



COVID-19 and the Future of Transportation

Nine factors to consider for a more resilient, sustainable, and socially equitable transportation system

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Introduction

Transportation was in a transition phase before COVID-19 — we had started moving toward electrification, connected transportation, shared mobility, and the beginning phases of autonomous vehicles. The global outbreak of COVID-19 has resulted in several modes of transportation practically coming to a standstill, with significant impacts on all aspects of transportation. As we live through this crisis, our transportation networks and systems began to look very different: very few cars on the road, empty lines at airports, clean air, very little noise, etc. The major questions now are: how will transportation be different in the future, and what are the main research questions as a result of these changes?

This is an ideal opportunity for the public sector, private sector, and academia to take a step back, work together, and figure out how transportation will come back after the pandemic and how we can start planning for a resilient, sustainable and equitable transportation system for the future. The outbreak of COVID-19 forces us to think differently about the future of transportation and provides us with some breathing room to do this thinking. We have identified nine considerations about where transportation will have an impact and where transportation will be impacted as a result of the outbreak of COVID-19. We also discuss possible research questions under each of the nine areas.

1. Spreading of Disease

Our interconnected world, linked by transportation networks, plays a major role in the spread of a pandemic such as COVID-19. The virus originated in a single community, but due to the global nature of transportation, it spread to other parts of the world, where it impacted local communities. And the cycle repeated, many times over. In the context of disease spread, transportation can be viewed as a “disease vector” because it can spread diseases through at least the following three mechanisms:

- Infected people and goods travel to other locations and can spread the disease when they reach their destinations.

- People congregate in groups and at higher densities when using public transportation, making it more likely that infected people can infect their fellow passengers.
- The surfaces in public transportation and shared vehicles can become infected through contact by infected people, potentially infecting others who touch the same surfaces.

Research questions:

- What is transportation's role in the spread of a pandemic such as COVID-19?
- How can we model the spread of a pandemic and evaluate the effectiveness of a range of mitigating options and policies?
- What is the effectiveness of cleaning products and various surfaces to reduce pathogens?
- What behavioral and structural changes can be made to passenger interactions while in transit to reduce the spread of disease?

2. Economic Implications

The world has taken drastic actions to curtail the spread of COVID-19. These actions, however, have other far-reaching consequences, including direct economic impacts. Apart from a large portion of the population not being able to work, the complete imploding of travel during the pandemic and possible reductions after the pandemic have many long-term economic implications. One example is large reductions in revenue generated through fuel tax and sales tax. This exacerbates the issues transportation agencies already face due to the move to more fuel-efficient vehicles including hybridization and electrification. Reduced travel will also result in a reduction in paid parking, tolls, fines, and other revenue-generating sources. Some state departments of transportation have already reported significant drops in their state highway or transportation funds. Therefore, considerably less funding will be available for new transportation projects, maintenance of the transportation system, and public transportation services. The falling oil price has many economic impacts including the loss of jobs and can also have a negative impact on the adoption of more fuel-efficient vehicles such as hybrids and fully electric vehicles.

The following transportation-related industries are struggling severely during COVID-19: airlines and airports, aircraft manufacturers, car manufacturers and dealerships, cruise lines, public transit, and private for-hire vehicles (taxis, Uber, Lyft, etc.). Seaports and the trucking industry seem to remain robust during these times.

Research questions:

- What are the possible impacts on transportation revenue, and what other revenue-generating options can be identified?
- Is there a better way to charge and pay for transportation infrastructure and services? How can we include the true cost of traveling and moving goods, including the effect of negative externalities?
- What is the impact of the falling oil price on transportation in general, and what are the possible negative impacts on the adoption of more fuel-efficient vehicles such as hybrids and fully electric vehicles?
- What types of transportation industries remain robust during a pandemic, and what types do not? How can vulnerable transportation industries be made more viable during such times?

3. Travel Demand and Related Impacts

There will likely be a lasting shift in work culture. People whose work mostly involves the use of a phone, computer and internet connection don't necessarily need to go to the office every day. Some businesses may decide to permanently have their employees work from home to save on real estate costs. There will therefore likely be a large shift to allow more staff to work from home. That will free up considerable commute hours (vehicle miles of travel), which in turn will reduce congestion, traffic crashes, vehicle emissions, noise, and several other transportation-related negative externalities.

One clear example during the COVID-19 outbreak is the dramatic improvement in air quality due to the significant drop in travel. If these reduced levels remain, we will see significant health benefits. In addition to well-studied and documented health benefits due to improved air quality, new research shows that there is a strong correlation between fine particulate matter (PM 2.5) levels and COVID-19 death rates. The higher death rates are due to preexisting respiratory conditions prevalent in areas with high PM 2.5 levels. This will make us think differently about air quality during a pandemic and beyond. Another important trend is the huge reduction in traffic crashes and associated fatalities. However, fatalities still happen due to increased speeding during low-traffic conditions with a few states even showing an increase in traffic-related fatalities.

Research questions:

- To what extent will telecommuting now be the norm, and what will be the resulting impact on travel?
- How will travel demand change by mode in the short, medium, and long term?
- What will be the impact of reduced travel on issues such as traffic safety, vehicle emissions, congestion, road maintenance, noise, public health, etc.?
- Will society look differently at issues such as air quality, vehicle crashes, noise, etc.?

4. Modal Choices

During the COVID-19 outbreak, people are afraid of public transportation and sharing rides with others. In addition, social distancing guidance prevents people from using transit or sharing rides. Data show that public transportation ridership has decreased by around 90 percent during COVID-19. The dramatic drop in public transportation ridership will significantly impact the ability of transit agencies to fund their services. These agencies will also have to spend more resources on making sure that their services are clean and disinfected. They will have to develop policies and rules for operations during pandemics to ensure the safety of passengers and operators. This can involve protective clothing and masks for operators, more frequent services to reduce overcrowding, enforcement of the allowable number of people per vehicle, implementation of rules about where people may sit, etc. It is unclear if transit usage levels will return to pre-COVID-19 levels once restrictions are lifted.

The future of micromobility (electric bicycles, electric scooters, etc.) is also unclear. People will likely be reluctant to use shared micromobility due to the possibility of diseases being spread by this mode of transportation. On the other hand, sales of these transportation devices for personal use have increased.

Transportation network companies (TNCs) such as Uber and Lyft that provide rides through cellphone apps are also hugely impacted by COVID-19. Like public transportation, these companies are now challenged to keep their drivers and passengers safe. Shared carpool services provided by Uber and Lyft

are now suspended in the United States and Canada. Another mode of transportation that will be severely impacted by COVID-19 is casual carpooling, or *slugging*, where people form a line to be picked up by drivers so they can reach their high-occupancy vehicle requirements. Slugging occurs in cities such as Washington, D.C., San Francisco, and Houston.

There is now an even stronger demand for e-commerce deliveries. People are unable to buy certain products in stores closed due to lockdown, and they also want to avoid close contact with other individuals. All the transportation-related issues of last-mile delivery of e-commerce will likely be magnified due to COVID-19.

Research questions:

- What policies are needed to ensure that public transportation is reliable, affordable, and safe?
- How can public transportation vehicles and facilities be kept free from pathogens to protect operators and passengers?
- How can public transportation operations be changed to reduce the probability of spreading disease?
- What is the impact on vulnerable modes such as micromobility, TNCs, slugging, etc.?
- What are the transportation-related issues due to the growth in e-commerce during a pandemic, and how can these issues be addressed?

5. Land Use and Infrastructure

The conventional land use strategies in support of better transportation — the so-called three Ds of *design* (pedestrian-oriented design), *density* (density of development), and *diversity* (diversification of land uses) — must be looked at differently when considering the impact of a pandemic. Various design aspects need to be looked at differently. For example, sidewalks might have to be designed wider to ensure proper social distancing during a pandemic. Higher densities in major cities make people very vulnerable and cause a faster spread of the disease. Finally, diversity must also be looked at differently because many land uses shut down during a pandemic, whereas critical ones such as grocery stores, pharmacies, and medical facilities remain open to provide for critical needs. It is therefore important to plan land use mixes so that critical ones are strategically located to remain accessible to the general public during pandemics. In addition to land use, transportation infrastructure should be looked at differently so that it will be resilient, sustainable, and socially equitable in the future.

Research questions:

- What transportation infrastructure changes need to be made to make it function effectively during a pandemic?
- What are the true transportation infrastructure needs due to the reduced demand during and after a pandemic?
- How do we need to frame the land use concepts of design, density, and diversity to make transportation function better during and after a pandemic?
- What should a future transportation system look like to make it resilient, sustainable, and socially equitable?

6. Equity and Environmental Justice

The COVID-19 outbreak is not totally dissimilar to previous natural disasters such as major hurricanes. Certain sectors of the population are clearly impacted more severely than others, and equity and environmental justice issues become very apparent during a pandemic such as COVID-19. Vulnerable sectors of society such as the elderly, disabled, and low-income communities are much more vulnerable during a pandemic. Many of these individuals are captive public transportation users, making them much more susceptible to getting and spreading the disease. Reduced and canceled public transportation services during a pandemic make it very difficult for these people to access critical services such as food and health care. Low-paying jobs are often the ones that get cut during a pandemic, making it much more difficult for low-income communities to survive during such times.

These communities also typically do not have the appropriate technology and means to work from home, nor work jobs that can be done from home. The lack of technology also negatively impacts school children in low-income communities because most schools move to a remote teaching model during a pandemic, requiring technologies such as a computer and reliable internet. These communities often struggle to maintain social distancing during a pandemic because of their higher-density living arrangements. Poor air quality areas result in a much higher mortality rate among COVID-19 sufferers, and low-income families disproportionately reside in such areas. The equity implications of these issues must, therefore, be considered and addressed.

Research questions:

- What are the equity and environmental justice issues highlighted during the pandemic?
- What role can transportation play to help address these issues?
- What is the impact of poor air quality on low-income communities during COVID-19, and what role does transportation play in this regard?
- How do we ensure vulnerable sectors of society access to critical services such as food and healthcare?

7. Resiliency and Supply Chains

The concept of transportation resiliency is relevant in dealing with a pandemic such as COVID-19. Resiliency is the ability of a system to react or bounce back from a shock or an impact. Often the desire is for the system to survive the shock and bounce back to its original state. However, in a case like this, the system might have to change to a new normal to be better suited for future pandemics. The resiliency concept ties in with the recommended actions for dealing with a pandemic — containment, response, and recovery. Transportation plays a major role during all these phases. For example, transportation had to be curtailed to help contain the outbreak, but it continues to play a major role in both the response and recovery phases.

COVID-19 has interrupted global supply chains, which has led to reduced inventory production and delivery in many sectors, including critical ones such as medical supplies, cleaning products, and certain foods. At a more local level, supply chain issues have also highlighted concerns with getting food or medical supplies to those in need, redistributing medical supplies and resources as the pandemic severity ebbs and flows in different locations, and transporting medical supplies and personnel to treatment sites.

Research questions:

- What will a resilient transportation system look like?
- What are the critical issues identified with the global supply chains, and how can they be rectified?
- What are the critical issues identified with local supply chains to get food and medical supplies to those in need?
- How can we ensure that critical supplies and personal protective equipment are available and delivered during pandemics?
- How can supply chains be made less vulnerable during pandemics?
- How can furloughed or underutilized transportation assets such as planes, trucks, roadways, and buses be used to respond to and mitigate an ongoing pandemic?
- What roles and responsibilities could the many public transportation agencies, private-sector companies and military transportation resources have in response, mitigation, and recovery?

8. Transportation Innovation

Innovation in transportation has been a hallmark of the last decade – the main innovations include vehicle automation, connected transportation, shared mobility, electrification, and dockless mobility. The driving force behind the innovations has been the private sector that capitalized on the internet, smartphones, and computer technologies, as well as entrepreneurial innovation. The COVID-19 pandemic can change this dynamic by having the public sector emerge as a stronger partner. There will also be a focus on new innovations based on the lessons learned during COVID-19.

A case can also be made from the public-sector perspective to use the limited resources to take care of and improve our existing transportation system before moving too quickly on new innovations. Some examples are better and wider sidewalks and bike lanes, and cleaner and less crowded public transportation systems. However, the need for innovation cannot be underestimated and should not be neglected as part of the solution.

Research questions:

- Do transportation innovations have the same importance to travelers and freight suppliers after the pandemic as before?
- Does a post-pandemic world impact the roles of public agencies and private-sector entrepreneurs in advancing and delivering transportation innovations?
- What will the continued adoption of transportation disruptors (connected transportation, autonomous vehicles, shared use, electrification, etc.) in the new reality look like?
- Are there other (more appropriate) disruptive technologies that should rather be considered during and as a result of pandemics?
- What role can autonomous vehicles play to provide clean and reliable transportation during a pandemic?

9. Public Health and Sustainability

Public health has become a major focus during COVID-19, as has transportation's role in public health. Transportation has many linkages or pathways with public health, such as physical activity, noise, vehicle crashes, and air pollution. Reduced traffic due to COVID-19 has resulted in significant health benefits that can be traced back to the various linkages between health and transportation. However, over many

decades, transportation has caused negative impacts such as poor air quality in certain areas, and people residing in these areas are now much more susceptible to dying from COVID-19. The health impact of transportation during a pandemic is therefore very important and should be studied carefully.

The framework of sustainability rooted in three dimensions or triple bottom line — social, economic, and environmental aspects — is useful to help us make decisions related to a pandemic such as COVID-19. The ideal is to have a win-win situation where we don't have to choose between the economy, the environment, or the quality of our lives (our health in this case). There are many examples in the world where cities developed their transportation systems to allow the economy to thrive, take care of the environment, and address social needs while considering equity. The focus of these systems is more on the people than on the vehicles. As a result, the general health of these populations is significantly enhanced.

Research questions:

- How are the linkages or pathways between health and transportation impacted during and after a pandemic such as COVID-19?
- How can we capitalize on the renewed emphasis on improved air quality and active living?
- How can we use the sustainability framework to develop a decision-making method to equitably address the competing dimensions of the economy, environment, and social needs during a pandemic?
- How can we use the sustainability framework to make decisions about how to invest transportation infrastructure funding so that we don't have to compromise either the economy, the environment, or our social wellbeing (our health)?
- What elements of a people-focused approach should be adopted to improve sustainability and public health during a pandemic?

Conclusion

People and their behaviors will be permanently altered as a result of COVID-19. Transportation, as a result, will also never be the same. How much it will change will not be known for a while. However, this should not stop us from observing trends, projecting and developing scenarios about what is going to happen in the future, and coming up with ways to best prepare ourselves for a better future. This document identifies nine considerations where transportation will have an impact and where transportation will be impacted as a result of the outbreak of COVID-19. We also identify several research questions that need to be answered so that we will not only be able to react but also be better prepared for events like this.

The COVID-19 pandemic, therefore, forces us to be better prepared for future pandemics and gives us the opportunity to design a better (resilient, sustainable, and socially equitable) transportation system. We need to take a broad and strategic look at the lessons learned from COVID-19 and develop appropriate strategies. This should occur in close collaboration between the public and private sectors as well as universities and research institutes. It will require out-of-the-box thinking through scenario planning and other techniques to develop new approaches to the planning, delivery, and operation of the transportation system. We all need to reimagine a future transportation system that will serve us, with or without a pandemic, by focusing on the needs of the people and not only the vehicles.

For Further Information

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