Transcript of R16 webinar "Expanding Use of Drones in the Railroad Environment" on August 8, 2018.

>>Thank you for joining us. This is the expanding use of drones in the railroad environment.

>>Welcome to today's webinar. My name is Kate [Kurgan], program manager. I would like to welcome you on behalf of the Federal Highway administration. Let's get started.

>>We have two great presenters ready to share with you. Our goal today is to broaden your thinking about the use of unmanned aircraft system commonly referred to as drones, with line of sight and beyond line of sight applications. You will hear from two speakers but the overall goal will be applying new technology so we can work more safely and efficiently. We have time at the end for questions. And type in your questions in the chat box and we will try to address as many as we can at the end of the presentation. We have over 100 participants today. A list of attendees is provided on the left-hand side of the screen. At the conclusion of the second presentation, we will continue with the life Q and a session. If you have any questions throughout the presentation, you can type them in the checked box. Due to proprietary information concerns, we will not be able to share this presentation or the recording after the webinar. You will be able to receive a transcript if you'd like to receive and review it later. A few housekeeping details--the phones are needed for these two presentations, we will addresses many questions as we can. I will read out loud as many questions as possible.

>>I am very pleased to introduce and welcome Paul and Todd. They will share the latest best practices from the DOT and railroad perspective. I will be moderating the webinar today. Pam [Hutton] is also on the line to address any questions. Prior to introducing her speaker, I would like to give you a little bit of an update on the program.

>>$232 million was dedicated to SHPR2 research. You can see on your screen that there are four focus areas that we are now implementing 63 solutions in the areas of safety, reliability, capacity and renewal. There are 16 products in the renewal area.

>>We have $155 million in direct funding assistance. We have 63 solutions and 430 implementable projects. For every one dollar invested, there is an average of two dollar investment return. Next let's look a little bit more in detail of the program. Here you can see a year ago, we reached over 300,000 individuals, engaging them through webinars, trainings, and workshops. We have led 12,000 outreach activities. We provided over 16,000 hours in technical assistance for our subject matter experts that work closely with this project.

>>Before we turn this over to our speakers, I want to tell you little bit more about the product. R16 facilitates successful project delivery through coordinated activities and opportunities. By improving coordination and collaboration, DOTs and railroads benefit. Frequent interaction builds stronger relationships and each entity develops a further understanding of the requirements. This allows the work to be done faster and with fewer headaches. In the end, R16 results in better management and stronger communications, cooperation and collaboration. It also helps to streamline projects. One of the most valuable activities is a strong group of railroad administrations. There's been collaboration between the railroads and DOTs. The priorities want to be the main focus of the community. Through coordination, webinars like today are possible. There a rich library of the presentations along with the case studies and printed are available. By providing railroad examples, we hope to empower more agencies through methods. It is my pleasure to introduce our first speaker, Paul.

>> Thank you for having me and for the invitation to present. I will discuss some of the unmanned aerial systems that have proven to be a valuable tool. I'm going to discuss where our program began and go on to some cases where we found some value. We'll go over storage and lessons learned. And the use has helped us to increase safety and productivity, while also being a tool to find innovative ways throughout the transportation system. It is been amazing to see after talking about these topics watch as per the imagination of other people. I hope it does the same for you guys today. To discover those ways were might be beneficial in your organization. I want to point out that the cases were done under part 107 rules and done within visual line of sight. There is a lot of operations that can be accomplished. The FFA -- FAA has been great to get waivers.

>>Our program started with my love for aviation. I've been playing RC aircraft for over 30 years. About passion for being in the air. In 2010, we are notified bone of our universities that they were building UAVs and adding --. This really intrigued me. I had a photo of the aircraft but it does not appear. A student had pieced together what looked like a home built aircraft. I did the MANOVA was going to fly at the time. You have a field, imagine a large rubber band braided together and a hook. They pulled back the aircraft stretching the rubber band into the air. It flew and flew quite well. It was able to collect data that was amazing. It really opened up a possibility. Started a few project pilots to see what it collected and at what caused. From those early pilot projects is where it all started. The project kind of had a few hiccups. They were not perfect but the data collected was really useful and gives the -- a whole new world for data collection. Those who want to know how started, that's were began. If you aren't familiar with the 333 a had to have unmanned aircraft license for that. Right as I was about to submit documentation that not to worry about sweating it because they're getting ready to release new rules called part 107 which is really change the world and created an explosion of --. I see the number growing in the future. I wish I had that picture see can see our current fleet. We have four different varieties of aircraft. Each of the aircraft fill a different role. We have some have thermal camels -- cameras. Have some cheaper ones as well. Those are kind of just starting. If you can really get started with minimal investment. Under $2500, you can achieve great results. If you're starting on your policies and procedures, we are happy to start with ours. They are on our website. One of the first areas where we started utilize these was the structure inspection. They do a job that is often underappreciated. If you can see in those pictures, especially on the left-hand side. Imagine hanging 400 feet above a drop off looking at the structure integrity of the bridge. And AirTran inspect this bridge. This is a job folks do every day. Can you think of a few ways where the unmanned aircraft could assist in this area? We tested using normal and thermal imagery to find voids. We also use it to map the deck after is been sounded to determine the quantity of the areas that need to be fixed. We save a vast amount of time on this. You can see the middle picture, each of the shapes there. If you can imagine a guy who would create a grid in 10 foot sections, no to do with an unmanned aircraft. We don't keep the lanes closed as long. We also is it to supplement those inspections. We could analyze it a little bit better at the office. With what is being very valuable to increase the frequency of bridge inspections. There is still some issues of some environments but we can still use this documentation. Site monitoring has been improved to be extremely beneficial. We're able to live stream vehicle to supplement those areas were he to not have coverage for traffic areas. We are able to have it up in minutes and live stream. A kind of gives you a birds eye view at a low cost. Imagine an accident and you find the roots to get -- routes to get emergency vehicles in. It is possible to do this right out-of-the-box. For land surveying, I started my career as a construction surveyor. We are utilizing unmanned aircraft for serving. The difference is the altitude is lower. And this ultimately gives us better data. The software and hardware that is out there is

great. See a great increase in productivity. There is an RGB point crowd. From this data we can really greed -- create stockpiles. We can it is faster than conventional methods. We can collect that data safely. It doesn't really replace surveys but supplements them. On the site he could see a few examples of the surfaces that were created. You can see the RGB point crowd, you can see were all of the images are. It is a deliverable from a short flight. Is a great tool. It can do is stockpiled quickly. And together we can combine the best methods to a hybrid model using CAD. I had a confidence report I could show you. How good is the date of? The answer is that it depends. Depends on altitude flown. If ground points are set. And also the amount of vegetation, there can be warping of the data. It is important to check and verify that data. Don't always trust the spec sheets that you get from the vendors. We are seeing tolerances within about a 10th of a foot. The difference is that you get more detail in the model. You can actually see all the detail in between. We have really changed the survey specifications to require these verification reports. To know how good the data is that we receive on the surveys. Sorry require random points. They showed the horizontal and vertical axis. We are changing the way we are doing are projects. We looked at our processes and found out what wasn't working and what was. We thought that if we change our process, and illuminate the paper plans. And deliver the 3-D document is a legal document. This is how RS are 20 came to be a first project. It was advertised as the legal document. Was an entry based model that we had callouts on it. There is intelligent in the design. We also used phasing and changing over time. Compared those services built by the contract by collect being those. We took this into CAD which is laid -- overlaid of the model. This is where we see the future going. There were a few issues on the project. It was easier to work through. Your return -- able to return the model and fix it. We didn't have to take the time to update the paper said. Seen some great time savings on that. With that project, there were issues. It still had an overall savings of over $80,000. It was still completed 25 days ahead of schedule. Div because of the new tools that utilize on the project. Is a couple of plants the don't have a favorable reputation. My you haven't account each one of these plants for removal. You are seeing those in the aerial photo. Is there a better way for that? We used a you AES to map the area. To help remove those undesirable plants. We can easily calculate the before and after to show what work had been done for removal. Were able to utilize the same data to move hot spring water into a closed system. And said of --. Are able to use the same data set for both of those cases. The same way that we are changing our products, we are looking at a way to handle our incidents. This can be extremely useful. Whether it be the live streaming or MAPI a fatality seen. Kind of gives you a new tool that can be extremely valuable. You can map a scene much quicker to get traffic moving quicker. Can see ways or pass into an accident or see how all traffic control is working. North Carolina did a study on this to reduce a traffic from four hours to one over. You get much more detail in the accident scene. Said only having the drawing on accident road. It is almost impossible to survey every thing out there. But with an image you can see everything like on amount. Receiving all that precious time. Thermal capabilities can be used to help find somebody who is lost or disoriented. It is important when some annuity has minutes left. What about it debris filled disaster? You can map out those DePree -- debris areas and you configure how many trucks you need. Our goal is to really equipped all of our management vehicles with the unmanned aircraft. Also want to talk on some of the amazing advances on software. You can determine the pavement condition. You can see some of the crack conditions that are automatically mapped on the pavement. This is traditionally completed with an employee walking out there it and measuring the crack. The productivity can be massive. Gives you really large return on your investment. Aircraft could pay for itself in just one project. This is been showcases one of the most dangerous roads on television. And is --. This is plowed during the winter to keep it open. A dirt road.

And if this roadway wasn't intimidated enough, let's throw a landslide on their. That is what happened earlier this year. We were able to get this flown in half a day. Here's the point crowd deliverable. We had the process and it delivered to determine the best way to repair the slide. The image is the point cloud. Imagine trying to survey that with conventional measures? Projects like this, we are seeing a 40 to 60% savings. There releasing high benefits to. This shows a railroad crossing, we are no using this for asset management. You can have it identify the assets and log into a database. We met all of our routes with -- which houses all the information. We hope for model-based design that was discussed earlier. We like to keep it constantly updated. The dilemma is storage. My suggestion is to plan for large data sets. Will be creating a lot of data. The question becomes how much. I am creating terabytes of data. It does create the problem of where to store and how much does it cost to story. These are things to think bone you start your program. Picture you have a plan on where to store it. We are keeping all of our flight logs. The date it is keeps growing. We trying to get as much use out of it. If somebody needs high-resolution data they conceive it's already there. Instead of having to go get it flown again. Saving time and money. The reason we are keeping so much data is partly for transparency and good stewards for the public. We try to keep good blogs to show exactly what the mission was. This go a long way in fostering positive relationships to help you understand what you're doing and why. Really works when you're utilizing this new technology. Are just like to share some lessons learned. Is easy to understand how the radiolink heuristics work in multiple environments. They may not always functions as you would expect. When you're in close proximity to power plants, the signal may not work as you expect. And you can lose your video feed. This can be disastrous such as flying close to the beams. Also plan for cold and hot environments, the battery life cannot last as long as you expect. Always plan for the worst in hope for the best. Complete your preflight checks. Really know that aircraft. Read that manuals. Use the video feed along with the visual line of sight. To keep that line open. Complete some test mapping. Looks can be deceiving. It may seem like 50 feet but might be 100 feet in the air. Monitor the manned aircraft with your aviation radios. Helps with your situational awareness. C can yield the right-of-way. Establish those good relationships with the public. Help them understand what you're doing and why. Keep a sterile environment for your pilots. With new tools come curiosity. Have another person there's of the pilot's attention can be where it needs to be. Thank you for allowing me to share some of the areas we've been utilizing this exciting technology. There are many uses. I hope this opens up thoughts on how you can use in your expertise. They can have a profound impact in your organization. This will ultimately change this perception. Report Camillus January that showed unmanned aircraft exceed aircraft 5 to 1. There are some real exciting things that are coming on the horizon. I hope to see how you can utilize these tools and see the changes that shape her future. That is the end of my slide. I can put up a contact slide.

>> Thank you so much. We're going to turn over to Todd.

>> Thank you. I am the director of technology services. I am assigned to a number of our research efforts. My favorite being our evolving use of unmanned systems for a wide range of operations. The first half of this presentation focuses on line of sight. I will show some of that.

>> Reporter: Of the presentation will focus on what we are doing with long range flight. That is a recent snapshot of our long range fixed aircraft. It is designed to fly up to eight hours. And carry a wide range of sensors. We will talk about some of these sensor capabilities. We will see some examples. Like to start with the stepchild of the latest aircraft. We started out, it was the early part of 2014. The began to investigate this. There were limited capabilities out there. Since that vision and this concept drawing, we

have accomplished all of the use cases that are being depicted and many other cases from the actual aircraft. We are actively using drones in a wide range of our day-to-day operations. The is a condensed timeline. Program really got started in 2014, throughout the course of 2014, we developed the concept of operations we also evaluated different airframes in different ways we could legally fly them and test them and ultimately we started with some of our first line of sight and some extended range, a longer-range in 2014. It was 2013 that we really got started with the section 333. We entered into our partnership with the federal administration. Partnership that for the first 3 years was titled the Pathfinder program. Pathfinder programs have since it but we have renewed our research with the FAA just recently. We of research that will not only benefit that but also long-range aircraft. We've experienced most everything you could experience. A lot of what we're using today, we had to develop because there were not commercial options to us when we started. We had access to military systems but that was always affordable. They had to develop a lot of what we're using today both in-house as well as working with a wide range of systems. We rolled in with an expanded operations and we are now looking at the second house -- half of 2018, we have some significant research and flight expansions planned. A line of sight operations, 20 15 missing a number of aircraft that is the military. It is a very stable aircraft. Since this time, we have added a wide variety of line of sight aircraft to the fleet. And depending on the location and time of the year. We use it for structure inspection. We are due to release a automated precision flight system that does not require GPS. Is designed to get that sensor to the exact spot of a particular point of interest we can process the images gathered and look at change detection. And do so for structures that are difficult to inspect. And also to -- difficult to access. Also use these systems for any number of uses. There it's for vegetation or preconstruction surveys. We also look at vegetation and the growth of. We also leverage them to give a certain 3-D contour maps or right-of-way maps to help us understand encroachment or encouragement potential. But also the vegetation that tends to grow in certain parts of our system. We Opry and $.28 -- states. -- 28 states. We is the sensors as well. We've also printed out how to supplement our light. We will leverage point clouds and build 3-D models. Can take a significant amount of images. I think as of today, the recent long grades quite collection and some of our short range your today is equal to six terabytes. We suck up a lot of data. We could not find anybody that wanted to sit around and look at single images. We had to develop a wide range of analytics and the involved training. We had a train what a real rated -- railroad in pieces look like and what they are not supposed to look like. We knew by the time we get to 27 team that we needed to have a fairly big model. We need these tools to be available by 2018. Had to imagine it was getting a lot of data and testing it. If you see the image on the rate, the computer was indicated that they may be fail ties. That was just rocks that was covering the ties. And go through all of those variables. To train the computer. We keep making refinements to it. We are also being test to do special weather evaluations. We will go out in in-hospital times and help prevent things that can happen when it gets too hot or too cold. If nothing else, we can supplement what is being done or be add to what is being done. This is a simulated curvy rail. Is not actually an image that we would be happy with. We does utilize this stuff -- soft Road what would be will -- what would look like to the computer. Happens in a split-second. Peak of the day, middle of the night. Depends on the environment. Have a wide range of systems that we used to detect them but we are supplementing with what we are doing with drones to add frequency and the precision of gathering data. Unfortunately, effects on the rail or Nexis happen. We can happen to service interruptions. We have specialized cases and data communications. They are ready to go at a moment's notice. 45 minutes is our guarantee that we will be at the hangar. Will have a number of private jets. Have had to respond to a number of these since the program I started. The

robots were able to get into areas that we would send a human. And we have significant values. Before we go into the longer-range discussions, something I should've started with, the program itself was started with the sole focus on the return on safety. That is what we are doing right now is the team. This particular area is that this is a return on safety. Think you've seen already that there is a wide range of safety benefits from using short range line of sight drones. But when it comes to longer-range capability, that was the early challenge. One of our senior customers as how we are going to inspect hundreds of miles a day? The challenge was to fly longer-range. And why you are flying long-range show us that you can supplement and add to our already industry leading cycles. Add to that without track occupancy that affects the movement of freight or putting people in an unforgiving challenge. Shows who could fly longer-range is one challenge and shows that is beneficial is another. That is been our whole focus of the longer-range program since we got started the end of 2014. The partnership that was started in mid-2015 has always been focused on the mutual benefit to both FAA and D.O.T. From their mandate and hours will supplement what we are doing. The key elements are that the FAA and us were commended. We are very similar and how you manage risk. We had a lot of natural properties that benefited. We are flying over very known routes. In our property lines do not move up and down. We know we are flying in a very known area and we have natural infrastructure that supported longer-range capability. Is a combination of technology and on the procedures. Also develops the models that must characterize certain corridors. And we develop a risk management. Than theirs does level of risk. And mitigate the risk. And that is really the model that we have approached. That has been our approach. We so one of the opening pictures of aircraft. This is a vertical takeoff and landing. This is 115 pounds. And for very long periods of time. It is race snapshot of what is on the bottom. We are rated about 380 feet. And is not just a extremely clear picture but it is a GEO accurate picture so we can trace it back to various information. Comparing change, etc. There is also a laser altimeter that helps us with latitude precision. We have real-time assessment capabilities. Especially if we are conflicting with other aircraft. Moving aircraft or they're coming to take a peek at us. We also use it to help avoidance for another layer of safety. Will put all this together and we leverage the right away. And all of our towers and telecom systems and all the network systems we have created this ecosystem. This allows us to fly for hundreds of miles at a time. Once the aircraft is in the area, it is gone. The pilots will not see it for five or six hours at a time. We are proud that we are in every way a participant and member of the national airspace. Here is an example of one of the benefits of our infrastructure. This is the current coverage of if you're below a certain altitude, the areas that are shaded are green, which is the highest coverage. This is where you can count on the provided surveillance systems for you to be aware of what's around you. There is large sections of this line that were invisible. But because we have towers, we then put that stuff on our towers. And now between the FAA, we are able to see other aircraft in the area and adds to another layer of safety. While we have done is that we have added two more. We essentially have longer-range card daily, the online of sites. In three different states. That is up in Montana. That is in New Mexico. That's a 500 mile linear Lake. We fly no less than 200 miles one way or 400 miles round-trip. It is significant longer-range. There is no visual observers. The pilots have the instrumentation. We are over 1800 hrs. We are the only commercial entity that is license to do this for beyond visual site. That is a nice thing for us, we are not -- that is not long-term. Here is some example reports. This is some examples. We are able to protect real movement and gaps. Were able to look at concrete ties and the decay. We are able to look at movement of ties and depending on the severity we can let 70 no. We are working on mechanisms where the most critical elements will be on their aircraft and can immediately locate the Piland's -- pilots on the ground. Plant use one of those for real-time collections. You can see

other pilot on the left, copilot on the right. This is down near Albuquerque. Real-time analysis of the past. Occasionally they will grab an image to make sure it everything is going well with the camera. They are talking with other communications. Have recently started operating from Fort Worth. Will take off in Montana handed off to Fort Worth. We think we will be able to go to multiple aircraft. And expand that. I will wrap up. And is a plane getting rated takeoff in the winter. I will turn it back over to you. Thank you for your attention.

>> Thank you. That is an amazing amount of information. We have a few questions in the check pod. For the sake of time, we will work with what we have in the check pod. You may see that your screen has gone blank. Is because we are going to be uploading some of those slides that Paul mentioned earlier see you can take a look at those. And after a few questions, we will let Paul walk you through those. We have a download and will make that available on the webpage. We have a couple of questions that came in. Is the beyond visual line of service linear or radial?

>> Radio -- it is always olio. -- Linear. We do have some areas where we might do plus or -5000 feet. It is highly linear other than that.

>> To they receive data to FAA?

>> It is available if they want it. But because below a certain altitude, they don't need it. I don't believe they regularly use it but they do have access to it. We are certainly visible to them and they use it when there's more visibility. We are doing a lot of operability -- a lot around a base. You're doing that Air Force coordination to support some research they needed to add some ability to enter a controlled airspace.

>> What is the battery usable systems?

>> The primary long rage flight, we use have a gas and electric hybrid. Is a gasoline engine once it is in the area. The battery surcharge while it is flying. We don't like to use the rotors more than we have to. They are so chargeable their in-flight. They average from 15 minutes to an hour. For batteries.

>> We are about 20 minutes typically with the exception of the wings. The spec sheet says 60 minutes but we get about 40 minutes at our altitude. And it depends on the elements. I can affect as well.

>> What are the size and thickness of the cracks that the automated system can text these detect?

>> It depends on what you're using for your can run. As long as your camera can see the cracks, the algorithms can get that as well. If you're using really high megapixel camera, you can get those very small cracks and we are getting a lot better detail on the cracks because trying to imagine a guy doing that with the wheel. We are getting a better detail on that. There is some issues because you're not getting the death. Which a guy on the ground can see. A person's eyes can do better. As far as the measurements for the with and the length guy you get a lot a higher quality out of that

>> We do have your revised presentation pulled up if you wanted to mention anything on this or anything else. And some of the time we have remaining?

>> The one up you can see the different aircraft that we are using right now. We are using tears we're looking to get into some light air systems. Want to has some obstacle sensors on the front. You don't have to spend a lot. Some of those funds are $45,000 for each of those. You have to spend a lot of

money to get into that. It is kind of a funny thing. This is the field I was going into with the ever been. There's a lot of sensors on the aircraft. It really only piqued her interest of what could be achieved. You can see the thermal that is on their. Of a crack, I get to the measurements on there as well. This is the verification report that I was talking to. This is required on our preconstruction surveys now. They've taken the random points and have the spreadsheet that provided by the contractor. It is really about a hybrid model. The UAVs do great and light air does great on some others -- other areas. This is a hybrid model on the right-hand side. This is an RGB cloud to, these aerial areas to chop down. That is basically it.

>> Let me ask one more question. Can resist technologies in tunnels where light is not enough?

>> There is a lot of capability to fly into tunnels. Technology to fly in GPS denied areas has matured quite a bit. When we started, it was very difficult to fly under bridges. Lots of technologies out there from optical and sonar syntheses to alter wide sensors. You can equip jury aircraft with a fly into almost any area and not need GPS of any kind.

>> Did you have anything to add to that before we close out?

>> I agree with him. Technology is getting better all the time. It was a struggle at the beginning. Credit-rating our guys to fly without GPS to correct for the wins and some could do it in some could not. Technology is getting better. You can fly without GPS. When there is no light I can use different cameras or sensors. Or have lights on the drones. Some imagery need light for the sensors see can supplement that. If you're using some other technology that don't need late, that works fine.

>> Thank you both so much. I regret to all of you that we do not have any more time. I do want to give a huge thank you to Paul and Todd for their amazing presentation. I know we had some outstanding questions. I know Paul has added his email address into the chat pod. Feel free to contact him directly. You're always welcome to contact a member of the team. We would be happy to address any of your questions or court date with Paul and Todd to get any answers. I really want to thank all of our participants. I hope this is been helpful to you. Feel free to reach out to anyone with questions. You can see information from our innovation library or any of her other documents. A transcript of this presentation will be downloadable on the webpage. We will also have a PDF available of the slides. Thank you for joining us. We look forward to future opportunities to share information about railroad strategies. [Event Concluded]