart Cities is integrating technologies already in use today to minimize knowledge gaps. As the Internet of Things (IoT) ecosystem (see side bar) grows in breadth with more and more sensors and Wi-Fi enabled capabilities built cheaply into our devices, organizations are facing an unprecedented amount of data to process and with it new opportunities. Microsoft has positioned itself as a leader in IoT, partnering with business, governments, and other groups to create meaningful solutions to interpret vast amounts of data and empowered by emerging technologies, like AI, revolutionize fact based decision-making. New partnerships and collaborations between private, public, and tech leaders will be fundamental in moulding the interactions between future urban dwellers and smart infrastructure.



The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect and exchange data, creating opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions.

That includes cities, communities, intelligent enterprises and every other type of connected organization.

The number of IoT devices increased 31% year-over-year to 8.4 billion in 2017[and it is roughly estimated that there will be 30 billion devices worldwide by 2020 – and a global market value of IoT is projected to reach $7.1 trillion by 2020.

NOTE: These stats may vary due to the complexity and volatility of changes impacting everything.

Microsoft's key development toolkit, Azure IoT, is an adaptive platform creating powerful custom applications enabling insights for clients through connecting their IoT devices. Remote monitoring, predictive maintenance, and the IoT hub are only a few of the solution accelerators the Azure platform offers clients through data-powered systems modernization. Using machine learning and AI to discover operational efficiencies, manufacturing isn't the only industry turning to Azure for optimization over costly traditional retrofits.

Real-time data monitoring is being used to streamline transportation, personalize healthcare powered by remote sensors and optimize retail store layouts through tracking customers' major points of contact. Innovative technologies are already reshaping how people and business interact.

Looking forward, Microsoft is poised to be an enabler creating smarter cities using the IoT – and have already began partnering with municipalities like the City of Vaughan, Ontario, to realize this new reality.

Over the next 10 years, Vaughan's population is expected to exceed 400,000 according to current mayor, Maurizio Bevilacqua. Facing exponential growth, Vaughan is striving to be proactive rather than reactive in developing new infrastructure in order to, "encourage civil engagement, accelerate economic growth, and generate system efficiencies." Seeing the opportunity to create a culture of knowledge in pursuit of planning innovative, sustainable, and creative growth, the municipality established the Smart City Advisory Task Force. Chaired by the Major and led by vice-chair Sandra Yeung Racco and facilitator Bill Hutchison, its membership is comprised of industry experts, academics, and community members bringing a breadth of cross-sectional experience to the project. With the purpose to advise city council, the Task Force's mandate is to better connect citizens to themselves, their leaders, and their city by engaging Vaughan residents through a series of productive workshops looking for the 'Big Idea'.

Detailed in Vaughan's application to be a part of the Government of Canada's Smart Cities Challenge the 'Big Idea' is to implement a Digital Gardens concept to connect the greater municipality. From the proposal, "a collaborative sharing platform for data, ideas, and solution," the main hub, Launchpad, will be centrally located in a new downtown core and use data to connect five local communities through 'Local Gardens'. A key function of the Local Garden systems will be to gather data using IoT sensors to collect data traffic, parking availability, air quality, active weather, event attendance, among other information to provide real time information to residents and city leaders, enabling civic conversations with proven evidence. IoT applications will be a crucial part of Vaughan's vision of their future and partnering with tech leaders like Microsoft with solution building platforms like Azure will enable these innovative possibilities.

References/Resources: Creating safer, IoT for smart cities and infrastructure

Create safer, more efficient cities by transforming infrastructures, buildings, and services with Internet of Things (IoT) solutions

www.internetofyourthings.com

CLIMATE IMPACTS ON THE SMART CITIES

QUENTIN CHIOTTI, PHD, SENIOR ADVISOR, SUSTAINABILITY, METROLINX

Toronto has experienced a prolonged period of significant growth. A key challenge associated with that growth is transportation. Congestion on the major routes has necessitated expansion of the public transportation network to restore calm.

Quentin Chiotti is one of the principal people tasked with expanding Metrolinx in a sustainable fashion. One of his main challenges is building out new infrastructure in the age of climate change.

The GTHA (Greater Toronto and Hamilton Area) is already experiencing climate change, which is projected to bring hotter temperatures, greater precipitation and more extreme weather. As Metrolinx delivers new projects that will transform the region's transportation options, Chiotti recognizes the need for infrastructure to become more resilient in the face of climate risk.

Artificial Intelligence (AI) will play an important role in infrastructure planning. Metrolinx has been tracking and reporting GHG emissions/inventory and forecasts for cities. This data is already being used to help manage Ontario's electrical grid using smart thermostats.

Mixing AI with climate science helps researchers identify previously unknown atmospheric processes and rank climate models

(Nicola Jones, in Nature, 2017).

AI and Big Data will also play a major role in understanding the impact of climate change in Toronto. Nevertheless, the need for expert judgement (from humans) is not going away and could become even more important given the complexity of climate.

There is a tremendous need to leverage improvements in technology along with big data and inter-operability to deliver innovative solutions to the increasing challenges that cities face. These principles need to be applied from municipal planning all the way down to the individual building level.

Leveraging technology, big data and the Internet of Things can improve quality of life and ensure we have cohesive and productive working communities that function for everyone.

SUMMARY SECTION

KEY TAKEAWAYS

- **"Rising level of poverty in developed countries, particularly youth poverty, is a very serious issue overhanging our future cities and the root causes require more attention. We like to hype AI, robotics, 5G and the Internet of Things for our future Smart Cities, but civil unrest will derail our great Smart City ideas and opportunities. We need to increase our focus on the human side". – Bill Hutchinson**
- **Technology should be applied to the front-end of the design process, rather than the opposite, allowing designers to make informed decisions and letting design do the work. This approach would lower operating and maintenance costs, increase climate resilience and promote sustainable infrastructure.**
- **Tech leaders like Microsoft, are enablers to create data-based solutions on a broader scale by integrating current technologies, like the IoT, in designing smarter cities that raise overall quality of life.**
- **Technologies like AI, Machine Learning, and Big Data have the potential to dramatically increase our understanding of the complexities of climate change. Leveraging these insights and interoperability can deliver innovative solutions to the increasing challenges cities face managing limited resources and delivering services.**

LOOKING AHEAD

In the future, more architects, designers and urban planners will embrace and employ the latest technology and building science data at the beginning of the design process rather than after all the decisions have been made. Through incorporating stakeholder interests across all aspects of urban life (municipality, developer, utilities, citizens, etc.) in the planning process will lead to Smart Cities. Taking advantage of data generating technologies like Machine Learning, AI and IoT devices, municipalities can make data-based decisions that will make our cities faster, cleaner, and safer for citizens.

THE FUTURE IS HERE
POWERED BY PRECISION AGRICULTURE

Brad Bass, PhD
Associate Executive Director, Foundation for Student Science & Technology

Joe Russo, PhD,
BASF (Zoth)

Paul Raymer,
SoilOptix

James W.S. Young,
PhD., P.Eng., P.Met. Senior Consultant, RWDI

Julian Northey,
PhD, Fr[illegible]er-Agriculture Sciences

New technology and innovations for producing a more reliable supply of healthy food at a time of climate change and surging population growth.

Optimizing the food supply from source to table is essential to human and social health. Agriculture may be described as a "canary industry" for future challenges – in the sense of the canary in the coal mine that ceases to sing when overwhelmed by poisonous fumes. Facing challenges such as climate change, competition for favourable soils and water-scarcity issues, agriculture is an industry ready for disruption. That revolution has already begun. The industry has been an early adopter of autonomous machinery and information technologies that help producers make timely, accurate, and sustainable decisions amidst competing stakeholders.

Globally recognized leaders at the leadership helm of this tech-enabled transformation of the agriculture and food industry have dedicated their professional careers to the discovery and deployment of solutions to the grand challenges impacting the supply of healthy and affordable food for our growing population of over 7.7 billion people, worldwide. According to the UN, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050. In terms of scale, China has the largest population – over 1.4 Billion. USA is the third largest at 362 Million. Canada is the 38th largest at 36.9 million inhabitants as ranked by the world clock (UN).

References/Resources: Science Alert, World Population Clock (June 2018)
www.worldometers.info/world-population

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5 BRAZIL: 210,856,648
6 PAKISTAN: 200,786,478
7 NIGERIA: 195,839,204
8 BANGLADESH: 166,355,976
9 RUSSIA: 143,964,888
10 MEXICO: 130,747,625
11 JAPAN: 127,187,462
12 ETHIOPIA: 107,516,280
13 PHILIPPINES: 106,500,622
14 EGYPT: 99,362,625
15 VIETNAM: 96,484,336
16 D.R. CONGO: 83,985,679
17 GERMANY: 82,292,178
18 IRAN: 82,005,650
19 TURKEY: 81,908,454
20 THAILAND: 69,182,133
38 CANADA: 36,953,76

INDUSTRY INNOVATORS – IGNITING THE CONVERSATION FOR ACTION

DR. JOSEPH RUSSO, BASF (ZEDX)

Optimizing the food supply from source to table is essential to human and social health.

Agriculture requires timely, accurate decisions on everything from crop planting times to applying fertilizer and knowing when to harvest (Figure 1). The industry's IT objective is to construct paths for decision-making that can be replicated and incrementally improved, thus promoting significant and continuous change.

The art of decision-making lies in the careful balancing of physical and intellectual resources to provide maximum production through the most efficient combinations of scarce resources.

The goal is not just to maximize short-term production, but to formulate more sustainable processes for generations to come.

The process begins with data collection and storage, tasks that can now be performed either by technicians or automated decision flows. Baseline data assembly is one of the key entry points of Artificial Intelligence in agriculture.

One level up, the decision-making tree involves the formation of basic analyses and models. Scientists, engineers and computer specialists are looking to design the basic building blocks of understanding how physical phenomena interact to fuel the transformations of energy, water, seed and soil into food and other essential products.

Aiding in this new understanding is the increasing availability of scalable and reproducible geo-data. Early electronic surveys were done through on-site trucks and equipment which would beam up data to satellites. Now the satellites themselves can gather, organize and store vast amounts of geographical and topographical data, enabling far more precise analysis.

Just as we say, "Justice must not only be done, it must be seen to be done," the analytical foundations and trade-offs in agricultural decision-making must be transparent to the public, and widely disseminated. Too often, agricultural innovation has fallen prey to fear-mongering and misinformation that stymie sustainable progress.

Artificial Intelligence may prevent such misunderstandings by providing more nuanced interactions between producers, buyers and consumers. AI can now translate new insights into innovative growing techniques and production practices. As a related example, social media has

led to levels of communication among growers that were unimaginable even 15 years ago.

For instance, imagine travelling in the outskirts of rural Kenya and observing farmers pausing from their outdoor work to check crop prices and weather forecasts from their iPads and communicating with customers in real time via mobile phones and the internet. AI, the cloud, and other new technologies are redefining "normal" and transforming the landscape into a hyper-connected digital space with 24/7 access to key decision-making data where and when needed. Agriculture is not exempt.

AI WILL PLAY A CRITICAL ROLE IN THE RACE BETWEEN NEW GLOBAL TRENDS AND LINGERING RESTRAINTS.

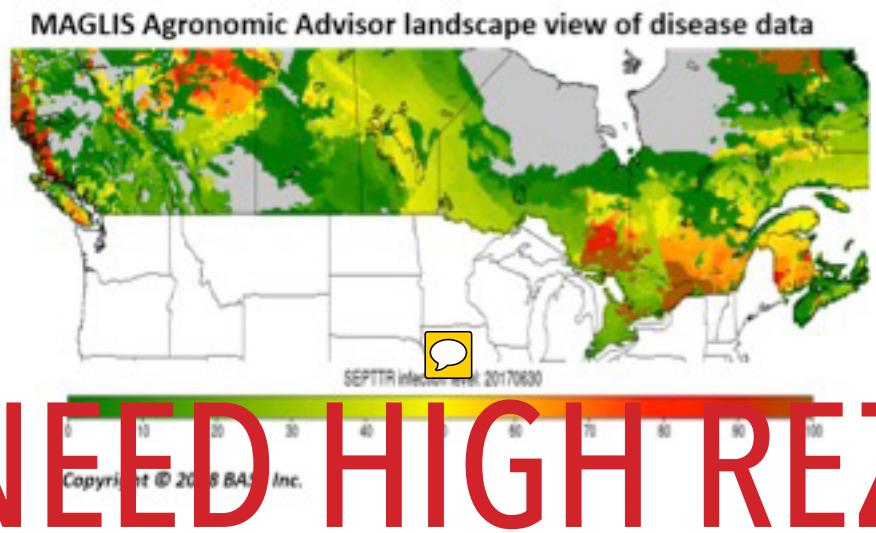
Total food demand and demand for food variety are both rising with income growth. Consumers want food that is traceable, carefully inspected, visually appealing and nutritious. Scientific breakthroughs will be vital to overcome continuing and emerging challenges, from ageing producer populations to regulations and compliance costs, trade barriers, and man-made environmental challenges.

ZedX has been a pioneer in pulling together all the factors that allow producers to truly manage their businesses. As part of its contribution to BASF's MAGLIS platform, it provides model-based, real-time analyses and forecasts for farm and field-level decisions. With its embedded Agronomic Advisor providing landscape views of crop and pest data (see Canadian disease map of Septoria leaf blotch in figure below), and customizable production calendars, MAGLIS is the modern-day Farmer's Almanac.

ZedX and BASF believe AI will augment, not replace, human decision-making by providing a transparent and replicable decision path. Like the industrial revolution, the information revolution will change how we do business and affect our social norms. AI will equal and likely surpass grower experience in making good production decisions. In the end, the new norm for many agricultural stakeholders will be one of constant learning in a continually changing information environment.

WHERE WILL FOOD AND AGRICULTURE BE THREE TO 10 YEARS FROM NOW AND WHY?

Not long ago in a question and answer session, growers were asked, "What are your three greatest needs in agriculture?" One participant answered with the knowing nod of others, "labour, labour, and labour."



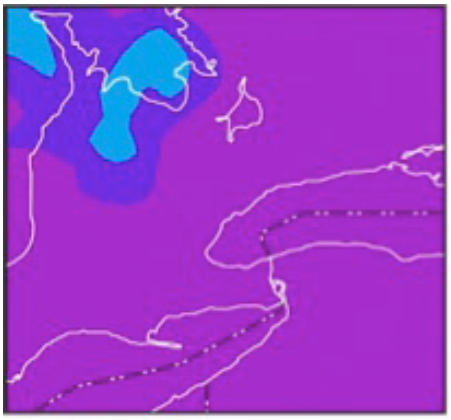
CLIMATE RISKS/IMPACTS AND PREPAREDNESS

DR. JAMES YOUNG, SENIOR CONSULTANT, RWDI

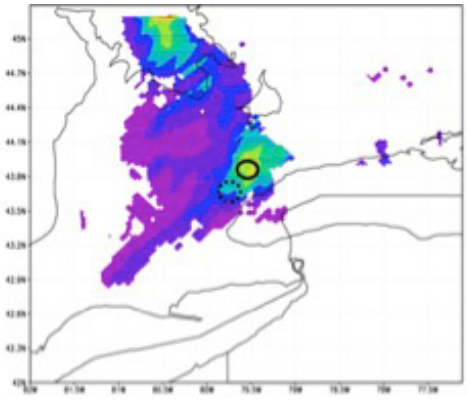
On the all-important topic of climate impact, Dr. James Young of RWDI provided a startling overview of what he called "forensic meteorology."

Young, a global leader in applied atmospheric research and modelling, and his company deal with strategic weather issues, such as increasingly powerful storms that often lead to flooding. RWDI's work examines issues such as climate change, the need for more data-driven and analytically-sophisticated weather forecasting, the usefulness of extreme value analysis, and wind gust forecasts.

Young notes that 141 mm of rainfall from a single storm on one day led to direct costs of $47 million for property owners and up to $600 million for insurance providers.



12x12 km grid simulation



1x1 km grid simulation

WHAT'S THE WEATHER FORECAST FOR THE FUTURE?

Weather instability continues to grow. By the year 2060, Toronto could see summertime daily maximum temperatures of 44 degrees Celsius (vs. 37 degrees today). Canada's biggest city could also experience more hot days (66 days vs. a current 20 days). This type of change is expected in rural agricultural areas as well – which will impact the sustainability of our food supply.

Expensive Consequences

What caused the 2005 collapse of a section of road on Finch Avenue West in Toronto? A single fallen tree branch partially blocked a culvert causing the stormwater to flow outside the pipe rather than through it.

OPTIMIZING SOIL USE CHOICES

PAUL RAYMER, FOUNDER & CEO, SOILOPTIX INC.

Engineer and entrepreneur Paul Raymer described Earth's soil layer as "the thin line between humans and starvation." Raymer's Tavistock, Ontario-based company, SoilOptix®, has developed an affordable, exacting soil-analysis system whose detailed field-nutrient and texture maps help growers make the best decisions for soil management and stewardship. With today's detailed soil and topography data, agriculture is just one of many sectors that will benefit from improved soil analysis and forecasting.

HEALTHY SOIL IS ESSENTIAL

The SoilOptix® team, led by Raymer, is striving to provide growers, agronomists and stakeholders of land the necessary tools and solutions for sustaining the health of soil by identifying where and how much (or little) is needed to achieve a balanced chemistry. This balanced soil is the key to ensuring crop health, growth and ultimately food production is continuously being met but in a sustainable fashion as to protect the land from further degradation and over fertilization. By relying on a system where the true raw information being collected is that of the natural existence of soil, and coupling with the dynamic soil fertility testing, we can try and achieve decisions based more on science than on "guess work".

By utilizing Artificial Intelligence, SoilOptix® uses a database of raw radiation and leverages relationships specifically to clay, sand and silt and enhances the prediction strength, while reducing the sampling needed to validate the field's texture percentage.

Much should be emphasized when evaluating base layers to any technology, specifically when implementing AI mechanisms. Gamma radiation, the raw information SoilOptix® sensors are collecting, offers a stable and repeatable source of natural information from the soil.

Figures 1 and 2 below offer insight on how a yearly progression from radiation is very minor and fitting within a level of standard error.

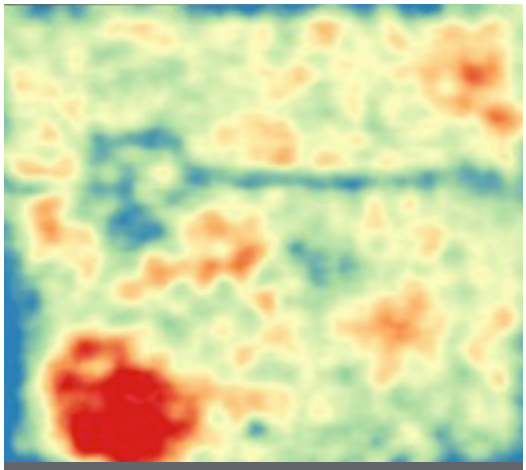


Figure 1: *Fall 2016 raw radiation*

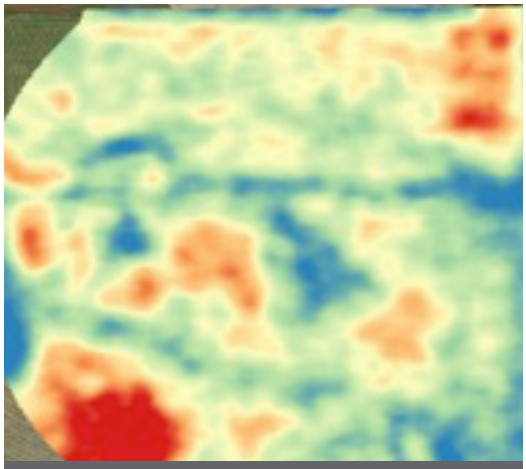


Figure 2: *Fall 2017 raw radiation*

This repeatability enables growers and agronomists to use the original survey data for over six years, and potentially untap how textural profiles change in a given period of time based on a potential shift in the soil profile of a field.

DATA DESIGNED PESTICIDES

DR. JULIAN NORTHEY, CO-FOUNDER AND CEO, FRONTIER AGRI-SCIENCE INC.

Ottawa-based Frontier Agri-Science focuses on the global problem of herbicide and pesticide use, especially in North America. Of the 1.8 billion people worldwide engaged in agriculture, most use pesticides on a regular basis. Many common pesticides have been used since the 1940s and '50s and are known to have both health and environmental effects. Atrazine, for instance, is an herbicide often applied to lawns and golf courses. As an endocrine disruptor, it causes cancer. In studies it has been found to de-masculinize male frogs and toads – to the point where some are even able to breed as females.

"…the biggest appetite for change is now being seen among the younger generation."

The challenge is to develop pesticides that work with the molecular structure of plants as opposed to the traditional spray and kill methodology. "Our goal is to use computer-aided algorithms for the development of new herbicides … to have more precise modes of action," says Northey. The potential, he asserted, exists to develop herbicides and pesticides that are tested and analyzed based on their impact on all living organisms, including crops, weeds, soil, and the end consumer. The goal is to reduce ecotoxicology and off-target human health effects.

FURTHER DISCUSSION

In response to questions from delegates, the panel of Precision Agriculture and Weather experts, engaged in a broader dialogue, mainly focused on how to enhance the reliability of food and other nutrients for our growing population.

On minimizing the impact on lakes due to agricultural run-off, Julian Northey said the industry is looking at fertilizers for plants that will be applied only at the precise moment they are needed. Researchers are working on time-release mechanisms based on Nano sensors. Jim Young spoke about working with Niagara College to use photographic data to apply herbicides and pesticides on an as-needed basis. Both agreed on the need to use AI and big data for soil/agriculture work.

What economic factors influence the adoption of new technologies? For instance, in the Greater Toronto Area only 20% of fields are being measured, and farmers' adoption of new technologies is entirely voluntary. The view expressed was that when farmers are making money, they rarely feel the need to adopt new techniques, despite the potential environmental and health benefits. Brad Bass, Adjunct Professor, University of Toronto, School of the Environment, suggested this disconnect represents a huge opportunity for producers and the industry.

The good news is that the biggest appetite for change is now being seen among the younger generation. – Dr. Brad Bass

SUMMARY SECTION

KEY TAKEAWAYS

- **The lack of workers at all levels of production is the most serious challenge to agriculture both now and in the future. As more "smart" machines are introduced in agriculture, production operations will be realized through a complex interaction of Artificial Intelligence, robotics, automated data collection, modelling, and machine learning. This fully automated vision of the future does include humans. However, their roles will be different: designing, building, repairing, and directing smart machines to do operations they once did – and unlike today, they will need higher levels of education and more advanced skill sets.**
- **Climate change has always been a fact of life. In our lifetime the change has been gradual. Now we are faced with a more rapid change because of the cumulative effects of the climate change to date that we did nothing about. Climate change will bring both threats and opportunities. AI can help us avoid the threats and take best advantage of the opportunities.**
- **Sustainable crop and food production truly rely on the management of the land that it is produced on. Reliable, stable raw information of soil coupled with fertility information from soil samples will allow land users to efficiently manage fields at the finest detail. AI will further the opportunity to leverage radiation across a geography to enhance an understanding of a field's true textural properties. This is the foundation to a sustainable crop and food production system.**
- **Innovative technologies will enable the development of 'smart' pesticides and herbicides that are designed to interact on the molecular level with plant structures to minimize collateral effects. In theory, future pesticides could have minimal ecotoxicology on all living organisms in the area of application.**

LOOKING AHEAD

Agriculture has been presented as the "canary industry" for future challenges. One such future challenge is the average age of farmers in many countries. Attracting millennials into agriculture remains a challenge. The advent of AI and big data, agriculture that is data driven, and other trends such as the rise of urban agriculture may help to reverse this trend, but it will remain a challenge for this sector. Panel moderator Brad Bass provides great insight expanding on this current and future issue in his case study, "Millennials, Technology, and Agriculture" featured below.

CASE STUDY MILLENNIALS, TECHNOLOGY AND AGRICULTURE

BRAD BASS, PHD and GEE ANN BARRO

"HOW DO WE KEEP ROBERTO ON THE FARM ONCE HE HAS SEEN THE LIGHTS OF SAN JUAN?"

In graduate school, during a course on agriculture and development that used Puerto Rico as a case study, this question was often open to discussion. Since that seminar, over 30 years ago, the question permeates agriculture across the globe. With the average age of farmers approaching 60 in many countries, it is obvious that youth are not interested in farming as a lifestyle or a career. Is it possible to attract the typical millennial to agriculture, both those raised on the farm and those millennials growing up in more urban environments? There are three trends emerging in agriculture that suggest the answer could be yes – urban agriculture, the use of technology – especially automation – and agri-tourism.

Urban agriculture used to be seen as the cultivation of small plots in a backyard or other available spaces to meet the needs of a household with some options for a small commercial venture. This was primarily an issue of available space. With the emergence of green roofs and green walls as viable technologies, space is no longer the issue. Green roofs and green walls have opened new spaces both on the exteriors of buildings and the interiors, but for the most part do not utilize AI and automation. This began to change in recent years when experiments in Singapore with precision, indoor, vertical food production paved the way for these technologies in large urban greenhouses. It is now possible to envisage large indoor environments using robotics and AI to intensify urban agriculture. The millennial demographic is familiar and appears to be more attracted to careers that utilize these technologies. Urban agriculture also allows millennials to stay in the city, which is overwhelmingly the preference of this demographic. With more effective utilization (or infusion) of technology to agriculture, it is anticipated that younger generations will be attracted to agriculture because it is more attractive and/or accessible. A farmer will no longer have to live in rural areas to choose farming as a career.

THE RISE OF PRECISION AGRICULTURE HAS PRECIPITATED THE NEED FOR NEW TECHNOLOGIES.

The increasing scale of farming as well as the possibility of large urban farms increases the likelihood of automation. Millennials are drawn to the development of new technologies in these areas, not necessarily for agriculture, but to address other problems that have emerged from agriculture or might be solved by agriculture. At a recent University of the Philippines Los Banos (Laguna, Philippines) conference hosted by an agribusiness student organization, a seed company, and the University's Center for Technology Transfer, students presented and competed their new technologies. Three projects were chosen to be implemented on demonstration farms, where after six months of implementation, the most effective innovation will win another set of awards and prizes. This could be a model for supporting the most promising of these new technologies through collaboration with corporations, academia and other sectors.

Agri-tourism presents another means to engage millennials in agriculture. This is not a new idea. Having young people earn room and board while living in another country has been a staple of Israeli tourism since the 1950s, although the commitment was for months. Opportunities that require only a week or two weeks have been emerging in many regions. The engagement in agriculture for a few days or weeks could be a starting point to introduce visitors to the potential in the agricultural sector.

One barrier to keeping Roberto on the farm is not just the bright lights of San Juan, but the attitudes of the parents. Farming is a physically demanding career and many farms operate at the margin, susceptible to a variety external factors such as the weather and the movement of global prices for inputs (fuel, fertilizer) and outputs from the farm. Naturally, parents want a better life for their children, and may be encouraging their children to pursue other careers. The family serves as the main factor influencing whether one sees agriculture as a sector full of potential and opportunities or the other way around. Whether the exhaustive efforts by several organizations and the advancements in technology can overcome a negative mindset passed on to the younger generation is a policy discussion for another summit.

THE **FUTURE IS HERE** – ADVANCING URBAN LIVING IN THE SHARED ECONOMY

Jane Taber
Vice-President of Public Affairs, National Public Relations

Adam Gromis
Global Sustainability and Environmental Impact Lead, UBER

Antoine Belaieff
Director, Regional Planning, Metrolinx

Adam Blinick
Head of Public Affairs Uber Canada

Peter Love
President, Love Energy Consultants

The world of transportation is changing exponentially, at unprecedented velocity, with positive implications for future urban life. Two key change catalysts are innovative technologies such as artificial intelligence, machine learning and data science, and the formation of partnerships and collaboration centred on scalable solutions that enhance the triple bottom-line: social, economic and environmental.

WHY IS THIS IMPORTANT?

The automobile fundamentally changed the urban living experience and how people relate to city living. Now, the age of the autonomous vehicle will trigger a similar transformation.

- 54% of the global population now reside in urban areas, versus 30% in the 1950s. This percentage is predicted to rise to 66% by 2050.
- In North America, 82% of the population is urban-based, with Europe close behind at 73%

Rural population growth has slowed dramatically since the 1950s. Africa and Asia are urbanizing rapidly: with 40% of Africans now living in cities, and 48% of Asians. Those numbers are expected to grow 56% and 64%, respectively, by 2050.

- The percentage of Canadians occupying single-detached homes is declining, to 53.6% in 2016 from 55% in 2011.
- Per StatsCan, "a number of factors have placed pressure on Canadians' ability, and even desire, to live in this type of dwelling. Higher house prices, the pressures of a long commute to work and an aging population are three of the many factors that may lead Canadians to live in different dwelling types."

The 2018 RSI AI and Sustainable Futures Summit explored the implications of these changes in a panel called "Rethinking Transportation for an era of choice, sustainability and autonomous mobility." The panelists, from ride-sharing pioneer UBER and the Ontario urban-transportation agency Metrolinx,

exemplify the innovative approaches devoted to planning for a crowded future.

Adam Gromis, UBER Global's Sustainability and Environmental Impact Lead, discussed the public's current over-reliance on cars and how the average car spends 95% of its life parked. In many cities, a third of all land is now dedicated to parking. Up to a third of traffic in city centers is caused by drivers circling to find parking.

Gromis highlighted how Uber's ridesharing technology is already producing positive change and pointing to new solutions in transportation.

One of Uber's most successful offerings is uberPOOL, in which Uber drivers transport several passengers – strangers with separate destinations in the same direction – at the same time. This turns the personal car into an on-demand transit solution at a lower cost than standard Uber or taxi services. Since UberPOOL was launched in the GTA two years ago, Gromis said, 20% of UBER users have opted for UberPOOL and has directly led to a reduction of over 9.5 million vehicle kilometres travelled. In UBER's eyes, ridesharing has always been the key aspect to any transportation system, and an innovative solution for improving public transit.

CASE STUDY: UBER – INNISFIL, ONTARIO

The fast-growing Town of Innisfil, just south of Barrie, was committed to "creating transportation options" as a key priority. In 2016 it calculated that a traditional fixed bus-route system with two buses would cost $610,000 a year but wouldn't meet community needs. Innisfil approached Uber seeking an on-demand service that could "transport passengers between Innisfil's great distances" more affordably.

Innisfil Transit debuted in May 2017, a first-of-its-kind partnership that offers residents an affordable and convenient transportation option, accessed through the Uber app. At three fixed rates ranging from $3-$5, Innisfil residents can get an affordable ride to work, to the commuter rail station, or to visit friends. UBER also built in flexibility in to the product, allowing users to input custom destinations within the town boundaries and were offered a 5-dollar credit. The Innisfil project expands the coverage and convenience over traditional transit while providing hundreds of local drivers the opportunity to earn money by helping move their community.

Innisfil estimates they have saved close to $8 million in one year through not investing in a fixed route system with the same reach. Gromis noted, however, that a custom ridesharing standalone service like this one, is not scalable to larger municipalities. "In more urban environments," he said, "we're better suited to be a first mile/last mile connector to public transit. And those are the relationships that have taken shape in U.S. cities."

A recent study by the American Public Transportation Association offered the following key finding: "The more people use shared modes, the more likely they are to use transit, own fewer cars, and spend less on transportation overall". Ridesharing apps are an innovative technology that enhances our existing public transit systems. At the end of the day, partnerships like the ones highlighted are moving towards an end goal of offering realistic alternatives to the personal vehicle in urban living.

Partnerships with ridesharing apps like UBER is only one example of how regional transit authorities are looking to new technologies to ensure the evolution in transportation is a change enabler for future urban living. Autonomous vehicles will advance the future of urban living through drastic evolution of transportation systems, a change enabler already on the Metrolinx radar.

Ridesharing Transit Solutions Today

First and last mile connections to transit are a key opportunity for ridesharing apps. This map illustrates partnerships across the US and Canada between local transit authorities and ridesharing programs creating multimodal options, increasing convenience for transit users and cost-savings for operators.

Highlights include, multiple pilot projects in Florida with the partnership between Uber and the Pinelles Suncoast Transit Authority (PSTA) specifically targeting low-income areas standing out. PSTA created the, "The Direct Connect" program subsidizing half the cost of the trip (up to $3) for trips made through Uber or the local taxi service that began or ended at a transit stop, rather than over investing in extending under-utilized bus services. The PSTA predict saving $100 000 or more through this arrangement.

AUTOMATION AND MOBILITY: TOWARDS THE FUTURE THAT WE WANT

ANTOINE BELAIEFF, DIRECTOR OF REGIONAL PLANNING AT METROLINX, TORONTO

Belaieff is a recognized thought leader on preparing for the implementation of autonomous systems. He says that autonomous vehicles should be viewed as a tool to help accomplish regional goals. For example, the province's *Growth Plan for the Greater Golden Horseshoe* seeks complete communities, housing options, revitalized downtowns, and a reduction in traffic gridlock through a wider range of transportation options.

He cited a recent thought experiment that looked at the ability of autonomous vehicles (AVs) to replace a subway line, a GO train line and conventional cars during the morning rush hour in Toronto's Don Valley parkway corridor. It concluded that only under ideal circumstances could private AVs provide the same capacity. Each vehicle would have to carry an average of five people, which means that a vehicle carrying one would have to be offset by a vehicle carrying nine, which starts to look a lot like a shuttle or a small bus. Congestion downtown would mar the journey from the highway to passengers' final destinations. Moving to shared AV commutes would also require significant technological advancements and cultural shifts, and trigger significant land use changes, which may not correspond to our ideal vision of the region if allowed to proceed uncontrolled.

CASE STUDY: METROLINX – DON VALLEY PARK

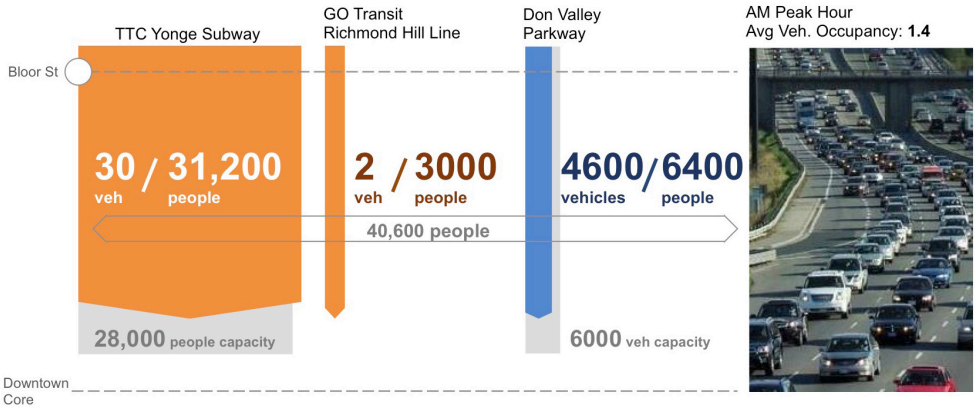
By using the Don Valley as a case study Antoine described a thought experiment that considered what would happen if Autonomous Vehicles (AV) were ubiquitous overnight.

Analyzing data sets available to Metrolinx on Toronto commuter habits between Bloor St. (midtown) to the downtown core, Figure 1 illustrates the relationship between current public transit systems and traditional commuting. Metrolinx staff wanted to consider the implications of replacing the current commuting structure with a single Autonomous Vehicle system handling the same capacity under ideal conditions. Figure 1.1 demonstrates that only under ideal circumstances could the Don Valley Parkway accommodate an AV system, and that is further ignoring the practicality of this system being realistic.

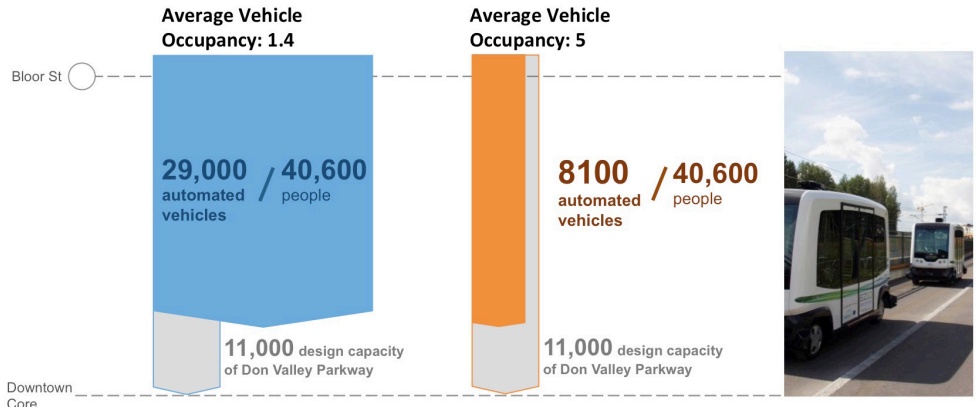
Belaieff raised a series of challenges for AV, such as how AV systems would interact with each other, the unpredictability of pedestrians and cyclists, impacts on land-use and curbside management. In short, autonomous mobility presents promise but also significant risks if we do not get things right.

Dense and vibrant cities rely on shared, frequent, and reliable high-capacity modes of transportation to keep people moving. In the future, the need for efficient use of space will not change, and ubiquitous low-occupancy Autonomous Vehicles would exacerbate rather than solve the challenges we face today. However, the meaning of transit must expand beyond vehicles and assets towards a comprehensive suite of mobility services that help people and cities fulfil their aspirations. This suite of services will be made more customer-friendly, accessible and efficient by autonomous technologies, but not defined by them.

A Thought Experiment … AM Peak Hour – Current State



A Thought Experiment … AM Peak Hour – Turn Transit "off"



CLIMATE CHANGE, ENERGY AND US

PETER LOVE, PRESIDENT, ROYAL CANADIAN INSTITUTE FOR SCIENCE

Polls have consistently shown that the majority of Canadians are concerned about climate change. While the details about just how bad it will be by what date are still being confirmed, there are five basic truths about climate change: "It's warming, it's us, we're sure, it's bad, and we can fix it." What's not so clear to many is what needs to be done.

...there are five basic truths about climate change: "It's warming, it's us, we're sure, it's bad, and we can fix it."

To better understand this, there are two critically important numbers. The first is 81%; that the portion of man-made greenhouse gas (GHG) emissions (which causes climate change) that come from the production and use of energy in Canada. This leads us to the conclusion that to confront the climate change challenge, we must focus on energy. The second number is 2/3; that's the amount of energy that is lost in Canada as it is converted from its raw form to the work that we use it for.

This now leads to the conclusion that reducing GHG can be done by reducing the amount of energy we use (energy efficiency behaviour and products) and by using forms of energy that do not result in GHG emissions (renewable energy like hydro, solar, wind and biomass). In practical terms, this means everyone needs to focus on the energy they use in their everyday lives. This can be broken down into two main activities; those associated with the built environment (homes, offices, factories, schools, appliances, etc.) and transportation (cars, trucks, public transit, etc.). Within each of these two categories, there are a few common approaches. When buying new, consider buying the more energy efficient product or the one that runs on renewable fuels. If you are not buying new, consider retrofitting your existing building to make it more energy efficient, ensure that it is operated in the most efficient manner and use the more energy efficient public transit system.

References:
www.energyefficiencyfundamentals.org/textbook

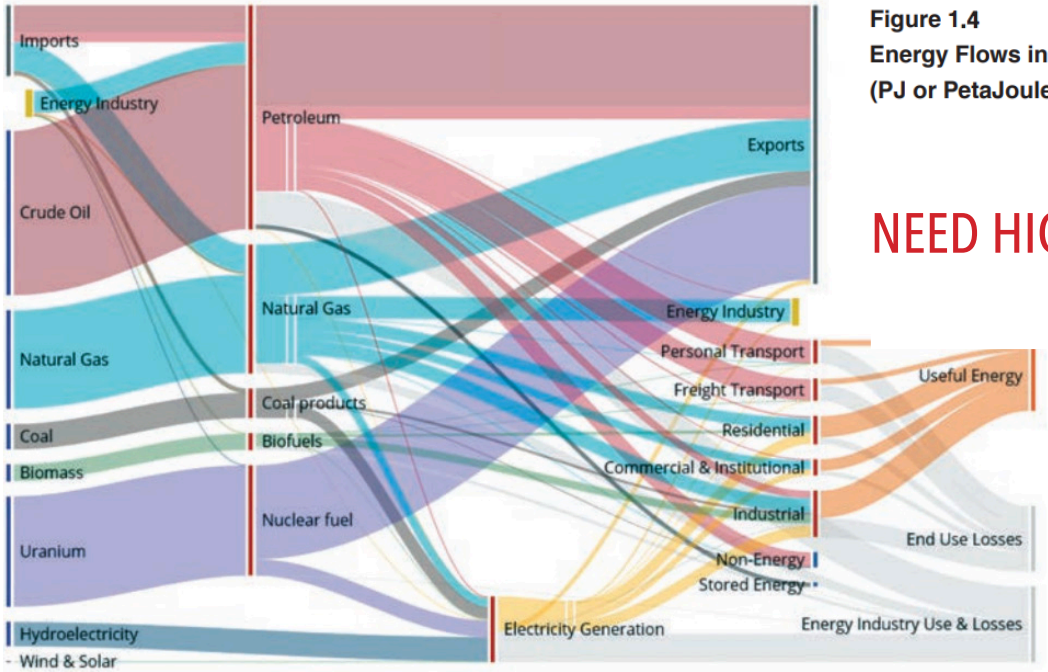


Figure 1.4
Energy Flows in Canada: 2013
(PJ or PetaJoules)

NEED HIGH RES

Source: Canadian Energy Systems Analysis Research[11]

FURTHER DISCUSSION

ELECTRIC VEHICLES

(EVs) are key to reducing greenhouse gas emissions. It is important now to increase EV exposure, and build the charging infrastructure to meet future demand. The Greater Toronto/Hamilton area has multiple collaborations addressing these areas.

Established in 2011, Plug'n Drive is a not-for-profit organization committed to accelerating the adoption of Electric Vehicles. Through the Electric Vehicle Discovery Centre in Toronto, sponsored by government, business and utilities, Plug 'n Drive lets the public learn more about electric vehicles, and take free test drives. https://www.plugndrive.ca/

The growth of EVs will depend on the availability of charging stations, especially street-side. Last fall Toronto city council approved a project to install 12 overnight charging stations in residential neighbourhoods to accommodate the city's 1600 EVs. (80% are currently charged in personal homes.)

Through the Electric Vehicle Chargers Ontario (EVCO) program, the Ontario government has committed to build more charging capacity. Koben Systems Inc. was selected to install a network of 500 charging stations.

ADAPTING URBAN SPACES

As ridesharing companies expand partnerships with transit authorities, they are forming new partnerships with developers to promote car-free living. Gromis cited two such partnerships at Uber. The San Francisco program offers members a monthly $100 rideshare credit – and residents can take UberPool to public transit for $5. In the U.K., Uber has partnered with Moda Living, which aims to reduce parking spaces in favour of expanding resident services. Any resident who opts out of a parking spot receives a monthly $100 credit with Uber.

PRIORITIZING INTELLIGENT TRANSIT SYSTEMS

Ontario is one of many jurisdictions starting to prepare for Autonomous Vehicles. The recent 2041 Regional Transportation Plan for the Greater Toronto/Hamilton area includes a series of background studies with scenario modelling, a "New Mobility" report and a strategy dedicated to "Preparing for an Uncertain Future." It also describes a potential priority bus network that combines priority lanes, intelligent sensors, lights, and signals. According to Belaieff, other cities are considering new approaches to curbside management and street design. Additionally, some U.S. states have introduced per-mile charges for AVs.

NEED HIGH RES

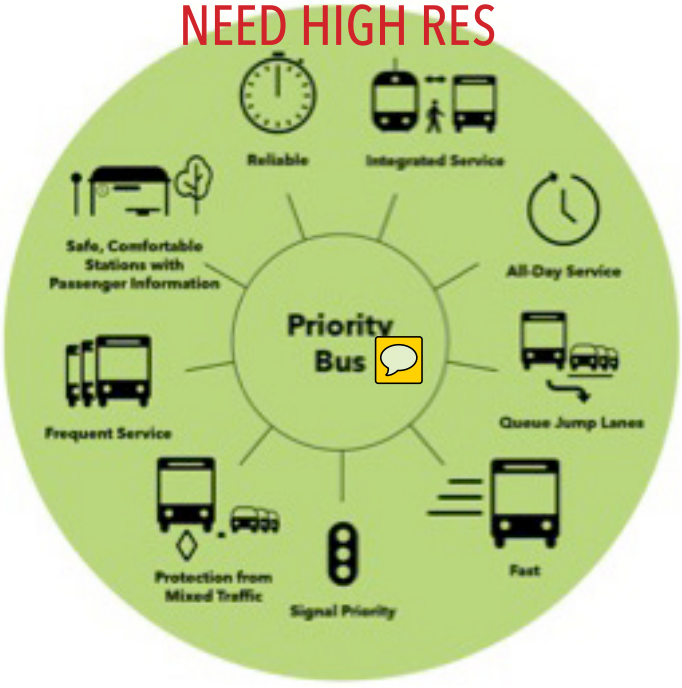


Figure SEQ:
**ARABIC 1 Priority Bus*
(2041 Regional Transportation Plan for the Greater Toronto and Hamilton Area)

AUTONOMOUS VEHICLES – PROS and CONS

PROS

- Maximize the quality of life of commuters who no longer are spending the time focused behind the wheel.
- Dramatically reduce automobile accidents including pedestrians stuck
- Minimize commuting times through integrated traffic control systems.
- Environmental benefits would be twofold, electric AV's would lower the demand for fossil fuels overall.
- Within the expansion of shared cities, autonomous vehicles would reduce the demand from personal vehicles, reducing traffic.
- Allow urban planners to rethink future city infrastructure, ex. parking lots wouldn't need to be designed for accommodate people and vehicles anymore, just vehicles.

Source:
www.futurism.com/images/7-benefits-of-dritverless-cars

CONS

- Will autonomous cars be so convenient and inexpensive that they undermine public transit? And are our streets ready to handle even more single-vehicle traffic?
- Will more productive travel encourage longer commutes? If so, how far will we allow our cities to expand?
- Autonomous operation may come first to trucking, an industry suffering from chronic driver shortages. But how will self-driving trucks share the road with passenger-driven cars?
- How will autonomous vehicles cope with Canadian winters?
- Self-driving cars guided by always-on video cameras will be constantly collecting gigabytes of data regarding road conditions, the physical environment, and the behavior of other motorists.

Source:
www.rethinksustainability.ca/2018/01/29/automation-and-mobility-towards-the-future-we-want

Mobility-as-a-Service: describes the integration of various transport services including public transit, bike or car-sharing, taxis, and ride-sourcing through the use of an app and bundling of payment. MaaS could be an important means to manage future transportation services to support access to public transit and payment integration between new and emerging transportation services. The key challenge of MaaS is not the technology itself but the establishment of partnerships between public entities and private sector service providers.

SUMMARY SECTION

Ridesharing and Autonomous Vehicles are only two of several transformative technologies shaping our future urban living. These snapshots illustrate how innovators in all sectors are forming partnerships for the future.

KEY TAKEAWAYS

- **Ridesharing apps are an innovative technology that enhances our existing public transit systems. At the end of the day, partnerships like the ones highlighted are moving towards an end goal of offering realistic alternatives to the personal vehicle in urban living.**
- **The meaning of transit must expand beyond vehicles and assets towards a comprehensive suite of mobility services that help people and cities fulfil their aspirations. This suite of services will be made more customer-friendly, accessible and efficient by autonomous technologies, but not defined by them.**
- **Reducing GHG can be done by reducing the amount of energy we use (energy efficiency behaviour and products) and by using forms of energy that do not result in GHG emissions (renewable energy like hydro, solar, wind and biomass). In practical terms, this means everyone needs to focus on the energy they use in their everyday lives. This can be broken down into two main activities; those associated with the built environment (homes, offices, factories, schools, appliances, etc.) and transportation (cars, trucks, public transit, etc.).**

LOOKING AHEAD

Automated Vehicles will result in dramatic changes to the way that people and goods are moved. There is an important role for government to play in helping to shape a future vision of mobility that ensures public safety and equity while allowing for the incorporation and experimentation with new technologies as they emerge. An automated future is compelling, but we need to remember that the transition period will need to be managed carefully.

As all mobility innovations, AVs will impact regional mobility in ways that we will not be able to fully predict. Learning from the past, we must endeavour to define the problems that we are trying to solve before committing to solutions, and ensure we are truly improving societal outcomes. At first, this means finding opportunities to test the technology, develop proof-of-concept and build public familiarity. We will need to document and understand unintended consequences and trade-offs that emerging technologies present, while keeping our eyes on the big prize: mobility services that serve people and do so better than what we have now.

THE **FUTURE IS HERE** – FINANCE IN A DIGITAL WORLD

Cindy Gordon, PhD

CEO & Founder, SalesChoice

Marc Lipman

Chief Operating Officer & Head of Innovation AIG Insurance Company of Canada

Troy Wright

Founder, CEO, Lendified Inc.

Rick Spence

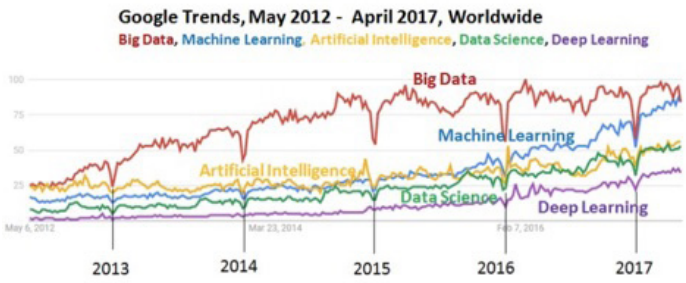
Business Innovation, Communication and Growth Leader

The world of finance and technology is converging into a blended digital space, catalyzed by AI, Machine Learning, DL and Big Data.

To dive into how this new world will look in the fast-emerging future, three recognized business and technology leaders share their views on possible scenarios. They also raise general concerns, such as whether Artificial Intelligence is really a force for social good. Skeptics, for instance, might ask if genuine intelligence, itself, has always kept in mind the greater good.

ARTIFICIAL INTELLIGENCE AND THE RISE OF GUIDED SELLING **DR. CINDY GORDON, PHD, CEO, SALESCHOICE**

Cutting through the role and future of Artificial Intelligence, it is a market that is expected to grow from USD 1.52 billion in 2018 to USD 10.88 billion by 2023, at a CAGR of 48.2% during the forecast period. The graph below provides an indication in the growing interest in the interrelationships of: Big Data, Machine Learning, Artificial Intelligence, Data Science and Deep Learning.



A critical question to ask is: **"AI will underpin every business process on the earth?"** This underlines an important aspect of AI: it is a foundational technology rather than a disruptive one. That is, AI will be a foundation for profound changes as to how business, society or home functions are designed and developed. In many respects, Dr. Gordon views AI not as the new electricity but rather the new air that will surround everything we know today.

A key success factor for AI will be the development of robust regulatory, security, legal and fairness frameworks to govern AI effectively and efficiently. As the industry matures, global frameworks will be needed.

The UK has rapidly positioned a fairness framework for guiding AI developments, while the European Economic Union are just framing a point of view, while USA and Canada lag in a clear privacy position on Data and AI.

A universal set of new governing laws will be needed and will require co-operation across jurisdictions to plan the new flows effectively. Much like we had to think of Air Travel routes carefully, with international safety and regulatory standards, we will need to think hard about the new pathways that AI and ML methods are rapidly creating, while the technology innovators are well underway. Countries like Saudi Arabia have given their first major Robot Sophia, more legal status that a female human, causing international concerns on AI Ethics.

Gordon's corollary point is that AI will not just address the long-standing human fragilities, such as lack of attention or a human's tendency to make mistakes. One of the key observations that Dr. Gordon made is that the human cognition capabilities have declined by 50% since the advent of mobile, driving the Rise of The Distracted Economy, which is often referred to also as the Attention Deficit Economy. One of the areas highly impacted by cognitive declines is B2B Sales Professionals who are already attention deprived, with 30% of sales professionals having attention deficit disorder. B2B Sales Professionals productivity has dropped to less than 33% of focused time on what counts, the customer, a drop from 50% productivity only 10 years ago.

New sales augmented intelligence tools are now available to help guide sales and marketing professionals to identify the best fit for a new lead, or the best customer buying profile ready to purchase, or even the best bundled solution to fit the customer profile. AI can crawl the world-wide web, as well as internal CRM business processes and string together the customer bread crumb trail to help provide insights on win or loss signals that can often yield 98% accuracy with AI and Machine Learning methods. But the replacement of error-prone humans with dependable AI systems may lead to job losses of an unprecedented scale.

The Nobel Prize-winning physicist, the late Stephen Hawking, suggested that in time human beings themselves may become extinct, due to their inability to evolve to cope in a more intelligent machine world.

"The development of full artificial intelligence could spell the end of the human race. It would take off on its own, and re-design itself at an ever-increasing rate. Humans, who are limited by slow biological evolution, couldn't compete, and would be superseded

– Stephen Hawking, 2017

One of the key success factors in getting ready for the new world order will be to ensure that corporate boards are fully educated on what AI and ML methods can do to solve different business challenges. AI is particularly strong at analyzing large data sets to predict anomalies, or fraudulent activities, or being able to crunch hundreds of millions of transactions to find insights that are difficult to find, given the intense computational needs to analyze large data sets, particularly in financial institutions.

As one looks ahead to the top AI trends in 2018, Gordon outlines some of the key trends that are recommended for leaders to be aware of:

1. Increase in processing capabilities of new and more powerful computers will accelerate AI and ML enablement;
2. New AI applications will be more data intensive due to cheaper access and storage to apply more unsupervised learning methods;
3. Back office applications using AI will intensity in areas like legal contracts, policy management, medical and insurance claims processing etc.;
4. Acceleration of AI will be hindered by legal, privacy and data controls that if not planned effectively will impact the evolution of AI, and
5. AI developer toolkits will become widely available to increase the utilization of data science methods into business users' access.

In summary, what is important to understand is that AI is going to have a transformative impact to everything around us. AI will integrate more into human levels by around 2029. By 2045, we will have multiplied the intelligence, the human biological machine intelligence of our civilization a billion-fold – hence we enter a new world order where man and machine could reach singularity as one.

It will take many brilliant minds to ensure we think of the new world we want to create, from many diverse view-points.

PRECISION ON THE RISE IN THE AI-POWERED INSURANCE INDUSTRY

MARC LIPMAN, CHIEF OPERATING OFFICER, AIG INSURANCE COMPANY OF CANADA

As a profession that has always worked to measure risk and predict human behavior, the insurance industry is poised to change and thrive in the era of AI. Like underwriting, AI is all about analyzing large amounts of data and balancing myriad variables to achieve ever more precise insights.

In the imminent, data-driven future, Marc Lipman, Chief Operating Officer at AIG Insurance Company of Canada, says AI has the potential to revolutionize insurance, business and society in many significant ways:

1. **Faster claims service:** AI can classify, evaluate, and calculate probable payments on a wide array of standard claims. Clients submit their claims to a chatbot, and "AI is used to actually adjudicate the claim," says Lipman. "If the claim is determined to be valid, then an automated payment is effected to the client. By embedding

AI within the adjudication process for less complex claims, the industry will align with current expectations of service. When new technology and traditional customer service align to meet the needs of the customer, then we have achieved the perfect customer focus.

Lipman notes however, AI must meet clients' need for personal attention, and reassure them their claim has been evaluated fairly. "Ultimately," he says, "we view AI as an opportunity to improve our clients' insurance experience, while at the same time gaining additional insight that can be used to better serve them."

2. **Understanding and assessing risk:** AI's ability to handle huge quantities of data will enable insurers to better assess and price risk. But Lipman says human experts will always remain part of underwriting: "We don't want to give up the art entirely for the science. We need to find the right blend between the two where AI acts as a tool for the benefit of underwriters."

Consider the predictions in a recent report by McKinsey ("Insurance 2030—The impact of AI on the future of insurance," April 2018) on the AI-powered insurance industry. In 2030, "Scott" jumps into an autonomous vehicle to head to a meeting across town, but then decides to do the driving. His personal digital assistant maps out a route and shares it with his "mobility insurer", which offers an alternate route with a lower likelihood of accidents. It also alerts Scott that his monthly insurance premium will increase by up to 8%, depending on the route he selects.

At his destination, Scott bumps into a parking sign. Immediately, internal diagnostics determine the extent of the damage. His personal assistant instructs him to take pictures of the front right bumper and the surroundings. The dashboard screen informs him of the damage, confirms the claim has been approved, and says a mobile response drone has been dispatched for inspection. The vehicle will be directed to the nearest approved garage for repair as soon as a replacement vehicle arrives.

He notes that AIG, one of Canada's largest commercial property and casualty insurers, is not just a user of new technologies, but a student of them. AIG needs to understand how other industries are applying AI, robotics and other technologies in order to understand their risk and underwrite their activities.

3. **New-product development:** From the deeper insights gained will come new insurance products that are tailored to individual clients' needs. Lipman says most of the data that insurance companies collect has so far gone under-utilized; putting it all together will help insurers identify countless new opportunities. "This will be a multi-year journey," he says. "Currently we can pick an area, pick a data set, and apply AI to gain some valuable insights. With the insights gained, it may be possible to develop an insurance product that better addresses our clients' needs."

4. **Measuring more complex risks (such as natural catastrophes):** Lipman says AI will soon enable insurers "to measure and identify accumulations of risk" – such as hurricanes, wildfires or overland flooding. The sheer number of variables involved – historical weather and climate records, topography, existing structures and building codes, property values, traffic patterns – require state-of-the-art computing power, and Lipman notes AIG has already entered into a strategic arrangement with Clemson University in the United States to access their "supercomputer" to begin the process of developing more accurate natural catastrophe models.

As development continues to grow in wind zones, fire zones and flood zones, these models will help business and society make better decisions about where and how to build.

Success will require collaboration from many different constituents including insurers, governments and other sources of relevant data, but says Lipman, " hopefully the effort will generate real, long-term benefits."

CLEARING AWAY THE COST OF UNCERTAINTY IN THE WORLD OF FINANCE

TROY WRIGHT, FOUNDER, CEO, LENDIFIED INC.

A former Scotiabank executive turned fintech entrepreneur, Wright's experience highlights yet another risk of AI – management's inability to understand the data and take the recommended logical steps.

Besides offering business loans, Wright notes that Lendified supplies banks with algorithms that can quickly and efficiently assess, quantify, qualify, and distribute loans. Its process reduces the personal friction between bank and their customers – reducing the time and aggravation involved in disputes by providing transparency and objectivity. While the process can clear the fog surrounding loan decision-making, there is still the risk that skewed or incomplete data may lead to wide-scale errors. The lending body can find itself facing significant liabilities from overly-restrictive loan practices (which may appear to be race-based) or under-restrictive practices leading to abuse.

For example, explaining decisions made by machine learning algorithms is technically challenging, which particularly matters for use cases involving financial lending or legal applications. According to McKinsey & Company, the finance sector is leading AI adoption, along with automotive and telecommunications sectors.*

Overall, though, some perspective is necessary. AI has made significant advances over the last 30 years. But the history of AI suggests it advances for a while, then reaches a barrier in funding and complexity. It takes a breather as bright people figure out how to overcome the problems and to reduce costs.

AI will still seem to take longer than some visionaries predict. While it is the technology of the future, human hands-on management of finance will be around a long while.

While AI is the technology of the future, human hands-on management of finance will be around a long while.

*www.mckinsey.com/featured-insights/future-of-organizations-and-work/ai-automation-and-the-future-of-work-ten-things-to-solve-for

SUMMARY SECTION

KEY TAKEAWAYS

- **Understand what Artificial Intelligence and Machine Learning Methods can be applied to your organization or business model. Start with: What question is complex for us to answer that we have large amounts of data to analyze to enrich our IP or insights?**
- **Your Growth and evolution will be highly integrated with the applications of AI into your world. Even if just buying an Amazon Alexa or Google Echo, this is a start to learning about AI in Natural Language with a Chatbot so you can be comfortable when Home Robots hit the market. Experimentation to learn is key to sustainable evolution.**
- **Not only will AI improve the efficiency of routine tasks in finance and insurance, AI must also meet the test of improving the customer's experience.**
- **The use of outside data has proven vital to the insurance industry, for example, in modelling the impact of climate change. With new and improved weather data (as referenced in the food and agriculture section), the insurance industry has been able to calculate risks and attendant costs more accurately.**
- **Algorithms that can quickly and efficiently assess, quantify, qualify, and distribute loans reduces the personal friction between bank and their customers – reducing the time and aggravation involved in disputes by providing transparency and objectivity.**

LOOKING AHEAD

The finance, technology and insurance sectors have the greatest potential for efficiencies achieved through the engagement of AI, Big Data and Machine Learning. These sectors also have the biggest risk to do harm.

It is incumbent on companies to develop policies and protocols that protect the privacy of its customers and provide the right checks and balances from a human perspective to ensure the algorithms are generating the expected results.

But there is significant value to be created by AI, which has the potential to impact the banking sector by close to $300 billion and insurance by over $200billion. Banking is expected to see AI impact of 35% while insurance a bit less at 28% share of AI impact in total impact derived from analytics. (McKinsey & Company, 2018). With this significant growth comes significant responsibility. Financial companies have the opportunity to lead the way, for AI to be a force for good.

THE **FUTURE IS HERE** – WORK AND LEARNING IS NOW

Yasmin Glanville

Founder, CTR Inc. and RSI

Krista Jones

Managing Director, Work and Learning, MaRS Venture Services

Andra Popescu

Senior Advisory Consultant, D2L Corporation

Chris Jackson

Finance and Operations Executive

Disruptive times call for creative, inspiring and inclusive leaders. How do we develop, attract and incentivize this scarce talent pool?

RETHINKING BUSINESS, WORK AND LEARNING.

The way people learn, and work is changing at rates previously unprecedented in human history. Many services that were standard in 2001 have been replaced today by new lifestyles, norms and expectations. Consider the ease of traveling in 2018: with a smartphone, anyone can access information to hundreds of hotels, rentals, flights, and travel deals, and book in minutes and read and access thousands of reviews from people all over the world. To contrast, 'Hotels.com' did not have online booking capabilities until 2002. Before this, leading options included going through a travel agent or looking up each hotel separately.

As humans become increasingly connected, advancements in Artificial Intelligence, Machine Learning and other modern technologies can impose system-wide changes in just a few years vs decades in shaping the future of the workforce and education.

In the 2018 workforce, we have already begun to see automation and AI replacing people in predictive labor-environments, with things such as automated self-checkouts and phone systems in traditionally human-dominated service sectors. As AI continues to develop, automation is expected to replace between 400-800 million jobs globally by the year 2030 (McKinsey, 2017). This will not

impact different sectors of the labour force equally. The greatest losses will be seen in middle and low wage occupations. To balance out the losses, the continued implementation of AI is predicted to pave the way for new and different employment opportunities; many of which have yet to be even conceived. The immediate challenge and opportunity is to prepare and train those who will be displaced, and new workforce entrants, with relevant skills and knowledge required to thrive in a fast paced world.

THE NEW EDUCATION NORM IS 'CONSTANT LEARNING' THAT FITS THE CHANGING SKILLS AND KNOWLEDGE REQUIREMENTS OF THE LIFE-LONG LEARNER.

Learning no longer ends when a student leaves school. We face an upcoming generation that needs to continuously learn new skills and knowledge to stay market relevant throughout their lifetime; especially as the pace of social and technological change speeds up. On the plus side, technological advancements allow people 24/7 access to a wealth of online education and training platforms and courses.

The transformative power of technology and other disruptive innovations is also changing the traditional structure of organizations, how people are hired, trained and retained. At the same time, with the rise of the on-demand, gig-economy, and a plethora of disruptive tech-enabled innovations, life-long 'students' across all generations, are becoming more empowered to choose what they learn to support what they think will make them successful at different points in their lifetime.

A GROWING NEED: PURPOSE, HUMAN TRAITS AND ETHICS

Futurist, Gerd Leonhard – who specializes in the debate between humanity and technology- predicts that accompanying the adoption of advanced technologies will be an increase in the need for workers with finely tuned social and emotional skills. He adds that "Anything that cannot be digitized or automated will become extremely valuable – because machines are good at simulating but not at BEING."

As AI continues to develop, automation is expected to replace between 400-800 million jobs globally by the year 2030 (McKinsey, 2017)

To build and sustain a human-centric, purposeful life for people, it's essential to include emotional and social skills, ethics, creativity and communications as core life-long learning requirements for all ages. Leonard, and other futurists, believe that humanity depends on it. Technology, as we know it, cannot do that.

THE FUTURE ORGANIZATION AND WORK

KRISTA JONES, MANAGING DIRECTOR, WORK AND LEARNING, MARS VENTURE SERVICES

Krista Jones, Managing Director, Work and Learning for MaRs Venture Services, highlights how the structure of organizations and how they hire and train people and operationalize the business is also rapidly changing. And exponential technology is defining Information Technology – and who we are and how we behave as people.

- **AI & Machine Learning**
- **(Advanced Analytics)**
- **Sensors & Networks (IoT)**
- **Blockchain**
- **Cybersecurity**
- **Cloud/Compute Power**
- **Personalized and Precision Medicine**
- **Next Gen Manufacturing / Robotics**
- **Advanced Visualization & VR**

IN 2018, EXPONENTIAL TECHNOLOGY IS DEFINING IT

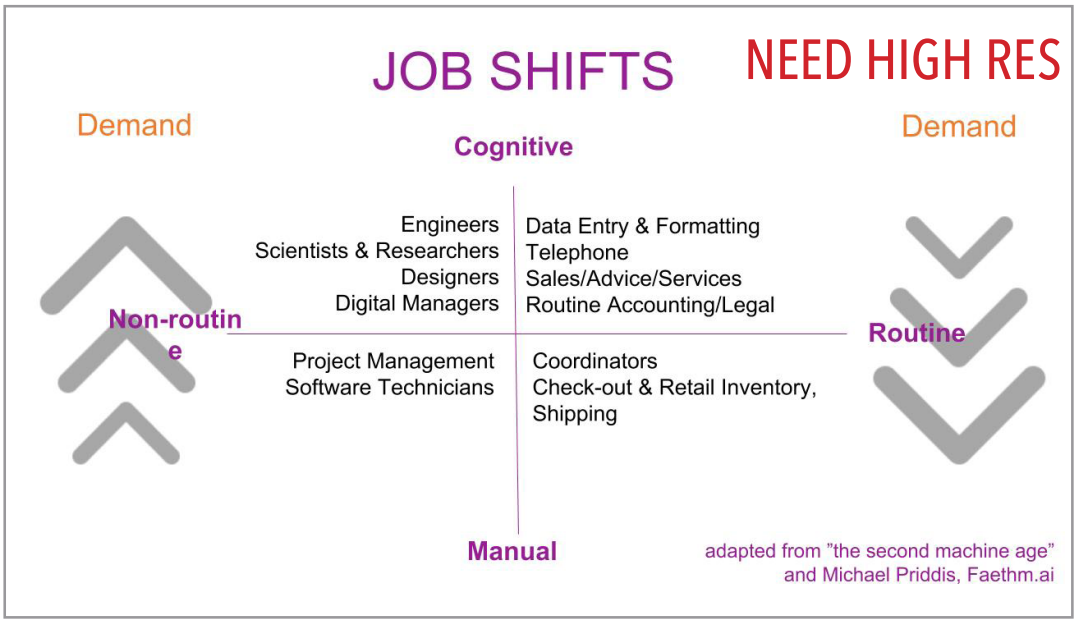
As Technology evolves, it is now defining who we are and how we behave as people. For instance, HR software advancements – or disruptions – have evolved from the launch of ERP Systems of Record in 80s to current systems of engagement and productivity. The latter are designed to engage, empower and connect people; and, help teams get work done in a productive and healthy way.

Here's another twist. It used to be enterprise first and then consumer. The consumerization of everything has flipped that. The office is not quite ready for AI.

THE WORKFORCE IS CHANGING TOO

In contrast to even five years ago, it's now:

- **Diverse / Multicultural**
- **Multi-generational**
- **Lifelong learners supported by 24/7 learning systems**
- **Global**
- **Hybrid Jobs requiring skills in two streams of training**
- **Innovative and agile**
- **Contingent work structures**
- **Work-Life Integration**
- **Desires to have Societal Impact**
- **Technology Savvy**
- **Video and voice enabled workforce communication**



WHAT IS THE IMPACT OF AI ON JOBS?
ARTIFICIAL, AUGMENTED AND AUTOMATED INTELLIGENCE

As shown in the Job Shifts model (adapted from The Second Machine Age and Faethm.ai), demand for cognitive, non-routine jobs, such as engineers, scientists will increase. Manual, routine jobs will decrease.

Thus, to stay relevant, all professions and industries need to reassess and adopt new requirements for future-proofing their organizations and competitive advantage.

For instance, the legal profession needs to redefine. Why? The articling system is outdated. This is an opportunity for process augmentation, not automation. AI allows you to do intelligent transformation of the process.

AN INDUSTRY IN TRANSITION – THE LEGAL PROFESSION

CHRIS JACKSON, FINANCE AND OPERATIONS EXECUTIVE

The practice of law in many ways has remained almost unchanged for decades, if not centuries. Lawyers bill their clients by the hour, increase rates on an annual basis and lean on a strong supply of young, aspiring lawyers as an economical labour force.

AI presents a huge opportunity and challenge for the legal profession. Tools already exist that can significantly reduce or even eliminate the need for repetitive human effort. For example, document review historically has been a task performed by new lawyers, billed by the hour. This type of task is ideal for the application of technology – AI tools are better at searching for key words, plus they don't get tired, hungry or bored! But when choosing to implement these tools, the law firm is fundamentally changing the economics of their business, as well as the means to develop and train their young lawyers; document review provided not only a steady revenue stream for the firm, at profitable hourly rates, but formed a critical component of the training of new associates on the path to being senior lawyers and eventually partners.

So, AI presents a challenge to firms, not only in how to best implement the appropriate tools to ensure quality service to clients--and, therefore the long-term viability of the firm--but just as fundamentally, how to train today's new associates so that there are enough skilled practitioners to advise clients in the future and to run the firms of tomorrow. The firms that will survive into the next decade and beyond will need to determine how best to innovate, adapt and embrace AI and other technologies or risk becoming obsolete in a new industry environment.

THE FUTURE OF LEARNING – THE MODERN LEARNER

ANDRA POPESCU, SENIOR ADVISORY CONSULTANT, D2L CORPORATION

According to Andra Popescu of D2L, 'disruption as the new normal' applies to the modern learner as much as the technology advancements driven by automation and AI. In a spring 2018 survey by Ipsos Canada of 2,000 Canadians, six in 10 Canadians feared, among other things, the "mass unemployment" that could arise as technology disrupts new industries.

In May 2018, Canadian technology firms, including D2L Corp, signed a 'Tech for Good Declaration' that was unveiled at the True North technology conference in Kitchener, Ontario by former Governor-General David Johnston. "In this digital age, 'innovation for good' needs to be more firmly and deeply fixed amongst all Canadian industries and organizations," Johnston told the crowd in a keynote address.

In addition to calling for transparency in the collection of personal information and in communicating how the data is used, the declaration requires signatories to ensure that people whose jobs are lost to technology are re-educated for new positions.

Two key questions underpinning the work of D2L Corp are: 'How does is technology used to dramatically transform learning? How ensure that everyone has access to the best possible learning opportunities? This is complemented with communicating the importance of engaging the workforce of organizations to strengthen reputational leadership and creating a connected learning culture for the modern learner.

FIVE STRATEGIES TO ENGAGE THE MODERN LEARNERS

- **Personalize learning**
- **Highlight achievements**
- **Provide video capabilities**
- **Develop bite size learning**
- **Engage social learning**

Organizations can further future-proof their workforce and engage learners by delivering the education the way the individual wants to receive it (i.e. device agnostic). "The return on value for an organization that brings continuous, agile learning to the workforce", says Popescu, "is an increase in learning adoption, satisfaction and net improvement."

"The return on value for an organization that brings modern, agile learning to the workforce is an increase in learning adoption, learner satisfaction and improvement in net promoter score."

Lifelong learning is also becoming an economic imperative. Technological change demands stronger and more continuous connections between education and employment.

WORK WILL NEED TO BE REDESIGNED TO ENSURE THAT HUMANS WORK ALONGSIDE MACHINES MOST EFFECTIVELY.

Organizations more inclined to invest in and adopt of new learning platforms when they have experienced the benefits' and, they trust the process and end benefits. The next step is helping human resource and business teams to make the business case for investment.

Ultimately, it comes down to the culture of learning within the organization and people who are flexible and curious will be ready for the future. Good organizational design will help people not feel overwhelmed and accelerate implementation of new skills.

WHAT ABOUT THE FUTURE OF LEARNING?

Flexibility in where and how employees learn is increasingly important, coupled with constant learning to ensure skill and knowledge relevancy

and a new "on demand" gig workforce. And to succeed in the future, organizations need to get beyond the digital, and focus on developing a connected, integrated and Intelligent Enterprise – as modelled below.

HOW WILL DEMAND FOR WORKFORCE SKILLS CHANGE WITH AUTOMATION?

The McKinsey Global Institute's Paper, "Skill Shift: Automation and the future of the workforce," predicts that adoption of automation and AI technologies over the next 10 to 15 years will transform the workplace as people increasingly interact with ever-smarter machines. These technologies, and that human-machine interaction, will bring numerous benefits in the form of higher productivity, GDP growth, improved corporate performance, and new prosperity. They will also change the skills required of human workers.

The demand for technological skills will increase as 2030 approaches, as will the need for social and emotional skills.

In contrast, the need will decline for both basic cognitive skills and physical and manual skills.

Tips for Enabling People for the Future

- *MaRS launched a new talent development program designed for people to move into futureproof jobs.*
- *AIG sends internal people to become subject matter experts in modern technologies.*
- *Sustainable.TO encourages its staff of architects and designers to spend 20% of their time on their own projects and learning – which we pay for*
- *CTR Inc. designs and delivers future proofing work and learning strategies and workshops for organizations, leaders and teams for being ready today for what's up ahead.*
- *UBER operates on a shared economy and learning model of collaboration and right-fitting skills and knowledge to deliver what's needed.*

This research suggests that through 2030, the time spent using advanced technological skills will increase by 50 percent in the United States and by 41 percent in Europe. The fastest rise being the need for advanced IT and programming skills, as much as by 90 percent between 2016 and 2030.

Accompanying the adoption of advanced technologies will be an increase in the need for workers with finely tuned social and emotional skills—skills that machines are a long way from mastering. While some of these skills, such as empathy, are innate, others, such as advanced communication, can be honed and taught.

The rise in demand for entrepreneurship and initiative taking will be the fastest growing in this category, with a 33 percent increase in the United States and a 32 percent rise in Europe.

The need for leadership and managing others will also grow strongly.

SUMMARY SECTION

KEY TAKEAWAYS

- **We need to prepare for a more connected and augmented intelligent world to do more, faster, efficiently and free up resources for other uses.**
- **Laggards will be left behind. Legal industry, for instance, needs a complete redesign to get past slow, labour intensive processes and practices. Use augmentation to do more.**
- **Work will need to be redesigned to ensure that humans work alongside machines most effectively.**
- **We need to support each other to make the transition so that people can grow their skills to add value to the organization. (Andras Popescu)**
- **Develop a network of trainers to move into future-proofing jobs, creating skillsets for the new and fast evolving corporate world in the digital era of disruption and hyper-connectivity**
- **Old top down, learning by rote and working in silos is obsolete. The world is changing exponentially, and we need to embrace our curiosity, collaboration and a sense of purpose that moves the dial forward and encourage other groups to engage with us.**
- **Cultivate a culture of learning and innovation. Proactively identify and train your workforce on key skills required for the new era to ensure relevancy of skills and knowledge as an industry leader today and tomorrow.**
- **We should be leaders of AI and support companies developing it. No reason Canada shouldn't take the lead on driving AI forward for good.**

LOOKING AHEAD

Shifting toward more specialized space, training, and team building areas: Even as work shifts and processing-oriented jobs continue to move offshore, people will still have to come together to train and develop interpersonal relationships. We foresee spaces inspired by residential and hospitality design that are high-tech and flexible.

- **Elevating building maintenance and facilities teams:** Someone needs to fix broken building systems, office tools, and even robotic employees, so we expect the role of building engineer to become a much more specialized job.
- **Continuing to shed real estate:** Large companies continue to shed space; small companies stay small. The average employee's office is anywhere they want it to be.
- **Disappearing keys and cards:** Technology enables access to everything employees need, such as unlocking the building and accessing prints, reducing the number of devices required in the workplace.
- **Controlling space at the individual level:** While this is happening today in workplaces such as Deloitte's The Edge, in the future not only mobile devices, but also wearable technology will be integrated with building automation systems. Spaces will sense us and immediately provide preferred settings and relevant information.
- **Transitioning to extreme focus on cybersecurity:** As more data is captured and transmitted electronically, there will be changes to the way devices are allocated and controlled, and the way infrastructure is designed and deployed.
- **Increased Workforce Diversity:** More diverse in terms of inherent attributes such as age, race, gender, religion, socioeconomic background, as well as acquired traits, like cognitive

viewpoints and life experiences. *(WorkDesign Magazine, 2017)*

- **Changing Workforce Composition:** More retirees returning to work (or simply staying on part time), employees seeking work/life balance and greater flexibility/autonomy, and the increased influence of the gig economy.

"Due in part to the sustained entrepreneurial nature of the workforce, significant growth in the peer-to-peer economy is expected, with an increased emphasis on global connectivity. Companies will have small core staffs with extensive networks of freelance workers; workplaces will shift provisioning and policy to become truly 24/7 operations."

– Jodi Williams, AVP, CallstnRTKL

- **Larger changes in worker type, available jobs, and ways of working caused by global socioeconomic shifts.** The rise of the middle class in emerging markets will have a large impact on the overall workforce. Currently, one-third of the global middle class is located in Asia Pacific. By 2030, this proportion will double, due in large part to expansions of the middle-class countries like China and India. (EY 2018)
- **New patterns will emerge in occupations:** jobs in service-oriented industries such as healthcare and hospitality sustain growth, but more flexible work arrangements and freelance jobs. Fast Company predicts that there will be an influx of jobs enabled by emergent technologies. (See highlights below)

FUTURISTS PREDICTION OF JOBS OF THE FUTURE WITHIN NEXT TEN YEARS

Excerpts from Fast Company article by Michael Grothaus journalist and author, featuring futurist Graeme Codrington, expert on the Future World of Work and Disruptive Change, Tomorrow Today Global and Joe Tankersley, a futurist and strategic designer at Unique Visions.

"In the last two centuries, we've seen two significant shifts in the global labor market. First, we stripped the agricultural sector of workers, and then we did the same to manufacturing. Now the machines are coming for the tertiary sector and will begin to strip companies of their white-collar workers in the next decade."

For instance, it's predicted that Private Bankers and Wealth Managers will be replaced with algorithms. What that means is that some of the hottest jobs of today could be obsolete by 2025. Yet, while many jobs that exist today will not exist in a decade or two, myriad new jobs are being created too.

PERSONAL WORKER BRAND COACHES AND MANAGERS

25% of today's full-time employees will be working 'on demand (Economist) referring to the increasing preference of companies to hire freelancers for short contracts when the need arises vs full time staff. This applies to any job that can be done at a digital distance for companies to opt for freelancers over staff, even when looking to hire "top-end professionals who can solve significant problems for companies. This will result in an increased need for individuals to brand themselves to set them apart from the competition. To do so, they will need a new set of skills related to "self-management, self-promotion, relentless marketing, administration, and self-development.

PROFESSIONAL TRIBER

Futurist Joe Tankersley says that as more companies rely on on-demand workers, the

role of a professional triber – a freelance professional manager that specializes in putting teams together for very specific projects – will be in demand. The professional triber is "the Hollywood model dispersed across the general workplace." Just as Hollywood studios don't themselves hire the individual cinematographer, editor, script writers, and actors to make a movie, neither will companies of the future want to hire individual components of a team to get a job done. Instead, they'll turn to the professional triber, or director, to let them assaemble the team they think is most appropriate to complete the project.

FREELANCE PROFESSORS

Tankersley also believes that "the continued growth of online courses and the introduction of alternative accreditations will spawn a growth in freelance or independent professors. By 2025 all you need to start your own university is a great online teaching style, course materials, and marketing plan."

URBAN FARMERS

Small artisan farmers will continue to grow in numbers as urban farming becomes a small but significant part of the food chain. Individuals and companies will spring up to teach and assist amateur urban farmers lead a healthier and more eco-conscious life.

END-OF-LIFE PLANNER

By the year 2100, the planet is predicted to have another 4 billion inhabitants. Before then, the average age of a person living here will also increase. As the average age continues to get older, Tankersley says end-of-life planning will become a hot job sector by 2025.

NEURO-IMPLANT TECHNICIANS

It may sound like science fiction, but advances in neurotechnology are set to explode in the next decade and neuro-implant technology will be a hot growing career field. Thus, Codrington says, "We will need a vast range of disciplines to be focused on neurosciences, including brain surgeons, neuro-augmentation and implant technicians and developers, brain backup engineers, real-time MRI scanners and interpreters, and neuro-robotic engineers to build mind-controlled robots and machines."

SMART-HOME HANDYPERSON

The burgeoning Internet of Things industry, expected to be a $19 trillion market by 2020, will create a number of new jobs not just for engineers, but for technically adept handymen and women. Specifically, there will be a huge market for smart-home installers – those who can bring various aspects of the Internet of Things into our homes.

VIRTUAL REALITY EXPERIENCE DESIGNER

Part of the expansion of the Internet of Things into our homes will involve the increasing use of virtual reality for both work and play. Offices could become obsolete if you can just log in virtually from your home office and interact with your colleagues as if you were in the same room. Virtual reality will be as much a part of our lives as the Internet and our iPhones are today–and that means people who can design the best VR experiences will be in huge demand.

CLOSING STATEMENTS

As with all thought leadership reports, we welcome comments and other inputs from other leaders, investors, entrepreneurs and experts who share the vision for a more sustainable future. Understanding the new realities impacting our existence – economic, business and social. And recognize the need for investing in life-long discovery, learning and sharing of relevant innovative tools, skills, knowledge and actionable future-fit strategies and solutions for advancing a better future – together and in our respective organizations and communities.

Think like a futurist. Rethink everything. Explore future possibilities. Tap into the collective intelligence of your tribes (teams, partnerships, communities). Adopt an open mindset. Include technical, business, social and emotional development in the life-long learning mix. Take time to pause, reorient and reignite. Balance everything with a healthy dose of skepticism and curiosity.

Embrace the future – it's here and changing exponentially every day.

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If you are interested in discussing this report, engaging our RSI and Partner experts to be a speaker for your event and/or to learn about Rethink Sustainability, send us a note at **Communications@rethinksustainability.ca**

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