Andrew Carpenter (00:00:09):

Hello, everyone. This is Andrew Carpenter. I am the Director of the National Center for Applied Transit Technology and today we are talking with a couple of folks from AECOM Automated Bus Consortium. And so we're going to speak with Suzanne Murtha, with AECOM's Automated Bus Consortium and Jean Ruestman from the Michigan Department of Transportation.

Andrew Carpenter (00:00:46):

The consortium is the first of its kind approach to accelerate the development of automated transit technologies and will combine the purchasing power and decision making of its founding transit agencies for a better group procurement. And if implemented their pilot projects will use full size, full speed accessible buses and allow consortium members to demonstrate and deploy automated technology in a live service environment, which is super exciting. Because a lot of the hype has been around personal vehicles, which from the transit world we know is long-term not going to be the best way to go about this and so this way we can get transit to also lead the way on automation.

Andrew Carpenter (00:01:41):

And so I want to thank both Suzanne and Jean for joining us today. We also have Marcela, our regular host with us. It's exciting to see this. And for a while this has been a nebulous idea floating around at CTAA and at other associations and transit agencies were trying to get their heads around this. And so it's exciting to have something starting to really become concrete around it and with that, Suzanne and Jean if you could both introduce yourselves and then share your story about how you ended up in the transportation industry and how you ended up getting to the Automated Bus Consortium from there.

Jean (00:02:40):

I'm Jean Ruestman. I am the Administrator of the Office of Passenger Transportation at the Michigan Department of Transportation. I actually have been in that office in different capacities for a little over 30 years. So I actually got into this industry quite by accident. I was simply searching for jobs and had actually never ridden a transit bus when I first got hired into MDOT and into this office.

Jean (00:03:09):

And it's really become a passion of mine to go from not knowing anything about it to understanding the importance of it to our entire society, it's been a thrill. So worked my way up over the years and I've also become active at the national level, I co-chair one of the transportation research boards standing committees on innovative public transport services and technologies and that's broadened my vision even more and made me even more passionate about doing projects what we're doing with the Automated Bus Consortium.

Jean (00:03:52):

So when the opportunity was presented to me, we jumped right in. Michigan wants to be a leader in this venue and I have a personal passion for it, so it's a no brainer for us to get involved in it. So now, I'll turn it over to Suzanne to introduce herself.

Suzanne (00:04:16):

Thank you Jean. My name is Suzanne Murtha and I am the National Lead for Connected and Automated Technologies at AECOM. So I support on a connected and automated side for the Automated Bus

Consortium. And I started out as an economist in the automotive industry. I studied business, a couple of other things and started out as an economist doing forecasting for sales and production of vehicles.

Suzanne (00:04:44):

So I spent a lot of time in Michigan where Jean is and then shifted over to ITS America, where I got to learn the private sector side and the public sector side and that was where we launched the very first connected vehicle working group and started to begin working with all these. The automotive manufacturers, the states and the cities and the federal governments on creating a connected vehicle environment for the first time.

Suzanne (00:05:11):

So I started working in standards for connectivity. I got very familiar with that industry. And speed forward a little, AECOM where I get to work on deploying connected and automated technologies and supporting that all over the world. And as part of that effort, we get to work with the Automated Bus Consortium, which is an incredible joy.

Suzanne (00:05:36):

And it's the first time me or anyone in my practice has gotten to work on transit. So Jean came up in transit, and we came up in automation. And so it was fantastic to work with the transit team at AECOM and have them learn about how to do automation and connectivity. And likewise, for us to work with the transit team and learn all the terms and all the people in the transit industry. So that's been an amazing opportunity.

Marcela (00:06:09):

It's a dream team.

Suzanne (00:06:15):

Yeah, it feels that way. Very, very cool. It's super unique.

Marcela (00:07:19):

howdy, it's Marcela, the other host of Next Stop: Transit Tech. So what was the initial spark that prompted AECOM to found the Automated Bus Consortium? And who are some of the folks that table?

Suzanne (00:07:42):

Marcela, I love that you ask that question because I love talking about it. And I get to brag on a lot of people at AECOM when I do that. So the idea actually came from someone on our team called Dick and Dick has a long, long history of supporting transit and many other aspects of transportation for AECOM. And I'm not exaggerating too much, I think Dick has been supporting at AECOM as long as I have been alive, it's very close, it's amazing.

Suzanne (00:08:20):

And so he realized that automation will be such an incredible way to save lives and to increase mobility in the transit world. And he also realized that it can be really challenging for any one individual agency to be able to support that and be able to do that and to be able to pay for it because it's so expensive to

develop technology. And that's challenging for transit agencies, which don't have budgets for that, generally speaking.

Suzanne (00:08:56):

So his idea was, that if we pull the funds of several different transit agencies, of many different agencies, they could all share the benefits of automation without having to all bear some of the same costs for development of the concept. So it was a brilliant idea on his part. We came up with the idea of reaching out to transit agencies across many different geographies and temperatures and route types, so that we would get a variety of routes included in the work that we're doing.

Suzanne (00:09:31):

And as I was mentioning earlier, this is an amazing combination of all of our teams. I'm not sure that this could have happened at very many of the places because we have some of the top automation folks in the country on our team and some of the top transit people. So folks like Bob Brownstein on our team.

Suzanne (00:09:50):

Bob, I think he's one of the, if not the author of the standardized procurement document that the American Public Transport Association has developed that's called APTA's White Book, which was a new term for me because as I've mentioned we're from automation. So he authored that and so he is on our team.

Suzanne (00:10:15):

I know everybody says APTA white book, of course, no but that's new for those of us in the tech world, right? And it wasn't new for Bob because he wrote that and so we were able to build on his work for that and knowledge of procurement that he has that's just unmatched anywhere in the world. He knows how to do bus procurements and knows how to write specifications for buying them.

Suzanne (00:10:38):

And then people like Greg Walker on our team, who has led our support efforts for transit agencies across the country. He's brilliant. Paul Avery on our team, he wrote a lot of the automation specifications to sit on top of Bob Brownstein's work on the APTA white book. So Paul was able to write all the specifications for the buses and a lot of the test requirements and specifications also, which is amazing.

Suzanne (00:11:10):

And then we also have Darrell Tabbula on our team and Darrell among other things is an incredible project manager and he is top notch with keeping everybody on track, which is not easy when we've worked with probably a couple dozen transit agencies since we started doing this. And so externally all the agencies and then internally all the folks at AECOM involved in each city and state and would be interfacing with the transit agency takes amazing skill set, and so that's Darrell.

Suzanne (01:13:37):

And while we're talking about the AECOM team, we also want to give a shout out and a thank you to Mariate Echeverry for introducing us, she brought us to this podcast and she's brilliant and we want to thank her too.

Marcela (01:13:59):

Yes. She's been great in introducing us and I value her as a colleague and as a friend.

Suzanne (00:11:43):

So our internal team has just been... And as I said, all of us on the automation side knew very little about transit other than riding it and the transit folks knew very little about automation. And so to put us together was very powerful and it's really an incredible opportunity to work on the project.

Marcela (00:12:06):

Very cool. That is a lot of moving pieces but it sounds like everything is in really great hands so that's amazing to hear.

Andrew Carpenter (00:12:19):

So to build on that, Jean, what brought you to the table for this consortium then?

Jean (00:12:29):

So we were actually first approached by a group previously known as Planet M, part of our Michigan Economic Development Corporation. That group is now going under the moniker of the Office of Future Mobility and Electrification. And they approached us to partner on this. I feel very strongly that partnerships are where everything is at and new mobility and an innovation and technology.

Jean (00:12:59):

And when I heard what the consortium was going to do, it fit very well into what my vision for our office was. And that was to advance technology, advance automation for the public transit industry and take some of the risk away from those local public transit agencies. It's very difficult for them to join a group like this where there is a risk.

Jean (00:13:28):

We know we're demonstrating new technology and so if we can help alleviate that risk, that's definitely what we are interested in doing and the fact that they are recruiting members from all over the country, so a wealth of knowledge through different large transit agencies and state DoTs to all put their minds together and do this amazing project. It was just a project I couldn't walk away from.

Jean (00:14:00):

So we did actually partner with the office now known as OFME to join the consortium and we then extended that to our transit agencies and we were able to select a couple of transit agencies to partner with us where the demonstrations were actually take place. So like I said, it was really a no-brainer when we heard what they were planning to do and how well it fit in with our vision or the direction we wanted to take in Michigan.

Andrew Carpenter (00:14:43):

Excellent. And so with that in mind, what does your first deployment or pilot or experiment look like at this point?

Jean (00:14:55):

Yeah. For Michigan, we've actually selected two different agencies and purposefully very diverse, not two similar projects. One is a partnership with Capital transit authority or CATA and Michigan State University, where they'll be deploying on the campus of MSU.

Jean (00:15:21):

MSU is really a leader in this vehicle automation. They've developed autonomous vehicles themselves, but all just cars, but they were very excited about the opportunity to look at transit. And because of their early involvement in this space, their campus is well set up to be connected. So that will be an awesome trial around their campus and linking to other multimodal facilities, parking lots and Amtrak station and central campus.

Jean (00:16:03):

And then our other partner that we chose to do a demonstration is a rural agency in a very rural part of our states. And of course, our state you always have to talk about our mitten, was shaped like a mitten. So this agency is in the thumb of the mitten and that is getting workers to jobs. Often the housing isn't located very close to where the jobs are in rural areas. And so this will be a rural route taking workers to jobs. We might also be looking at taking students to educational opportunities at community colleges in a neighboring county because there simply aren't those in every county.

Jean (00:16:51):

So two very different projects and we are really excited about the lessons we can learn for not only urban deployment of autonomous vehicles but rural deployment of those types of vehicles.

Marcela (00:17:09):

Since the members of the consortium are all over the nation and like you're saying, include pilot projects in rural areas, college campuses in major cities, can you tell us a little bit more about how these projects were selected?

Marcela (00:17:42):

For example, what route characteristics are most favorable for automated vehicle deployment?

Suzanne (00:17:55):

Yes. So as Jean described, it's two different questions, right? The first question is how do we select the routes and what characteristics are most favorable? And so part of our work as a group, as a team on the ABC was that where agencies would suggest routes that maybe give three or four for us to look at and consider. And they are based on needs as Jean suggested, as Jean described, that is a little bit different for each agency on what they would to see automated, the type of routes. So that varied a lot.

Suzanne (00:18:36):

So we would take all the routes that the agencies suggested to us and we would see if the route, for example, was very duplicative of an existing agency's route or maybe didn't add to the diversity or the challenges what we are trying to achieve. And so that drove a little bit of the decision making for picking which of the routes that we ultimately chose. And so then another driver and the route that we chose was also which, as we're looking at were the most favorable for automations, right?

Suzanne (00:19:18):

So in doing that, we started to work on it. We started to video the routes to be able to have a visual look at them. And we started to do analysis and out of it Paul Avery on our team, developed something that we call CRCS, which is a route selection tool. So it's a digital tool that we put together and it helps us analyze across three different matrix and matrices about how to look at a route in terms of its viability for automation.

Suzanne (00:19:58):

And we based that on TRB work on this topic on route classification and we looked at the simplicity of the route basically. So we can layer in a whole bunch of different aspects. What we've been looking at mostly for our CRCS work is, can the bus see clearly on the route? Can it get connected vehicle signals from intersections? And can the bus simplify data that it sees along the route its using?

Suzanne (00:20:33):

So it turns out and when we do these analyses, our outcomes for routes are red, yellow or green for the length of the route. So we can look at the areas that come up as red on our map because he's built this amazing visual interface for it. We can look at all the areas that are red and then we can look at if there are things that we can do to make, to turn those red areas green.

Suzanne (00:20:56):

And if a route is very complex and if it's red throughout the whole route, then that might be a reason to reconsider doing this route. And what might drive a route to be red the whole way is if, for example, maybe there's a lot of traffic and there are a lot of vehicles or people operating or stepping out in front of buses or vehicles on that road or there are a lot of intersections or unprotected left hand turns are one of the most challenging operations for an automated vehicle.

Suzanne (00:21:25):

And then I guess at the other end, the most simple route would be a dedicated bus lane. So we have some of those in the Automated Bus Consortium. And so this is where the whole route is set aside for only buses. So that is much easier. Those look all green on the CRCS analysis. So those are some of the easier ones, but automation and our requirements for automation that will be published soon basically are designed to work in across all of the operational design domains.

Suzanne (00:22:09):

So a very interesting thing that we did was we put all the routes together on a spreadsheet and looked at all the route characteristics as a whole. So looked at, for example, unprotected left hand turns, how many of the routes had unprotected left hand turns? So we looked at each characteristic in each application for automation singularly across our test development and then we can develop good tests to go with that particular characteristic when we look at them as a whole, across all of them.

Suzanne (00:22:41):

So that way we are able to standardize or harmonize all of our tests and all of our requirements and all of our specifications across all of the routes together. And it's been an amazing opportunity to save each of the agencies on having to develop specifications for each one of those applications and each one of those use cases when we can do it broadly across the country.

Suzanne (00:23:09):

So we think that this was a great opportunity for transit when we're able to look at things broadly like that and looked at routes as a whole and write requirements for automated buses that can execute a really wide variety of applications and routes across the whole country and across all different kinds of traffic and issues.

Marcela (00:23:30):

That's a whole different type of planning and I think it's just the beginning. It's going to be more and more common, so knowing these things and being able to make the connections between automation and vehicles I'm excited for it. And the unprotected left hand turn, I know that's tricky as a human driver. So-

Suzanne (00:23:58):

Indeed.

Marcela (00:24:00):

... just because it's a computer, doesn't mean you solve that turn.

Suzanne (00:24:06):

Well, I'll add to that. Paul Avery on our team, always reminds all of us that we are not testing the buses, we are essentially testing drivers, right? Because the bus becomes the driver, so it's a test of the bus system, a test of the bus' ability to execute on that but it's also essentially a driver's test built in.

Marcela (00:24:34):

That's a great point.

Andrew Carpenter (00:24:45):

Okay. That is fascinating. So, Jean, since you had mentioned that you have both a rural and an urban operator involved in your pilots, and this question goes out to both of you in general, is there any difference in how large and small urban agencies and also rural agencies are shaping this process? Are they resulting in different approaches or outcomes or are they kind of, I dare use the word synergize, in some way?

Jean (00:25:32):

I love that word. No. And that's a great thing about the consortium, right? Everybody has an equal voice. Everybody can help. All the members can help shape what this looks like. And the real purpose for being in a consortium and pulling so many different agencies together is that we want to learn different things about different settings.

Jean (00:25:55):

So each agency along with consultation from AECOM, decided on what route they wanted to do and each of those routes are really unique and will lend itself to this whole pool of information that we can all then go back and use to advance this throughout our states or throughout service areas. So every voice counts. Every vote counts, whether you're a large urban or a small rural agency, it matters to the overall ecosystem of deploying AV public transit.

Jean (00:26:39):

And I don't know if Suzanne has a different take on that, but that's one of the things that really drew us to it is that we can really let everyone's voice be heard in this.

Suzanne (00:26:51):

And I love that, what you're saying Jean. And then the only thing I would add to that is that not only can agencies in Michigan then gain from that, right? But now other rural routes and other rural transit agencies in the country ultimately can take Michigan's success and Michigan's forward thinking and add it to their approach for automation.

Jean (00:27:15):

Absolutely. When we're thinking transit industry, we rarely think what's good just for our state. We were a large community and we're always thinking, "How do we spread this across our country?" We all learn from each other. We all gain from any one's success, right? Because we can take those lessons and we can scale them to work anywhere in this country to improve mobility for everyone.

Andrew Carpenter (00:27:49):

That's one thing I genuinely just love about working in this industry, is it's an industry where everyone builds on everything as opposed to competes and keeps the information for themselves. And so one of the main things that N-CATT focuses on is finding these lessons learned so that not everyone has to keep learning those lessons, but you can build on them as you go. Certainly it's the real world version of research and development and so-

Jean (00:28:28):

Yeah. I know a lot of people's concept of research and development is that you keep those lessons to yourself so you are the winner, right? And that's not how public transit thinks, right? We're all winners. If one of us wins because we can all gain from those lessons.

Jean (00:28:47):

So like I said at the beginning, partnerships are so incredibly important in new mobility advancement and that's one of the reasons. You partner to learn from each other and to do a greater good. I love that about this industry as well.

Andrew Carpenter (00:29:11):

And with that in mind, I know we're very early in the days of the consortium, but are there any lessons learned yet?

Jean (00:29:25):

Well, we are early on in it, but I think for us lessons learned were that when we were trying to reach out to the public transit agencies in Michigan to find out which agencies we would partner with, that everyone has a little different concept of what might be possible and whatnot. And we definitely had agencies around the state who were ready to jump at the chance to try something this and some who said, "Oh, yeah. It's still too risky even though and that you're helping us take the risk, it's still too risky for us."

Jean (00:29:59):

And honestly, since the consortium started and we had already chosen our two official partners, we've now had other transit agencies come and say, "Hey, you know what? We actually are interested." I know one of our large providers in the state has since on their own joined the consortium. So that's one lesson learned, is that sometimes you just have to give people time to process a concept that's this big, right? That's this foreign.

Jean (00:30:31):

And also I think it's that you have to be flexible. The original service we were planning in for the rural provider, things happened with the employer and with the housing and what we first were going to do crumbled. And so we said, "Okay. What else can we do?" There's a lot of use cases and we found something else. You have to be that flexible when you're dealing with new technology.

Jean (00:31:01):

So from my perspective, those are a couple of lessons I've learned, but I think I'm guessing Suzanne probably has some different lessons they've learned on their end.

Suzanne (00:31:19):

We had such good leadership, I mean, I think from Dick and some of these people who are so experienced and so trusted and in doing excellent work throughout the country and throughout decades of experience, that we've been able to work with so many people.

Suzanne (00:31:38):

And be flexible, exactly as Jean said, that so far it's gone about as well as could be. And aside from COVID, I mean, I think that was a major challenge for us because transit agencies were so hard hit financially and had such problems with maintaining ridership during that time period. Things are starting to bounce back, but I think that was a major setback for us and for a lot of our agencies as well.

Suzanne (00:32:17):

When I hear the question, lessons learned, I jumped to our biggest challenges and what we took away from them. And COVID was probably our biggest challenge. And as Jean said exactly right, the way we got through that was having really great staff, great agency members and having great staff on AECOM side with experience and steady leadership throughout the whole situation.

Suzanne (00:32:47):

That and flexibility as Jean said was probably the key to being able to push through that and support from AECOM side as we continued to work even though we didn't always have funding for this, right? So it was incredible to have support from the AECOM side and to be able to push through all this. And I'm super proud of those folks and being a part of that organization and working with people like Jean who were able to be flexible with all of us through that most challenging part.

Suzanne (00:33:28):

But overall, it's been a pretty amazing experience, the past few years to be a part of that team.

Marcela (00:33:42):

That's great. Just a lot of flexibility, it seems like COVID-19 was a good primer for the flexibility and adaptability it takes to implement a new technology, very unexpected hurdles and you just have to keep going and find creative solutions too, whether it's convening groups of people or modifying your service or your policies to adapt to something that we have never experienced in our lives at this scale.

Suzanne (00:34:28):

No. We've not and to your point, I mean, we have people who have a lot of experience. It's a very experienced team and nobody has experienced anything like that before.

Jean (00:34:41):

No. I totally agree. It's that flexibility and when you look at any technology, not just automated vehicles, what we found is that there's technology out there that we thought was good just for one purpose and then we realized, "Wait? It has all these other benefits."

Jean (00:34:59):

As we've had to reimagine public transit during the pandemic, we've been able to find all kinds of other benefits from new technologies. And I think automation is the same way. We're going to keep learning different benefits and different ways that it can really improve mobility for all of our citizens.

Marcela (00:35:27):

Very true. That leads me to a question that I had spurred from earlier conversations with Suzanne about members of the consortium shaping the technical specifications of the buses as you all developed the procurement documents. So I'm curious. What were some of the features that agencies were looking for and, I guess, were there any surprising technological requirements or things that agencies weren't quite thinking of since automated vehicles are such a new technology? It's almost like going shopping for something and you're not quite sure what you need quite yet.

Suzanne (00:36:21):

Right. Yes. And so let me start off. I think... So to get to an interesting answer to that is that we didn't start off... We started off with having knowledge about how all automated vehicles work, right? Those were the not surprising things. So when we think about automated vehicles overall and the applications that they do and how we can apply that to transit, maybe those were some of the more expected applications that we could do and so. And those were fun to integrate into this.

Suzanne (00:37:01):

Then, I guess, guiding what the agencies were looking for. I asked all about this. I asked him what were some of his favorite applications that the agencies wanted. And he reminded me that the agencies all chose existing service routes. So this means that we nobody wanted to create routes just to do this. So how interesting that we are building on as a truly needs based situation that we use to build the requirements for existing routes.

Suzanne (00:37:42):

Now, one of the things that's unique about what we're doing is that we think that our specifications are really broadly inclusive of just about anything a transit agency could want. We're not looking at just a small set of applications. We're not looking at only one route or one use case, but we're looking broadly

at a lot of them. So maybe some of the more interesting features that we don't see, for example, in other automation projects that we might not see outside of transit nor the transit-based one.

Suzanne (00:38:19):

For example, ADA. Trying to make sure that the buses are able to support users who use wheelchairs, riders who use wheelchairs and how do we do that in an automated situation? Our plan is for the buses to have safety drivers on them so they can bring their wheelchairs up, but there are systems coming out that are available now or soon that where that automated supporting, getting the wheelchair onto the bus.

Suzanne (00:38:49):

Another really interesting transit specific feature that was challenging to work around is things like integrating bicycles onto the buses because all the sensors are on the front of the buses.

Marcela (00:39:05):

Okay.

Suzanne (00:39:06):

So, right? So can we put the bicycle racks where the sensors are. But broadly, those are some transit specific ones that were some of the more interesting ways, things that we looked at that I was surprised about. Some of the other applications, of course would be looking for bike lanes, being able to interoperate with bus stops the same way.

Suzanne (00:39:38):

So how do we... Maybe there's a way that we could know that if people are waiting for a route at a bus spot, if it's a shared stop or maybe it's a stop only for that transit route, so the bus knows to stop and the bus can see if there are people they're not or can get feed from the video at that stop to see if there are people there. So maybe not stopping at that stop or ~~planning or~~ even there are some really cool applications related to transit signal priority based on how many people are in the bus.

Suzanne (00:40:13):

Our friends in Utah DoT have executed that. So that's a really cool thing to look at how we interact with the people with potential riders at bus stop.

Suzanne (00:40:24):

Then interacting with signalized intersections. Connectivity. I mentioned I have a background in connectivity. So that's one of my favorite applications if we can get connectivity to operate with the buses so that the buses can get information about signals in and out and over the air environment. So there are a lot of signals in many of our routes, so that would be helpful.

Suzanne (00:40:50):

We're also looking at maintenance yard activities, that's also a very interesting one. Several of our agencies wanted to look at automating maintenance routes, so that would mean that when the bus comes into the maintenance yard in the evening or when it's done as route, it can park itself or it can

take itself through the river washing and cleaning process. This is something that's fairly new for the automation industry that we worked on.

Suzanne (00:41:22):

And that would save drivers who were in one route, who are in one yard specifically where the buses have designated spots and so some of the drivers who have to park in the back of the lot have a really far walk and that can be very challenging in inclement weather. Also the ability to not have to have the driver on the bus through the cleaning process allows them to be able to rest after they've driven all day too. So those are some pretty interesting ones.

Suzanne (00:41:59):

Then we have some of the basic ones. Lane centering, lane following, lane changing, merging, following in platooning, that's been a very interesting discussion as platooning is now a part of our requirements so all of our buses will be able to support platooning.

Suzanne (00:42:21):

And I think that's a lot. I think I just gave a big list. There are certainly more but those are some of the fun ones.

Jean (00:42:27):

Can I just add in something interesting as we're talking about deploying these in rural areas and the differences for a rural agency as opposed to an urban agency, where in an urban setting the bus needs to be able to detect people while in a rural setting it needs to be able to detect wildlife. It needs to know if there is a large farm tractor in front of it, so that the lane might not be fully accessible.

Jean (00:42:56):

So it's been really interesting to plan that rural route and to broaden people's perspective of what does an automated vehicle need to be able to detect and identify. So I thought that was fun. And to Suzanne's point about ADA and accessibility, we are putting automated wheelchair securement systems on these buses and those who choose to and those have been used around the country in regular transit buses more and more. We're deploying several in Michigan.

Jean (00:43:36):

But a lot of the other connected technology that's associated with these buses help multiple people. So if a bus can detect that a bus stop is coming up, it also means that there's a potential for it to interact with the actual riders that are waiting there. And so with an app on your phone that talks to the app on the bus, you can let the driver know or the bus know in this case, who is the driver, that you're sitting there waiting and that maybe you have a special need, that you're going to need more time for onboarding because you have a disability that makes it take more time for you.

Jean (00:44:15):

So it really opens up all these other possibilities of technology that we can incorporate in both the bus and the infrastructure that the bus interacts with.

Marcela (00:44:28):

That's very cool. I was actually recently talking to someone about vehicles and the various needs of riders. And one of the considerations is wheelchairs or if you have a service animal and if you can communicate that to your driver slash bus via an app.

Jean (00:44:56):

Yeah.

Marcela (00:44:57):

How will these connections will create a more seamless experience? I didn't know that there is automated wheelchair securement, which blows my mind because even if it's a station or a regular bus driven by a human driver that saves time and especially in COVID times helps reduce contact.

Jean (00:45:30):

Absolutely. And the other thing that it really does is maintain dignity for the passenger. So yeah, we've deployed them on several buses in Michigan, not on automated buses, just on regular route buses.

Jean (00:45:47):

People at first are a little skeptical or worried about how it's going to work but it's fairly simple to maneuver into it yourself and the people who've used it have said it's was great. It really made them increase their level of feeling independent, that they could get on and especially if it's a low floor bus that they can wheel on to themselves and then get themselves into position in a secured position. It's just a win-win. It reduces, like you said, the contact that the driver has to make and the passenger, so for health reasons. And it really increases their whole feeling of independence. Yeah. Technology spawns more technology and it's pretty awesome.

Marcela (00:46:35):

Yes. I think that bringing together all of these folks at the table allows you to brainstorm all of these different situations. I'm not sure if a tractor would have been my first thought or something Suzanne said and I hadn't considered, I think it might have been the passenger loads and transit signal priority. That's a really great connection there.

Suzanne (00:47:38):

You're covered, but yeah, I have to give the credit for the idea of the using a connected vehicle system to prioritize lanes, prioritize signals with the most amount of buses that goes to Blaine Leonard, in the Utah DoT, did what I think is the country, maybe the world's first deployment. Not an experiment, not a pilot, but a deployment with the Utah Transit Agency of being able to use passenger count and sending that data to the signal and then having the signal adapted to that need. They're really amazing.

Andrew Carpenter (00:48:23):

One diversion from this that you made me think of when it comes to having safety drivers, at least in the short-term and then being able to automate a lot of things so that it lessens direct contact between drivers and passengers. I'm wondering how you see the role of the driver evolving as these technologies are deployed onto transit routes and start to grow across agencies?

Jean (00:48:56):

I think agencies are really going to have to reimagine a lot of their staff and a lot of their roles. I think drivers may become emergency drivers in these cases, right? So they are there to take over in case of an emergency, but they're also there to provide assistance and reassurance.

Jean (00:49:18):

I think public transit because of the inherent way it operates and what it means to people, having that person on the vehicle that can assist if something goes wrong or is simply there for peace of mind in case something goes wrong. Even if it never goes wrong, knowing that that person is there and can handle things. But quite often in transit, especially in outlying areas not necessarily route buses, but still some of those, people need some personal assistance.

Jean (00:49:56):

They may need a hand to get up. They may need you to assure them that they're at the right stop, which yes technology can do that too, can tell them they're at the right stop, but that personal touch I think is still really important. And so driving roles may actually expand into that, that you are truly that customer service person on the bus, that you're there to assist and assure the passengers and be there to take over in case something happens, that something goes awry or that bear does run out in front of the bus and it's not recognized.

Jean (00:50:37):

I think a lot of staff are going to have to readjust because working on an automated vehicle is very different for a mechanic, especially if we're going to electric buses. It's very different needs than a diesel powered bus as far as a mechanic is concerned. So I think everybody's going to have to really take a look at roles and responsibilities and redefine them for the future, but I think people are still going to be important.

Jean (00:51:10):

It's not like machines are going to take over everybody's jobs. People are still very important, especially in the public transit industry.

Suzanne (00:51:20):

And I would add to that, Jean. Did I mention I'm new to transit? One of the things that I learned being new to transit is the important role of the driver. I didn't understand and it didn't occur to me that drivers are also important for everything that Jean said and then also for security.

Suzanne (00:51:43):

I learned that many of our transit agency members count on drivers to be aware of human trafficking, to be aware of fights on the buses and people who are doing the various things they shouldn't be doing, often the front line for that can be the driver. So those things aren't going to change anytime soon and so it's really important to have eyes on the street. And so we're really grateful to the drivers for playing that role too. And what a challenging role in the COVID world, right?

Jean (00:52:21):

Definitely. I totally agree with you Suzanne. And again, if I can take it to a rural setting, I have numerous stories of rural bus drivers who have noticed that one of their regular passengers didn't come out for the

bus today or didn't make it out and called and found out that that person was a need, that they had been in a medical emergency and no one was there to check on them. So there's still that personal touch that I hope we never lose that personal touch.

Marcela (00:53:00):

In an earlier podcast with North Central Regional Transit District, we were having a conversation that a lot of times a transit driver may be the person that you talk to you that day and you really get to know them. So that personal connection is I think something that we bonded over is what drew us to transit, is that you get to meet people, you get to know your community and you just don't get that experience when you're commuting in a single occupancy vehicle.

Jean (00:53:40):

Right.

Marcela (00:53:40):

You just get to know yourself really well because you've talked to yourself as you're stuck in traffic.

Jean (00:53:46):

Yeah, exactly.

Andrew Carpenter (00:53:55):

A kind of related question that I have is, again, going back to the idea of having safety drivers in the beginning and some form of staff around most to all of the time, is what level of autonomy are you all looking for, I guess in the short-term and over the long-term for the buses? And then-

Jean (00:54:36):

So I can take that at a low level and then Suzanne can step in if she wants to give more details because she's definitely more of the technical expert than I am. But we are looking at level four autonomy. So there still would be a safety driver on board. There are still some situations that the vehicle may not be able to handle themselves, itself, how do you refer to AV?

Jean (00:55:07):

As far as the process for incorporating them into the fleet, that's what we're learning and that's why we're doing all these different types of demonstrations to the consortium is to figure out where do AVs fit best in an operation. Is it the entire operation or is it one factor of it? Is it one type of route? Is it one type of service? That will really help define how you incorporate it in overall.

Jean (00:55:37):

My guess is, and I fill secure about this, that at first it will be a blend of autonomous vehicles and non-autonomous depending on the use need. This consortium, I think that's what's still exciting about the consortium is that we're doing so many different types of demonstrations on different types of routes. Everybody can learn from that instead of one by one learning, "Okay. Can I do it on a BRT, a bus rapid transit route? Can I do it on a shuttle? Can I use them for rural service?"

Jean (00:56:11):

And we're learning that all at one time and that will really help with agencies being able to figure out how they incorporate it into their specific agency because they are all different and everybody's going to incorporate it differently.

Suzanne (00:56:30):

Yup, exactly. I would only add some technical details to that. Jean is spot on. We're looking at level four automation.

Suzanne (00:56:51):

NHTSA and Society for Automotive Engineers have agreed on five levels of automation spanning from zero to five. The difference between four and five, five being that a vehicle can operate without a driver on any operational design domain. So the term of that ODD, it's called. And an ODD is the area where the route on which the automated vehicle is designed to operate.

Suzanne (00:57:24):

And a level four automated vehicle, the vehicle can operate on its ODD, on its operational design domain without a driver, but it may not be able to operate outside its ODD without a driver. Whereas level five can operate anywhere without a driver, right?

Suzanne (00:57:47):

So the idea is here that Automated Bus Consortium is looking at level four with drivers included. That's the intention. And so the broader picture, yes, and that's a whole other practice area that we have, Andrew, where we look at integration of automated vehicles across all levels into existing fleets, into existing traffic. And they are all different opinions and all different forecasts for when that will happen.

Suzanne (00:58:21):

I think that in the transit agency, the transit industry I think that will be determined by the needs of the particular agencies. So maybe there is an agency who does want to have automations and support safety and mobility to relieve some effort from the most dangerous driving tasks. Maybe some of those agencies have turnovers on their plates faster than other agencies, which may choose not to do that.

Suzanne (00:58:54):

So I think we'll see a blend and a mix in the transit agency for automation. And then more broadly there are some people who say we will never see full automation of all vehicles, that level five is not something that exists and certainly not in my lifetime and maybe not in yours. There are all kinds of different opinions about that and then there are some automotive manufacturers who say that they're doing level five automation right now. There are all kinds of different thoughts about that.

Andrew Carpenter (00:59:27):

And one very technical question. Is there a difference between automated and autonomous and/or automation and autonomy?

Suzanne (00:59:40):

Oh Andrew, that's my favorite question. Jean, do you mind?

Jean (00:59:44):

Oh, no. You've got this one, Suzanne.

Suzanne (00:59:48):

It's embarrassing because I love grammar and I love being precise with language. So that's an important one for me. If we look it up in the dictionary, the word autonomy describes things that operate independently of other things. Historically, it's been used to describe nations or people when they turn 18. It hasn't been applied to mechanics historically.

Suzanne (01:00:20):

The most correct term, well, the term that SAE and that USDOT have standardized is the term automated, right? Because that describes when a machine does the work of a person. And that's what we're describing here. And so that's the term that I use. And automation is the adjective that I use because that describes the different levels of a machine taking on the role of a person in the driving task. Right?

Suzanne (01:00:55):

So that's been very helpful in explaining automation to a lot of our clients who are less familiar with automation and how it works, just to explain using the term automation because it describes not a machine that's roaming around doing its own thing, but it describes how we can adapt the environment to the needs of a machine that's doing the work.

Suzanne (01:01:23):

So in the manufacturing industry had picked up on the term autonomy, and has come up with some adjectives that you describe that go along with that. And I think that the government and the academic folks tend to use the term automation. And so we describe automated vehicles, we describe levels of automation. And so that's the term that I prefer, but other people have a different approach to that.

Suzanne (01:01:56):

And I also fully confess that I think entirely too much about grammar. That's my footnote.

Jean (01:02:05):

I'm a grammar geek too. But I agree with Suzanne, that when you say autonomous, it does make people picture a vehicle with absolutely no driver. And it only makes you think of acting independently too, right?

Suzanne (01:02:19):

That's what the word means. Yup.

Jean (01:02:21):

Yeah. And automated vehicles are meant to interact with everything around them. So they're not acting completely independently. And it's not a phrase that I often correct people for using if they say autonomous, and I know I often say autonomous instead of automated, but it is a distinction that it's helpful for people to understand so they get the right picture in their brain when they think of an automated bus, that it is an interconnected piece of a bigger puzzle.

Suzanne (01:02:54):

You said that more beautifully than I have ever said it, Jean, and I've been saying it for years. So I really, really appreciate your addition there.

Jean (01:03:02):

No problem.

Andrew Carpenter (01:03:05):

That's awesome because I've been using those interchangeably. So I've now firmly in the automated camp.

Suzanne (01:03:10):

Right? Isn't that interesting? Somebody else said that to me, "You mean they're not the same thing?" So, yeah, I looked it up because I wasn't sure either, Andrew. So the dictionary is what turned me.

Marcela (01:03:23):

Yeah, I think I'm also team automated. -I also have a little bit of a technical question. For the buses in the Automated Bus Consortium, because I'm thinking about the future and I automatically assume that automated vehicles are electric. For the pilots in the ABC, are those buses necessarily electric? Or are some of them going to be diesel buses as well?

Suzanne (01:04:12):

All right. So for the automated... I love that you separate out all those different functions because they are different functions. And another separated function, Marcela, is connectivity, right?

Marcela (01:04:24):

Mm-hmm (affirmative).

Suzanne (01:04:25):

So I'm going to answer your question directly and then I'm going to dive in a little bit deeper. All of the Automated Bus Consortium members voted on how they wanted to proceed with regard to electrification and power in general. And they all voted for to choose electric powered buses. So all the buses in the Automated Bus Consortium currently are, well I should say, the RFP will require electrification of the automatic buses. So that's the direct answer.

Suzanne (01:04:59):

Now, it is important though to understand that electrification helps automation. They work very well together because of the electric requirements and how electricity is used to execute automation. So they are very important together. However, they do not have to function together. There will be aftermarket outfit, there's a way to outfit diesel buses and other types of power buses to have them execute automation on the roadway safely. So it doesn't have to be, but it's very helpful.

Suzanne (01:05:37):

And so likewise with connectivity. We hear the people use the term CAV a lot, meaning connected automated vehicle, right? But there are actually two different features. So for example, that the safest connected vehicle is an automated vehicle, but they don't have to be the same. It's the same thing. Connectivity, electricity, electrification and automation are all connected and are all good things and all work together really well, but they are separate functions, and don't have to be together, but our buses are all electric.

Jean (01:06:12):

The one thing I'll add to that, Suzanne, is there's different schools of thought on it, on what's best, right? We don't know what's best yet because it's too new. But we felt as we're moving forward because that new mobility, right? It's about technology enabled and it's also about being carbon neutral. It's about helping the environment, helping the atmosphere. And so electric, just seemed the right thing to do. But certainly we need all technology to advance.

Jean (01:06:49):

So if automated technology can advance more quickly by being put on to existing vehicles that are diesel or gasoline or whatever, we want that to continue as well. And a lot of people who aren't in it don't understand that all of those things are separate. So that's great to explain that, Suzanne, that the stacks, as they call them, for autonomy can be put on any vehicle, but there are things that make it work better and more efficiently.

Jean (01:07:21):

And we've talked a lot about purpose built vehicles. And that's the idea that instead of having everything be an add-on, whether it's the automated features, the connected features or simply accessibility features, that you design that from the ground up. You don't take an old product and say, "Well, how can we change this to make it work for other people?" You start with the people first and say, "What do people need? And how do we build a vehicle from the ground up around what people need?"

Jean (01:07:54):

And that's really where the industry is heading. And I think it's a very exciting place for it to head because everything we're doing in the transit industry should be people first. It should be based on needs of people, not, "Hey, we've got this shiny new toy. Let's figure out how we can use that." It's, "Hey, we've got this problem, we've got this mobility need, how do we solve it?"

Marcela (01:08:24):

That's awesome. And thank you for the clarification. And yeah, they are definitely separate things. But it's good to know that they're coming together for this particular consortium because I know electrification is its own whole entire process.

Jean (01:08:47):

Yeah.

Marcela (01:08:49):

So might as well, lump it all, get it done.

Jean (01:08:53):

I used to think that when I said, "Yeah, we want electric buses," that that was just a simple thing. And it meant one thing, and boy, did I get educated on that. There are all kinds of electrification and I had no idea that whole world existed.

Andrew Carpenter (01:09:31):

So after talking about all of this, based on where the consortium is now, is there a way for interested agencies to get involved and how else can they get involved in learning about exploring or experimenting with automated vehicles?

Suzanne (01:10:16):

So everyone can for sure reach out to us at AECOM. You can find me on LinkedIn or the automatedbusconsortium.com is the website that we have. So please check that out. But as it turns out that a lot of our agencies who have joined have actually joined because Jean talked them through how awesome it is so I'm going to pass it to Jean for the rest.

Jean (01:10:41):

Yeah. Thanks again. I was actually going to suggest that if somebody wants to know what it's like or what our thought process was for getting into it and what the considerations are on a state DoT side or even a transit agency side, they can feel free to reach out to me or really any member of the consortium. I think we're all excited to be a part of it and we're all happy to share our stories and our perspective with new members.

Jean (01:11:07):

So anybody is welcome to reach out to me if they just want to talk it through before joining, but also everybody on the AECOM is very knowledgeable and they're not going to twist your arm to join. They're going to give you the information you need because it's got to be something you personally committed to and that you really want to do. It's not something that you go into lightly. It's something that needs to be a thoughtful decision, but for us it's been a really terrific decision. I'm thrilled that we are part of this group.

Marcela (01:11:46):

~~Yup~~. I'm really glad that this group exists so that wheels are going to be on the ground in the coming years and that automated vehicles are not just a Jetsons, like so far in the future that you can't even imagine it, concept anymore like I used to think they were. So thank you for joining us and for sharing so much great information on the pilot projects, on the work that the Automated Bus Consortium has been doing and for providing so much technical information because I don't think I've ever dove in so deep on automated vehicles before.

Jean (01:12:35):

Thanks for having us. It's been a pleasure.

Suzanne (01:12:39):

Thank you.

Andrew Carpenter (01:12:44):

All right. Thank you everybody and anyone that is interested in learning more, you can feel free to reach out to us at n-catt.org and we will happily connect you with all of the information that you need, whether we have it or folks like Suzanne and Jean have it.