Background Report:

Emerging Technology

Hamilton

CITY OF HAMILTON
TRANSPORTATION MASTER PLAN
REVIEW AND UPDATE

Emerging Technology Policy Background Report

1.0 Introduction

The transportation landscape is changing rapidly. There has been an explosion of new technologies that continue to transform how people move in the future. This is a transformation that will continue to accelerate well beyond 2031. The purpose of this policy paper is to identify emerging technologies and describe how Hamilton can prepare to respond to the ongoing opportunities and challenges technologies pose.

2.0 Sharing Economy

The concept of the sharing economy is not new. A traditional form of this type of economy was experienced through the barter system, where goods and/or services were traded. The modern sharing economy can be defined as an economic system, whereby assets or services are shared between private individuals (peer-to-peer), either free or for a fee. Typically, the internet facilitates these activities and transactions.

This represents a paradigm shift away from the traditional ownership of assets. The sharing economy has facilitated the creation of new markets and economic activity where none previously existed. Some examples of the sharing economy as it relates to transportation includes: car share, bike share, micro-transit, personal transportation providers, as well as parking spaces. This shift is partially being driven by the reduced number of people obtaining or delaying obtaining their driver's license. Figure 1 identifies the downward trend in persons aged 16-25 in Hamilton possessing a driver's license. This is also creating a shift in the marketplace and how automobile companies view their changing market[1].

With the growth of ride-sharing and car-sharing, some predict changing ownership models for cars in the future. Car-sharing offers opportunities to gather information on consumer trends, and expose users to the latest models and features. Auto manufacturers are laying claim to this growing segment of the auto industry such as Toyota's investment in Getaround, Daimler's car sharing app called CROOVE, General Motors' car-sharing program Maven, and Ford's bike share program in San Francisco.

3.0 The Internet of Things[2] or IoT

Simply put, this is the concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). This includes everything from cellphones, coffee makers, washing machines, headphones, lamps, wearable devices and almost anything else you can think of.

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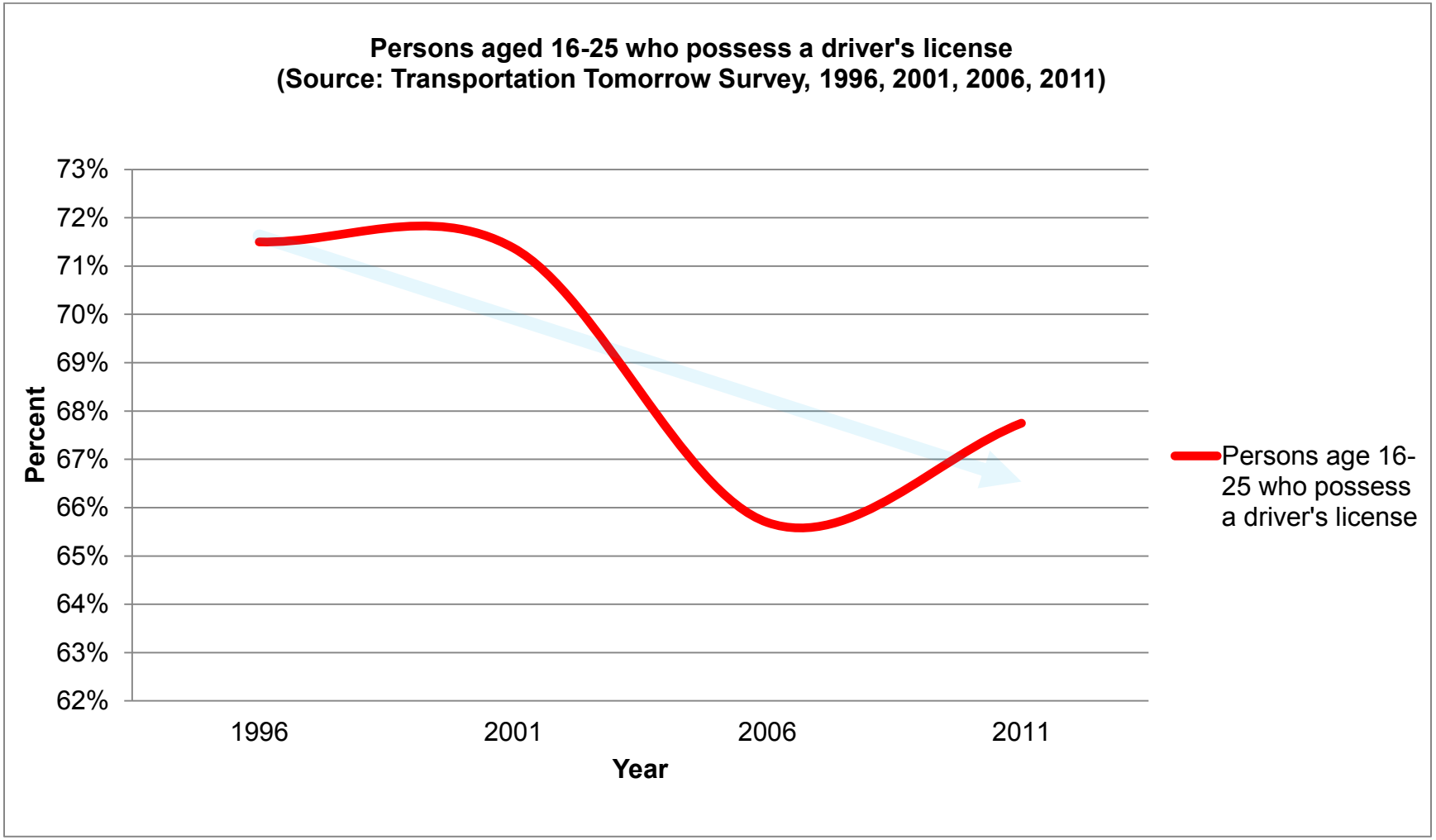
[1] The Globe and Mail (Why millennials are forcing a shift in the auto industry, April 26, 2016)

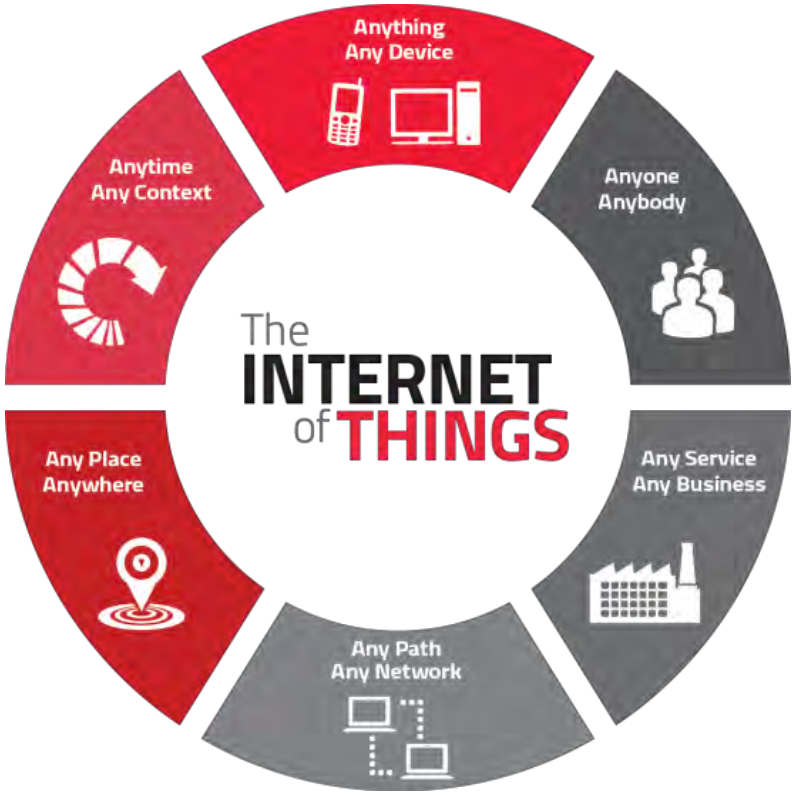
[2] Forbes Magazine (A Simple Explanation of "The Internet of Things", Jacob Morgan, May 13, 2014)

Figure 1: Hamilton's Historical Trend of Persons who Possess a Driver's License 1996-2011



Experts predict that up to 25 billion Internet of Things devices will be in place within a few years. That represents between four to six devices for every person on earth. The IoT is a giant network of connected "things" (which also includes people). The relationship will be between people-people, people-things, and things-things, as illustrated in Figure 2. The new rule for the future is going to be, "Anything that can be connected, will be connected." For example, a person is on their way to a meeting; their car could have access to their calendar and already know the best route to travel. If traffic is heavy, the car might send a text or email to the meeting attendees notifying them that you will be late. A current example within the City is the Hamilton bike share system, where all of the bicycles are connected.

Figure 2: Concept of the Internet of Things[3]



3.1 Smart Cities (Intelligent Communities)

On a broader scale, the IoT can be applied to things including transportation networks and other government services. The concept of smart cities[4] (intelligent communities) enables and encourages citizens to become a more active and participative member of

[3] https://thefinancialbrand.com/63285/banking-internet-of-things-iot-data-analytics-payments/

[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/246019/bis-13-1209-smart-cities-background-paper-digital.pdf

the community and attracts people to live, work and visit. However, the concept is not static: there is no absolute definition of a smart city, no end point, but rather a process, or series of steps, by which cities become more "liveable" and resilient and, hence, able to respond quicker to new challenges. Thus, a smart city (intelligent community) should enable every citizen to engage with all the services on offer, public as well as private, in a way best suited to his or her needs. It brings together hard infrastructure, social capital including local skills and community institutions, and (digital) technologies to fuel sustainable economic development and provide an attractive environment for all.

In terms of transportation, smart cities leverage emerging technologies to provide opportunities to address transportation problems and envision bold new solutions that could change the face of transportation in Hamilton. It also provides a challenge to meet the needs of residents of all ages, abilities and incomes; and bridging the digital divide, so that everyone, not just the tech-savvy, can be connected to everything within their city.

3.2 Mobility-as-a-Service (MaaS)

The concept of transportation as a service, commonly referred to as mobility-as-a-service or MaaS, is a paradigm shift in transportation. Whereby, the ownership of transportation assets is replaced with an integrated and flexible mobility package to facilitate the movement of individuals from any point A to any point B at any time. Similar to cellular and cable packages, mobility would be available to users for monthly plans. Again, this change is being driven by the market place and is quickly being adopted by the automotive industry, who have a vested interest and are transitioning from selling cars to selling mobility. Major investments have been made by the automotive industry to partner with car sharing companies or develop their own car/rideshare business models. This investment has also included the advancement of autonomous vehicle technology.

As mentioned in a previous section, many in the auto industry are adapting to the sharing economy by selling mobility. For example, Ford Motor Company has ambitions to transform itself from a traditional car company into a global mobility provider. The company has laid the groundwork for this evolution by creating a subsidiary, Ford Smart Mobility, to house its future-minded transportation ventures. As part of this transition, Ford announced the acquisition and expansion of their ride-sharing service Chariot.

3.3 Big Data

Big data[5] is a term that describes the large volume of data – both structured and unstructured, which inundates a business on a day-to-day basis. But it is not the amount of data that is important. It is what organizations do with the data that matters. Big data can be analyzed for insights that lead to better decisions and strategic business moves.

[5] https://www.sas.com/en_us/insights/big-data/what-is-big-data.html

While the term big data is relatively new, the act of gathering and storing large amounts of information for eventual analysis is not new. The importance of big data does not revolve around how much data you have, but what you do with it. You can take data from any source and analyze it to find answers that enable:

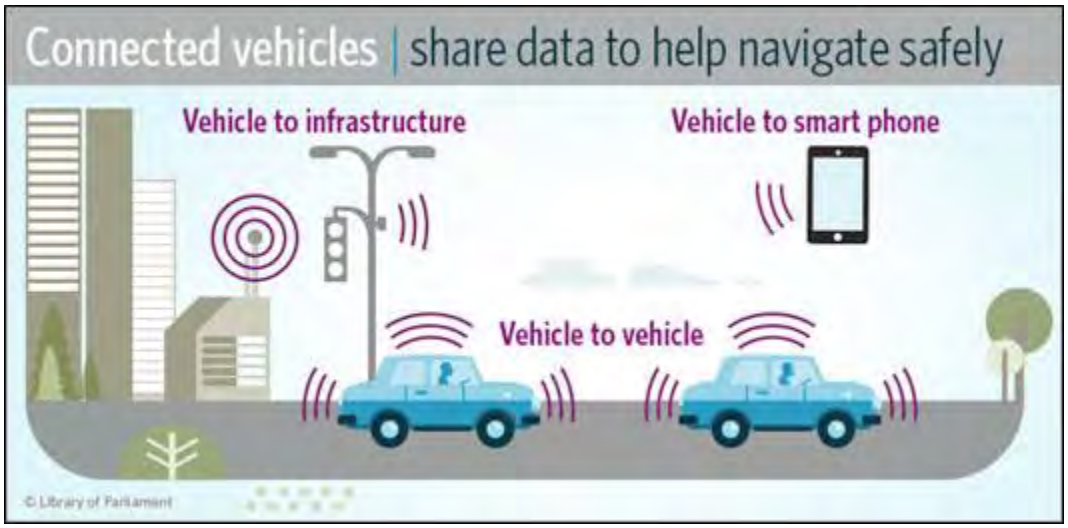
- Cost reductions
- Time reductions
- New product development and optimized offerings
- Smart decision making

Hamilton has an opportunity to use big data to improve the quality of city services and become more responsive. Among the challenges associated with emerging technologies and the use of big data is the potential resistance to adopt its use, as well as having the appropriate infrastructure to support and maximize its potential once adopted.

3.4 Connected and Autonomous Vehicles

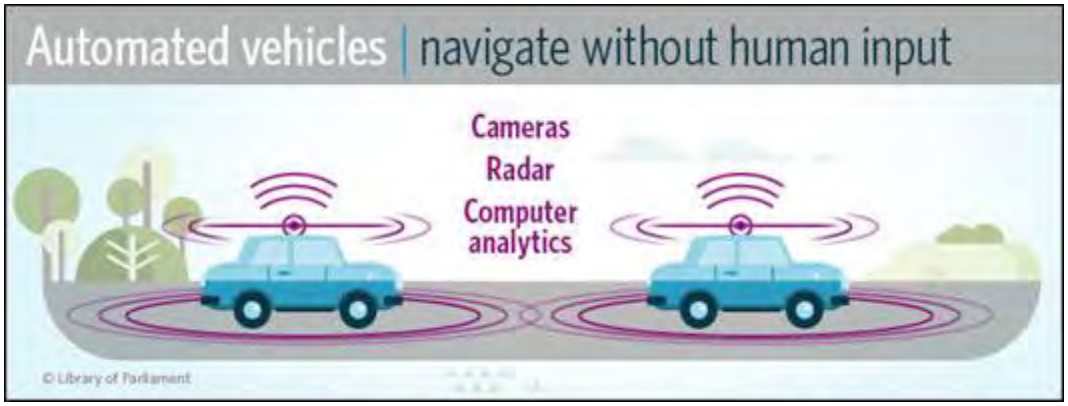
Connected vehicles use wireless technology to connect with other vehicles, transportation infrastructure and mobile devices to give motorists the information they need to drive more safely. Automated vehicles, also known as self-driving vehicles, rely on sensors and computer analytics to sense their environments and navigate without human input.[6] Figure 3 illustrates these definitions.

Figure 3: Connected and Autonomous Vehicles[7]



[6] Ontario Centres of Excellence, 2017 http://www.oce-ontario.org/programs/industry-academic-collaboration/cvav-research-program/how-it-works

[7] Government of Canada, Legal and Social Affairs Division, Parliamentary Information and Research Services "Background Paper, Automated and Connected Vehicles: Status of the Technology and Key Policy Issues for Canadian Governments", September 2016. Publication No. 2016-98-E



Vehicle automation covers a wide variety of technologies, uses, products, and services. Some elements of automation have existed for several years, such as cruise control. More advanced driver assistance systems, such as pre-collision braking, parking assist, and adaptive cruise control, are now available on vehicles. Near-fully self-driving cars and trucks are being tested on public roads around the world, including Ontario. They have crossed the United States and rolled long distances on Japanese and European highways. Mining operations in several countries routinely depend on automated trucks.

A working definition of the various levels of autonomy developed by the Society of Automotive Engineers (SAE) is identified in Figure 4.

3.5 Use of Drone for Air Freight

Drones are in a situation similar to the one faced by self-driving cars. Companies such as DHL, Amazon, UPS and others have been conducting tests and have found that the current drone economics are good for deliveries that take less than 1 hour. As the development of this technology evolves, it will provide a number of challenges. Some challenges include:

- Regulatory use in urban areas
- Available delivery space for medium/high-rise residential and office buildings
- Land use changes that require smaller urban freight distribution centres
- Perceived or real privacy, safety and security concerns

4.0 Greater Toronto and Hamilton Area Response

In Canada (and worldwide), the term Intelligent Transportation Systems[8] (ITS) is often associated with leading and reacting to technological change. It is defined as the application of advanced and emerging technologies (computers, sensors, control, communications, and electronic devices) in transportation to save lives, time, money, energy and the environment. Many municipalities use ITS strategies to assist in improving their transportation system.

[8] Intelligent Transportation Systems (ITS) Canada, 2017
https://www.itscanada.ca/education/overview/overview/index.html

Figure 4: Society of Automotive Engineers (SAE) Levels of Autonomy

SAE Level	SAE name	SAE narrative definition	Execution of steering and acceleration/deceleration	Monitoring of driving environment	Fall-back performance of dynamic driving task	System capability (driving mode)	BASt Level	NHTSA level
Human driver monitors the driving environment								
0	No Automation	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n.a	Driver Only	0
1	Driver Assisted	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes	Assisted	1
2	Partial Automation	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* performs all remaining aspects of the *dynamic driving task*	System	Human driver	Human driver	Some driving modes	Partial Automated	2
Automated driving system ("system") monitors the driving environment			System	System	Human driver	Some driving modes	Highly Automated	3
3	Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a request to intervene						
4	High Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a request to intervene	System	System	System	Some driving modes	Fully Automated	3/4
5	Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	All driving modes		

As part of the Big Move (Regional Transportation Plan) review, Metrolinx recognizes that the Greater Toronto and Hamilton Area (GTHA) will need to adapt to new mobility service models. New mobility is difficult to define, and will be even more challenging to regulate because many emerging service models are fluid and evolve very quickly. They occupy a middle ground between traditional public and private transport services, avoiding neat categories that satisfy today's transport policies and regulations. Some service models have created conflicts in the transportation industry, as new players have either taken advantage of regulatory gaps or side-stepped existing rules altogether. For example, the taxi industry, which is facing disruption from Uber, Lyft and other personal transportation providers was one of the first sectors to feel the impact of new mobility. Similarly, some Chinese cities have experienced bikeshare companies deploying bicycles without any policy regulations or oversight, which has created numerous concerns.

Metrolinx also identifies that transit is also starting to see the effects of emerging technologies and will likely face greater competition over time. Government's role in operating transit services may diminish, but its role in ensuring safety, equitable access and the public good may be ever more critical.

The Ministry of Transportation of Ontario (MTO) has permitted a pilot to test AVs on Ontario roadways. MTO recognizes the importance of new vehicle technology, especially if it can expand mobility options for Ontarians. As safety is a top priority, the ministry reviews all new vehicle types and technology to determine whether they are safe for Ontario's roads.

In 2015, the City of Toronto Transportation Services Division commissioned a discussion paper as part of a broader project under the University of Toronto, Transportation Research Institute (UTTRI). The purpose of the paper is to equip City of Toronto decision makers with the information they need to identify and evaluate short and medium term policy, planning, and investment options that pertain to the onset of vehicle automation. The report demonstrates Toronto's proactive response to this emerging technology.

Another example in the GTHA is MTO's COMPASS system. COMPASS is a high-tech Freeway Traffic Management System, which was developed to respond to traffic congestion problems on urban freeways. COMPASS helps reduce traffic congestion and increase safety by:

- Allowing for the prompt detection and removal of freeway incidents and vehicle breakdowns
- Providing accurate and timely freeway incident and delay information to motorists
- Effectively managing peak rush hour traffic flow through innovative traffic control devices

4.1 Hamilton's Response

Hamilton has been applying ITS technology to develop a dynamic transportation system. A recent example of this is the implementation of the Advanced Traffic Management System (ATMS). The City has also been applying many of the concepts discussed above, which includes:

- Mobile apps (e.g. TravelWise mobile-enabled webpage, The Transit App, Google Maps)
- Personal Transportation Providers (e.g. Uber, Lyft)
- Big Data (e.g. WAZE, SoBi Bike Share)
- Real-time transit data
- Mobility Sharing Operators (e.g. ZipCar, Community Car Share, SoBi Bike Share)
- E-government
- Electric Vehicle Charging Stations
- Presto

A number of the above identified elements have developed largely in silos and would benefit from using a coordinated and collaborative MaaS approach.

5.0 Opportunities and Risk

Policy and infrastructure work slowly. It can take decades to feel the full effects of some policies, and years of planning, engineering, design and construction are needed before a rapid transit line can carry passengers.

Change continues to unfold as those things happen, so while we plan for the short term we must also look further ahead and consider trends that are only starting to emerge. A key role of Metrolinx is to watch for emerging trends, and to consider their potential impact on transportation in the GTHA. The City of Hamilton's role is to help inform Metrolinx on local issues pertaining to these trends. Some examples of opportunities and risks have been identified below:

Opportunities

- Safer roadways
- Improved incident and emergency response
- System efficiency
- Dynamic pricing
- Parking efficiencies (lower parking requirements – more developable space)
- Greener technologies with less environmental impacts
- Dynamic messaging (traveller information)
- Improved enforcement
- Providing and facilitating convenient modal choices for citizens

Risks

- Labour force disruption
- Cyber security
- Not being prepared
- Competition to traditional local transit service
- AV induced sprawl
- No-occupancy vehicles
- Decrease participation in active transportation