Insight Report

Digitizing and Transforming Mobility Systems:
Lessons from the Detroit Region

March 2020

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Foreword

Since its inception at Davos in January 2017, the Seamless Integrated Mobility System (SIMSystem) project has challenged the present set of transforming technologies of the Fourth Industrial Revolution in its promise to deliver impact for all. In June 2018, the World Economic Forum chose the Detroit region to pilot the concepts behind the integration of disparate mobility modes with three questions in mind, all approached in this report in depth:

1. The region benefits from a dynamic ecosystem of multistakeholder partnerships, competitors and complex public-private interests. How can they coalesce around data-driven reform?

2. The region is a great living lab to better understand mobility deserts, and the way they perpetuate socioeconomic disparities. What is the operationalization framework to make use of data-driven technologies for impact on vulnerable populations?

3. Detroit applied to become the SIMSystem project's geographic partner in partnership with the cities of Ann Arbor and Windsor, creating a living lab across an international border. How can cities benefit from a closer relationship with their neighbours?

Throughout the SIMSystem pilot in Detroit, the World Economic Forum partnered with public, private, civic, academic and non-profit organizations to explore each of these questions in depth. Beyond all else, the pilot demonstrated that the power of data rallies across sectors, interests and operating models. In a world that still suffers deeply from socioeconomic disparities, persisting racial segregation, a profound gender gap and lack of access to core services such as healthcare and education, the potential for improving the state of the world via data-driven technologies has never been greater.

The SIMSystem pilot was a first, crucial foray into the activation of that potential. Let's follow it with ever greater initiatives. The World Economic Forum launched the Inclusivity Quotient project in January 2020 as a first step towards the future. Join us.

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Mobility and the pursuit of happiness

Mobility, or the ability to move, is not an end but a means. Many cultures celebrate the first-time ownership of a major mode of mobility as a critical milestone, an enabler of freedom and a vital step in the pursuit of economic opportunity and happiness. The ability to move infers the ability to choose a home suited to the household's needs rather than the constraints of land-use patterns. It means getting to work on time, a requirement of particular relevance for hourly employees who tend to belong to the lower quintile of household income. It can make the difference between life and death – according to the United Nations, **75% of infant mortality** can be attributed to transportation gaps.[1]

Traditionally, transportation decision-makers have had to rely on subjective assumptions and manual data-collection processes to optimize the efficiency and planning processes for the systems for which they are responsible. With the Fourth Industrial Revolution, data-driven technologies have transformed this process and created a new promise for the role of mobility in the pursuit of opportunity and happiness. In this brave new world, data can create objective, achievable insights on systemic gaps that prevent access to core services for vulnerable populations, which can be used by decision-makers to use mobility as a literal pathway towards better healthcare and more diverse socioeconomic growth.

For rural communities, this might mean opening new business opportunities capable of coping with the challenges of low-density neighbourhoods, which have lower demands. For older adults, it could mean the reintegration of active individuals into social and economic activities, even after they can't drive a car. For families, it could mean enabling both caretakers to bring in a much-needed pay cheque.

The World Economic Forum's Seamless Integrated Mobility System (SIMSystem) project was launched to explore the potential of data-driven technologies to optimize the efficiency of mobility systems and support decision-makers. Since launching in June 2018, the SIMSystem pilot in Detroit, Michigan – in connection with the neighbouring cities of Ann Arbor, Michigan, and Windsor, Ontario – has looked particularly to define the impact mobility could have on quality of life and socioeconomic development.

This is a region in which the population has a broad range of needs, ages and abilities; where there is a wide socioeconomic diversity across race and ethnicity, but also high concentrations of both wealth and poverty; that varies in its provision of transportation services, but is highly car-dependent; and where convenient access to jobs, services and daily needs is extremely weighted towards car-based access compared to access via public transport or other modes. That is why data on these differences is critical to decision-makers, and vital if it is to have an effect on outcomes for poorly served parts of the region.

Between 2011 and 2016, Detroit added **31,000 jobs** – an increase of about 20% in five years, spread through 20 of Detroit's 26 zip codes. Yet, over the same period, **2% more Detroit residents became unemployed** and less than half of Detroit's zip codes recorded an increase in employment rates. This report examines in some detail the hypothesis that such disparities are furthered by what the Seamless Integrated Mobility System pilot group called "**mobility deserts**", geographic areas within which residents are not given adequate access to core services, opportunities or the ability to improve their quality of life. Detroit has the highest cost of car insurance in the United States – **21% of residents' average pre-tax income**. Still, the city's transport system is drastically car-centric. If, in addition to this challenge, the city does not have the resources or knowledge to transform its transport master-planning process from assumption-driven to data-driven, how could it not keep missing its blind spots?

At a workshop hosted by the World Economic Forum in 2019 with Automation Alley, a leading non-profit in Michigan, a high-level political official asked bluntly how local residents would be able to get to educational and professional opportunities if they could not afford a car to get there, and did not have other commuting solutions. How does a region keep growing if its inhabitants can't access the new benefits of that growth or even keep up with it? How can we better record and transform the reality on the ground of people's travels to the opportunities they need and want? What does reality look like for Detroiters, and what can the world learn from Detroit's journey? The hypothesis driving this report, demonstrated through the Seamless Integrated Mobility System pilot in the region and applicable on a global scale, is that **systemic mobility gaps drive systemic economic gaps** and that the **Fourth Industrial Revolution** can help **bridge** these gaps, if it is embraced and managed appropriately.

Why this matters: Impact on vulnerable populations

Some 40% of Detroit residents do not have cellular data; **60% don't have broadband access**. The city has the nation's highest rate of fatal crashes, with a third of fatalities being pedestrians. The Detroit Department of Transportation (DDOT) has seen a **52% decrease in service hours** between 2003 and 2016. Still, the city boasts the highest cost for car insurance in the country, averaging $6,000 a year, compared to an average income of $30,000 a year.

If residents are not connected, how can they use digital technologies? If the cost of car insurance alone amounts to **20% of average income**, how can they connect to core services when the DDOT has had to decrease its service hours?

To highlight just a few challenges:

– The City of Detroit is spread over a vast area of nearly **140 square miles** and includes a large number of very low-density neighbourhoods. These development patterns increase the cost of providing both fixed-route and demand-responsive transport services.

– Residents of smaller communities or rural areas outside of Detroit are hampered by insufficient integration between urban, suburban and regional service providers. Some communities have chosen to opt out of the Suburban Mobility Authority for Regional Transportation (SMART). By 2015, **51 communities in the Detroit region had opted out of bringing this regional public transport service** to their communities, making commutes to and from these smaller communities highly onerous for public transport-dependent residents.

– Similar to the lack of coordination for fixed-route public transport services, demand-responsive transport – those services that do not follow a fixed route or that schedule senior shuttles provided by human service agencies or non-profits – are equally **fragmented**. There are more than 50 of these community transport providers in the region, yet it is often impossible to cross jurisdictional boundaries to complete a trip if one is unable to drive.

– Detroit has a rapidly ageing population. In total, 119,036 of Detroit's 680,250 residents (24% of the population) are aged 60 years and over. About **20% of these older households do not have access to cars**. At the same time, according to the Southeast Michigan Council of Governments, **65% of households with senior members are beyond a 30-minute public-transport trip to any healthcare facility**. The limitations of the existing public transport system mean that this population has inadequate access not only to daily needs, such as groceries, but also to critical healthcare-related destinations and other vital services.

– **Women are burdened by a lack of safe and reliable transport options**. This holds true especially for low-income women, who are more likely to be reliant on public transport. Numerous studies, including a 2019 report entitled *Understanding How Women Travel* by Los Angeles Metro, have revealed that women have different travel patterns from men, including a greater number of trips with varied purposes at different times of the day or linked to each other (a "trip chain"). These travel patterns generally require greater flexibility, frequency and coverage than is provided by the existing public transport system in Detroit.

Critically, vulnerable populations are also often not adequately heard. For example, focus groups from the Hope Village in Detroit stated their primary concerns about transport options were safety and timeliness, and while residents of the area were supportive of shared-use mobility services as alternatives to private cars, such as Uber or ZipCar, the focus groups identified concerns regarding access to credit, costs associated with smartphones, ability to use smartphones, sharing data and safety.[2] A less in-depth study might have led decision-makers to believe that residents were simply not ready for these services, even if they just need product design adjustments to be made.

Last but not least, several studies published by the AARP (formerly the American Association of Retired Persons) have quantified the cost of social isolation, a silent killer of elderly people. On an economic level, a Medicare study found that isolation among older adults is associated with **$6.7 billion** in additional government spending annually. Medically, isolated adults are more likely to suffer from "depression, have difficulties performing one or more activities of daily living (ADLs), and to have five or more chronic illnesses".[3]

Figure 1: Effects of social isolation on monthly medicare spending and likelihood of service use, by type of service

Type of service	Marginal spending per month	Service use[a]
Total	+ $134.0* *	-
Inpatient	+ $81.0* *	1.2
Outpatient	- $5.8	0.92
Skilled nursing facility	+ $74.5* *	1.29*

Source: Authors' analysis of Health and Reirement Study data linked with Medicare Claims, 2006–12.

Note: Effect is for individuals who are socially isolated compared with a reference group of people who are connected. All models include full adjustment for health and functional status, region of residence, socioeconomic status, demographic characteristics, whether the respondent is covered by Medicaid, and living arrangement. Significance tests evaluate differences with the not-isolated group; p-values: *p<0.05, **p<0.01.

[a] Adjusted incidence rate ratio for inpatient and outpatient spending, adjusted odds ratio for skilled nursing facility.

In this particular study, 35% of isolated older adults died within six years of the interview for the study, compared with 22% of those deemed to be well connected.

Figure 2: Socially isolated older medicare beneficiaries have higher death rates three and six years after baseline interview

Time after baseline interview	Group	Percentage dying	Compared with connected group
Three years	Well connected	8.9%	0.83
	Connected	10.6%	1.00
	Isolated	16.3%	1.53
Six years	Well connected	22.3%	0.93
	Connected	24.0%	1.00
	Isolated	35.3%	1.47

Actionable findings from Detroit's mobility deserts

When the World Economic Forum came to Detroit as part of its SIMSystem work, one question loomed large: How can transport serve the needs of the many Detroiters who lack adequate access to necessities, including jobs, healthcare and education? Approximately 25% of Detroit residents do not own a car, which can make them dependent on public transport. The statistics highlighted in the previous section outline the stark reality that many Detroiters face in their daily lives.

The City of Detroit is spread over a vast area of nearly 140 square miles and includes a large number of very low-density neighbourhoods. **The first step in transforming the situation is the identification of data sources that can allow policy-makers to prioritize necessary transportation investments in these areas.**
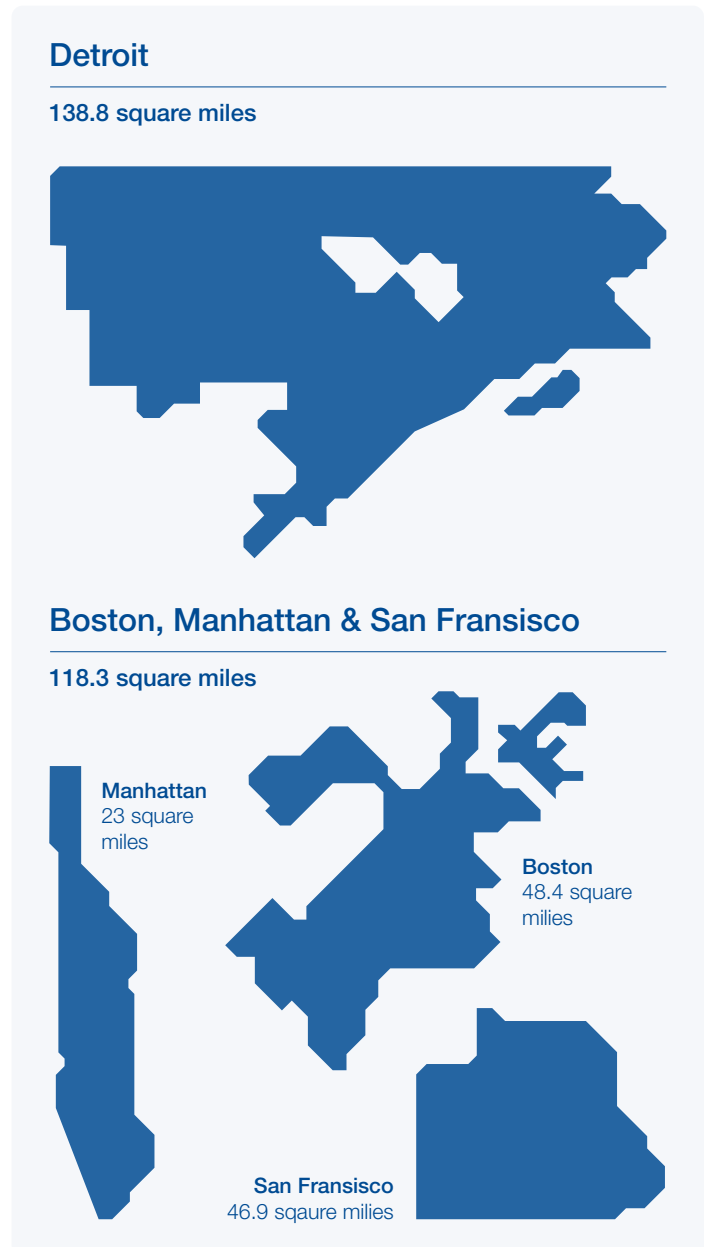
Next, but no less important, to realize its enormous potential, **Detroit, like many cities of similar size and resources, leans on its ecosystem, a necessary enabler.**

The working group of the SIMSystem project, composed of representatives of the public, private and non-profit sectors, joined leading members of this ecosystem to define mobility deserts for the region. The group coalesced on the following definition: **a defined geographic area within which vulnerable populations lack accessibility to core services and the opportunity to improve quality of life.** Incorporated within this definition are a few important recognitions:

– Access to destinations is the goal, not mobility in and of itself

– Access can be achieved both through land-use changes (i.e. ensuring proximity of destinations to where people live) and through safe, reliable and predictable transport options

– All residents of a city ought to have access not only to those destinations that are necessary (jobs, education, healthcare) but also to desired destinations that improve quality of life (recreation, parks, libraries)

Several databases have been compiled for Southeast Michigan that can help focus the characterization of mobility access. For example, affordability is a prime concern for unemployed individuals who plan to use public transport for employment access. Geographically resolved data from the Southeast Michigan Council of Governments (SEMCOG) is available that shows levels of unemployment and income for Detroit. A superposition of information on economic and social economic status with public transport routes and frequencies can identify underserved regions that are particularly sensitive to fare prices.[4]

Figure 3: Comparative area of Detroit

Detroit

138.8 square miles

Boston, Manhattan & San Fransisco

118.3 square miles

Manhattan
23 square miles

Boston
48.4 square milies

San Fransisco
46.9 sqaure milies

An additional example is the number and type of transport options for people using wheelchairs for assistance. These two examples have some intersections of shared relevant data (e.g. frequency of accessible public transport). However, a programme to improve the challenges described in these two examples would not necessarily use entirely common metrics. In other words, **a geographic region can be a mobility desert for one community, but not necessarily another.** Ostensibly, the purpose of identifying a region as a mobility desert is to address the challenges of that region. Consequently, the definition should encompass specific metrics that can be targeted for change.

Table 1: Characteristics to assess equitable access to transport options

Attribute	Measurements
Safety	– Frequency and hours of public transport – Quality of shelter at access points – Distance required to access transport from trip origin to trip destination
Affordability	– Costs of public transport, on-demand and shared mobility resources – Insurance costs – Parking costs – Vehicle costs
Accessibility	– Type of transport available to differently abled persons – Ease of access to user information such as schedules, smartphone requirements etc. – Range of destinations, e.g. work, social, environmental etc.
Diversity	– Range of transport options available, e.g. train, bus, on-demand etc.

Table 2: Examples of metrics to assess mobility solutions for underserved populations

Stakeholder	Assessment
Passenger/user	– Pre- and post-programme surveys, interviews and focus groups (early sampling and longitudinal sampling) – Data to include benefits such as cost savings, travel opportunities enabled, impact on quality of life, ease or challenges of use etc.
Driver/supplier	– Pre- and post-programme surveys, interviews and focus groups (early sampling and longitudinal) – Data to include costs/profit, skills required/acquired etc.
Programme administrator	– Demographics of programme participants (including riders and drivers, and targeted and achieved goals) – Safety – Costs

It should be noted that **there is insufficient data** for many of the services on which vulnerable populations depend the most: namely, transport options that do not follow a fixed route or schedule. While many older adults and people with disabilities can use ordinary public transport, others may simply be too frail or unable to use the fixed-route public buses and trains. While demand-responsive transport services may be mapped, those maps tell us little about the days and hours of service, whether one can cross jurisdictional boundaries or the out-of-pocket cost to the individual. Cash-based systems and networks of social favours are also near-impossible to map and track adequately, even if they can be essential solutions for vulnerable populations.

Tackling systemic mobility gaps with data: A case study from Michigan

The Southeast Michigan Council of Governments (SEMCOG) formed a task force in 2015 to establish an analytical method with regional transport and demographic planning resources that could help track access to core services across the region. The Access to Core Services Task Force set out to measure access, benchmark the performance of the existing transport system and recommend regional policies and local actions to improve how well that system connects people to the places they need to go. The project, in its cost, findings and impact, provides a good baseline to understand how systemic mobility gaps can be identified in regions such as Michigan.

For this analysis, accessibility was specifically measured and evaluated to understand how well Southeast Michigan's transport system provides access to core services across four modes of travel – cars, public transport, walking and cycling. The core services measured for accessibility were fixed-route transport, jobs, healthcare facilities (including hospitals, community health centres and urgent care facilities), supermarkets, public parks, schools and libraries. Travel time was selected as the main determinant of accessibility, as opposed to proximity or distance, based on feedback from constituents.

For the Access to Core Services Task Force, three population groups were defined as "focus populations": 1) public transport-dependent households; 2) households in poverty; and 3) senior households (65-plus years of age).

Key considerations:

– **This is partly a numbers game.** Higher levels of accessibility tend to be found where there is a greater number and variety of destinations, as well as a wider variety of transport modes. In order to improve accessibility, additional transport options, such as improved walking and cycling conditions and connections, and more accessible and mixed land-use patterns can reduce travel distances. Even telecommuting options might be seen as new mobility technologies, in that they can replace physical travel, decrease congestion and reduce carbon emissions.

– **Accessibility is determined by real-life priorities.** Individuals perceive accessibility based on their own prioritization processes. For some, a better commute may deliver the highest value, but for others it can be more important to access parks and outdoor activities. Additionally, as office cultures have evolved beyond dependence on a fixed location (e.g. growth in IT sector jobs and technological advances in telecommuting), there is reason to believe that increased accessibility to more services and amenities will become of high importance in terms of both retaining and attracting residents.

– **Money and time matter most.** Another vital component of accessibility is affordability – both the cost of the mode of transport and the affordability of living in more accessible locations. The most affordable transport modes are walking and cycling, but both generally provide the most limited accessibility in terms of distance and time. However, vehicle size and physical accessibility features can be a deal breaker for older citizens or individuals with disabilities.
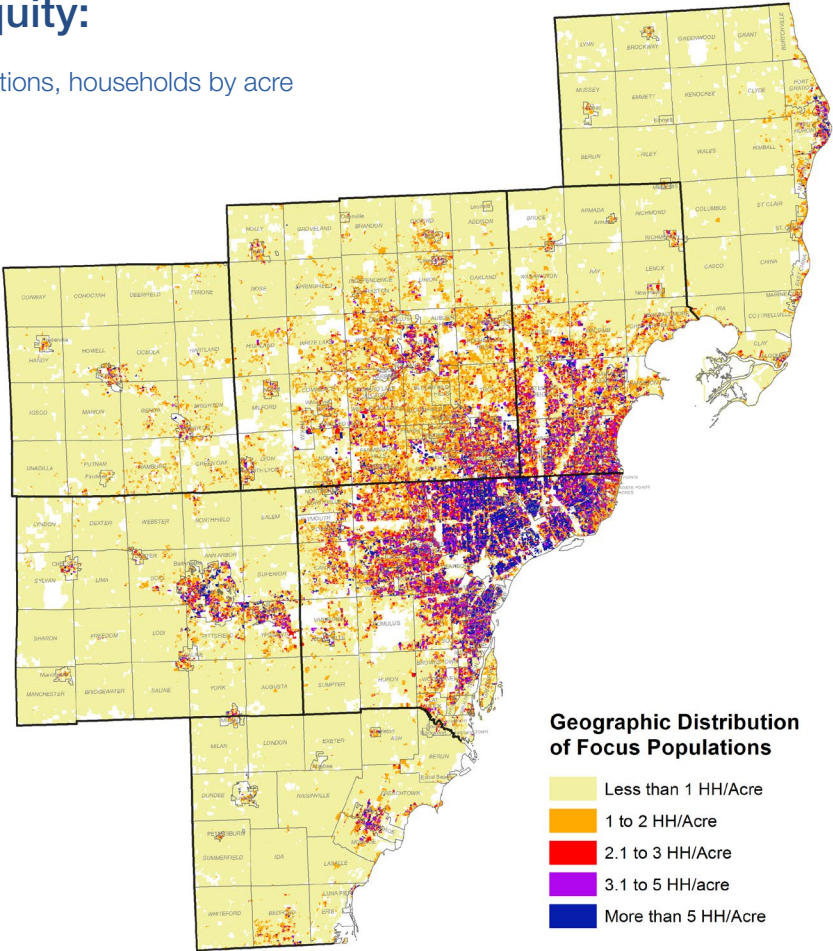
Core services:

For the Access to Core Services analysis, the following seven core services were measured and evaluated for accessibility across four modes of travel – car, fixed-route transport, walking and cycling: 1) fixed-route transit; 2) jobs; 3) supermarkets; 4) healthcare facilities; 5) parks; 6) schools; and 7) libraries.

These seven core services were selected for measurement because they are the major destinations that households need to reach on a regular basis. Each plays a vital role in enhancing the quality of life in Southeast Michigan.

Mapping inequity:

Figure 4: Focus populations, households by acre

Geographic Distribution of Focus Populations

- Less than 1 HH/Acre
- 1 to 2 HH/Acre
- 2.1 to 3 HH/Acre
- 3.1 to 5 HH/acre
- More than 5 HH/Acre

To benchmark accessibility in Southeast Michigan, this analysis measured travel times in reaching core services across four modes of transportation – car, fixed-route transport, walking and cycling. For each core service, a "reasonable" travel time was established through input from the Access to Core Services Task Force and through analysis of national studies and research. The figures below illustrate some of the findings from this case study:

Figure 5: Travel time benchmarks for accessibility in Southeast Michigan

Fixed-route transit	Jobs	Supermarkets	Healthcare facilities	Parks	Schools K-8/9-12	Libraries
Walking – 5 mins – 10 mins – 15 mins – 30 mins **Cycling** – 10 mins – 30 mins	**Car** – 26 mins **Public Transport** – 60 mins – 90 mins **Walking** – 30 mins	**Car** – 10 mins **Public Transport** – 30 mins **Walking** – 10 mins – 30 mins **Cycling** – 10 mins – 30 mins	**Car** – 10 mins **Public Transport** – 30 mins **Walking** – 10 mins – 30 mins **Cycling** – 10 mins – 30 mins	**Car** – 10 mins (regional parks) **Public Transport** – 30 mins (regional parks) **Walking** – 10 mins (any park) – 10 mins (park or school)	**Car (9-12)** – 10 mins **Public Transport (9-12)** – 30 mins **Walking** – 10 mins – 30 mins **Cycling** – 10 mins – 30 mins	**Car** – 10 mins **Public Transport** – 30 mins **Walking** – 10 mins – 30 mins **Cycling** – 10 mins – 30 mins

Figure 6: Walking access to fixed-route transit, Detroit area

Access To Transit

☐ 10 minute walkshed

Demographic Distribution

☐ 1 Dot = 5 Households

● Transit Dependent Households

● Households in Poverty
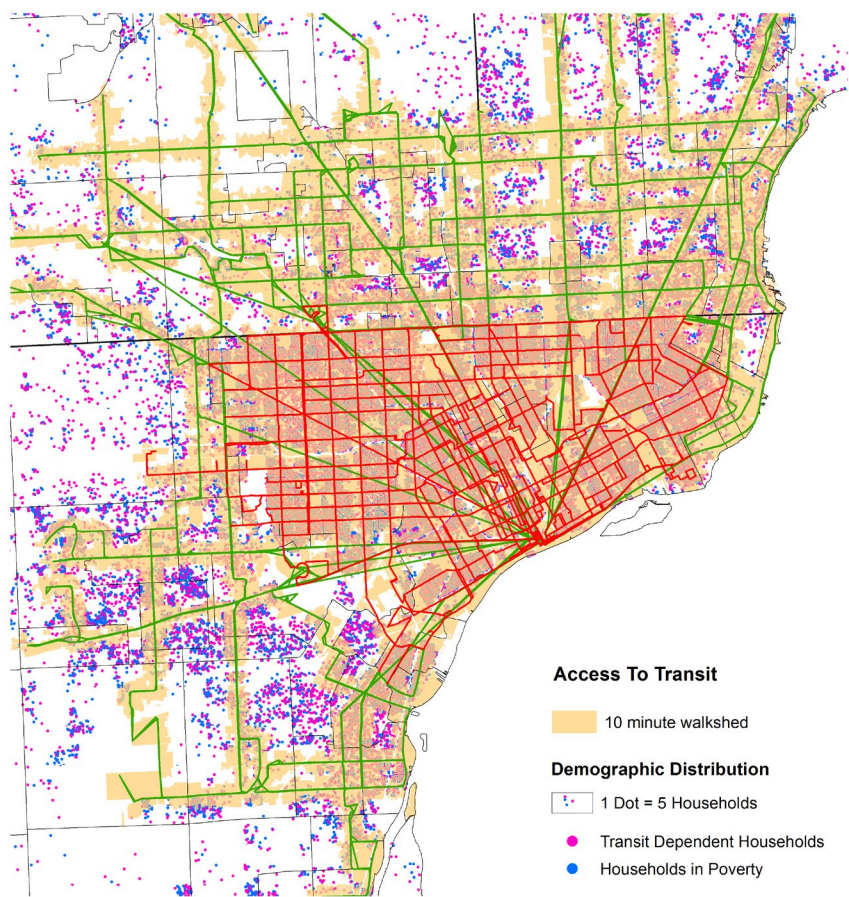
Figure 7: Transit access to jobs within 90 minutes

Transit Access To Jobs
Jobs within 90 Min. Travel Time

- 6 – 35,000
- 35,001 – 75,000
- 75,001 – 120,000
- 120,001 – 165,000
- 165,001 – 230,000
- 230,001 – 300,000
- 300,001 – 365,000
- 365,001 – 465,000
- 465,001 – 800,000
- 800,001 – 1,000,000
- 1,000,001 – 1,220,157

Total Regional Jobs = 2.5 million
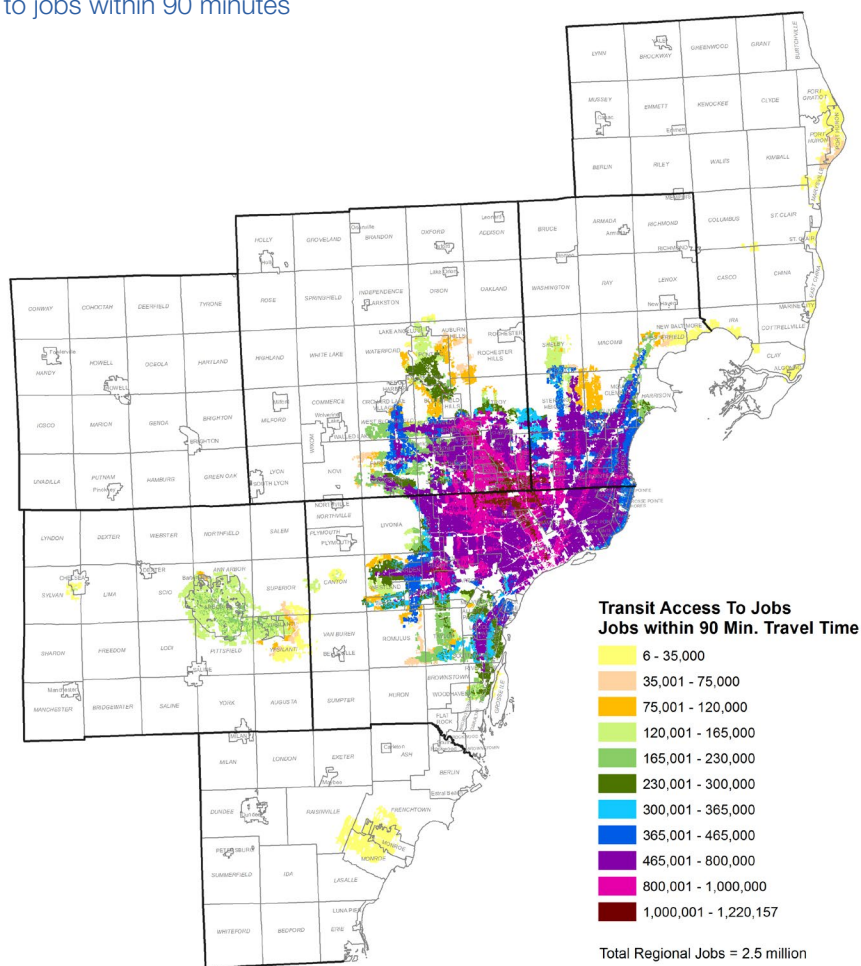
Figure 8: Access to hospitals within 30 minutes

✚ Hospital

Transit and Walk Access To Hospitals

🟪 30 Min. Walk (1.5 Miles)

🟧 30 Min. Transit Travel Time
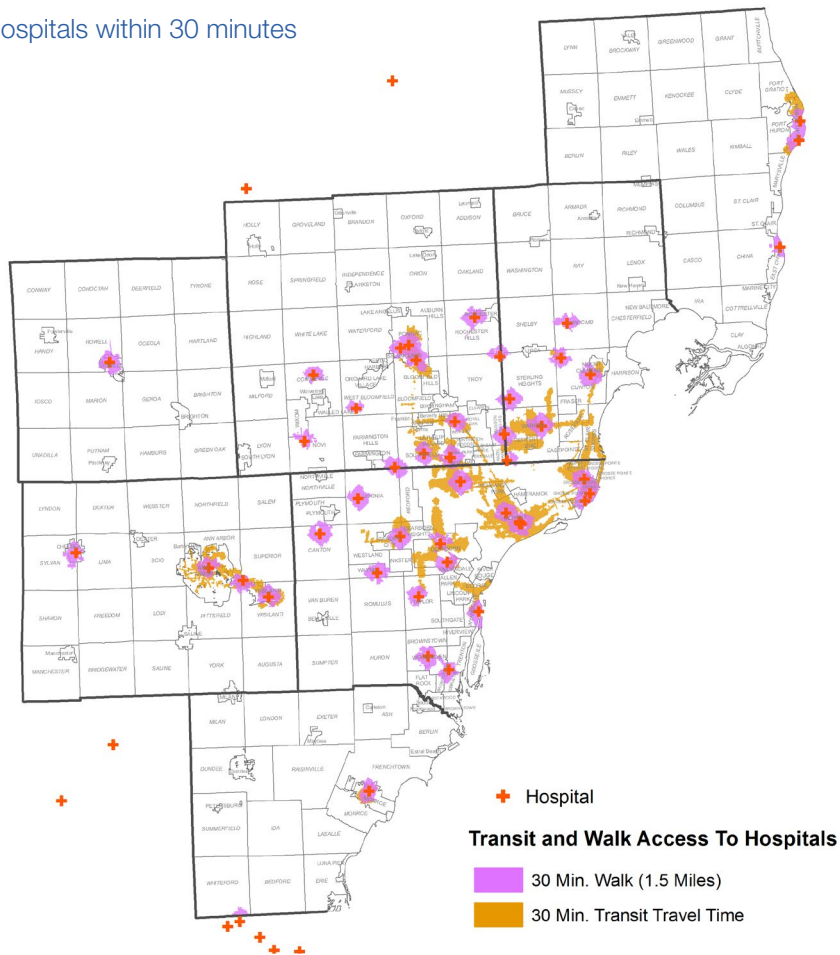
Figure 9: Access to supermarkets within 30 minutes

▲ Supermarket

Walk and Transit Access To Supermarket

🟪 10 Min. Walkshed

🟧 30 Min. Transitshed

Demographic Distribution

· 1 Dot = 5 Households

● Transit Dependent Households

● Households in Poverty

● Households with Seniors
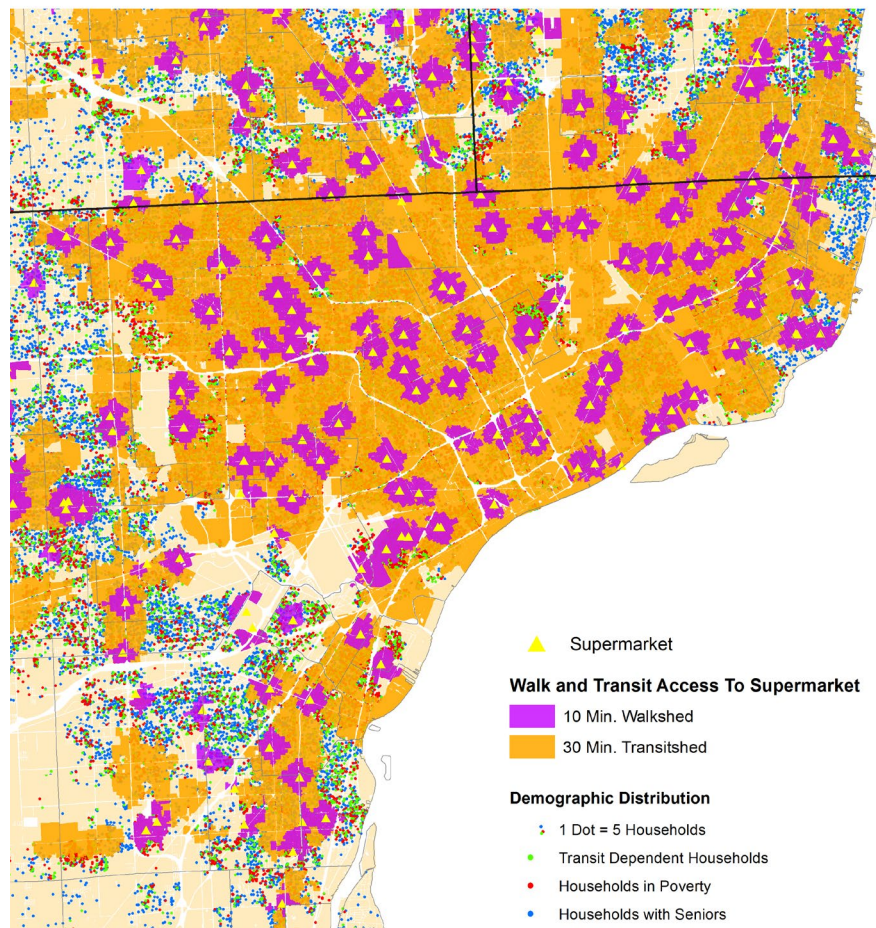
Figure 10: Regional benchmarks, walking access to parks and parks or K-12 schools

Legend: ■ 10 min. walk to a park ■ 10 min. walk to a park or school

Categories (with values):
- Total households: 35.9% / 50.3%
- Transit-dependant HH: 47.7% / 62.2%
- HH in poverty: 49.9% / 63.9%
- HH with seniors: 35.1% / 50.5%
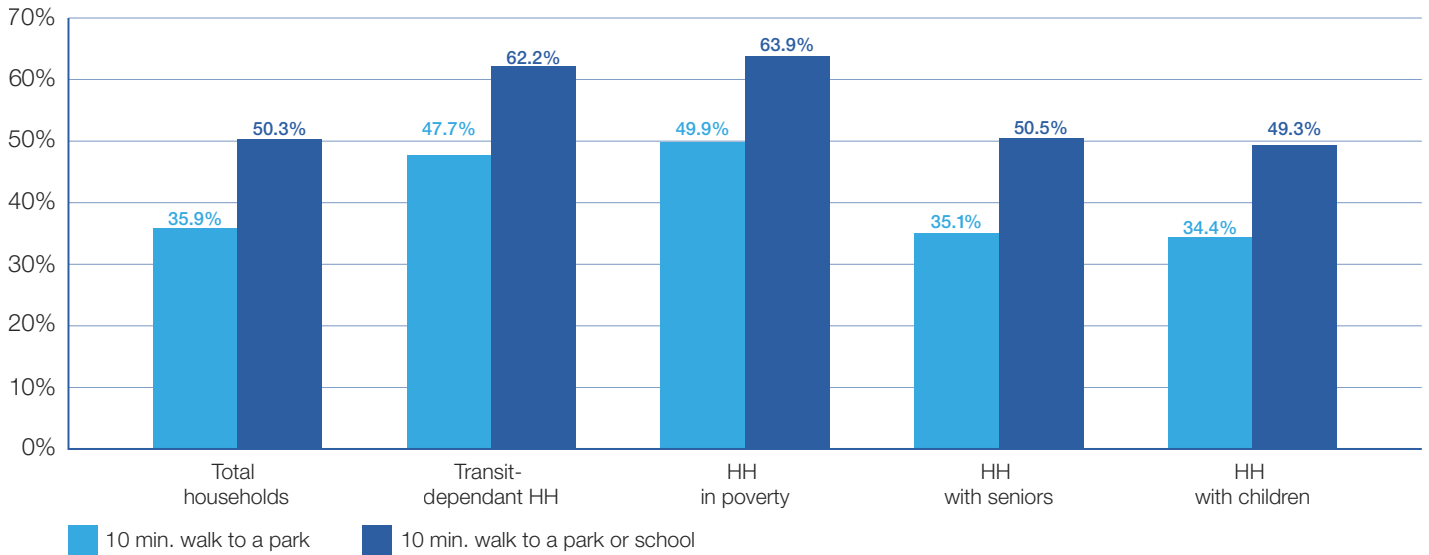- HH with children: 34.4% / 49.3%

Figure 11: Zooming in on a car-centric region:

Key insights

20% (1 in 5) public transport-dependent households are beyond a 30-minute walk to a fixed-route transport service, and 35% are beyond a 10-minute walk

Even for households with high (within a five-minute walk) or moderate (15-30-minute walk) access to fixed-route transport, bus availability and frequency of service is often a challenge

7% of the region's jobs are accessible within a 60-minute public transport trip; only 22% of the region's jobs are accessible within a 90-minute fixed-route transport trip

40% of households in poverty are beyond a 30-minute public transport trip to a supermarket, and 22% are beyond a 30-minute walk

65% of households with senior members are beyond a 30-minute public transport trip to any healthcare facility, and nearly half (49%) are beyond a 30-minute walk

87% of public transport-dependent households are beyond a 30-minute trip to a large regional park, and 38% are beyond a 10-minute walk to either a public park or school.

Throughout the region, cars provide moderate-to-high levels of accessibility across all seven core services measured in this report. While there are certainly gaps in access by car, including access to hospitals and jobs, these gaps are generally less significant than by the other three modes of transport – fixed-route transport, walking or cycling. These gaps primarily relate to geographic and distance challenges (i.e. the location of a household is beyond a reasonable travel time to reach core services)

and to population and transport challenges (i.e. the household has limited means, ability or transport options available to reach core services). This makes the region inaccessible to anyone who does not own or operate their own vehicle. It is further worth noting that the distances mapped in the figures above assume that a 30-minute walk to the hospital, or a 30-minute walk back from the supermarket carrying groceries, would be manageable for all residents.

The promise of technology for inclusivity

New technologies deployed over the past few years have made the ambitious promise to transform mobility desert environments for the better, to improve quality of life of vulnerable populations and revolutionize access to opportunity and happiness. However, they still present potential drawbacks, especially if implemented poorly. Four technologies in particular have been acclaimed as potential game changers in the mobility industry. How could they change a situation like the one described above? What potentially negative effects should decision-makers remain aware of?

1. Micromobility

Many urban residents have embraced the onset of micromobility options, primarily bicycles and scooters, as an excellent way to travel short distances. Dockless options, especially scooters, offer even more ease of use for travellers and early evidence suggests that, in some conditions, around a third of micromobility trips are used to reach or leave transport stations.[5] Micromobility options can also more easily reach lower-income and other underserved communities as they require minimal infrastructure. Another positive is that, since bikes and scooters are either manually or electrically powered, they also are emission-free. In the City of Detroit, residents can use MoGo bikesharing and several scooter options, including Bird, Lime, Spin and the seated scooter company Boaz Bikes.

Many cities have struggled with implementing these micromobility options. Safety of users and other residents is one of the largest micromobility-related issues city leaders face. Cities must determine where scooters and bikes should operate when there is no dedicated infrastructure for them: on roads or pavements? And, for dockless varieties, where should they be stored so they do not create safety hazards on pavements, roadways and other pathways for older adults, people with low vision and those who use wheelchairs? Finally, how can unbanked residents take advantage of them?

2. On-demand

On-demand services, including everything from ridehailing and ridesharing to microtransit, have the potential to get people where they need to go quickly, conveniently and relatively affordably. Both Lyft and Uber increased ridehail sales substantially in 2016–2019.[6] Similarly, carpool-matching apps, such as Scoop and SPLT, have had success in recent years focusing on commuting solutions for employees of large companies. Microtransit firms, such as Via, are expanding in cities across North America and Europe. The ubiquity of companies like Uber and Lyft and the steady increase in services from companies like Via and the ridesharing apps indicate the market value of the mobility options these companies offer. Uber, Lyft and Scoop operate in Detroit, and companies such as Bedrock have experimented with microtransit.

The new transactional data specification for demand-responsive transport published in November 2019 by the Transportation Research Board further offers a new opportunity for existing community transport providers to seamlessly coordinate their services, even across jurisdictional boundaries. Implementation of the data specification could vastly improve the quality and availability of publicly subsidized and affordable specialized transport services.[7]

While on-demand services are filling a market niche, they are not without negative externalities. Take congestion, for instance. While ridesharing, and microtransit to a lesser extent, takes vehicles off the road, ridehailing services have actually increased congestion in many cities.[8] In essence, there are more taxis driving around looking for riders. And, like micromobility options, on-demand services are significantly limited or made unattainable to those without access to a smartphone or bank.

3. Smart cities technology

The term "smart cities" encompasses many different aspects. Taking its broadest definition, a smart city uses connected data to make everything – from buildings to mobility to city services – work more efficiently. By using the internet of things (IoT), companies and cities can offer methods to integrate multimodal payments, track emissions and improve traffic flows in congested areas. The downside in doing so, however, is that they also require increasing amounts of data from residents and visitors. People have generally approved usage of their data in exchange for services offered, such as mobile phones and credit cards. Along those lines, the City of Los Angeles is spearheading the Mobility Data Specification (MDS) effort to gain access to real-time, anonymized data from micromobility providers, and has been joined by many cities through the Open Mobility Foundation (OMF). Various stakeholders from civil society, NGOs and private companies have expressed that there is a great need to review carefully the confidentiality of private information and the risks of making users' data public. In the case of the private sector, the interest is also related to maintaining full ownership of data and rejecting what is viewed as government surveillance. Because cities can control more things than individual companies, sharing and securing data – especially individual data – should be handled with caution.

4. CASE (connected, autonomous, shared, electric) mobility

Many car manufacturers and mobility companies are racing towards a future of connected, autonomous, shared and electric (CASE) transport, but they are overlooking a critical component in the CASE model: defining shared mobility beyond the individual rider to truly transform urban environments for the common good. The investments to date have focused on e-hailing, semiconductors, AV sensors and infotainment. Often the focus in the industry is on ridehailing as car-share business models have typically been challenged to prove their value.

The focus on ridehailing for the industry typically supports riders' desire to improve their individual financial savings and mobility needs. As seen with on-demand technologies, this individualized focus results in increased VMT (vehicle miles travelled) and congestion in cities. The congestion might only get worse as those vehicles transition to becoming autonomous, allowing more people the opportunity for personal transport, such as young, elderly and disabled people, or any person without a driver's licence.

As an example of how CASE technologies can transform ridership, May Mobility shuttles in Grand Rapids follow an existing bus route but have converted riders who had never used public transport before. In contrast, their shuttles in Providence fill a transport desert, connecting a low-income neighbourhood, the Amtrak station and downtown Providence, solving first/last-mile problems with multimodal transport.

Strategies for digitizing mobility systems: Basic technical and human requirements

However compelling the promise of new mobility technologies, mid-sized cities such as Detroit find themselves in an impossible situation, where the available technical and human resources simply don't match the vision expected by residents. What should these cities begin with?

Harnessing the full potential of data-driven technologies is a difficult task; this data comes from disparate, large-scale data sources, has different formats, is collected at different temporal and spatial granularities, and is often stored in different platforms and files that cannot be easily linked. The World Economic Forum formed a project with the University of Michigan and the City of Detroit, co-funded by the University of Michigan and the Knight Foundation, to provide a unified solution for managing and integrating disparate mobility data sources (e.g. traffic volume, scooter information, rideshare services, real-time bus data and street-view data). The resulting solution will enable the use of the trove of generated mobility data, support seamless analytics that can help provide insights into mobility patterns in Detroit and lead to more informed transport planning, decision-making and policy evaluation.

Strategies for a successful partnership

This project was launched by a collaboration agreement between the Michigan Institute for Data Science of the University of Michigan (UM) and the City of Detroit. Several conversations between the city officials and the university representatives led to a common understanding of the needs and the main aspirations of each party, aligning goals, securing the necessary resources and calibrating the expectations of both sides. The ingredients of this partnership consist of key contributors, a data-sharing scheme, a set of projects, a sustainable funding scheme and an inclusive model of engagement.

1. **Contributors.** Three classes of key contributors were identified who collectively define, perform and evaluate the outcome of projects: 1) the stakeholders from the city; 2) the university facilitators; and 3) the students at UM. The stakeholders own the data and play a central role in defining the use cases that are of high value for the city and implementing the outcomes.

2. **Data assets.** Data is the central pillar of this collaboration. It needs to be collected, shared, modelled, interpreted and acted on. While the abundance and variety of collected data makes the project appealing for the researchers, different portions of the data are owned by different departments at the city, which requires multiple data-sharing schemes and agreements. The project will set out by focusing on the public portion of data that can be shared readily.

3. **Project formation.** Another pillar of this collaboration is the identification of high-value projects. The facilitators from the university and the city need to allocate their time and resources efficiently to collectively define and address projects that are of common interest and provide opportunities for impact for the city and growth for the students.

4. **Securing funding.** The prime element of sustainable research collaboration is funding. The first phase of this partnership is enabled primarily by funding from the City of Detroit, which originates from the Knight Foundation, as well as funding from different units at the University of Michigan (College of Engineering, Michigan Institute for Data Science [MIDAS], University of Michigan Transportation Research Institute [UMTRI] and the Computer Science and Engineering department). The funding will be used to pay for the necessary resources (e.g. computing platforms) and compensation for the students as part-time researchers. Identifying robust financial resources by all of the involved parties is necessary for long-term engagement and for establishing a multidisciplinary team at the campus.

5. **Academia-government engagement.** An inclusive, interdisciplinary model of engagement is necessary for the success of the collaboration. During the project, the facilitators will make the results and insights available to the City of Detroit.

Technology governance gap

The city of Detroit, like many other cities, currently lacks a set of practical guidelines on how to deal with the data, e.g. how to collect, where to store, what format to use and how to share the data with third parties. Research outcomes might therefore include a set of theoretical tools and practical guidelines on "how to deal with data".

Evaluating algorithmic fairness and biases is another essential, but often overlooked, element of an inclusive and equity-integrated automated system. For data-informed decisions that affect the residents' lives, it is crucial for decision-makers to assess the short- and long-term impacts, with the aid of automated tools (when needed). Despite major advances in the past few years, the theoretical framework around algorithmic fairness and biases is still in its infancy and their applications are rare. Assessing the state-of-the-art theoretical framework in the wild and providing auditing tools

for the practitioners and policy-makers to evaluate biases and fairness of the resultant automated mobility system will help towards filling in the current technology governance gap.

Translating technology to policy changes

Translating results from data-driven models to achievable decisions and informing new policies is rather challenging. Although data-driven models are powerful and harness the information that is encoded in large amounts of data collected from heterogeneous sources, there are many biases that need to be accounted for – including activity-based data generation, data collection and algorithmic bias. These biases ought to be carefully considered when the algorithmic results are used to inform the decision-making process. Instead of providing black-box decisions, it is necessary to develop simple, interpretable models whose results will augment the current process followed by policy-makers at the City of Detroit. Thus, the ultimate goal is data-informed decisions, which will prioritize the residents' needs even if they may not be optimal from an operational standpoint.

Roadblocks, challenges and risk mitigation

Such a complex, impactful partnership between academia and the local government will inevitably encounter roadblocks and challenges. The main expected challenges are mostly related to data, methods, technology translation and student training.

1. Data issues

The city has collected vast volumes of data that requires systematic inventory, dedicated data sharing and data-integration schemes. A detailed catalogue of all of the data is the first step towards understanding what is available and how each data source may relate to high-value questions

about mobility in Detroit. Moreover, it is necessary to know the type and size of the data in order to define the appropriate technology for sharing the data securely. Finally, separating the data into private and public is important in ensuring that no identifying information is shared or leaked, thus protecting the residents' privacy.

Given the large number of data sources (~100), numerous data integration challenges are expected. Many of these stem from the data-collection processes; collection practices may change over time to adjust to technology updates (e.g. new devices, sensors) or new goals. Moreover, it is not uncommon for devices to go out of calibration or stop functioning for some period of time, leading to noisy, inaccurate or missing data. These issues – in combination with the fact that data can come in different temporal and spatial granularities and is often stored in different platforms – pose significant challenges for linking that data in one unified platform. Besides, the data-sampling process may be biased (e.g. systematically missing data from specific regions, times or demographics). Therefore, robust techniques are required to mitigate sources of uncertainty and bias in data.

2. Method issues

The practitioners and decision-makers might not be tech-savvy. Therefore, it is of particular importance to develop methods and a uniform system. A robust and efficient system should be designed to minimize the maintenance burden on the city. The resultant framework should be sufficiently modular, allowing the merging of code from multiple contributors, as well as readily usable, with a focus on delivering results in formats that are easily understood by the end users/practitioners (e.g. appropriate visualizations and confidence scores for the results).

3. Student-training challenges

Many of the students who will be involved in the project may not have research or work experience outside of the classroom. Working for the first time on open-ended projects, handling non-curated real-world data, and collaborating with stakeholders can be challenging and overwhelming. Training students to become familiar with different types of data and state-of-the-art techniques (spanning pre-processing, data mining, machine learning, computer vision, optimization and more) is expected to take a significant amount of time, but it is of paramount importance for the success of the project. Diversity in teams also brings challenges: Synchronizing activities and communicating ideas in a simple way that is understandable by non-domain experts will require time and effort from all of the involved parties.

Another expected challenge in an academic setting is student turnover (due to graduation, heavy course load). To mitigate this, designing modular tasks of varying durations and carefully assigning them to students according to their availability is critical. Moreover, continuity in projects needs to be ensured by employing effective methodologies in documenting progress so that new contributors can take over when needed.

Impact

The city of Detroit will have access to untapped talent across multiple disciplines and will benefit from knowledge transfer from the university. The collaboration has the potential to identify issues with the data collection and other processes that will inform future efforts led by the city, long after the conclusion of the project. Access to a diverse student body may also lead to a richer pool of candidates for internship and employment opportunities in Detroit.

Such a partnership can become a model for mid-sized cities to source top yet affordable talent to manage some of the complex strategic choices inherent in the transformation of mobility systems and bear some of the burden of the processes behind data integration and the overall digitization of mobility infrastructure.

Extrapolating findings into a global framework

If this is how the digitization of mobility systems can be operationalized in Detroit, then what other lessons can be learned on a global scale? The World Economic Forum and Deloitte Consulting explored 13 cities' journeys to the activation of their own seamless integrated mobility systems.[9] The research uncovered four primary strategic design choices every city needs to address in activating seamless integrated mobility systems. It is important to note that these are not binary choices, but rather a continuum along which cities and other stakeholders will need to move. In a perfect world, a city might aspire to achieve both ends posited by the design choices.

## Individual journeys in the context of systemwide optimization

The first strategic design choice concerns journey optimization. Specifically, cities must decide what they are optimizing: an individual's ability to choose their preferred trip, or the efficiency and throughput of the overall system? While recent innovations in mobility-as-a-service are beneficial to their users, they might exacerbate the systemwide challenges of congestion, sustainability and access that require more active management and influencing of consumption choices through policy.

The most successful cities understand what they are solving and what is going to move the needle on mobility transformation, rather than pursuing one-off pilots or discrete strategies.

Leadership roles for the public and private sectors

Cities have a critically important voice in determining what roles the public sector and private sector play, and in balancing competing priorities, incentives and capabilities to affect a city's mobility system. However, there is also a wide spectrum of activities in which governments can allow private-sector players to drive. Cities must objectively discern their willingness and capabilities to manage mobility innovation – and identify areas in which complementarities from the private sector may make sense. They must also actively work not to stifle private-sector innovation out of an allegiance to legacy systems that no longer serve their citizenry or are suboptimal from the perspective of budget investment return. How to balance the multidimensional role of the public sector while effectively engaging different parts of the private sector is an open question.

As part of the SIMSystem pilot, the cities of Ann Arbor, Windsor and Detroit met with representatives from Jalon, who have been working with the city of Montreal on the transformation of their mobility system, and also met with the team behind Smart Columbus. In both cases, the public-private alliances formed by the city were major forces propelling the transformation forward. The exact distribution of roles matters less than getting all relevant stakeholders around the table.
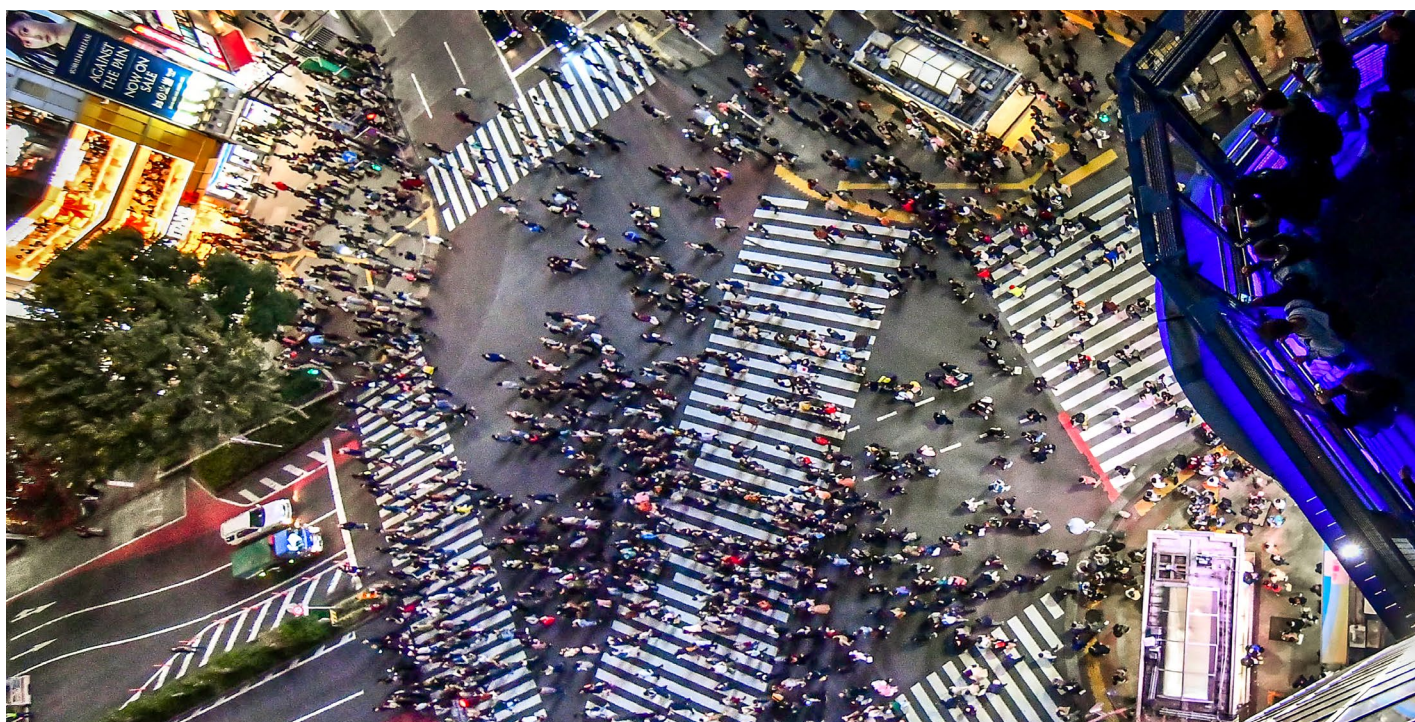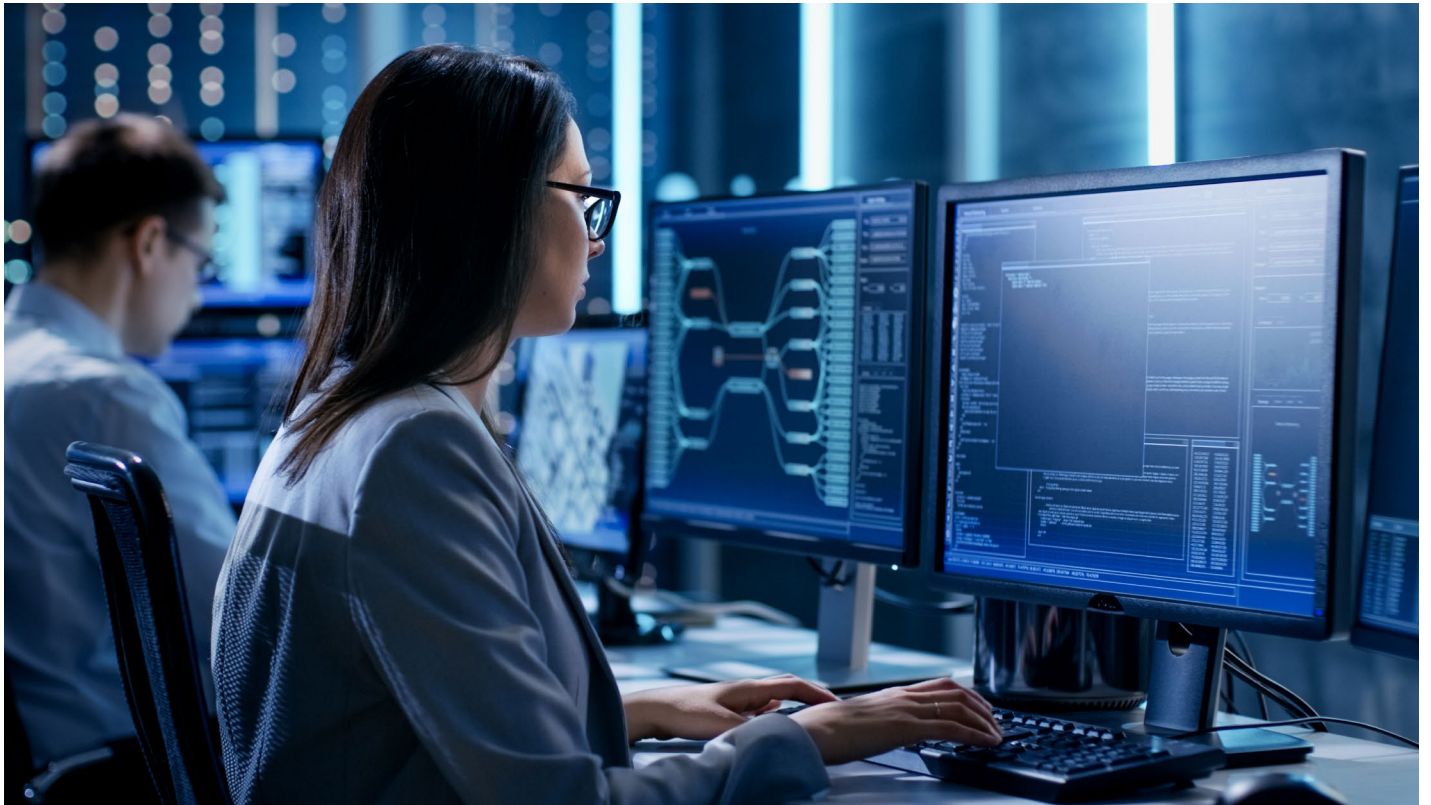
Data openness, transparency, privacy and security

Cities must figure out what data to collect, specific use cases, how to house it and how to create common standards to produce achievable insights. Often, cities collect an immense amount of data before knowing what to do with it, in what format to house it, where it exists or how to create common standards to produce achievable insights. This can create paralysis in an area that is so critical to success.

The City of Los Angeles stands out as a pioneer in public sector-led initiatives on open data exchanges. The City of Los Angeles Department of Transportation (LADOT) developed the Mobility Data Specification (MDS), designed to encourage a common approach among cities for collecting and sharing mobility data. The recently established Open Mobility Foundation seeks to manage the MDS's continued development and deployment, and to share effective techniques across 50 cities in the US and dozens internationally. Many cities around the world are facing similar challenges relating to the question of data. By using existing standards and common languages, cities can simplify the path to adoption and ease the burden on private-sector providers. MDS is just one example; further standards and principles have been offered by the New Urban Mobility Alliance,[10] the National Association of City Transportation Officials,[11] the World Business Council for Sustainable Development[12] and others.

City-regulated approach in response to market-led innovation

New mobility services and technologies have often outpaced regulation. As cities come to grips with this more dynamic transport environment, they must choose whether to proactively create policy, legislation and regulation that set guidelines within which the private sector must act, or allow a more open, market-based approach to drive the pace of innovation and let regulation follow.

In August 2018, representatives from the cities of Detroit, Ann Arbor and Windsor sailed to Portugal to explore methodologies related to this design choice. In Lisbon, for example, city officials have welcomed innovators introducing their services in micromobility. They have adopted a posture of regulating the services as needed once they have become established. In effect, they have designed a regulatory approach based on the type of innovation they see: soft regulation for "greenfield" opportunities and harder, rules-based regulation for "brownfield" opportunities. In most successful cities, however, public-sector regulators and private-sector providers co-design the path towards the future.

Ultimately, all cities will have situational, political and economic factors that guide their response to these design questions. But, within those constraints, cities have a span of choices under their control, and many cities have made interesting, nuanced and differentiated choices in regard to their path to mobility transformation. While no two paths will appear the same, their journeys offer important insights for others looking to achieve a truly seamless, integrated mobility system.

Forming new public-private partnerships

The case study of the project between the City of Detroit and the University of Michigan illustrates well the need to redefine partnership models in order to unlock the Fourth Industrial Revolution. Another powerful example of creative partnerships is Project Kinetic, managed by the Michigan Economic Development Corporation's Planet M. Project Kinetic is a unique collaboration formed in January 2018 between the public (City of Detroit, Planet M), private (General Motors, Lear, DTE Energy, Quicken Loans Community Fund, Bedrock Detroit, Boston Consulting Group) and philanthropic (New Economy Initiative) sectors. Representatives from each of the organizations worked hand-in-hand for a 12-week period in early 2018 to brainstorm more than 120 innovative solutions to tackle some of the most pressing mobility challenges facing Detroit through new scalable business models. During this

innovation sprint, the partners gathered feedback from over 100 residents and visitors to the city.

Together, the project board and working team launched six pilots: Busority, Car4You, ChargeD, CTI, MicroTransit and ParkDetroit.

Of these pilots, Car4You is a particularly interesting one to look at more deeply, since it enacted the global trend of moving away from car ownership to embrace mobility as a service, while still embracing the car-centric necessities of the region. Put simply, it makes a car available to all residents to "borrow", instead of owning or leasing. The hypothesis is that the city with the highest cost of car insurance in the country might be the perfect testing ground for this revolutionary concept.

Figure 12: Project Kinetic board and working group

Figure 13: The most expensive cities in Michigan

Detroit	Dearborn	Southfield	Redford	Flint	Average
$5,706	$4,993	$4,443	$4,014	$3,929	$2,920
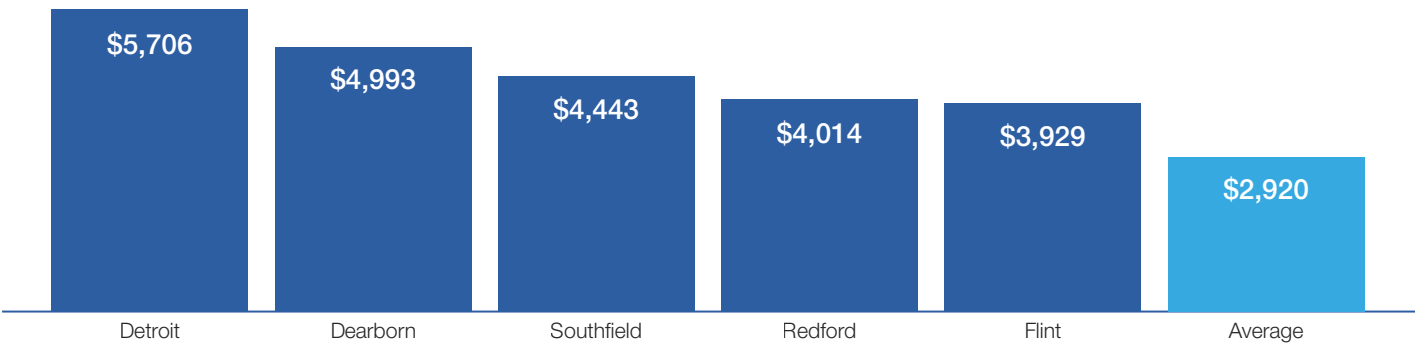
Crucially, the project members used community engagement to properly launch Car4You. The product was first introduced at a community event, the Osborn Neighborhood Parade, and community members were asked to act as ambassadors for the project, driving interest from others. In an effort to serve the community broadly, the team enabled product features allowing service to individuals who might not have personal access to broadband or cellular data, or to a credit card.

Key lessons shared by the team include:

– Form positive partnerships with a **cultural match** between stakeholders

– Don't make assumptions, and take time to **build trust**, particularly for novel partnerships including non-profits and community organizations

– **Engage the community** meaningfully, making sure to include a feedback loop and use public ambassadors

Detroit is not the only environment supporting public-private networks to enact the transformation of its mobility systems. Several US cities, including Minneapolis and Pittsburgh, are currently implementing networks of mobility hubs – nodes at which multiple transport options are **integrated physically** and operationally. In Pittsburgh, the deployment of 50 such hubs is being led jointly by the city and a collaboration of different service providers, from scooters to carsharing services, with the advice and support of the New Urban Mobility Alliance (NUMO). A growing number of cities in the US have expressed interest in this model. In addition to the physical integration of modes via mobility hubs, operational integration also promises significant benefits for transport users. For example, integration of fare payment systems can significantly increase the ease of using public transport, while bundling of trips to take advantage of the cost and funding structures of different transport modes can facilitate service provision. Whether physical or operational, the integration of public transport with additional transport services has the potential to enhance first-mile/last-mile transport options for those vulnerable populations that currently struggle with inadequate access to safe and reliable transport.

In forming partnerships, do not dismiss your neighbours

Divided by political boundaries and governed by multiple jurisdictions, including three municipalities, a state, a province and two countries, the three cities of Detroit, Ann Arbor and Windsor are connected by a common "economic energy" and a common way of life. They share a rich history of working together, a similar landscape and weather system and are connected through a network of families and friendships. The border between them also sees the greatest number of cross-border commuters between Canada and the US and the largest trade corridor in North America.

Yet Detroit, and its connection to the cities of Ann Arbor and Windsor, is beset by multiple challenges and obstacles that make mobility across the region difficult. Between them, the three cities manage six different public transport agencies and host more than 50 community transport services with little or no cohesiveness between them, resulting in significant challenges for those who need to use multiple services to complete a trip across the region. In the healthcare field alone, this population includes 6,500 workers crossing the border every day to go to work.

The lack of integrated transport further damages the region's brand, making the area less attractive to top talent and businesses and thereby stifling economic growth. Recently, the three cities have increased their levels of collaboration, with several initiatives:

– Last October, plans to establish the Detroit Center for Innovation were announced. Anchoring the site will be a research and education centre operated by the University of Michigan, with the goal of serving 1,000 graduate and senior-level undergraduate students pursuing advanced degrees in a range of high-tech innovation disciplines.

– In July, the City of Windsor, with funding from the Windsor Essex Economic Development Corporation (WE EDC) (via the Ontario Centres of Excellence), deployed Miovision traffic equipment along its main trade corridor to align with Detroit's traffic system.

– The City of Windsor continues to offer cross-border public transport via Transit Windsor's tunnel bus service between Windsor and Detroit.

– The WE EDC has also received federal government funding to create an automobility cluster in Windsor Essex and the surrounding area

Despite the numerous examples of economic, social and cultural integration, the multiplicity of jurisdictions makes it difficult to categorize the region as being "highly" integrated. Similarly, the international border dividing the region means that parts of the region are not completely immune to protectionist actions, even with the approval of the US-Mexico-Canada Agreement (USMCA).

Regional integration does not mean uniformity. Rather, it enables each party to strategically employ differences or complementarities for combined economic benefit. Increased regionalism has the potential to build on the region's enduring competitive advantages as a global automotive cluster, advantages that lie increasingly in "local IP" – knowledge, relationships, motivation – that distant rivals cannot match. The City of Detroit benefits directly from the leadership of the University in Ann Arbor. Hospitals in the region get much of their talent from residential neighbourhoods in Windsor.
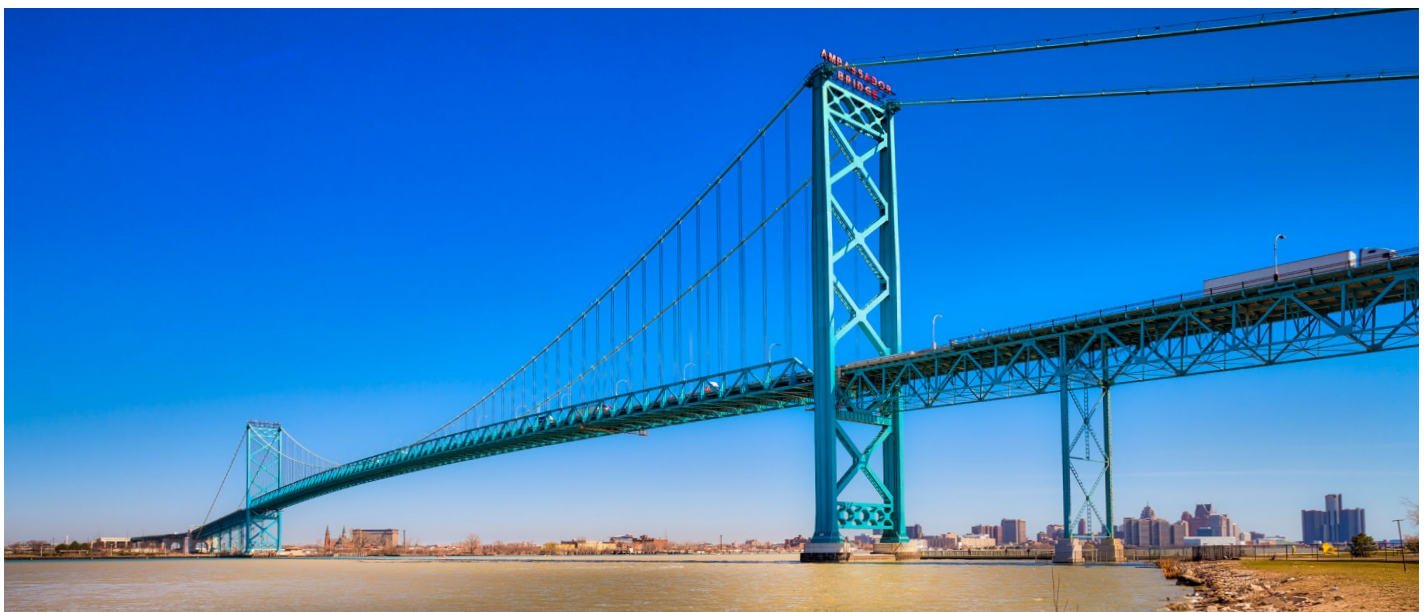
The essential contribution of civic and academic organizations

For mid-sized cities, it is particularly important to consider the support that civic and academic organizations can bring. In the case of Detroit, private institutions such as Quicken Loans and JPMorgan Chase have famously been instrumental in helping the city recover from its bankruptcy, but they have not been the only important players in the region. Vital support from the Knight Foundation, for example, enabled the City of Detroit to match the funds put forward by the College of Engineering at the University of Michigan to create the multidisciplinary student task force described above. The university itself even earned a place in the **World Economic Forum's Corporate Mobility Challenge** for operating the Detroit Connector, a public-transport option running between Ann Arbor and Detroit several times daily that is used by students and employees to commute between the two cities as well as by members of the general public.

The University of Michigan's involvement in the SIMSystem project was based on a request early in the programme from two pilot members. In this case, the cities of Ann Arbor and Detroit had previously worked with UMTRI, having combined since 2011 to deploy connected vehicle technology throughout the community. Even though UMTRI did not possess all of the expertise needed to support the project, the institution made every effort to gather the internal resources, including funding the involvement of both students and faculty, to lend a hand to the piloting cities.

However, it is not uncommon for academic institutions to be overlooked, particularly in regions where their working relationships with the local public and private leaders are not as well established as they are in Michigan. Still, a few considerations make academic institutions prized allies for mid-sized cities and their region.

– When an academic institution receives financial support from state or provincial governments, it will generally **incorporate community service into the organizational mission.** When that is the case, record of service to the community can be a significant consideration in the promotion and tenure process.

– US academic institutions are **not affected by borders in the way most public organizations might be.** The University of Michigan, for example, considers Windsor to be part of its community given the pivotal role the city and its province of Ontario, Canada, play in the State of Michigan's overall mobility economy.

– There is **a natural trade of talent for experience** in technology development between academic and municipal institutions. Local governments have treasure troves of data but lack the human resources to develop them. Universities have extraordinary pools of talent, working at the edge of innovation, but lack real-world experiential training. This realization was fundamental for the City of Detroit and can easily be replicated globally.

Civic organizations are the other unfairly overlooked institutions in traditional partnership models and are poised to reclaim a prominent role. First, they provide a **neutral viewpoint** regarding transport services, planning and delivery. Second, they add **critical nuance** to conversations about mobility, beyond technicality and industry.

One of the big issues that civic institutions and multistakeholder collaborations can help to clarify is who benefits and who pays. Local, state and federal governments can suffer from a wrong pocket problem; in other words, the entities that benefit from a solution often are not always the entities footing the bill. For example, it might make more sense to subsidize transport that helps to access jobs, healthcare appointments or nutritious food than it does to pay for the consequences of unemployment, missed healthcare appointments or poor nutrition. Within the SIMSystem pilot, this meant exploring a public-private partnership between the cities of Detroit and Windsor and the Henry Ford Health System to launch a commuting solution for some of their 900 workers who cross the bridge every day to get to work and fill part of the local skills gap.

One way to increase the effectiveness of transport measures is to build alliances of different stakeholders from within and outside of the sector, who can link transport and access to other important outcomes. For instance, NUMO was created as an alliance-based organization that aims to convene a broad base of stakeholders from different sectors, such as the government, private companies and community groups, in such a way that they can have a dialogue about vital transport issues and move forward in finding solutions to concrete problems in specific places.

The path to operationalization

A common pattern in the modern economy is the implementation, by some organizations, of incentive schemes for employees using shared and/or sustainable mobility options ranging from free rides in carpools to reimbursement of travel costs, gifts of bicycles or other travel modes. However, the success of new transport solutions is determined by the consumers' response, and the ability of the industry to match that response, or demand, with the appropriate supply. One of the reasons why such efforts generally do not bring about significant changes of behaviour is that they are almost never based on data from users. Since transport is a means of reaching a goal and is an intensely need-based phenomenon, long-term behavioural changes must be tied to the selected population's goals and aspirations, whether that is healthy living, efficient time use or better quality of life, instead of assuming they must centre on financial short-term gains. In other words, **begin with understanding what motivates your users, not what you think should motivate them.**

Mobility users have three main currencies to trade: 1) monetary; 2) time; and 3) energy. Some travellers value travel time above all else, while others need flexibility, comfort or accessibility more than they need a shorter commute. **Gather data on which one matters most to your users.**

In addition to stated preference data, revealed preference data can be collected via smartphones. Novel methods can be used to combine the trajectory data from GPS and the survey data to develop behaviour models for agents with different travel needs and destinations. In the case of the SIMSystem pilot, existing travel behaviour was not sufficient. Rather, to understand the actual burden of the journey, **decision-makers needed to explore the motivations behind the patterns**, so they could appropriately shape incentives. For example, using shared transport may not be a viable option for someone without last-mile connection, or to accommodate trip-chaining behaviour. **An activity-based model developed using multisource data provides a more realistic view of travel patterns** by recognizing chains of trips, the interrelated nature of multistop trips and the influence of factors such as time of day on activities and hence, on trip scheduling. Data sources may include: 1) the travel patterns collected through the ridesourcing app; 2) data collected through surveys; and 3) other information on travel patterns and parking accessibility of participants. Such models can also provide greater insights into viable alternatives and effective incentive structures to motivate people to adopt shared mobility solutions.

Case study: 900 healthcare workers crossing an international border to get to work

Over the second half of the 20th century and the beginning of the 21st, Henry Ford Health System (HFHS) has bucked the prevailing trend for major companies in Metropolitan Detroit by retaining a major presence within the city proper. This commitment to the city speaks to the organization's mission, legacy and vision for the future. From a spatial perspective, however, Henry Ford's Detroit presence has entrenched a difficult dynamic in which single-occupancy vehicle commuting over long distances is the norm, and space and the operational needs of the car dominate land-use decisions and consume outsized resources.

At Henry Ford Hospital, free parking has historically been provided to all employees as an enticement, to avoid the perception of imposing a "penalty" on Detroit workers, who are also subject to a city income tax. Parking facilities are a mix of ageing structures on campus, and ground-level car parks on both owned and leased land within a mile of the campus. Employees assigned to car parks located more than a couple of city blocks from their job location are generally provided with shuttle access on a fixed route. Assignments are based primarily on tenure, with some employees needing more than 15 years of experience before gaining the opportunity to park on campus.

The commuting and parking situations create tangible dissatisfaction among many groups of employees. The discontent associated with long commutes, traffic backups, waiting times for shuttles and constant parking-space reassignments is not limited to mere grumbling: There are real costs created by a crisis in transport, including decreased job attendance and negative effects on retention.

Through all this, the hospital has made little progress on promoting "alternative" commuting modes, beset by the issues of a region with minimal investment in mass public transport that remains neither reliable nor popular. It has been historically difficult to ascertain how many employees arrive by bus, carpool or bike, and at what frequency. The pilot group therefore created a workstream to explore a vision incorporating new mobility technologies with incremental improvements. The idea was to launch a commuting solution using shared mobility technologies, eventually incorporating autonomous vehicles to help commuters cross the border more efficiently.

The first major output of the workstream was focus-group work with HFHS job seekers who reside in the Windsor area. The findings were unequivocal: There is high interest and minimal trepidation about using an employer-sponsored autonomous shuttle on a regular basis. From these findings, the hospital derived its first potential pool of employees to serve as a test case for the deployment of the project: Canadian nurses, whose shift-based schedules might make them more amenable to shared transport.

However, anecdotal responses to the possibility were more hesitant: "Commuting from Windsor, Ontario, to Detroit, Michigan, on a day-to-day basis may be a puzzling concept for some. However, in the Windsor Detroit Region, it is a very normal experience," an HFHS Canadian employee explained. "The commute is relatively easy once you have procured the right tools to expedite the process […] There can be a wait entering the US depending on traffic, threat levels and holidays, but […] the Nexus program also allows commuters to use dedicated lanes at the US port of entry where commuters are processed faster." On good days, the commute takes 20 minutes. However, what frustrates many cross-border commuters is the unpredictability of wait times at the border. Employees have to build extra time into their commute because of the uncertainty of the wait times at the two border crossings between Windsor and Detroit.

The benefits of commuting in one's own vehicle include a special rewards programme from the Ambassador Bridge Company, with discounted prices on tolls, petrol and items at the duty free. Similar incentives are also available at the Detroit-Windsor Tunnel. While the pilot team dismissed them initially, they hold value for commuters. Interestingly, the greatest pain points for the commute are not focused on crossing the bridge, but on the last mile. Employees are required to park at a significant distance from their building, which can be particularly problematic during the extreme weather the region is known to experience. When asked individually about the motivation to use a shared mobility solution, employees stressed the possibility of being dropped off at their building and bypassing the long walk from their parking spot – a different result from what the pilot group had expected.

This case study illustrates well many of the challenges highlighted in this report:

– Decision-makers make **assumptions** about the needs of their constituents

– Targeting the right source of **funding** early is critical. In this case study, ample funding was available for a cross-border autonomous vehicle solution, but the pilot team ended up leaning towards a more incremental solution. Pilots need to match the needs of constituents rather than the available funds

– Modern movement patterns are **difficult to reconcile** with new technologies, including last-mile challenges and behaviour such as trip chaining

– Despite having the only binational public transit system in North America, many cross-border commuters maintain a preference for car-centric solutions, and this **behaviour is not easily changed**

It also illustrates the only way forward:

– **Engage in deep and honest conversations with your constituents, and be ready for the answers**

– **Do not treat technology, or mobility, as an end but as a means**

– **Focus on the motivations to change behaviour**

Motown in 2020

There is poetry in the decision of the World Economic Forum to pilot the SIMSystem project, a foray into the digitization of mobility systems and the future of infrastructure development, in Motown, the city that used to be emblematic of transport innovation. Detroit and its region was built for cars and remains radically car-centric. Yet, as seen earlier in this report, this car-centricity is no longer adapted to the socioeconomic development goals of the local government or the needs of its residents. Still, the city's economic renaissance presents unique advantages, such as an energized ecosystem and strong external support.

Perhaps this is why the mission of Mark de la Vergne's team at the City of Detroit focuses so deliberately on individuals' experiences: "Making it easier for people to get around Detroit by collaboratively ideating, piloting, operationalizing and funding effective transit solutions to improve transit access and experience." The city has launched a wide variety of initiatives towards this mission, some of which have been described earlier. ConnectTen enabled unified

fare payment in September 2019 across DDOT, and the SMART, FAST and QLine mobility solutions. A pilot scheme in a partnership with Lyft solving last-mile challenges for late-night Woodward line customers was expanded when residents requested it.

Beyond these foundation-building initiatives, the city is also harnessing the power of data to strategically integrate new technologies, such as scooters, resulting in high ridership.

The region's ambitions do not stop there. In September 2019, US senators Gary Peters and Debbie Stabenow, with US Representative Debbie Dingell, announced that a $7.5 million grant from the US Department of Transportation would go to the City of Detroit, the University of Michigan's M City and the American Center for Mobility. These funds will be used to develop programmes that use autonomous vehicles to address urban mobility issues, and to test autonomous technologies at Southeast Michigan's world-class facilities.

Figure 14: Ad for DDOT

Figure 15: City of Detroit: Total scooter rides vs. month
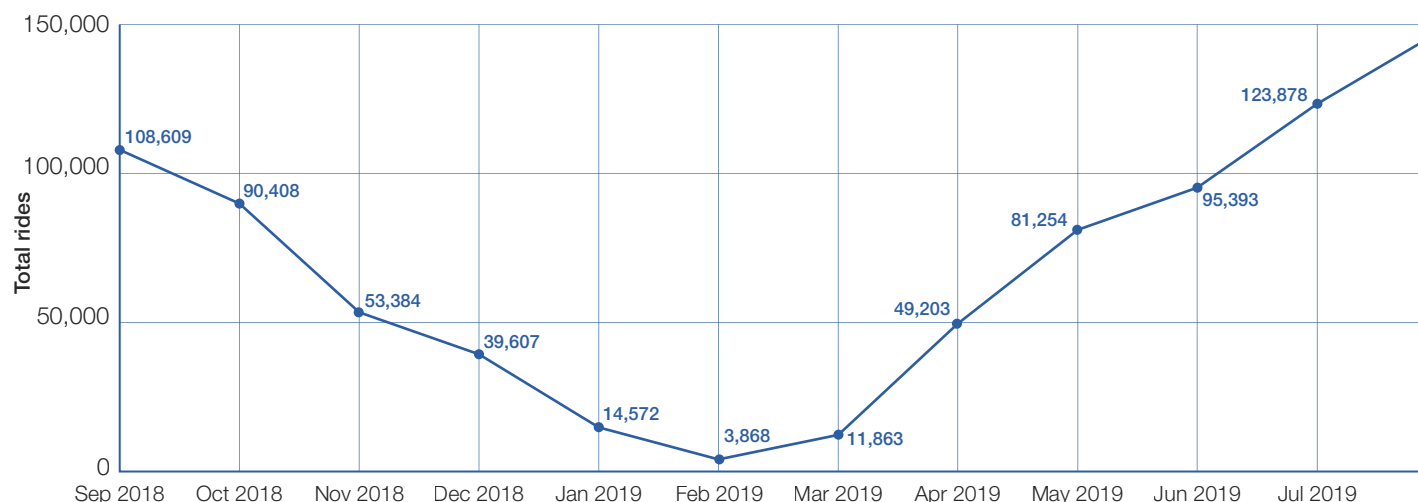
On the global scale

The current transformation of the transport sector, including the rapid growth of new mobility in cities, is shining a spotlight on urgent questions about equity of access, the allocation of public space and the purpose of transport. At the same time, the transport sector's growing share of greenhouse gas (GHG) emissions during a time of widespread concern about the climate crisis calls for a fundamental re-examination of our existing transport systems. The decisions made today in response to these dual challenges will shape our transport and mobility systems for years to come. We are thus faced with both an unprecedented opportunity and an urgent need for cities such as Detroit to ensure affordable, safe and healthy mobility options for people of all ages, means, races and abilities, while reducing transport's climate impact.

There are many cities like Detroit with limited human, financial and technical resources. Like Detroit, they are supported in part by their ecosystem, and depend on multistakeholder engagement in a world that is in a permanent state of transformation and in which roles are ambiguous. Also like Detroit, they are exposed to intense socioeconomic pressure. Mid-sized cities will bear the brunt of urbanization in the next 10 to 30 years. They face the impossible challenge of becoming ever more attractive to talent and businesses, to a diverse society and culture, while fixing inequalities and healing the planet.

Pilots such as the World Economic Forum's Seamless Integrated System hold a simple message to these environments: **Data might not be the end, but it is certainly a means.** Integrating disparate modes and technologies with single platforms, provides a groundbreaking opportunity for strategic, cross-sectoral decision-making. By providing objective, achievable insights, it highlights blind spots and lets vulnerable populations come out of the dark. And because of its infinite power, it rallies, it brings stakeholders together from all sectors, all regions, all industries, in newly found common goals. It is up to the readers of this report, the Detroits of the world, to come together and share effective techniques, questions, ideas, mistakes and winning strategies to harness the true potential of the Fourth Industrial Revolution.

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