CLOSUP Student Working Paper Series
Number 42

December 2018

Autonomous Vehicle Development in Michigan

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This paper is available online at http://closup.umich.edu

Papers in the CLOSUP Student Working Paper Series are written by students at the University of Michigan.
This paper was submitted as part of the Fall 2018 course *PubPol 475-750 Michigan Politics and Policy*,
that is part of the CLOSUP in the Classroom Initiative.

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December 10, 2018
Public Policy 475

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1. Executive Summary

Autonomous vehicles (AVs) are the transportation of the future, promising mobility like the world has never seen. The development of this technology is still underway, and a finished product is years-to-decades away. Michigan should fight to be the leader of AV development. With an economy centered around the automotive industry, the state stands a lot to gain, as well as a lot to lose, when the AV technology sector finally settles down. Current attempts to attract AV development focus on the regulatory field, but with more and more state competition, Michigan needs to focus on other improvements that can transform the state into a haven for autonomous technology. While there are endless options for economic development policies, it would be in Michigan's best interest at the state level to continue utilizing public testing facilities and focusing on workforce development. Perhaps more importantly, though, local governments must prepare for the new, advanced fleet of vehicles through infrastructure improvements.

2. Background and Introduction

2.1 What are autonomous vehicles?

Michigan is the home of the automobile. At the turn of the twentieth century, the automotive industry created a booming economy and an industrial cluster on the cutting edge of innovation – changing the way people live their lives across the world. Since the 1913 mass-production of the Model-T, the Michigan economy has seen ups and downs, currently stagnating

in a post-Great-Recession world (History.com, 2018). The industry's hope for salvation is in developing the automotive technology of the future: autonomous vehicles.

Autonomous vehicles, often referred to as self-driving vehicles, are automobiles that have the capacity to operate without a driver. These vehicles, not yet perfected nor commercialized, would be able to drive people around utilizing cameras, short- and long-range radars, and a connectivity system that speaks vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I). As shown in Figure 1, the connectivity aspect will rely on the Internet of Things (IoT) to communicate between vehicles and infrastructure, requiring built-in systems within each vehicle and throughout roadways with the capability to detect and communicate.

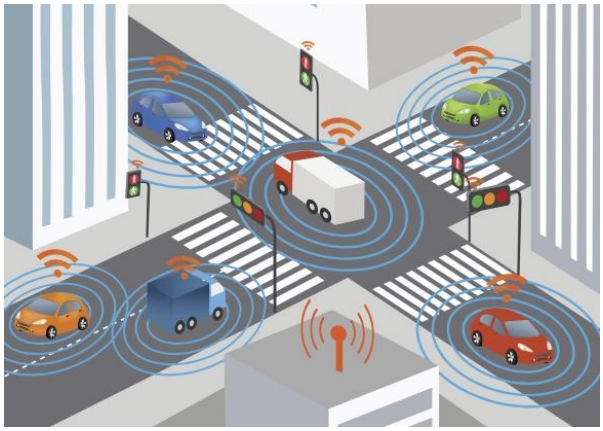

Figure 1: V2V and V2I
Source: https://www.geotab.com/blog/connected-vehicle-technology/

The main benefits of autonomous vehicles are thought to be safety, improved quality of life for individuals with mobility issues, and decreases in congestion. In terms of safety, it is estimated that 94% of traffic accidents are due to human error (Schaper, 2016). Without human error in the driving equation, the number of traffic accidents and deaths would decrease greatly. To quote Bert Kaufman, an executive at the AV developer Zoox, "Autonomous vehicles will never be drunk, distracted, or drowsy" (Reinicke, 2018). Additionally, the quality of life for those unable to drive would improve, especially in regions like Michigan that rely so heavily on vehicles to get around. AVs could "drive" the elderly out of isolation and to the doctor's office or a family member's home. Lastly, is congestion. It is estimated Americans spend millions of hours, equating to hundreds of billions of dollars in lost productivity from sitting in traffic each

year (Schneider, 2018). The fleet of autonomous vehicles would be able to communicate with each other to speed up traffic and create ridesharing opportunities to decrease the number of vehicles on the road.

Most new vehicles on the market already have some level of automation, most often measured by the Society of Automotive Engineers' (SAEs) "levels of automation." As shown in Figure 2, the SAE scale ranges from zero to five – zero has no automation, the first and second levels have minimal automation with the driver still mostly in control, the third level requires a driver for supervision, the fourth level needs no driver under the vehicle's operational domain, and the fifth and highest level requires no driver under any circumstances. The vehicles currently in production have adaptive driver assistance systems (ADAS) considered level one or two, leaving a lot of room for development.

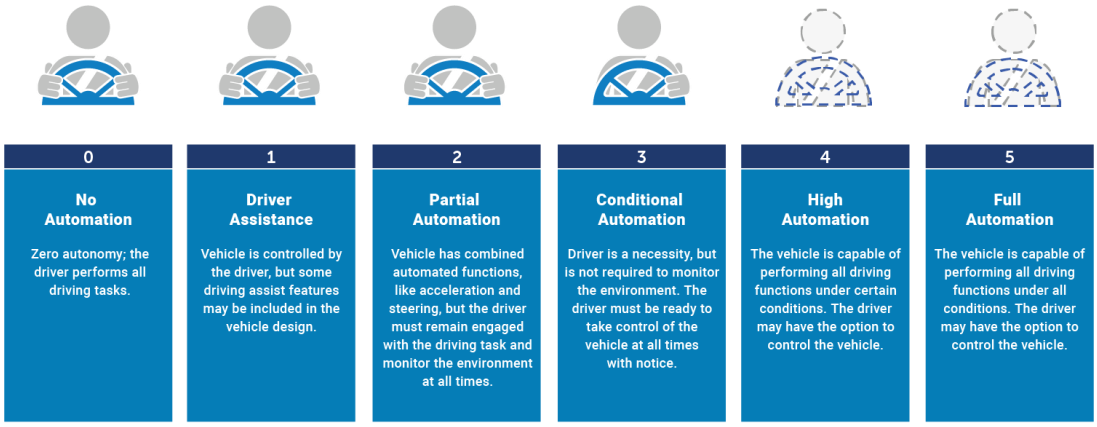

Figure 2: Levels of Automation
Source: National Highway Traffic Safety Administration

2.2 What does AV development have to offer?

It is the level four and five vehicles that will change the entire automotive industry, and the region where their development takes place can count on numerous economic benefits, as with any new business. States and individual communities will benefit from increased corporate income tax revenue and a larger property tax base. Local businesses will likely see an increase

in sales. New businesses also commonly hire local labor from the community, sharing economic prosperity with the individual residents as well.

Although initially there will be some job loss due to automation replacing traditionally human-performed services, further along in development and deployment, the opportunities take off. Specific to the automotive-technology industry, 9.5 million people nationwide are currently in the digital mobility market, and that number is expected to grow (Kane and Tomer, 2018). The online recruiting platform ZipRecruiter saw job postings for autonomous driving occupations rise 27% from 2017 to 2018 (Reinicke, 2018). However, with the creation of these jobs and the development of self-driving vehicles, there will be simultaneous displacement in the ride-hailing and trucking industries. The decreased demand for drivers will inevitably stem directly from the commercialization of autonomous technologies. These jobs can be made up for on the state level through new mobility jobs related to technology, but this pivot will require a certain degree of retraining.

Fortunately, once an industry like the automotive tech industry is settled in one region, it is a relatively immobile business. The nature of AV testing requires numerous testing facilities, research centers, and vehicles. Despite the mobility of computing, the technology itself is large, heavy, and impractical to move around the country. As commercialization nears, manufacturing will add additional locational stability, because production plants will require vast amounts of capital and be nearly impossible to relocate. The immobility in the product forces any economic benefits from the industry to be long-lasting – extending as far out as the lifespan of the company.

2.3 What does Michigan have to lose?

While the state stands a lot to gain if the automotive technology industry fully locates in the Michigan, its heavy reliance on the automotive sector puts the state at risk of losing a lot if the future of automotive migrates elsewhere. According to a Brookings Institute study, approximately 4.5 percent of jobs in the United States are supported by the "strong presence of the auto industry" in in the U.S. (Kane and Tomer). Compare that national 4.5% to the 20% of Michigan workers directly participating in the automotive industry (Northwood University, 2017). The state is home to more than 2,200 facilities with the purpose of automotive research and design, including 96 of the top 100 auto suppliers in the country (Detroit Regional Chamber, n.d.).

There is no doubt that Michigan is an auto state, bit its continued status in the industry shouldn't be taken for granted. Given the relative immobility and tremendous regional benefits of the automotive tech industry, Michigan stands to lose a great deal if AV development is not located in the state. Without the automotive industry, there is a huge loss in jobs and possibly a huge loss in residents. Even in the early stages of autonomous tech development, Michigan has been losing its foothold. States like California, Arizona, and South Carolina have seen huge increases in investment and testing. Broken down by state, Michigan is in the middle of the pack for employees in the digital mobility industry, seemingly odd for such an auto-centered state (Kane and Tomer). The major OEMs like General Motors and Ford have announced new facilities in New York, California, and other states, with much of the testing that requires computing and IT now being done offsite, away from their Michigan headquarters (Dennehy, 2017).

Workers will be directly affected by industry losses anywhere in the country, but the lack of action to keep and attract the automotive technology industry in Michigan will hurt everyone in the state. The large OEMs and supply base provide tax dollars to keep state and local governments going. They invest in the communities around them through various charities. They partner with local university bodies, like the University of Michigan's Transportation Research Institute. The automakers bring in all of the economic prosperity that any large, successful corporation brings to a region, with the amplifying benefit of longstanding community ties.

3. Regulatory Changes

Every level of government can shape the technological landscape in the development stages of AV technology – from a local city or township to the federal government. Recent talk has been largely focused on laws and regulations regarding autonomous vehicles, both restrictive and unrestrictive. The attention to regulations thus far has partially distracted from other steps that can be taken to encourage and attract AV development, such as infrastructure and workforce improvements, but the regulatory environment is nevertheless vital to technological innovation.

3.1 National AV Policy

The widely held notion that industry – not just autos – doesn't like regulation is a misconception. Regulations and restrictions are often seen as anti-business, but this is not the case with a playing field as broad as AVs. OEMs need a certain amount of guidance and consistency in order to properly test and develop a useful, commercializable product. They need legislation to determine who will be at fault in case of an accident, guidance regarding how to teach the computer "drivers" to make decisions when faced with tough choices on the roadways, and the list goes on. With a patchwork of laws across states and localities, it can be a difficult

terrain to navigate, particularly for a product littered with unknowns. Smart, data-driven regulations are, in fact, desired.

Despite this desire, there has been a considerable amount of gridlock in Congress on the topic of autonomous vehicle legislation. The House of Representatives passed the SELF DRIVE Act in 2017, with no hope of getting the bill through the Senate. Instead, the upper chamber created its own legislation with more considerations, from cybersecurity to built-in evaluations. This act, titled the AV Start Act, received input from the auto manufacturers and other stakeholders, and is considered much more comprehensive. Discussion continues to focus on passing the act before the next Congress, with a majority-Democratic House of Representatives, takes office. No real progress has been made, and the regulatory bodies, such as the National Highway Traffic Safety Administration, have deflected to Congress for a decision. In turn, Congress has openly passed the buck on decision-making and policy testing to the states.

3.2 Michigan AV Policy

For the most part, the state government in Michigan has seized the opportunities afforded by the Commerce Clause to create a useful set of AV laws and regulations. Michigan can take advantage of Congress' inaction to differentiate itself. The state has been on the cutting edge of policymaking – the national government has looked to Michigan, in addition to a few other states, as a model for their own blanket policies. "NHTSA is very interested in what we're doing. [The federal government] is tackling some of these same issues we've been dealing with the past year," said Kirk Steudle, the director of the Michigan Department of Transportation (2018). Additionally, our US Senators have taken the lead on crafting legislation in Washington, D.C., with Michigan Senators Peters and Stabenow acting as two original co-sponsors of the bill.

In order to create a sort of regulatory haven, the state began lawmaking in 2013 and made significant improvements in 2016. The 2016 changes created a council focused on mobility, allowed for automated semis to travel in very close proximity (platooning), increased the number of test vehicles allowed, clearly stated the responsibility of manufacturers in an accident, and allowed for an on-demand driving system like we see with ridesharing ventures today (Bhuiyan, 2016). Each of these are geared at incentivizing OEMs to develop the technology in Michigan by making a clearer path to commercialization, and in the end, profitability.

Other states have also taken advantage of the federal government's lack of action. California, for instance, has created a comprehensive set of regulations and has seen a lot of testing done in the state, partially due to addressing the AV issue and partially due to the location of the tech industrial cluster located in Silicon Valley (Wakabaya, 2018). Arizona, on the other hand, has pointedly chosen to stay out of creating a regulatory framework, with the belief that this approach will actually be more likely to attract AV development. The state has avoided making any assumptions about what the technology will become, and thus, has left the playing field open for developers (Kang, 2017). In March of 2018, Arizona added requirements surrounding test-vehicle registration, but this did nothing to prevent the deadly AV crash the state saw later that month.

Given that Michigan has similar or "better" policies in place to benefit OEMs, the increases in testing and development in other states cannot be linked directly to Michigan's lack of policymaking. One factor that could encourage testing elsewhere is proximity to businesses and suppliers that offer the benefits of industrial clustering. It used to be that Michigan had the advantage in terms of proximity to industry, but with the increased need for artificial intelligence

and computing, IT hubs like California are gaining advantage over Michigan's manufacturing prowess.

3.3 Local Policymaking

Formal local governments, such as cities, counties, townships, and villages, have not had a large role to play in the regulatory environment. As the conversation around AVs has been almost entirely policy-focused, these smaller governing bodies have been largely overlooked. In some instances, though, additional regional "governments" have been created and have taken it upon themselves to encourage AV development. Michigan, for instance, has a Regional Transit Authority of Southeast Michigan that has created plans and opportunities for increased testing.

4. Beyond Regulations

With the national focus on regulations, Michigan has the opportunity to make additional policy advancement through more unique economic development methods – not unique to economic development policy, but unique to the issue of attracting autonomous vehicle development.

4.1 State and Local Tax Incentives

A common initiative to attract business is to offer a tax incentive for locating in a state or region. These could come in the form of corporate income taxes on the state level or property tax exemptions on the local level. A prime, and very public, example of this was the recent battle for Amazon's HQ2 facility. The Amazon corporation elicited bids from each city interested in housing the second headquarters for the company. Cities, seeing the economic promise the facility would likely bring, offered tax breaks and subsidies in their bids (O'Sullivan and McGuire, 2018). It created a sort of "race to the bottom," with each city competing to bid lower

taxes than the next, thereby undermining a huge portion of the benefit offered by the Amazon location in the first place.

The case of Amazon is not abnormal, with the exception that the bidding was heavily publicized. Michigan should hesitate before committing to this sort of economic development policy. It might bring in facilities, but it also might not be worth losing out on the tax revenue Michigan so desperately needs. The same mistake has been made in the past with the film industry, not just in Michigan but around the country (Thom, 2015). These types of incentives are increasingly unpopular and should not be recommended for Michigan.

4.2 Public Facilities

Another draw for developers is a "public-use" testing facility. Creating test tracks, especially with the advanced technology the V2I will require, is extremely costly. Many new entrants into the field are start-ups or small businesses with innovative components or computing. The creation of an individual facility for each of these companies is not feasible from an economies-of-scale standpoint. Instead, localities, regions, or states should create one or more testing facility to draw businesses through the tangible asset.

Fortunately, Michigan is ahead of the curve in its testing facilities, and it needs to make a point of keeping up with the needs of the auto tech sector. Through the University of Michigan, developers can partner with the university to utilize MCity, the Transportation Research Institute's testing center for autonomous vehicles. Additionally, the American Center for Mobility – an initiative with partners from industry, the Michigan Department of Transportation, and local universities – offers a testing facility that can be leased to companies for testing and design. Both of these locations in Southeast Michigan point to the work being done by the business sector and the state to attract and keep AV business.

4.3 Workforce Training

As Michigan recovers from the economic downturn and population loss that it saw over the 2000's, there is concern that the workforce will not be ready for the increased demands AVs will add. This problem surfaced in the bidding for Amazon's HQ2 when stakeholders voiced concern over Detroit's inability to provide the skilled, white-collared workers necessary to fill the new location. In recent years Michigan has experienced a particularly large amount of "brain-drain," training workers in the state only to have them move elsewhere (Livengood, 2017).

In an attempt to keep the workforce prepared for new opportunities, Michigan Governor Rick Snyder recently announced his Marshal Plan for Talent to reinvest in Michigan workforce training, particularly in the STEM fields. Unfortunately, there has been speculation that this plan does not do enough to train the Michigan workforce and does not fully address the drain of talented workers from the state (Gallagher, 2018). Due to its network of public universities, the state is best suited to handle the problem in Michigan, but it may need to do more than Governor Snyder proposes. Michigan should improve its workforce development program to propel the education of workers specifically for the automotive technology sector and work towards keeping these highly-skilled workers from taking their talents elsewhere – in doing so, the state will become a welcoming environment for businesses focused on developing AV technologies.

4.4 State and Local Infrastructure Improvements and Planning

The biggest improvement Michigan must make to set the state apart from others, or just to stay in the game, is to improve its infrastructure in a deliberate way. In order to operate fully, level 3 and higher vehicles will require complete infrastructure connectivity, at least within their operational design domain, or the area in which they have complete autonomous capabilities. Michigan, or even just the Southeast region, can become that operational design domain.

Michigan's most recent infrastructure report card gave the state a D- on roadway infrastructure (American Society of Civil Engineers, 2018). The roads and bridges are in disrepair, and this has become an important issue to residents. The 2019 governor elect, Gretchen Whitmer, even ran much of her campaign on her commitment to "fix the damn roads." This disheartening problem also provides an opportunity that states with recent improvements might not have. Because the majority of Michigan's roads must be updated, the state can take advantage of the overhaul to upgrade them all to work together with the future of mobility.

While this can start as a statewide push from Lansing, it is necessary for execution to be at the local level. In Michigan, local governments own and take care of all local roads in their jurisdictions. Through levied taxes, these governments make new roads and perform upkeep on the existing structures in addition to daily maintenance like snow plowing. As the owners of 92% of roads in Michigan, cities, villages, and counties are in a critical position when it comes to infrastructure upgrades (Taylor, 2007). Localities now play in an unanticipatedly large role in the development and deployment of autonomous vehicles.

Despite their increasing role, local governments do not recognize infrastructure as a problem to technological development. In the Michigan Public Policy survey of all local officials in Michigan in 2014, only 24% of local officials who answered the question felt that poor infrastructure was an obstacle to entrepreneurship in the community. Moreover, only 22% felt the lack of IT infrastructure to be an obstacle (see figure 3). While the date of the survey might make this a conservative estimate, the lack of future planning is a major concern. Local governments need to acknowledge that the technology is coming and address it through their development plans, particularly roadway development.

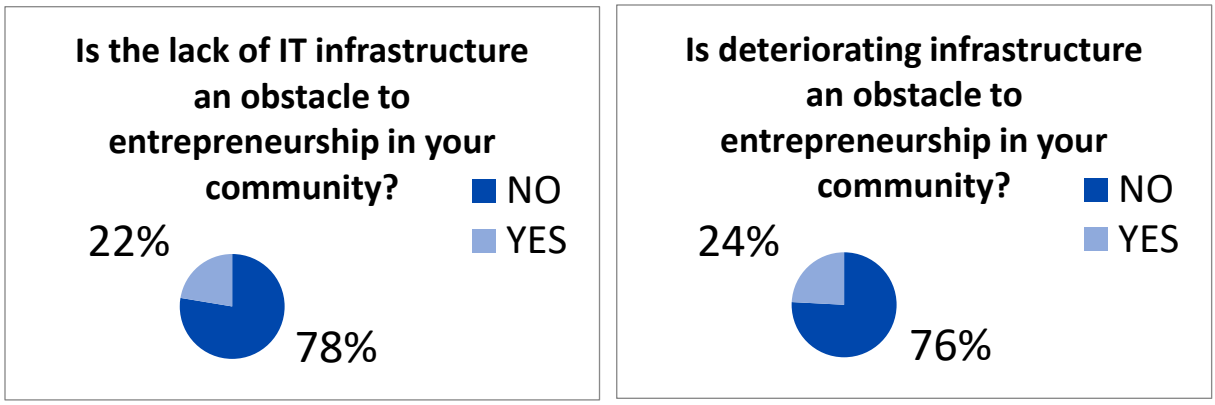

Figure 3: MPPS Data

Source: Center for Local, State, and Urban Policy. "Michigan Public Policy Survey," Spring 2013. Non-response answers were excluded.

It becomes difficult to know exactly what planning should be implemented to cater to the still relatively unknown technology of AVs, but developers offer a few recommendations to both encourage development and maximize community benefits. To make AV development and deployment easier, localities can implement clearer street marking that are easily readable by vehicles. In California, for instance, much of the state is removing their raised lane markers and replacing the lines with a brighter paint (Bizjak, 2017). Other suggestions include expanding the connectivity in street lights or increasing lane size (Oliver, Potocnik, Calvard, 2018).

In terms of realized benefits to the community, a recent Politico report argues that parking will be the first of the surface transportation infrastructure to see significant effects from autonomous vehicles entering the market. Urban lots are particularly at risk due to the ride sharing model that many believe will arise following AV commercialization. Planners should therefore design infrastructure in cities that can be repurposed in the years to come when there is less demand for parking (Mintz, 2018).

The question that comes along with any government spending is the price tag. Local governments in Michigan are already strapped for cash and the state is not much better off. Improvements to infrastructure most similar to traditional improvements, like line-painting or

more consistent traffic signs, will cost a similar amount to what the government has already budgeted for – with or without AVs lines will need painting and signs replacing. The more advanced improvements to roadway infrastructure required by V2I connectivity will come at a much higher cost. Estimates for roadside communication sites with the capability of connecting to each vehicle within its 400-meter range are estimated at upwards of $51,650 per site (see figure 4). At a relatively steep price, focus should be on implementation in the automotive development region in Southeast Michigan, working outwards.

Table 1: Total Potential Average, Non-Recurring Costs of Connected Vehicle Infrastructure per Site

Cost element	Average cost
Planning and design average costs	$6,650
Equipment average costs	$7,450
Installation average costs	$3,550
Backhaul average costs	$30,800
Signal controller upgrades average costs	$3,200
Total potential average costs per site	**$51,650**

Source: American Association of State Highway and Transportation Officials and DOT, | GAO-15-775
Note: "Per site" refers to each specific location where a roadside unit is deployed.

Figure 4: V2I Infrastructure Costs
Source: U.S. Government Accountability Office, 2015.

5. Conclusion

The automotive industry is embedded in the Michigan culture – without it, the state would have both an economic and an identity crisis. Michigan needs to take additional action to fight for the development of AVs. While the state is doing well in its competitiveness on the regulatory front and with the implementation of public testing facilities, there are still other improvements that could use policymaker's attention. It is advisable to avoid utilizing tax breaks as an incentive for business, but instead Michigan can focus on state-level workforce training plans. Policies for the local level, and perhaps the most differentiating for the state, should focus on improving infrastructure with the capacity to incorporate connectivity technology, if not now,

then in the future. Michigan cannot take its automotive cluster for granted and needs to take important steps to differentiate itself from the rest of the regions considered by the automotive technology sector. Changes to the way people get around are coming, and Michigan should fight for those changes to happen here.

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