THE AUTOMATED VEHICLE: THE COMING OF THE NEXT DISRUPTIVE TECHNOLOGY

by

BRIAN FLEMMING, CM, QC

SENIOR FELLOW,
VAN HORNE INSTITUTE,
CALGARY, ALBERTA.

Erik Brynjolfson and Andrew McAfee, the authors of *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, tell us that the world is today at an “inflection point” that heralds the dawn of the Second Machine Age. The Industrial Revolution ushered in the First Machine Age, the first time in human history that progress was driven primarily by technological innovation, and the most profound time of transformation our world has ever seen. The Second Machine Age promises that whatever tasks are today routinely done by humans will soon be done by computers.

The disruptive technologies that are coming at us will transform 21st Century civilization beyond recognition. Some of these disruptive technologies include: quantum computing, 3D printing, nanotechnology, financial blockchains, metadata mining, amazing new mobile phone technology, 3D scanning and fission power. But the transformative technology that will soon impact the average person the most is the arrival of automated vehicles (AVs), also known as autonomous, self-driving or driverless vehicles. AVs are not just on some drawing board somewhere but are actually operating, or are about to operate, in many parts of the world. AVs will be nothing less than the first widely-available “autonomous robots” to be used by nearly everyone in the world's advanced economies.

One year ago, three other authors and I published a paper with the same title as my address today. Two of the authors --- Paul Godsmark and Barrie Kirk are part of CAVCOE --- the Canadian Automated Vehicle Centre of Excellence --- an organization whose work I commend to anyone in Canada who wants to keep up to date on this whole subject. In mid-December, 2015, CAVCOE published a White Paper on what they think the Government of Canada should be thinking and doing in preparation for the roll-out of AVs. It is well worth reading.

As Ottawa prepares to spend billions on infrastructure, it will be important for all levels of government to be aware of the impacts AVs will have on many projects. Indeed, on many expensive transit projects, for example, an “AV audit” should be done before large sums of money are committed because AVs will dramatically influence transit projects of all kinds. The other author of last January's paper was Vijay Gill who was then with the Conference Board of Canada. By the way, the Conference Board is
planning a major conference on April 19th and 20th in Toronto on the subject of AVs. Check out their website for more information.

It is important to understand that AVs are not only “coming” but they are already here. As The Economist --- when reporting on the recent annual Consumer Electronics Show (CES) in Las Vegas --- told its readers:

“Incumbent [automobile] manufacturers are recognizing the double threat posed by [AV] technology, as car-sharing takes off and driverless vehicles come closer. First, some people who might hitherto have wanted to own a car may no longer do so, cancelling out the growth the motor industry might otherwise have expected from the rising middle classes in developing countries...Second, technology firms might be better placed than car makers to develop and profit from the software that will underpin both automated driving and vehicle-sharing. Some of these [tech] firms may even manufacture cars on their own.”

As my paper of last January said: “as the list of companies and governments promoting or permitting AVs grows exponentially, Canadians have to ask the question, Where is Canada positioned as the age of AVs arrives? Historically, Canada has frequently been behind as new technologies have been introduced.” The ownership of the automobile manufacturing companies slipped from our grasp a hundred years ago. So did the introduction of radio and TV when those technologies were in their infancy. And good manners keep me from mentioning disasters like the design and disposal of the AVRO Arrow, the collapse of Nortel and the ongoing difficulties of Research in Motion, a.k.a. Blackberry.

To show how fast things are evolving, Elon Musk, the “parent” of the Tesla automobile among other ventures he is involved with, recently predicted that, in two years, an automated vehicle will drive from Los Angeles to New York, without the necessity of a human having to touch the wheel in the car. For those of you who are interested in the history of transportation, this is very much like the prediction of the first non-stop flight of an airplane from coast to coast. That happened in 1911 and look what has happened to aviation since then.
For several years, cars have been boasting more and more self-driving features. Parallel parking arrived a number of years ago as did lane-departure and pedestrian-detection warning systems. As more complex driver-assistance systems are added to our cars, full autonomy is getting closer and closer. Google's famous self-driving cars have logged more than a million miles on northern California highways, without an accident that was actually caused by the Google car. One of the most significant things to know about AVs is that the Googles and the conventional auto manufacturers have different visions.

Google plans to hit the market with an electric, fully-automated, low-speed (40 kph) two-seater prototype vehicles. One hundred to 200 of these experimental vehicles may be available in California this year, thanks in part to regulations allowing the operation of fully-autonomous vehicles that California introduced last year. Ontario recently took some baby steps towards that same kind of regulation a few months ago. Ontario requires formal applications from any company that wishes to test AVs but is offering nearly $3 million in matching funds grants to support AV research, development and commercialization. But other Canadian provinces are nowhere to be found in their preparations for AVs. As part of the massive infrastructure spending being planned by our new federal government, one trusts Ottawa will spend some of the money on thinking about AVs and the profound impacts they will have on the Canadian transportation system.

Six US states --- California, Florida, Michigan, Nevada, North Dakota and Tennessee --- plus the District of Columbia have legalized AV trials and about 20 other states are looking at AV legislation. The German Ministry of Transportation has, with the help of car manufacturers and supply chain participants, released a report on automated and connected-driving technologies. Highly automated vehicles are expected to hit the German market by 2020. Last year, the UK government issued a code of practice for AV testing and is trying to establish a UK-based AV manufacturing industry. This year, Volvo is planning to run a 100-car AV project in its headquarters city of Gothenburg. And the following countries are making serious government-supported AV initiatives: Australia, China, France, Japan, Korea, the Netherlands and Singapore. Where is Canada?

Google aspires to have vehicles that are capable of travelling fully autonomously on city streets and freeways in the public's hands by 2017-19. In Canada, the most significant class of autonomous vehicles are the large trucks that are owned and operated by Suncor in the Alberta oil sands. Fully one-third of Suncor's fleet is now autonomous. The remainder will be converted to autonomy in the coming year or two, thereby eliminating scores of well-paying jobs forever. I'll say more about this trend
Elon Musk claims he will have a completely driverless passenger car for sale in 2018. The semi-autonomous Mercedes Benz S-Class car is already commercially available. Driverless taxis are already operating in Milton Keynes in England. Navya Technologies of India has launched the “Navya”, a fully-automated shuttle vehicle for campuses, airports and places that are susceptible to low-speed vehicle applications. It is rumoured that Apple --- a company with about $180 billion in cash in its treasury --- is planning to enter the competition to design and market AVs. If that happens, that will be a true game changer!

In contrast to the software giants, the car manufacturers are coming at the AV future in a different way --- an evolutionary rather than a revolutionary way. As all of us know, they are gradually adding Advanced Driver Assistance Systems (ADAS) to familiar vehicle models, starting with high-end ones. Current ADAS systems include: lane keeping, intelligent cruise control (including braking) and automated parking. By 2020, most major car manufacturers will have vehicles in their showrooms that are capable of driving themselves for some of the time. By 2025, several manufacturers have indicated that they expect to have fully autonomous vehicles. The Big Question is: will the Google, Tesla and Apple cars squeeze the conventional automakers out of the field? It is worth remembering that, of the thousands of wagon manufacturers that existed in North America at the end of the 19th century, only Studebaker made it as an automobile manufacturer. And where is Studebaker today? Gonzo. Wild cards in this brave new world are car parts manufacturing companies like Magna. Magna company may be able to survive no matter who winds up manufacturing the AVs.

The rate of adoption of AVs and the associated market dispersion will be rooted in several factors. How quickly will users buy into AVs? Certainly, no matter how completely the AV takes over driving in cities and on main highways, there will always be a market for people like sports car enthusiasts who will want to self-drive their MGs, Triumphs and Miatas along country roads. Some observers argue the switch over to AVs from the existing human-driven fleets will take many decades. As my paper of last year said:

“...it is worth noting that it took about a dozen years for New York to switch 'from horse power to horsepower. In 1900, 4192 cars were sold in the U.S.; by 1912 that number had risen to 356,000. In 1912, traffic counts in New York showed more than horses for the the first time. The equine was not replaced all at once, but function by function. Freight haulage was the last bastion of
horse-drawn transportation; the motorized truck finally supplanted the horse cart in the 1920s.”

I am old enough to remember horse-drawn carts delivering ice, milk, fresh fish and groceries to my home in Halifax so it took a long time for the horse to vacate the streets completely. Given the successful experiments --- most recently in Nevada --- with autonomous 18-wheelers, I think the automated truck will not be far behind the automated car on North American roads. If that happens, the direct employment displacement will be historic and socially nothing short of a major crisis.

In Canada today, there are about 560,000 drivers of trucks of all kinds --- 1.5 per cent of the Canadian workforce --- and about 50,000 taxi drivers and thousands of bus drivers. All told, there may be 750,000-plus people --- mostly men --- plying these trades. What will happen to them and their families? We are already seeing the profound changes that Uber and Lyft have wrought in many cities around the world as “professional taxi drivers” are replaced by “amateur Uber drivers.” What will happen when Uber reaches its corporate Valhalla of elimination of all its drivers and conversion of its business to driverless cars? Another Big Question is: who will own the automated vehicles? Will Google and Apple --- like IBM in the early days of large main-frame computers --- want to own all the cars and simply “rent” them to you? Or, if the car manufacturers win the game, will you be able to own your very own AV? Will you want to? Or will it even be possible in some societies that governments may want to own the vehicles?

One of the most interesting questions in Canada at present is: what have Hon. David Emerson and his advisers written about the future of Canadian transportation in their Canada Transportation Act Review report that was submitted to the Canadian Minister of Transport on December 24, 2015? Will some of these questions be addressed? Certainly, Emerson said he wanted to look out far into the future in his report --- 30 to 50 years out. When I met with him and his advisers several times last year, we certainly talked seriously about some of these big future questions. Given the new government's professed desire to open the federal coffers quickly to start its stimulation of our economy, I think Hon. Marc Garneau, our Transport Minister, should release Emerson's report sooner rather than later, if for no other reason than to see whether Emerson laid out a blueprint for fixing our infrastructure, including a plan of how to deal with the arrival of the AV.

One of the key recommendations of my paper of January, 2015 was that no new major transportation project should be contracted in Canada without an “AV audit” being carried out. In the area of public transit, particularly with very expensive projects
--- like LRTs, subways, bridges, superhighways and elevated transit --- great care should be taken not to commit billions to projects that have 30-50 year lives without considering the impact AVs will have on their long-term viability. Toronto is already considering this kind of question. If you want to know more about what is happening there, get your hands on the recent paper by David Ticoll entitled “Driving Changes: a Report for the City of Toronto on AVs.” The paper foresees a revolutionary --- and very disruptive --- change in how transit will look in a decade or two. There may be no buses or trams or new subways or new LRTs by 2030 --- just thousands of AVs taking people seamlessly to and from work, to and from shopping, to and from the cottage and so on. Every city in Canada should be watching closely at what is happening in Toronto today. Every city should take all this into account before they beat up the new government for money for new buses.

AVs have many benefits: the most significant one is safety. By removing the human driver from behind the wheel, AVs could eliminate most of the 93 per cent of collisions that currently involve human error. Eight years ago, a Transport Canada study reported that road collisions cost society $62 billion or nearly five per cent of GDP. Plus more than 2000 people die annually on Canadian roads, and thousands more are injured. The next great benefit will be to transform the driving world to a transportation-as-a-service (TaaS) model, i.e. the use of cars on a short-term rental basis as an alternative to ownership. I think it is conceivable that existing car rental, taxi and car-share business models will converge into a single model. A beneficial side-effect of this change will be the disappearance of the need for parking spaces, especially in downtown cores where they are never adequate and where they consume huge amounts of land. This will lead inevitably to more space being available for green spaces and a significant decrease in the kind of pollution that afflicts so many cities around the world, including Toronto.

AVs are being designed to travel on existing roads without requiring modifications to the current infrastructure. In Canada, existing technology is facing the challenge of guiding AVs along snow or ice-covered roads in winter but that problem will eventually be overcome through ever-more-powerful computers, by 3D laser-radar scanning and by GPS positioning technology. The key first step will be to ensure that the AVs will be able to navigate the built environment of the standard city. And since 83 per cent of Canadian live in cities, that will be an easy hurdle to clear.

AVs will be able to travel closely --- indeed, many truckers are planning “truck trains” that will travel nearly bumper to bumper. That will increase the capacity of existing roads as measured in vehicles per hour. In the early days, roads will be divided into AV and non-AV lanes. HOT lanes that are being established in many place in Canada could be early places for AVs to travel safely. More roundabouts will be built to
replace traffic signals because roundabouts work more efficiently for AVs. And cities that have a Transit-Oriented Development (TOD) policy that encourages development close to subway stops or suburban car parks next to transit stations may find that the benefits of having this kind of policy will diminish. Some cities may even make their city centres pure AV zones where no human-driven vehicles of any kind are permitted. What is certain is that the number of vehicles on the roads will decrease with the coming of the AV. And for Canadians, perhaps the best demonstration project the new government in Ottawa might consider funding would be the development of the completely automated snow plow.

Let me touch briefly on another great impact that AVs will have, namely, the potential to reduce household expenditures on transportation. This will be significant because Canadian households spend more on transportation than they do on most other goods and services. In fact, Canadian households spend about $11,000 per year on transportation versus $7,700 per year on food; $3000 on recreation and $3500 on clothing. Only spending on shelter --- $15,800 p.a. --- exceeds transportation costs.

The only study of the socio-economic impacts of AVs in Canada is found in the limited material in my paper of last January. But, in the U.S. Morgan Stanley, issued a blue paper that estimated, when AVs were fully deployed, the US would save, in the base case, $1.3 trillion per year (about eight per cent of the US GDP) and global savings would be more than $5.6 trillion per year. Taking the Canadian economy as being 10 per cent of America's, that means the savings for Canada would be about $130 to 150 billion per year.

According to Morgan Stanley, the savings in the US from collision avoidance will be nearly $500 billion. In Canada, that would be $50 billion. It is interesting to note that, since the Morgan Stanley paper came out, the US Department of Transportation has said that the 2010 societal cost of road crashes was $871 billion or the equivalent of six per cent of US GDP. Productivity gains from regained driver time in the US will be $507 billion, based on average commute times of 25.5 minutes for the US, which times are similar to Canadian average commute times of 25.4 minutes. Fuel savings will be $158 billion which will be delivered through the improved efficiency of AVs and the reduced time drivers would have taken driving around urban centres looking for parking spaces. Congestion avoidance savings will amount to $138 billion and fuel savings from congestion avoidance will be $11 billion.

The cumulative potential benefits for Canada from the factors described above are more than $65 billion per year with collision avoidance being $37.4 billion; time value being $20 billion; fuel cost savings being $2.6 billion; and congestion
avoidance being $5 billion. One of the major headaches for society will be the employment displacement that AVs (and other disruptive technologies) will bring. Direct employment displacement would include these job categories: truck drivers, taxi drivers, bus drivers, auto body repair personnel, those selling auto insurance or adjusting claims, lawyers practising personal injury law relating to autos, traffic police, road safety professionals, tow truck drivers, driving instructors, emergency room staff and trauma medical doctors, rehabilitation doctors and nurses, parking lot attendants and road-building companies.

On the other side of the coin, there will be new business opportunities for the auto and technology industries that are designing and manufacturing the software for AVs. The size of these opportunities will partly depend on the extent to which the federal and provincial governments will stimulate activity in the AV space. Many countries are gearing up for this challenge but Canada is nowhere to be found on this turf. And because most AVs will be electric vehicles, it is safe to predict that the overall consumption of petroleum being used for powering vehicles of all kinds will fall. Already, many large truck fleets are switching over to using natural gas rather than diesel. Indeed, in Quebec, along a major highway from Quebec City to Montreal, stations already exist to fuel trucks with natural gas.

Land values --- particularly here in Vancouver and the lower mainland --- will be impacted by the AVs. There is a strong likelihood that people will be more willing to tolerate longer commutes if they are able to be productive in their vehicles while being able to pay less for their housing. This could result in more sprawl and the reduction in land values in suburban and ex-urban areas. Paradoxically, densification may also be encouraged by AVs because there will be less need for urban parking and the possibility that more housing can be developed on existing parking lots and garages. This trend will be reinforced because the cost of transportation will be reduced for city dwellers who use the shared AV fleets --- the TaaS model --- and therefore do not own their own vehicle.

The “sharing economy” that has already been seen in the rise of companies like Uber, Lyft and Airbnb will be a factor. It is interesting to note that GM recently made a huge $500 million investment in Lyft, a competitor to Uber. The sharing economy is all about using fewer resources more efficiently so AVs could be the most significant contributor to that objective. Certainly, the so-called Millennial Generation is already part of this trend. Millennials are taking longer to get driver's licences or to buy automobiles. AVs will allow this generation and others coming behind it to significantly improve their access to transportation in a way that lets them maintain their increasingly connected worlds, not to speak of the savings that they will get when they don't buy and
maintain privately-owned automobiles. Indeed, these new generations may make a leap to basing their offices in a vehicle that allows them to visit worksites and clients — like the Lincoln Lawyer — without having the costs associated with offices in bricks and mortar.

Finally, let me talk a bit about the impact of AVs on infrastructure. The best way to approach this subject is to look, once again, at history. In the early 20th century, when the first automobiles were introduced, sales volumes were huge and the impact on infrastructure was huge. Roads, traffic management systems, parking and gas stations were built to accommodate the adoption of the new technology. What will AVs do? The first thing to realize is that numerous AV developers — Google in particular — are very keen to ensure that their AV technology can operate on existing roads and infrastructure without any modifications. Their intention is to incorporate enough sensors, software and intelligence into vehicles so that they are not reliant on additional external infrastructure or communications systems. (This may not be possible in Canada with our snow and ice-covered roads.)

AVs will be able, not only to travel on existing roads, but will be able to travel closer together. In other words, existing roads will become more efficient. There may, therefore, be a reduction in the need to expand existing roads or highways or to build new ones. This trend, in turn, may lessen the drive towards twinning and tolling existing roads.

When designing infrastructure projects, there is a tendency to assume that the future is simply an extension of the past. But AVs are a truly disruptive technology and we therefore cannot forecast the future by simply extrapolating the past. As I said earlier, because major infrastructure projects are being designed and planned all across Canada — projects that will last for 30 to 50 years or more — it is imperative that everyone in the planning business become educated — fast! — in the conception, planning and design of AVs and their potential impacts, and demand that their governments — at all levels — start developing the necessary regulatory frameworks to cope with this disruptive technology. This is something that is particularly important for our New Masters in Ottawa to grasp. Will they? I live in hope that they will but time will tell.