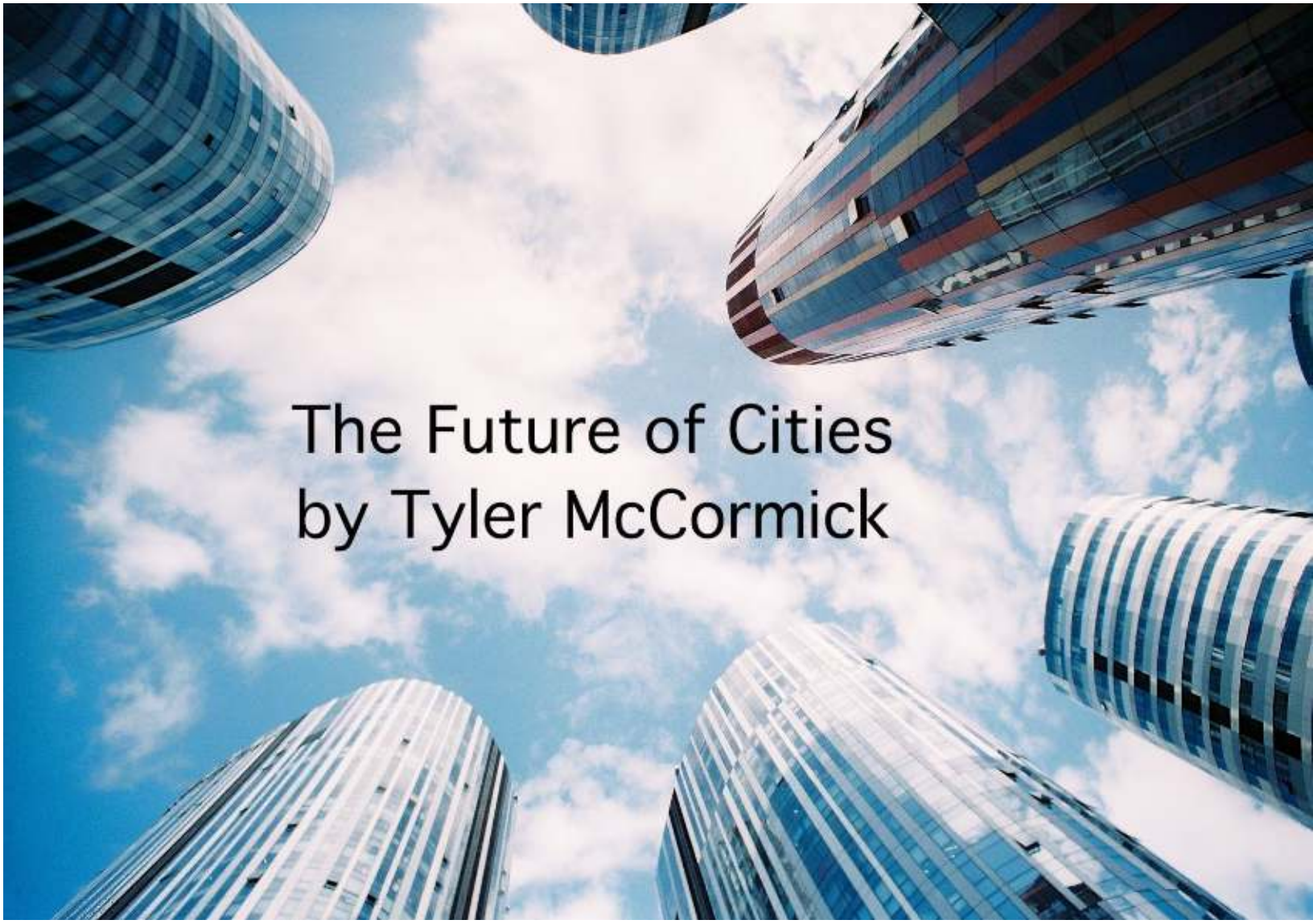

Individual Senior Intensive

May 30, 2020

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Introduction:

The vast majority of American cities have an infrastructure that is a century old and are not meant to support the number of people and cars that are there today. As a result, traffic is worse than ever, many people cannot find affordable housing, and cities have become run down. People in Los Angeles spent an average of 102 hours in traffic in 2016, which cost the city 19 billion dollars based on lost productivity, wasted fuel, increased cost to transport goods through congestion, and other factors (Schneider). One-third of people who live in urban areas worldwide – 1.2 billion people – lack access to safe and secure housing (King). These issues will only get worse as thousands of people move into cities every month. As the population grows and issues like climate change and mobility arise, humans and cities need to become more efficient, sustainable, and purposeful in the way they operate.

So, how can cities become more efficient, sustainable, and purposeful in the way they operate to prepare for the future? To answer this question, I talked to experts and read articles to address four guiding questions. The first question was, what aspects of cities and towns have the most room for improvement? This required trying to understand the problems that cities faced the most and needed to solve. The second question was, what is the biggest barrier to improving a city's technology and infrastructure -- cost, people, or something else? What was preventing cities from solving their most significant problems? It seemed that funding was most likely the biggest barrier to solving some of these issues. However, I wanted to make sure I understood specifically if there were some ways to lighten the hindrance it causes and if there were other things preventing solutions from being implemented. The third question was, what new

technologies and innovations can be implemented to cities and towns to improve efficiency and human lives? I wanted to understand both the complex and simple solutions that could be used by cities and towns across the planet to address their urban issues. There seemed to be many new technologies that could play a huge part in addressing some issues, but are there also some simple things they could do to easily solve some of their problems. If so, why are they not being implemented? The last question was, how have some cities integrated new technology and concepts? I wanted to explore examples of how some cities have addressed urban issues and see if some of their ideas and learnings could be applied by other cities as well. I used these four questions to try to help answer my overarching question, how can cities improve and adapt for the future?

What aspects of cities and towns have the most room for improvement?

One of the most significant issues when it comes to cities is that many are incredibly overcrowded with outdated infrastructure. I-4 in Orlando, for example, was built in the 1960s and was meant to be able to handle 70,000 cars a day. But now it sees up to 200,000 cars every day (Campo-Flores and Overberg). Traffic is so bad in cities and urban areas because the roads and highways that run through them are handling more than double the capacity they were meant to support. Orlando had a population of 200,000 when I-4 was first built, but it now has a population of over 2.5 million people, with 75 million tourists each year (Campo-Flores and Overberg). Fixing and updating these roads can be extremely costly and disruptive. Around 175

billion dollars was spent in 2016 on highways and roads across the US, according to the Urban Institute. In addition to the massive costs that it takes to fix roads, doing construction on roads disrupts daily traffic and can heavily affect people's commutes.

Not only are roads simply overcrowded, but their structure and design are very poor, according to many urban planners. One of the experts I talked to, Amrit Dhir, who is the Director of Business Development at Sidewalk Labs, says that one of the significant issues is that cities and roads are designed for cars when they should be designed for people. Streets currently favor drivers and cars much more than pedestrians, and changing that is one way Amrit thinks cities can become a more pleasant place for people. I also talked to Jeffrey Shumaker, The Director of Urban Planning at BIG, and the Former Chief Urban Designer for NYC. He also thinks that roads have a lot of room for improvement, as they are the primary public space for most cities. He believes we need to fundamentally reimagine what our streets look like, and how they are used. Both Jeffrey and Amrit think moving cities away from being car-centered would have a plethora of benefits. A massive amount of space in cities is used for storing cars since the average car is parked 95 percent of the time (Barter). A reduction in the number of cars in cities would free up space that could be used for more buildings and public space. The alternative to cars in cities is an excellent public transportation system. But public transportation is an issue for many cities and urban areas with 31 out of 35 major metropolitan areas in the US have seen decreased ridership during the last year, according to New York-based TransitCenter. Urban areas need to find ways to increase public transportation use and decrease individual car ownership. This will not only free up space, and help transform streets, but also deal with the massive issue of climate change.

Climate change and sustainability are easily one of the biggest challenges and threats that humans are going to have to deal with in the coming years and decades. And cities can do a lot to help with climate change. Reducing carbon dioxide emissions is the only way to slow down climate change. And the three areas where we get the most carbon pollution in America right now is in our buildings and homes, what we're burning, from our cars and light-duty trucks that we drive, the generation of electricity where we're still using a lot of carbon-based fuel to make that happen (Budds). Cities can significantly help climate change. 70% of the world's CO2 emissions are generated by urban areas (Sisson). Transportation and buildings contribute to a tremendous amount of greenhouse gas emissions in cities. Buildings can become much more efficient with their energy usage. A lot of buildings have systems that use a large amount of natural gas instead of electricity because it is cheaper, according to Chris Edmonds, a Senior Sustainability Associate at Sidewalk Labs. But he says that simply electrifying buildings are not enough. Electrical infrastructure also should be sized for peak electricity hours, with renewable energy sources like solar and batteries to hold the energy for when people need it. With climate change's effects already being felt, cities need to find ways to become more efficient and sustainable quickly.

From talking to experts and doing background research, I found that some of the aspects of cities that have the most room for improvement are infrastructure and sustainability. Particularly when it comes to infrastructure, roads and public transportation systems have a lot of room to improve. Many roads not only need to be updated to deal with the immense amount of traffic present in today's cities but maybe even completely redesigned to make them more livable. And having robust public transportation systems will be a big key factor for decreasing

car usage for the benefit of having better streets, and being more eco-friendly. Buildings also need to become a lot more eco-friendly with both energy consumption and where they get their energy from. There are certainly many other issues with cities besides these. Affordable housing is in issue in urban areas across the globe, and as cities become more technologically advanced, some experts worry that cybersecurity will need to vastly improve. But the issues of infrastructure and sustainability seem to be areas with an immediate need for change, as identified by many of the experts I talked to. But identifying these issues is an easy first step; trying to solve them is undoubtedly more complicated.

Towards the end of my research, the Coronavirus became a global pandemic with dense urban cities like New York City becoming the hardest hit. Cities struggled to contain the virus and acquire the resources they needed to protect their citizens with PPE and testing. This all happened as I was wrapping up my interviews and research; thus, I did not have an opportunity to explore how cities could have been improved to better handle the pandemic. As people were forced to stay at home to keep the virus from spreading too quickly, we saw a considerable reduction in global warming with office buildings closed and cars off the streets. But clearly, that will not last, and very soon, we will see carbon emissions back to old levels. However, with social distancing requirements, cities are now re-evaluating their layouts and infrastructure. Who knows what changes will be lasting and what new problems will arise, and which ones may be resolved since we are still in the middle of this pandemic and the "retrofitting" of cities needed to manage Covid-19 has just begun.

What is the biggest barrier to improving a city's technology and infrastructure -- the cost, people, or other factors?

The most obvious barrier to improving cities is money. It costs a lot of money to fix infrastructure, or adopt new systems. According to a survey by Business Insider, 70% of city officials said budget constraints were a top-three barrier to adopting smart city technologies. Barcelona spends 230 million a year in taxpayer money for their smart city developments (Business Insider). The American Society of Civil Engineers estimates that the US will need to spend 4.5 trillion dollars by 2025 to improve the country's infrastructure, which includes roads, bridges, dams, airports, and schools. But the cost alone is not the sole barrier to improving cities.

The biggest reason that new solutions and technologies can be so expensive is that a lot of the time, decades-old infrastructure has to be redesigned and rebuilt to implement smart city solutions. It may be that the power grid is not capable of supporting a new building, or that all the roads have to be redesigned for autonomous cars or some other mode of transportation to work. Thus, the cost is not only the cost of the technology but also the cost to update the infrastructure that can support that technology. Most cities have infrastructure that is very out of date. Public transportation systems require a lot of supporting infrastructure and funds. And while public transit use is growing, it is already underfunded. It would currently cost around 90 billion dollars to fix the backlog of transit projects, and that cost is estimated to increase to 122 billion dollars by 2032. Many public transportation systems that are currently in place are not extensive enough to get people to give up individual car ownership. People who live in the suburbs still need a car to get to the bus or train station from their house (English). Creating an

effective public transportation system that can truly replace cars will mean having to not only improve or replace the current system but also expanding it out to reach more areas. It is not a simple problem with a simple solution. With so many parts of urban infrastructure already behind, it makes moving forward that much more expensive.

Politics adds another layer of complexity to improving cities. City planning is a public endeavor, which means that it is a longer process than the pace of change at a private company (Amrit Dhir, Sidewalk Labs). Jeffrey Shuker, the urban planner at BIG, also said that removing political barriers would make things a lot easier. He says that it can be tough and time-consuming to pass plans and projects through multiple levels of government. In addition, there are a decent amount of people in cities who can have a nimby attitude and oppose new development and change. So the people who live and run cities can complicate the process of improving and preparing cities for the future.

Money, outdated infrastructure, and people all make improving cities a bit more complicated than the sole issue alone. And while these barriers do make things more complicated, they can be worked around and solved. It just means that people need to take these barriers into account when developing and implementing solutions.

What new technologies and innovations can be implemented in cities and towns to improve efficiency and human lives?

Transportation in cities, especially public transit, will be a huge thing to address to try to improve efficiency and human lives in cities. One of the biggest things that cities can do is to try

to get people out of their private cars. This will greatly reduce emissions in urban areas, and free up space on the roads and land that is currently being used for parking. It will also help cities manage traffic as cities grow. The way to achieve getting people to give up driving their own car is to make other options more convenient. Many American cities have public transportation systems that fall short in doing this, due to the fact that most systems are unreliable and not frequent enough, and are lacking when it comes to accessibility, especially in the suburbs (English). Many commuters would need a car to get to a public transit station, so they may just as well drive all the way to work instead of using public transit since they already need a car. Cities should try to expand public transit services like buses out further into the suburbs. Having more frequent and consistent service would also be beneficial. In addition, many people do not feel totally safe using public transit, according to Harriet Lai Ross, who has worked and done urban planning for the city of Sacramento. Adding extra security could also get more people to ride public transit. In addition, things like subscription services for all modes of transportation in a city and having all mobility systems accessible from a single app would make public transit more convenient for riders. All of these things would help make convenience less of a deciding factor for riders and could boost public transportation ridership in cities. Autonomous cars and vehicles would also help get a lot of cars off the street. Jeffrey Shumaker says that autonomous vehicles will help fix a lot of the damage that has been done to cities by the introduction of the car. Having a shared pool of autonomous cars would immensely reduce traffic, and almost eliminate the need for large parking areas in cities with most cars parked 95% of the time. Autonomous cars would be another convenient mode of transportation for people and also reduce accidents. While autonomous vehicles may seem far fetched to some people today, a lot

of things could change in the coming years, especially since younger generations are more open to sharing things like cars. The big thing that cities need to try to do is to provide efficient and convenient modes of transportation that the masses are willing to use as opposed to individual car ownership.

Roads are arguably the biggest, most used, and most important public space in a city, and many things can be improved about them. A couple of the experts I talked with mentioned the possibility of having multi-use roads at different times of the day. For example, having a particular road be used solely by cars during traffic hours, but be for pedestrians only when traffic is light. Self-driving cars could help multi-use roads be implemented. Jeffrey Shumaker (BIG Design) said that streets should be for moving the most amount of people in the most efficient way. And the way that people move changes throughout the day. So having multi-use roads that change throughout the day would allow for roads to always be moving the most amount of people in an efficient way. Amrit Dhir (Sidewalk Labs) said that having sidewalks that are not raised, and on the same level of the street would make roads much larger if they were used by only cars at a particular time. In addition, new technology could allow cities to start paving roads differently. Roads have been paved the same way since 1876. But what cities could start doing is using modular pavement. Modular pavement is individual slabs of pavement that can be easily and quickly picked up and replaced. This would allow easy access to pipes cables under roads, and make fixing potholes and cracks in the road much easier and less disruptive to traffic. It also would help with floods since the pavement is somewhat permeable, unlike regular pavement. Modular pavement slabs can have lights on them to help direct traffic and people. The pavement could also have strips of carbon fiber inside them, which can heat up very quickly,

preventing snow from accumulating on roads (City of the Future, 2018). As the most prominent and most-used public space in cities, improving roads would dramatically improve cities.

Cities need to become more sustainable to try to limit climate change. And cities will need to do even more in the coming years. As I previously mentioned, having fewer cars on the street is a big way for cities to reduce emissions, and having only electric cars is even better. Buildings are also a massive emitter of carbon in cities. Electrifying buildings using renewable sources like solar, and maximizing the efficiency in which the electricity is used will greatly help with the sustainability aspect of buildings. But there are also new building materials that can help the environment. Mass timber is large buildings and skyscrapers made of wood instead of steel and concrete, which is much more eco-friendly. Panels of wood can be cross-laminated to create stronger beams of wood. The wood beams and pieces can be laminated offsite and then put together onsite for quick and straightforward assembly that can be built at a rate of up to a floor a day based on the building. Calculations have proven that this technology could have been used to construct buildings as tall as the empire state building. Large buildings were not built with wood in the past because of fire concerns. Currently, many cities have height limits for wood buildings but none for metal and concrete ones. Wood still does not light instantly, and it takes time to light dense wood. And while deforestation is something to consider, there is plenty of wood to use in North America, as long as forests are managed correctly(City of the Future, 2018).

Cities also have to deal with the effects of climate change that are being felt right now. The planet and cities are getting hotter and hotter, and heat is starting to become more of an issue in cities. Jeffrey Shumaker says that cities can do a couple of things to try to combat the heat in cities. Having less asphalt and more trees and greenery is a great way to cool cities. Planting

trees provides shade, captures carbon from the air, and makes cities look more beautiful in general. In addition, many roofs could be painted white rather than black, so that roofs attract less heat. This would also help lower cooling costs for buildings. Coastal cities also have to deal with rising sea levels. Jeremy Goldberg, the Deputy Secretary for Technology and Innovation for the New York Governor's office, says that cities are going to have to start to develop a new relationship with the water around them and figure out how cities are going to be able to live with water. Seawalls will continue to have to get higher and higher as the sea level rises. Jeremy says that preparing for storms is kind of a race against time because you do not know when the next big storm is going to hit, you just know that there is going to be another one. Cities can also rezone areas to make sure that essential buildings and areas are not in high-risk flood areas.

While new technologies can help improve many aspects of cities, there are also a lot of simple and small things that can be done. Jeffrey Shumaker said that a lot of problems could be solved by proper fundamentals instead of new technology, like having enough public spaces or making sure the sidewalk is big enough. Cities can implement adaptive traffic lights that use AI and machine learning to automatically adjust traffic lights based on the traffic. Jeremy Goldberg said cities need to make sure they emphasize investments in critical infrastructures like bridges and roads and making sure infrastructure is able to sustain the growth and population of the city. Harriet Lai Ross mentioned how having mixed-use land could be very beneficial. Mixed-use land is a large part of efficiency planning and involves mixing land zones, like residential and commercial. This allows people to not have to get into a car to go to the store or go out to eat. Higher density areas also support public transit, since there need to be enough people to support a public transit system. Jeremy says that having the right people is the most important thing.

Technologies have to be implemented correctly in order to work. And cities need to have talent and people to implement, maintain, and use the technology. He says that smart cities are really about the people who live in them and design them. People are the most important resource for creating an efficient and prepared city.

How have some cities integrated new technology and concepts?

There are many cities around the world that can be used as case studies, and show what has worked when it comes to improving cities. Many American cities are behind when it comes to public transportation due to the fact that most systems are unreliable and not frequent enough and not super accessible to a lot of people, especially in the suburbs. In many countries, public transit is an alternative to cars, while in the US, many people still need a car in order to get a public transit system. Toronto has addressed the issue of accessibility by implementing bus systems in the suburbs that allow people living there to get to subway systems to get them to the city (English). Asian countries have done a lot to support public transportation. In the Urban Mobility Readiness Index from Oliver Wyman Forum and the Institute of Transportation Studies at the University of California Berkeley, 5 of the top 10 cities, including #1 (Singapore) were Asian cities. Asian cities and countries have realized that new transportation technologies can help with pollution and congestion, which can boost economic growth and make urban mobility more seamless. So, many Asian cities have regulated and invested in infrastructure that promotes

new mobility technologies. Policymakers recognize new mobility technologies as a way to boost the economy. Singapore's government created the Smart Nation Initiative, which helped identify and support future mobility companies and startups. China currently has the largest market and is the largest manufacturer of electric vehicles. This is because China has given significant subsidies to people who buy electric vehicles over the past decade. They have also been limiting the number of license plates available for internal combustion vehicles. China created an initiative called Made For China 2025, which gave support to electric vehicle startups. The mobility-centric policies in China have really helped large cities like Shanghai and Beijing deal with large populations and pollution. Both have around 400 miles of subway and 16 lines in each city. Asian municipalities have also been funding and supporting both public and private research in autonomous cars (Thibault and Bayen).

One way cities have been exploring innovation and implementing new technologies, especially with cities, is through pilot projects. Jeffrey Shumaker talked a lot about how Mayor Bloomberg's administration in New York City did a lot of pilot projects. He says that the benefit of pilot projects is that cities can try certain ideas on a small scale to see if they work or not, and they can always scrap the idea if it does not work out. Prior to Covid-19, Sidewalk Labs, which is an Alphabet Company centered around urban innovation, was set to build a 12-acre neighborhood in Toronto, which would include many of the urban innovations I mentioned earlier (Sidewalklabs.com). One of the goals of the neighborhood was to see how these urban innovations would work and set a blueprint for how other cities could implement certain things. Another company, Oceanix, has plans to try to build floating cities on the ocean that would be completely self-sufficient, by utilizing renewable energy sources and aquafarming (Oceanix.org).

There are many different companies and organizations with different ideas and innovations on how to solve many urban issues. And giving organizations a platform to pilot their innovations could surface important breakthrough ideas that could make a huge difference for cities in the long run.

Conclusion:

When I started this project, there seemed to be a lot of excitement about new innovations to make cities better. A lot of this was initially fueled by autonomous cars that could eventually become the dominant transit system promising less congestion, safer roads, and more efficient movement for all. This innovation is what got me interested in learning more about other innovations and ways to improve cities in the future. As I learned more about this topic and discovered innovations like ocean cities and multi-use roads, I became excited about the future of cities and how life could be so much better decades from now. Possibly gone are the days of sitting in traffic for hours and car accidents, one of the leading causes of death. I was feeling optimistic that cities could possibly reduce their emissions to slow global warming by making the right investments in smart energy use that will pay off in the long run. Right now, our cities are struggling with outdated infrastructure, overcrowded cities, and an inability to be innovative to solve some of the biggest problems in their cities.

Towards the end of this project, Covid-19 became a global pandemic, and the health crisis became an overwhelming concern for cities as they were tasked on a city and county-wide

basis to fight the pandemic replacing any priority that existed before. The infrastructure and overcrowding problems did not go away; they just became less important during this time. Even climate change and global warming, which the effects of which can have the power to be much more devastating to the human population than Covid-19, has taken a backseat to this global pandemic. Extraordinary amounts of funding have been needed to manage the health challenges and economic crises. Thus funding any infrastructure, transportation, or innovation for the future will be even more challenging.

While there are many things that cities can do to address urban issues and prepare for the future, it will all be put on hold as we address the immediate challenges of Covid-19. Even Sidewalk Labs, an Alphabet Company (parent company of Google), has recently announced that they are no longer going to pursue their pilot city in Toronto, due to funding issues that Covid-19 has created. So, clearly cities and towns should not be rushing to spend money to create better and smarter cities right now. But after the pandemic is over, or even as the pandemic starts to slow down and the economy starts to recover, I hope that cities will resume their efforts to make their cities better for the future, especially since overcrowding of cities is also a challenge to slow down the spread of the virus. Deploying some of the ideas mentioned above, such as multi-use roads, using AI in traffic lights, and widening sidewalks could provide more space for people to be socially distanced, as well as improve general city life. A long-term investment in autonomous vehicles and robust public transportation options would provide more space for people in dense towns that could slow the spread of a future virus, and cause less daily traffic.

Innovations that make a city better for people could also make a city more resilient in fighting a pandemic. Cities should start considering how some of these ideas and innovations

could be implemented, and start piloting projects. A city that has learned how to pilot new ideas, can act quickly when a crisis hits, whether the crisis is a pandemic, an earthquake, a hurricane, or global warming. Establishing a culture of innovation and improvement can have both long-term and short-term benefits. Developing private and public partnerships, and like Jeremy said, having talented people is what makes a smart city "smart."

As cities are trying to figure out the "new normal," they should take the opportunity to establish a special task force to focus on what city's need immediately, as well as what they need long-term to be more resilient and more livable. This is a perfect opportunity to deploy many of the innovations I discovered in this project and to uncover other innovations that enable people to move more freely and with more space which supports more safety. The task force should include community partners with big companies and small companies. It should target overcrowding and sustainability. This pandemic has presented an opportunity to redesign cities so we can live and move around safely. While Covid-19 has paused most of the focus on the ideas that I explored in this research on the future of cities, cities should continue to leverage the ideas and innovations that generally make a city better and continue to invest in the future. Because the future is coming and cities need to be better prepared for it.

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