

ACTIVITIES **1**

A Conversation on the Future of American Mobility Infrastructure Aiming for a Fair and Sustainable Mobility Infrastructure System

To contribute through its Social Innovation Business with a focus on a future sustainable global society, Hitachi has set mobility systems as its focus sector, establishing a new company “Hitachi Astemo” that deals with vehicle-related technologies and strengthens these efforts around the world. What does the future of US mobility look like amid the prolonged COVID-19 pandemic, the looming threat of climate change, and the struggle for racial justice/equity? How can we build fair and sustainable mobility infrastructure systems in response to growing public opinion calling for the comprehensive overhaul of domestic transportation infrastructure and a renewal of the mobility sector? In an interview hosted by Hitachi Ltd.’s Washington D.C. Corporate Office, Robyn Boerstling, Vice President of Infrastructure, Innovation and Human Resources with the National Association of Manufacturers (NAM) discusses those prospects with industry experts from Hitachi.

COVID-19

Robyn: The novel coronavirus pandemic has ground public transit to a halt and passenger rail has been hit particularly hard as riders opt for more socially-distanced modes of transportation. Allan, what is COVID-19’s long-term impact on passenger rail, and what impact might this have on rail infrastructure projects moving forward?

Allan: In the short term, we have seen public transit ridership decline in response to social distance requirements and localized pandemic response plans across the country, making it difficult to understand any long-term effects on ridership. What is clear to us is that transit agencies need time and resources to work out long-term plans as well as funding their short-term operations, which have continued and provide services for essential workers and the public. Without critical short-term funding to cover operations, some US transit authorities have warned that they will be left with



Robyn Boerstling

Vice President, Infrastructure, Innovation and Human Resources, National Association of Manufacturers (NAM)

Joined the NAM in 2008. Prior to her work at the NAM, she served as the counselor to the assistant secretary for transportation policy in the Office of the Secretary at the US Department of Transportation (DOT). She joined the DOT in October 2001 as a “Schedule C” presidential appointee and held various positions at DOT. Her early career was spent on a congressional campaign and working in the Connecticut General Assembly. A native of Connecticut, Ms. Boerstling is a graduate of Colby College in Waterville, Maine, and she earned an MA in English from Trinity College in Hartford, Connecticut.



Allan Immel

Turnkey Business Development Lead for North America, Hitachi Rail STS

Allan leads the development of Hitachi Rail’s turnkey systems win and execution strategies for the North American transit market. With more than two decades of increasing executive experience with the organization, Allan established and led the project management office and, most recently, led the US bidding group. Among the most recognizable worldwide providers of total railway solutions, Hitachi Rail’s innovative mobility technologies and expertise covers rolling stock, signaling and turnkey, digital solutions, and operations and maintenance.

no other option than to implement draconian service cuts of up to 50%. If deployed, those strategies would effectively have a long-term impact too since long-term capital programs are often linked with operating plans for projects. For example, this might impact the overall upgrades to train control systems, lines, vehicles, and so forth.

Robyn: And frontline workers still must get to hospitals. First responders still must get to firehouses and police stations. Essential workers have to show up to work in the USA, no matter what.

Allan: Yes. The New York City area is a great example of that with regional commuter rail and metro subway service, as well as all of the different transportation service options in the region. Without these, the essential workers that are so vital to that metropolitan area are directly impacted. There is a financial impact to the essential employee who uses public transportation as well as an environmental impact to society from adding more vehicles, along with greater congestion for streets, roads, and highways. That is not just true in the New York metropolitan area, it is any major US metro area. So, we create additional impacts to our vital services, which may include everything from fire, emergency management, and medical to police and front-line grocery and food service workers. Without operating funding and without infrastructure support — both types of funding we have talked about — then transit authorities may end up with draconian service cuts and the people who could be most deeply affected are probably the people we

need the most in terms of essential workers.

Robyn: Harsha, I can imagine that the situation is going to be a little bit different for autonomous vehicles (AVs) and how the pandemic has impacted AV development and deployment. But, there has been an interesting opportunity, I think, to demonstrate the power of autonomy during the past six months. What impact has the pandemic had on AV systems?

Harsha: The pandemic has rapidly accelerated the need for the development, testing and deployment of autonomous mobility technology. I think we will see results, first, in the area of logistics and delivery. What we have seen in these last three or four months is the rapid deployment of AVs for the delivery of essential goods such as groceries and medicines. So, before we get to transporting people in an autonomous manner, I think the first step and essential step is how can we safely navigate a vehicle in, let us say a dense, open, high-traffic environment.

I think that utilization of some of these companies testing their fleet in urban and suburban areas, gives us an insight into what it would require to have the deployment of this technology. Through this exercise, there are two key technologies that will be addressed. One is what we call localization, which is basically figuring out where the vehicle is at any given point of time. And the second one is path planning. Just imagine you are making a right turn... as humans, we just look for the all clear and slowly make a right turn. But for a computer, it needs to figure out the



Harsha Badarinarayan, Ph.D.

Vice President, Research & Development, Hitachi America, Ltd.

Harsha Badarinarayan is also the Leader of Detroit Research Center for Hitachi America, Ltd. He has been with Hitachi for over 17 years. In his current role, Harsha is involved in strategic planning for business expansion in the USA, specifically related

to the connected and autonomous vehicles (CAVs) and smart manufacturing. He spearheads the development and implementation of pioneering technologies dedicated to autonomous mobility (AD/ADAS), smart infrastructure, and IoT. Harsha holds 15 US patents and has authored or co-authored over 30 technical publications.



John Nunneley

Senior Vice President, Design Engineering and Program Management, and General Manager, Farmington Hills, Michigan Office, Hitachi Astemo Americas, Inc.*

John Nunneley holds a BSEE from Michigan Technological University with more than 30 years of experience in engineering. He worked in the design engineering group for Hitachi Automotive Systems in Michigan, 1995–2011. John worked for Hitachi Automotive Systems in Japan, 2012–2016. He returned to the USA in July 2016 to take his current position managing Hitachi Astemo Americas' full product portfolio including engine management, electric powertrain, drive control, and car safety and information systems.

* Hitachi Automotive Systems Americas, Inc. has changed its name to Hitachi Astemo Americas, Inc.



radius of curvature, the trajectory, the speed, and so on and so forth. This is not a trivial problem. I think this pandemic has really accelerated the development of these key technologies. I hope that slowly, as things get back to normal, we will be able to translate some of this into passenger movement, very step-by-step and in a gradual manner.

Robyn: John, 2021 was already projected to be a tough year for the traditional automotive industry and then the pandemic presented a whole new set of challenges. We are seeing some bright spots and some recovery for sure, but I was wondering if you could share what you are seeing in the automotive space?

John: Sure, Robyn. From the early part of the pandemic, clearly it was very tough on the automotive industry, but as you said, there has been some recovery. Looking a little bit further into the future, the questions are: What is going to happen with the home office? What is going to happen with people working remotely? Are companies going to have their salesforce, their engineers and everyone return to commuting to the office five days a week? Many companies are saying that this probably is not going to happen in the next six months or even ever. So, if this continues, the number of miles people put on their cars is going to be reduced. If your family has multiple people in the household working from home part-time, are you going to need a second car or are you going to need a third car?

So, from the home office standpoint, are the number of vehicles sold going to be reduced overall? Then you contrast that with the current reverse urbanization. Now people are moving out of the city, so maybe they have a longer commute if and when things go back to normal. So, it will be interesting to keep an eye on the number of miles people are putting on vehicles, because that really drives the number of vehicles that people purchase. And that is what I think some of the concerns are.

Robyn: There is a whole segment of the population who maybe thought they did not need a car and now suddenly

realize they want one so they can safely travel to see family, avoiding air travel.

Others are finding they need cars after moving out of or away from urban centers, as you alluded to. The pandemic has inspired an exodus from metro areas. Allan, how might this increase in suburbanization affect existing mobility models and mobility infrastructure?

Allan: Although we can estimate and analyze, the full story has yet to unfold. No one knows what is ultimately going to happen. Remember, while there are people who are living in the suburbs and working from home — and a lot of us are very fortunate to be able to do that — there are also a lot of people who prefer city living over the suburbs where the public transportation networks have become so vitally important. There is also the affordability of city versus suburban living, owning and renting a home and all of the costs and factors related to where we live and where we work, if remote working is not an option. So, yes, I anticipate that commuting patterns will start to change. Perhaps we will see less weekday peaks coming from the suburbs into the city, with the exception of essential workers or others who rely on mass transit.

Another interesting point that John mentioned about shared AVs is that if your transportation modes are well aligned some people might not need to own a car at all because they have enough affordable choices. I do think that the net effect of Covid-19 remains to be seen. Some people will not be commuting like they are now and the use of our metro systems may then serve a different need.

Harsha: Just from the Detroit area, if I might add, we are seeing a lot of new houses being built in the suburbs. And now with interest rates so low, many people are looking at buying homes. Having said that, this changes the environment in the sense that you have got to now build infrastructure to match this mass movement of people. In Detroit, we have got several government initiatives that are working on developing new infrastructure. We have



got this initiative that connects Detroit to Ann Arbor. It is a 40-mile route and has a dedicated lane for autonomous vehicles. Going forward, as we see this massive transition, I think infrastructure needs to keep up, otherwise it is going to create a lot of chaos.

John: And I think the infrastructure side of it is interesting because for years we were moving out of the cities and we built these huge transportation systems in the suburbs and around the suburban areas. Now, recently it has been more urbanization and trying to create transportation opportunities in the urban areas. And now the pandemic is causing it to go back in the other direction. There are a lot of the freeways out in the suburban areas that will really need maintenance and expansion if there is a re-suburbanization going forward.

Climate Change

Robyn: In addition to the pandemic, climate change is also front of mind for the incoming Biden Administration.

I know Hitachi Automotive Systems Americas, Inc. is helping facilitate the shift to greener auto technology by pioneering the development of electric vehicle (EV) systems and component elements required for EVs. And the market dynamics for electric vehicles are shifting and shifting very rapidly. I think that they are becoming more appealing as the cost of battery manufacturing decreases. What does EV infrastructure in the USA look like right now? What should it look like as we develop a more robust mobility infrastructure system, including for heavy duty vehicles?

John: I think the electrification of passenger vehicles is happening slowly, much more slowly than we predicted. We always look out five years and make a prediction on the number of electric vehicles, and it has not kept up with what our predictions have been. I think one problem has been the cost and you have stated that that cost is getting

more in line, it is getting better. But if you look at how far you can travel on a battery charge in an electric vehicle, or the range, the modern EVs now are 200 to 300 miles (approximately 320 to 480 km). That is similar to what you can get on a tank of gas. Think of the infrastructure we have for gasoline vehicles versus what we have for electric vehicles. Anywhere you are, you can fill up your car with gas. Whereas if you are running low on battery charges, it is much more difficult to find somewhere to go charge.

So, I think infrastructure has really got to be in place, a standard charging interface. And those types of things have got to be there before most people are comfortable going with purely electric vehicles. If we all agree that this is the right direction to go with the current environmental impact, then I think it is in the government's best interest to push people's buying preferences toward electric vehicles. And to do that, we need the infrastructure. If you look at what is happening in Asia and Europe, the USA is falling behind other countries as far as EV ownership because of other countries' governments pushing the people toward these types of vehicles much more quickly than is happening in the USA.

Harsha: We talked about the infrastructure and the cost and motivation for passenger vehicles, but I think the benefits for the truck industry, the long-haul truck, are tremendous. When you think of things like a truck, the question comes in terms of infrastructure and charging, not just what you need but you could even think of hydrogen fuel vehicles, for example. So, how do you build the necessary infrastructure? And even if you build the infrastructure, you need to think about the timing for recharging or refilling. It should be comparable to a regular diesel engine. We have the technology somewhat, but I think the infrastructure is lagging. And unless there is some push from regulators and the government, and also some incentive-based mechanism to make this more commonly available, I think it will still take time before it sets off at a mass scale.

Robyn: Harsha, automated and connected driving could lead to lower carbon dioxide (CO₂) emission levels as fuel efficiency and traffic flow improve... Alternatively, the adoption of AVs could introduce more users to the roads and reduce public transit use. What impact do you see AVs having on the environment and infrastructure needs?

Harsha: Most of the AVs that we expect to hit the road in the coming years, for both freight and passenger applications, will be EVs and so in that sense the impact to the environment, especially in terms of emissions will be significantly less than an equivalent internal combustion engine vehicle. Having said that, there will be need for change in the infrastructure, especially, to put in place charging stations (more especially, Superchargers) that will be analogous to gas stations so that it eliminates range anxiety which will encourage folks with EVs to use it not just in cities but also long distance travel. We are already seeing private-public partnership to put in place these charging stations not just in cities but also along major interstate highways.

Mobility Equity

Robyn: The nationwide protests for racial justice last summer put the issue of “mobility equity” at the center of mobility infrastructure discussions. Allan, what role does passenger rail play in connecting underserved communities, and what infrastructure needs must be addressed to achieve greater coverage for those communities?

Allan: Equity is about movement and the ability to move across, whether this is across cities, across regions or across the country. That infrastructure then gives you access to freely move across. It gives you access to things like universities and higher education, to your job and different opportunities for increasing your wealth through employment and so forth. Where I see the economic equity regarding passenger rail is that it allows for movement. It allows people to go to where the opportunities are or to find them. So, I think it provides a vital role. Additionally, when you

consider carbon emissions and congestion, or if we look at electrification of rail transit, we need to see investment in that kind of infrastructure and more efficient sustainable electrification schemes for our transit network. With electrified and hybrid vehicles that make use of energy storage systems, there are other more sustainable ways for freight to travel besides air to truck and truck to train. Both freight and passenger rail transit are proven to be very efficient and greener ways to move people and goods around the country.

Robyn: John, ridesharing has expanded transportation access for lower-income individuals and communities... But we are now seeing a resurgence of the single vehicle car ownership model due to pandemic-related health concerns. How do you see these models evolving over the next few years and how will this evolution affect infrastructure design?

John: Well, I think obviously ride-sharing is down right now. People are not going to share a vehicle. Shared ownership, ride sharing is all suffering greatly in the pandemic. And that hurts, as you were talking about earlier, the equity side of it, also. It impacts the people who cannot afford a car and have a harder time getting to work without available ride sharing or public transportation. But ride sharing, I think has to come back. I mean, people need to be able to get around. Once we get past the pandemic, I expect ride sharing will have a resurgence and will come back. Ride sharing is also important for AV development. One of the things Harsha was talking about earlier is the early test beds for the highly autonomous technologies was in the ride-sharing vehicles in urban areas, ride-sharing robo-taxi type applications. So I expect all that to come back and ride sharing to recover.

Harsha: I think the business model of some of the original equipment manufacturers (OEMs) or the vehicle manufacturers are changing. It is changing from now selling a car or even if it is my car to a car that comes to me when I want it. So, the question of equity, if we are able to make this available to a much larger audience, then the cost will go down and it will become a lot more affordable. So when we think of ride sharing, yes, we already have ride sharing now, but in the future, we start thinking of mass transport

or mobility as a service where you are able to move a group of people in some sort of shuttle over short distances. I think the higher the utilization you have, the lower the costs will be. Right now, you drive your vehicle to work and you park it. It is parked for 95% of the time. So, if we are able to increase that utilization rate, I think that would definitely make it more accessible.

Robyn: Harsha, when the general public thinks of AVs and AV technology, they tend to imagine expensive Teslas... But, individuals of means are not the only ones who will benefit from AV technology. How can AV technology expand transportation access in an equitable manner?

Harsha: The business of vehicle sales and ownership is rapidly changing — we are moving toward a “pay-as-you-go” model. One of the main benefits of deploying AVs on a large scale is that it can be accessible “on-demand” to a large population of society without the individuals being burdened with the capital cost of owning this technology. We are already seeing that in some areas of the country where delivery is made using these autonomous “pods” at a minimal or no cost to the end consumer. We anticipate that in the coming several years, we will see AVs being gradually introduced in ride-sharing services and will potentially reduce congestion in cities since the utilization rate of these ride-sharing AVs will be significantly larger than if each individual owns and drives their personal vehicle.

Future Gazing

Robyn: As we conclude our conversation, what is the most exciting mobility solution or infrastructure solution you are working on today that excites you the most on behalf of Hitachi’s customers?

John: From the automotive side, the connected AV, which would naturally be an EV is really an exciting development going forward. You are improving efficiency, increasing safety, and increasing convenience, all things that are highly beneficial to the users and society. I think as we move forward toward fully autonomous connected EVs, that will



define the future of the automotive industry.

Harsha: From a researcher’s point of view, I think we are very excited about how we can integrate fifth generation (5G) and other complimentary technology such as multi-access edge computing (MEC) for how we can reduce latency and offer near real-time vehicle control for connected AVs. I think that is a very interesting problem that we are currently working on, and hopefully we have something to demonstrate soon.

Allan: A confluence of events is shaping up to drive a renewed rail renaissance in the USA, with particular momentum building for high-speed rail and driverless systems. Infrastructure spending appears to be a rare area of bi-partisan agreement that will support the post-pandemic economic recovery. We also see a future in which these transportation options support the public’s increasing expectation for environmentally sustainable mobility solutions. When you experience the luxury and convenience of high-speed rail elsewhere in the world, it is an amazing and convenient alternative to short-haul air travel in Europe and Asia.

Already, we see high-speed rail projects catalyzing into action in Florida, Texas, and California. Hitachi has a key role to play as a global expert in high-speed rail, especially when you consider our historic developments starting with the Shinkansen and now moving world-wide to many of the world’s most beloved high-speed rail routes. Similarly, with driverless, we make the case for this from Copenhagen and Riyadh to Lima and Honolulu. For both, we see increased interest from customers, elected officials and community leaders alike who recognize the connection between rail infrastructure, jobs, economic impact and sustainable modes of transportation.