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TECHNOLOGIES TRANSFORMING TRANSPORTATION: IS THE GOVERNMENT KEEPING UP?

HEARING

BEFORE THE

SUBCOMMITTEE ON SURFACE TRANSPORTATION AND MERCHANT MARINE INFRASTRUCTURE, SAFETY AND SECURITY

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

JULY 7, 2015

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ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

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TECHNOLOGIES TRANSFORMING TRANSPORTATION: IS THE GOVERNMENT KEEPING UP?

TUESDAY, JULY 7, 2015

U.S. SENATE,
SUBCOMMITTEE ON SURFACE TRANSPORTATION AND
MERCHANT MARINE INFRASTRUCTURE, SAFETY, AND SECURITY,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 1:35 p.m., in room SR–253, Russell Senate Office Building, Hon. Deb Fischer, Chairman of the Subcommittee, presiding.

Present: Senators Fischer [presiding], Blunt, Booker, Nelson, Cantwell, and Klobuchar.

OPENING STATEMENT OF HON. DEB FISCHER, U.S. SENATOR FROM NEBRASKA

Senator FISCHER. Good afternoon, everyone. I am pleased to convene the Senate Subcommittee on Surface Transportation and Merchant Marine Infrastructure, Safety, and Security for its sixth hearing, which is titled "Technologies Transforming Transportation: Is the Government Keeping Up?"

Ranking Member Booker suggested holding this hearing, and he and I are excited to bring together a range of issues that we have worked on together here in the Senate. For example, we underscored the important role that technology plays in our daily lives by collaborating on the Internet of Things Resolution at the beginning of this Congress. I was pleased to see that our resolution passed the Senate earlier this year. We've also made progress on several transportation matters related to maritime, rail, and highway infrastructure. Our hearing brings our work on these various issues together.

Today, we will explore the Federal Government's response to the current technological developments in our Nation's transportation industry. In order to maximize the efficiency and safety gains being made by the private sector, the Federal Government must ensure that it is keeping up with modern technology, regulatory frameworks must facilitate rather than hinder technological advancements. In some ways, our hearing is entering uncharted territory, because government is generally reactive rather than proactive. Today's hearing is an opportunity to look into the future and to identify ways to make innovation easier so that we can grow quicker, safer, and easier.

Automated driving, for instance, has the potential to make trucks more efficient, and could result in thousands of dollars in annual savings. Additionally, automation has the potential to make American companies more competitive in the global market. As our stakeholders will testify, a patchwork of State laws is holding back the transportation's—industry's ability to take advantage of the benefits technology provides. Clearly, more should be done to foster innovation and streamline obsolete regulations. Step one is educating policymakers and innovators on what exists and how we can facilitate more voluntary solutions to our transportation challenges with cutting-edge technologies.

Technology has the potential to automatically process, sync, and coordinate complex transportation systems. Increased automation and connectivity make transportation and logistical networks more efficient. Most importantly, innovations in transportation offer tremendous opportunities to improve safety. Autonomous trucking technologies, for example, will strengthen driver awareness and reduce accidents on our Nation's roads.

Additionally, we will hear how the increased use of trackside monitoring devices and the development of robust data bases will provide the railroad industry with the ability to better repair and upgrade critical infrastructure. In other words, the Internet of Things and Big Data are identifying the challenges of tomorrow with technologies that we have today.

We must also appreciate the role our Nation's ports play as centers of intermodal connection in our transportation network. To compete globally, America's ports are modernizing to drive efficiency and keep goods moving throughout the country. The benefits of technological advancements are clear for our economy, for our safety, and for the efficiency of our transportation networks.

I look forward to hearing from our witnesses about the kinds of policies that will promote innovation. Our country is a leader in innovation, constantly creating the next big thing to drive the global economic engine.

And I would now invite Senator Booker to offer his opening remarks.

STATEMENT OF HON. CORY BOOKER,
U.S. SENATOR FROM NEW JERSEY

Senator BOOKER. Thank you, Senator Fischer.

I want to also just acknowledge that—Senator Blunt, it's good to have you here this afternoon.

I appreciate that Senator Fischer is holding this hearing. We've done extensive work together on both technology and transportation, and I'm excited to examine further where government can help and, conversely, where government could stop hindering. And in the "meeting the infrastructure challenges" especially, this is important.

Senator Fischer and I have discussed the tremendous innovation happening in this country—we're both excited by it—and how some of our government agencies may not actually be equipped to keep up with this incredible innovation. This is a theme that I'm sure our panel of witnesses will update us on today.

Technology is rapidly changing. Everything we do, including how we commute and maintain our critical transportation systems, is changing. It's changing how we get to work, how we drive our cars, and even how we hail a cab. We have an opportunity to harness new technologies to dramatically improve public safety, reduce costs, create jobs, and address infrastructure problems in creative new ways. The Federal Government can be a key player in helping to advance and utilize these developing technologies.

Let's take a look at safety. While traffic-related fatalities and injuries continue to decline, over 30,000 people each year still die on our highways. We continue to see trains that derail too frequently, putting enormous burdens on our first responders. In the face of these challenges, we've got to understand the opportunity that comes with technology and improving our transportation systems. Our country has already invested billions in interstate highways, bridges, rails, and ports. Technology could help us to get more out of what we've already built.

Today, there are market-ready, proven solutions to make our roads safer, from automatic braking to high-tech camera technologies to sensors and radar, and even autonomous cars and drones. Advanced technologies can now alert a truck driver, and even take control of a vehicle if they began to drift out of their lane or fail to brake with stopped traffic ahead. Technology can enable a smartphone, using realtime information, to suggest to a driver the best time to hit the road for their commute or family trip, or direct a driver to the nearest available on-street parking place, something we need in Washington. Harnessing technology will not only save time and fuel use, it will reduce traffic congestion for everyone else on the road, something drivers in my state and throughout the Northeast know all too well. New technologies can improve the safety and efficiency of our rail network and our port facilities. It is critical that we reexamine how we invest in our infrastructure, how we plan for the future, and how we make the best use of these technologies.

I look forward to hearing from our witnesses today about how the Federal Government can help existing businesses thrive, how the Federal Government can be a worldwide leader and—help us to be a worldwide leader in innovation and advance, not stall, innovative and transformative innovations.

Thank you.

Senator FISCHER. Thank you, Senator Booker.

And I would like to welcome our first panel of witnesses today. We have Ms. Susan Alt, the Senior Vice President, Public Affairs, Volvo Group North America; Mr. Paul Misener, Vice President of Global Public Policy, Amazon; Mr. Gregory Fox, Executive Vice President, Operations, BNSF Railway; and Mr. Michael Christensen, Executive—Senior Executive Lead, Supply Chain Optimization, Port of Long Beach.

And, with that, I will begin with Ms. Alt if you would like to give us your testimony, please.

STATEMENT OF SUSAN ALT, SENIOR VICE PRESIDENT, PUBLIC AFFAIRS, VOLVO GROUP NORTH AMERICA

Ms. ALT. Thank you.

Chairman Fischer, Ranking Member Booker, and distinguished members of the Subcommittee, thank you for the opportunity to be here today to talk about new transportation technologies and how they improve both safety and efficiency in our transportation network and the role that the Federal Government play in either facilitating or hindering that development.

The Volvo Group is a world leader in sustainable transportation solutions. We build stuff that make the roads, and we build stuff that uses the roads. In the U.S., we produce heavy-duty trucks under the brand names of Mack and Volvo, Volvo construction equipment, Volvo Penta marine engines, and Prevost coaches and Nova transit buses. We subscribe to a build-where-you-sell philosophy, and we have more than 12,000 U.S. employees with nine manufacturing facilities in six States. And our goal is zero accidents.

I'm going to comment today from a heavy-duty truck perspective, because trucking delivers more than 80 percent of the value of the freight that's shipped in the United States.

Buyers of heavy-duty trucks today can opt for technology that will keep the driver and other vehicles on the road safer, things like lane-departure warning systems or active braking. But, on the horizon, we see great potential for both vehicle-to-vehicle—V2V—and vehicle-to-infrastructure—V2I—technologies. Messages for V2V and V2I applications are sent on the 5.9 gigahertz bandwidth of the radio frequency spectrum. It's sent using dedicated short-range communications, or DSRC. In 1999, the Government got it right when it set aside and protected this frequency for only safety-related communication. But, in 2013, the FCC began exploring using the 5.9 gigahertz spectrum to also support unlicensed Wi-Fi users. Proposals have been provided, but no consensus yet reached. The concern is that allowing other technologies to be shared on the same spectrum could create a lag or a latency in sending lifesaving communications signals.

So, let me clarify. Let's say vehicle number 1 is approaching an intersection with a green light, but the view of an oncoming vehicle is blocked by a building. Using a DSRC V2V application, the driver in vehicle number 1 can be alerted of an oncoming vehicle number 2 that's not slowing down for his red light, and the alert will allow the collision to be avoided. If there's any latency in that signal because of interference—for example, a Wi-Fi user watching a video—the accident likely would not be avoided. So, until a solution is found for spectrum-sharing of the 5.9 gigahertz frequency, we want it to remain dedicated for safety-related applications only.

An example of where vehicle-to-infrastructure—V2I—can improve safety and freight efficiency is the roadside weight and inspection stations, where trucks stop along the interstate to wait in long lines that can create potential hazards. The Volvo Group has already demonstrated technology using V2I communication protocols from the truck to the weigh station that allows moving trucks to wirelessly communicate their credentials to the inspection stations, such as if the weight of the vehicle is below the limit or if

the driver is wearing a seatbelt. It keeps those trucks moving and allowing authorities to focus on the condition of other trucks that haven't been validated in a program we call Trusted Truck.

Let me end with what is probably the talk of the town, and that is automated technology or autonomous vehicles. That is using connected vehicle technology fused with onboard collision avoidance technology. We think the area is very interesting, but caution our pace of implementation will be set by how safely it can be adapted to the vehicles, to the infrastructure, and society.

Platooning is one example of automated technology. This is where there's a lead or a pilot truck. It's wirelessly linked to a truck that's following behind it. Volvo Group and the California Partners for Advanced Transportation Technology, or PATH, are in the process of implementing a two-truck platoon demonstration at slow speeds that will be extended to three trucks in 2016. Full-scale demonstration has yielded some 10 percent fuel efficiency gains by platooning trucks because of the reduced air drag.

We're developing technologies for connected and automated driving because of their potential to enhance safety and improve productivity. Increasing the speed of adoption for these technologies could be achieved if we eliminated 12 percent Federal excise tax that's added to the purchase of a new truck and offsetting that with a higher fuel tax.

Another challenge is that, though our products roll across state lines, different states are developing different regulations to promote autonomous vehicle testing. We'll need a national standard before these vehicles can become operational.

With uncertain funding for the U.S. transportation surface—surface transportation system, adoption of these new technologies will allow us to move increasing amount of freights for a growing population, but it won't solve all of our freight capacity problems, and it doesn't let Congress off the hook to do its job of providing Federal funding and passing a long-term surface transportation bill.

Thank you for the opportunity to testify to you today. I look forward to questions.

[The prepared statement of Ms. Alt follows:]

PREPARED STATEMENT OF SUSAN ALT, SENIOR VICE PRESIDENT, PUBLIC AFFAIRS, VOLVO GROUP NORTH AMERICA

Chairman Fischer, Ranking Member Booker, and distinguished members of the Subcommittee, I would like to thank you all for the opportunity to appear before you today to discuss the importance of innovative transportation technologies that are improving the safety and efficiency of our transportation network and the role the Federal Government plays in either facilitating or hindering that development. My name is Susan Alt and I am the Senior Vice President for Public Affairs for Volvo Group North America.

The Volvo Group is one of the world's leading manufacturers of trucks, buses, construction equipment, and drive systems for marine and industrial applications. When it comes to surface transportation, we build products that make roads and we build products that use them. In the United States, we produce heavy-duty trucks, engines, and transmissions under the Volvo and Mack brands, Volvo Construction Equipment, Volvo Penta marine engines, plus Prevost coaches and Nova transit buses. The United States is the largest single country market for the Group worldwide and since we subscribe to a "build where you sell" philosophy, we have more than 12,500 U.S. employees and nine manufacturing facilities in six states. We firmly believe that technology drives both improved safety and efficiency of the U.S. freight system and the Volvo Group has long been a leader in developing and implementing safety technologies without regulation on all our vehicles. Our goal is zero

accidents, which can only be achieved by close cooperation between public, private and non-profit stakeholders.

The primary questions before the Subcommittee today are how technology can improve the safety and efficiency of our U.S. transportation system and whether the government is helping or hindering the adoption of new technologies. I am going to answer these questions primarily from a heavy-duty freight truck perspective because trucking delivers nearly 70 percent of the domestic tonnage and more than 80 percent of the value of freight shipped in the United States. These questions come at a transitional time for the heavy-duty commercial vehicle industry because a great deal of vehicle technology is emerging to help mitigate accidents and increase on-time delivery of freight. The government can help by putting in place policies to ensure the safest and most efficient adoption of these technologies in vehicles.

Let's say you want to purchase a new heavy-duty Class 8 truck, and you want to take advantage of available technologies to help reduce the risk of an accident and ensure the freight is delivered on-time all the time. Today, there are at least four areas where newly developed technology will help you.

1. The first is new safety technology on the *vehicle* itself such as electronic stability control (ESC), adaptive cruise control, rear view cameras, active braking and lane departure warning systems;
2. The second is new technology to improve *driver behavior* such as remote monitoring of the quantity of hard braking applications, the speed traveled, or hours of operation on routes;
3. The third area is new technology to predict the *vehicle uptime* such as remote vehicle monitoring and diagnosing to predict a failure and alert the driver or dispatcher to take action before it occurs;
4. And fourth, new technology to dynamically *plan the driver's route* to minimize stops or delays due to traffic congestion.

You would specify all of these options to be installed on your new truck to meet your objective. (N.B. the National Highway Traffic Safety Agency (NHTSA) recently finalized a regulation that mandates ESC for new truck tractors. The rule is applicable to typical three-axle truck tractors manufactured on or after August 1, 2017 and allows four years of lead time for all other truck tractors).

The next step to further reduce the frequency of vehicle accidents, while also improving efficiency of the freight system is the adoption of technology that wirelessly connects trucks to each other, to other vehicles and transportation users, and to the infrastructure itself. We see great potential from both vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) technologies. Volvo is the only truck member of the Intelligent Transportation Society of America (ITS America) participating in the newly formed V2I Deployment Coalition. We are also the first truck OEM to formally participate in the Crash Avoidance Metrics Partnership (CAMP) V2I consortium, whose mission is to assist the U.S. Department of Transportation in developing, evaluating and testing V2I applications to enhance safety, mobility, and environmental sustainability. The protocols for V2V and V2I applications are supported by the dedicated short range communications (DSRC) standards and operating in the licensed 5.9 GHz band of the radio frequency spectrum. With communications occurring ten times per second, it is critical that these messages be free of any signal interference. The Institute for Electrical and Electronics Engineers (IEEE) and the Society of Automotive Engineers (SAE) are professional international organizations that set standards for these communication protocols. DSRC standards are largely mature, but are in a revision phase prior to NHTSA issuing a draft rulemaking that will mandate DSRC for light duty vehicles later this year. For example, the IEEE 1609.2 standard that outlines security services needs a re-defining of the data structures and encoding. The SAE J2735 message set dictionary is currently being finalized. The SAE J2945.0 and J2945.1 standards that specify the on-board minimum performance requirements for V2V safety systems are expected to be published later this year. These examples show that solutions are coming to address concerns regarding security/privacy, positioning, and scalability, to name a few.

The government got it right when in 1999 the Federal Communications Commission (FCC) had the vision to set aside and protect the 5.9 GHz frequency spectrum for only safety related communication. However, in 2013, the FCC began exploring the possibility of using the 5.9 GHz spectrum to also support unlicensed Wi-Fi users and the coexistence of Wi-Fi and vehicle safety communications on the same spectrum. Two proposals to share the spectrum using different access mechanisms have been developed; however, no consensus position was reached. The concern is that by allowing other technologies to be shared on the same spectrum, it could create

a lag or latency in sending critical and lifesaving communication signals. Therefore, we join with the automotive industry, ITS America, and others in opposing S. 424, the Wi-Fi Innovation Act that would open up the 5.9 GHz frequency spectrum to Wi-Fi access for non-safety and other applications such as entertainment and advertising. Passage of this legislation is premature as the automotive, Wi-Fi and transportation safety communities work with the FCC, NHTSA, and the Department of Commerce's National Telecommunications and Information Administration (NTIA) to explore whether a technical solution exists that would not compromise the opportunity to save lives.

To clarify how this works, let me provide an example: a Vehicle to Vehicle (V2V) safety message may be something as simple as vehicle #1 (a loaded tractor-trailer operated by a professional commercial driver) approaching a signal intersection that is green, but the view of oncoming vehicles is blocked by a building. Using a DSRC based V2V application, it is possible to alert the truck driver of an oncoming vehicle #2 that is not slowing down for his/her red light, and the system alert will allow the collision to be avoided. Furthermore, there are opportunities to integrate this alert with the vehicle braking system to achieve partial automation to enhance safety. If there is any latency in that signal because of interference from (e.g.) a Wi-Fi user watching a video, the accident likely would not be avoided. Consider how such risks can multiply exponentially in situations involving not just two vehicles in an intersection, but hundreds of vehicles moving through a heavily congested area. For this reason, until a solution is found for spectrum sharing of the 5.9 GHz frequency, we want the spectrum to remain dedicated for safety related applications only.

Getting back to that next technology—the V2V and V2I connected vehicle technology—to further improve safety and efficiency in our transportation system, let me share an example of a Vehicle to Infrastructure (V2I) message that could greatly improve safety and freight efficiency. Truck inspections play an important role in maintaining safety. However stopping along the interstate to wait in long lines at weigh stations negatively impacts fuel efficiency and the environment, increases driver fatigue, and causes potential delivery delays. To avoid these disadvantages, the Volvo Group has already demonstrated technology using V2I communications protocols from the truck to the weigh station here in the U.S that allows moving trucks to wirelessly communicate their safety and maintenance credentials to inspections stations—keeping them moving and allowing authorities to focus on the condition of trucks that haven't been validated in what was called Trusted Truck®. These messages coming from sensors on the vehicle can provide driver's credentials such as if he is wearing a seatbelt or the "health" of a truck, such as if the tires are fully inflated or the overall weight is legal. Field testing such a system could further validate this concept.

Another example of V2I technology's potential contribution to play an important part of safer and efficient transportation is the Volvo Group's experimental technology that allows a 360 degree scan of everything that happens in a truck's environment. The truck analyzes the traffic around it, with the possibility to predict up to 5 seconds ahead what surrounding objects like people, cyclists and other vehicles will do—even when moving. If a collision is imminent, the driver is warned audibly and if the driver doesn't stop the truck, the truck brakes for him or her. By alerting the driver of risks and, when needed taking control of the vehicle, the system helps eliminate human error and further mitigates the risk of accidents.

I've told you about newly available technology and I have given you a look into the potential of connected vehicles. Let me end with what is perhaps the final frontier—automated or autonomous driving technologies. That is, using the connected vehicle technology fused with on-board collision avoidance technology. NHTSA has defined this as Level 3 in its criteria for Driving Automation. With many OEMs touting some version of this technology in the works, trucks equipped with autonomous driving technology seem to be the "talk of the town" in our industry.

Volvo Group believes that vehicle automation has significant potential to improve traffic safety and transport efficiency while reducing the environmental and other societal costs. It also has the potential to increase road capacity with limited investment in road construction as more trucks could travel safely within shorter driving distances. Given the "high tech" character of trucks equipped with autonomous driving technology, and the fact even a so-called "autonomous truck" will still need a human driver for the foreseeable future, it may even lure younger drivers to an industry sorely lacking drivers. As an OEM with a global presence and many product areas, the Volvo Group sees potential for autonomous driving technologies for many types of transportation scenarios and application areas.

Perhaps you have driven a car with adaptive cruise control or ACC? It is where you take a "leap of faith" by allowing the car's automation technology to slow itself

if the distance set between you and another car becomes too close. We have the same adaptive cruise control technology in our heavy-duty trucks. *Cooperative* Adaptive Cruise Control (C–ACC), Adaptive Cruise Control married with vehicle connectivity technology, also called "platooning," is an early application of automation that we believe will have a positive impact on safety, reduce road surface usage, improve traffic flow, as well as provide a significant potential to reduce fuel consumption. Full-scale experiments indicate that platooning reduces fuel consumption for long haul transports by approximately 10 percent over a complete transport mission due to reduced air drag.

Future development will continue with vehicles equipped with autonomous driving technologies to be confined to operating in areas at low speed as an important first step towards higher degree of automation. Full automation and operating at higher speeds on public roads will take longer and need more research. Research needs to be performed in close collaboration with governmental entities in order to handle legal issues and public acceptance. Vehicle connectivity (V2X) will increase the performance of existing and future safety systems and is a prerequisite for vehicle automation; also, collaboration is necessary to agree on standards and implementation roadmaps. The technical solutions and advanced concepts for both V2X networks and integration of autonomous technologies are being conceptualized by researchers around the world. The U.S. could take a leading position in this field with more robust research and development funding for academia and the private sector.

A challenge for us as a U.S. manufacturer is that different states are developing different rules and regulations to promote autonomous vehicle testing, but a national standard is needed as our vehicles travel across all state lines. For example, there are regulations regarding the allowable distance to follow a truck on public roadways that need to be changed to allow for further testing and demonstration. Clear, precise and thoughtful definitions must be provided. In this brave new world of "automation," careful consideration must be given when writing new regulations for this area. Using generic terms like "driver", "control", or even "system" in regulations can create confusion and misinterpretation. Additionally, regulations written when trucks were not as "smart" as they are today can have a drag on adoption. There are inconsistent state laws for axle loading that prevents the wider adoption of 6x2 liftable axle configurations. The required position of marker lights at the rear of a trailer conflicts with the aerodynamic position of a boat tail is another such example

Volvo Group and the California Partners for Advanced Transportation Technology (PATH) are in the process of implementing a two-truck platoon at slow speeds that will be extended to three trucks in 2016. These trucks leverage the V2V messages in addition to forward-looking sensors, using radar plus a camera, to help maintain constant clearance and dynamically harmonize cruising speeds. The SAE standards organization is working to develop and harmonize the message sets and protocols together with the European Telecommunication Standards Institute (ETSI).

We are interested in developing technologies for connected and automated driving because of their potential to enhance safety, environmental efficiency, and productivity that are paramount to us and our customers. This may substantially change how the traffic system and the vehicles are designed, both in urban and extra-urban environments. With these technologies in widespread use, we will be able to more efficiently use the available road space to increase mobility and transportation efficiency. This will truly support sustainable development in the face of growing population and transportation needs.

I've mentioned several times that a faster rate of adoption of these technologies will help meet our overall goals, but they will only be achieved if the customer can make a business case for their purchase. Today there is a 12 percent Federal Excise Tax (FET) on the purchase price of each new Class 8 heavy-duty truck. As advanced technologies are added to trucks and the purchase price increases, this FET becomes more onerous. If we eliminated that FET, and offset it with a higher fuel tax, it would encourage faster integration of vehicles with new technologies on our roads.

In the face of either stagnating or uncertain funding for our U.S. surface transportation systems, it is the adoption of these new areas of technologies that will allow us to move increasing amounts of freight for a growing population. The technology will help ease congestion on the roads, but it won't solve all our freight capacity problems and doesn't let Congress off the hook to do its job of providing Federal funding to maintain and grow the overall infrastructure.

The last major transportation reauthorization, Moving Ahead for Progress in the 21st Century (MAP–21), was an important step in implementing key surface transportation policy reforms. However, infrastructure investment must be considered as a long-term strategic objective. The Volvo Group believes that a full six year, well-funded reauthorization is needed to address the persistent challenges that are al-

ready well-documented and recognized as problems facing our transportation system. We are encouraged by the recent action of the Environment & Public Works Committee to pass the DRIVE Act and stand ready to work with the Commerce, Science, and Transportation Committee on its portion of the Senate's reauthorization bill this year.

Transportation moves our economy, and we need every sector of our economy functioning to maintain growth and remain competitive globally. A strong infrastructure has a direct and vital impact on America's competitiveness. Technological innovations in the trucking industry can not only improve safety, but can also improve the efficiency and productivity of the network. The Federal Government should continue to work collaboratively with the industry to ensure that these innovations are accepted in the market. Thank you for the opportunity to testify today, and I will be happy to respond to any questions.

Senator FISCHER. Thank you.

Mr. Misener, welcome.

STATEMENT OF PAUL E. MISENER, VICE PRESIDENT, GLOBAL PUBLIC POLICY, AMAZON.COM

Mr. MISENER. Thank you, Madam Chair. Thank you for having me.

Amazon began selling online 20 years ago this month, in July 1995. Our challenge was to create at scale a new form of warehousing, where truckloads of pallets of goods would be received and stored, but, instead of newly assembled big pallets being periodically trucked out to retail stores, we would ship brown boxes via carriers directly to customers. Thus, we developed pallet-in/box-out. At first, the sales through our website were only at retail, but now third-party sellers are responsible for 40 percent of all the units sold through Amazon, and many of our services—and many use our services to warehouse and fulfill orders of their goods. So, now we receive not just pallets of goods, we often—also receive small brown boxes to be stored, waiting for a customer to place an order for the goods. In sum, our warehouses, which we call Fulfillment Centers, now support box-in and box-out.

Last December, Time magazine produced a brief video illustrating this process. And thank you, Madam Chair, for showing it here today. It begins deep inside a truck trailer parked at the loading dock at one of our warehouses, looking backward as the trailer door is opened.

[Video presentation.]

Mr. MISENER. There is sound for this. There we go. Thank you.

After we receive an item, it is stored, awaiting a customer order. Those orange things are robots. They move shelves that weigh up to 750 pounds.

Once a customer orders an item, it is retrieved and sent for packing, and then it is loaded on a truck for shipment.

While we continue to improve the efficiency of operations within our facilities, we also have developed and invested heavily in a more efficient way to hand off boxes to the U.S. Postal Service. Rather than give the UPS—USPS an unsorted stack of boxes, we've begun operating over 15 so-called Sortation Centers that provide the USPS groups of boxes all going to roughly the same location. This arrangement, as well as Amazon's package volume, benefits the USPS by letting it make better use of its facilities, equipment, and personnel without incurring the costs of building additional capacity in its upstream logistics network.

But, of course, we and our partners, and ultimately our customers, need government to keep up by providing adequate funding, innovative policies, and balanced regulation.

Thank you again for inviting me to testify. I look forward to your questions.

[The prepared statement of Mr. Misener follows:]

PREPARED STATEMENT OF PAUL MISENER, VICE PRESIDENT, GLOBAL PUBLIC POLICY, AMAZON.COM

Thank you, Chairwoman Fischer and Ranking Member Booker. My name is Paul Misener, and I am Amazon's Vice President for Global Public Policy. Transformative innovations in commercial transportation technology are dramatically improving the way American consumers buy and receive goods, but the private sector cannot make all of the necessary improvements; government needs to keep up. Thank you for your attention to this important topic; for calling this hearing; and for inviting me to testify.

As familiar as the Amazon.com website may be, the physical infrastructure and transportation operations that support the delivery of physical products ordered through it are less well known. Some of that infrastructure and operations—such as within our warehouses—is completely controlled by Amazon; some of it is shared with third parties, such as parcel carriers, with which we work closely; and some of it is beyond our control, such as the construction and maintenance of public highways and bridges. All of it is necessary, however, to support how American consumers shop online.

Amazon first began selling online 20 years ago this month, in July 1995. By that time, other companies already had perfected large-scale warehousing designed to support networks of physical retail stores. In their model, warehouses are designed to receive, from suppliers, truckloads of goods, usually stacked on pallets easily moved by forklifts. Inside the warehouses, the pallet loads—for example, one pallet of light bulbs, another of staplers, and another of printer paper—would be disassembled, and the goods stored on shelves, awaiting distribution to physical stores in the region. Periodically, perhaps daily or weekly, and based on the inventory needs of individual stores, a new truckload of pallets would be assembled for delivery, perhaps with one of the pallets carrying, among many other things, two dozen lightbulbs, three staplers, and two boxes of printer paper. In sum: pallet in and pallet out.

Our challenge at Amazon was to create at scale a new form of warehousing, where truckloads of pallets of goods would be received and stored, but instead of newly assembled big pallets being periodically trucked out to retail stores, we would ship out little brown boxes via carriers directly to customers. To meet this challenge efficiently, we needed to create a new kind of warehouse infrastructure that was highly reliant on computer technology and automation. For large items, such as a washing machine, we still needed to handle them individually, but for relatively small items—which comprise the vast majority of the items we sell—we developed elaborate conveyor systems which can whisk items quickly through a warehouse from where they are stored to other locations where they can be boxed and loaded into a carrier's truck. Thus we developed at scale, pallet in, *box* out.

At first, the sales through our website were only retail, meaning that we had bought the goods ourselves and then sold them to our buyer customers, *i.e.,* consumers. But in order to increase the selection of products for our buyer customers, we invited a new class of customers to *sell* through our website. These seller customers, through what became known as the Amazon Marketplace, have become a very important part of our customer experience, and currently are responsible for 40 percent of all the units sold through Amazon. Many of these seller customers now also use our services to warehouse and fulfill orders of their goods. Through this service, known as Fulfillment by Amazon, we now receive not just pallets of goods, we often also receive little brown boxes, to be stored, waiting for a customer to place an order for the goods. In sum, our warehouses—which we call "fulfillment centers"—now support box in, box out.

There are three particularly transformative aspects of our fulfillment center technology. The first is random placement of items. Take, for example, a teddy bear. A teddy bear is not stored on a shelf labeled "Teddy Bears" or "Stuffed Animals" or even "Toys." It is placed among other completely unrelated items, such as a Cuisinart product. This process, by which products are stored anywhere within our fulfillment centers is called, appropriately, "random stow." But although it might

seem haphazard as well as random, it is not. This process, carefully monitored by our computer systems, allows us, following a customer order, to find the most efficient path for that item to travel from where it is stored to the place where it is boxed for shipment.

The second aspect to note is the extensive conveyor system, which I mentioned before. Much of this automation was designed specifically for our kind of operations, at large scale. Our fulfillment centers are indeed very large: many exceed one million square feet and, with mezzanine floor space included, some contain 59 football fields of floor area under one roof. At these sizes, it is essential for efficiency and customer delivery speed that items can move within the building at high speed, hence the extensive use of conveyor technology.

Lastly, there are squat mobile robots from Amazon Robotics that carry shelves around the fulfillment center floor. A natural extension of our conveyor automation, these robots greatly increase the speed of order fulfillment for our customers. They each weigh 320 pounds and can lift 750 pounds—something like an NFL lineman—and we now have more than 15,000 operating in 10 fulfilment centers across the United States. Another kind of robot we use is called "Robo-Stow" which, at over five tons, the size of a male elephant, is Earth's largest robot arm. This machine allows us to move items quickly between floors in our buildings.

The highly-automated kind of fulfillment center is known as "sortable," because it is designed to quickly sort items and, if there are multiple items in a customer order, to combine them into a single box. Another kind of fulfillment center—designed to handle larger items—is called "non-sort." In total, we have over 50 fulfillment centers throughout the United States, and each generation of fulfillment center is more technically sophisticated than the prior. Ten of our eighth generation fulfillment centers are operating already, and the first of our ninth generation is under construction in Kent, Washington.

We are continuing to improve the efficiency of our operations within our facilities but, of course, the speed of customer order delivery also depends on how quickly ordered goods move from our fulfillment centers to our customers, so we also are working to improve efficiencies outside these buildings. One way, as I recently described to the Committee, is package delivery by drone, in the future Prime Air service. Drone deliveries not only require innovative aviation technologies and government approvals, but also meeting logistical challenges within our fulfillment centers.

We also have developed a more efficient way to hand off boxes to the U.S. Postal Service. Rather than give the USPS an unsorted stack of boxes, some bound for Nebraska and others destined for New Jersey, we now are sorting boxes and consolidating them into sets of boxes heading for customers in the same particular area of the country. To help do this, we have begun operating over 15 so-called "sortation centers" that provide the USPS *groups* of boxes, all going to roughly the same location. So, in addition to "pallet in, *box* out," and "*box* in, box out," we now are providing what amounts to pallet or box in, and box or pallet out.

Amazon has invested heavily in building these sortation centers at locations optimized for injecting packages deep into the USPS network. For deliveries coming from Amazon sortation centers, the USPS provides only final mile delivery services: Amazon arranges for transportation from our fulfillment centers; for sortation at sortation centers; and for delivery of sorted boxes to USPS facilities. Individual USPS facilities receive these packages in the early morning, so that postal carriers can deliver them the same day. In a single day, a typical Amazon sortation center will sort tens of thousands of packages, speeding up delivery times as well as providing later daily cutoff times for customer orders.

USPS and Amazon have worked together to create innovative technology and develop efficient processes, including improvements in labelling, to help the Postal Service reduce the costs of providing final mile services. This arrangement and Amazon's package volume benefit the USPS by letting it make better use of its facilities, equipment, and personnel throughout the week and provide final mile delivery without incurring the costs of building additional capacity in its upstream logistics network. As on other days, Sunday shipments arrive at USPS post offices presorted and ready for delivery and, because Amazon provides destination address information in advance, the USPS has improved efficiency on Sundays by operating only from select hub locations and tailoring routes to actual requirements.

Upstream of our fulfillment centers, we are working to ensure that goods can easily flow into our warehouse network, including via U.S. ports on both the Pacific and Atlantic coasts, and via rail across the country. Our work and partnerships with private commercial infrastructure and transportation providers of multiple modes will only increase in the coming years.

But, of course, our partners, we, and ultimately our customers, need government help to maintain adequate public infrastructure and provide appropriate regulation. For example, the productivity of U.S. ports is a significant concern. Ocean carriers have built larger ships, but the U.S. west coast ports have not improved their throughput and thus have fallen behind the larger ports in the world, and will continue to do so, especially as U.S. exports continue to grow.

There are three examples of government help that deserve brief mention here. The first is the biggest and perhaps hardest: America's public transportation infrastructure simply needs investment. Thank you, Chairwoman Fischer, for your personal attention to transportation infrastructure funding. As you have pointed out, our highways and bridges are in dire need of investment. Like other American businesses, Amazon and our customers depend on an efficient and reliable transportation system, and we agree with your belief in the importance of long-term transportation policy and long-term reauthorization. Second, we need innovative policies for developing the future transportation infrastructure. A bill sponsored by the Ranking Member, Senator Booker, as well as Senators Murray and Cantwell from Amazon's home state, is one such innovative proposal, for multimodal freight policy. Lastly, as several of the carriers we work with have pointed out, permitting the use of slightly longer twin highway trailers would dramatically decrease the number of truck trips and miles driven. Amazon believes that such efficiency improvements should be embraced. Moreover, as the carriers note, research indicates that, if weight limits are maintained, the longer trailers actually would improve their handing properties; a finding supported by experience in Florida and North Dakota.

In conclusion, commercial entities are deploying technologies to transform and improve the transportation infrastructure of the United States, and recent innovations already are providing impressive efficiency gains, improving the way American consumers buy and receive goods. But, to keep up with these advances, government needs to provide adequate funding, innovative policies, and balanced regulation.

Thank you again for inviting me to testify; I look forward to your questions.

Senator FISCHER. Thank you very much.

Mr. Fox, welcome.

STATEMENT OF GREGORY C. FOX, EXECUTIVE VICE PRESIDENT, OPERATIONS, BNSF RAILWAY COMPANY

Mr. FOX. Thank you very much for the opportunity.

My name is Greg Fox. I'm Executive Vice President of Operations for BNSF Railway. What I'd like to do today is really walk through how BNSF is utilizing technology to improve safety and efficiency of our network.

BNSF, as hopefully most of you know, is a large western railroad, over 32,000 route miles and 47,000 employees. My team runs the railroad. And, in my 31 years at the railroad, I've seen safety improve, year after year.

In 2014, BNSF and the rail industry achieved best-ever safety results. And you can see the trend that we've achieved over the last decade. Technology has clearly played a role in this success. While technology is the focus of today's hearing, investment in rail infrastructure and an inclusive safety culture for all BNSF employees are critical contributions, as well, to our safety results.

Investment in maintenance and renewal of the railroad, the orange bars that you see on this chart, is also an important piece of safety. BNSF invests significant amounts of this kind of capital into our network to contribute directly to safe operations as well as to ensure reliability of our network for our customers. This is the largest component of our $6 billion of capital spend in 2015.

The Nation's rail operations are basically a 140,000-mile outdoor production line. This scope and complexity means that infrastructure and equipment sometimes fails or that human error can occur. Because of this, BNSF focuses on a risk-based initiative for all as-

pects of our operations. This slide shows the categories of incident causes and examples of the kinds of countermeasures that we put in place to reduce risk. They're a combination of critical safety processes as well as technology.

While you're very familiar with the implementation of Positive Train Control, I'd now like to share a brief video that illustrates the numerous other inspection and detection technologies that we deploy on the railroad to produce safety benefits.

[Video presentation.]

Mr. FOX. These technologies include track geometry vehicles. These vehicles utilize electronic and optical technology to monitor track geometry or the relationship with the rails at one point or over a distance; rail defect detection systems that utilize ultrasonic technology to detect internal rail defects; wheel temperature detectors that use infrared technology to identify wheel bearing fatigue; and machine visioning systems that inspect freight cars for defects in passing trains.

BNSF is also now deploying unmanned aircraft systems, or drones, for supplemental visual track and bridge inspections in a variety of conditions. Also, earlier this year, we were one of three companies awarded the Pathfinder Program status from FAA for extended-range track integrity flights. The DOT has been a valuable partner in advancing the use of drone technology in our safety program.

All of these technologies, as you might expect, generate a tremendous amount of inspection data. Leveraging this data through advanced analytics is where we're headed next. BNSF is currently working with IBM on a big data advanced analytics initiative to take the information that we already use for—to detect safety standard deviations, to ultimately drive further understanding of the factors that cause these deviations in the first place. Our goal is to drive proactive maintenance practices that ultimately prevent derailments from occurring.

Let's take a look at one example. I'll walk you through how we're using advanced analytics to improve equipment—rail equipment safety. You saw the equipment detectors in the video earlier. BNSF currently has over 2,000 trackside detectors located along our 32,000-mile network that continually monitor the overall equipment health of passing trains using a combination of thermal, acoustics, visioning systems, and other technologies. Today, these systems identify defective equipment and actions taken to address these defects as they're identified. Our goal is to move from—to a more proactive and preventative type of response. We will go from focusing on absolute alarms really to understanding composite alarms that tell us when a combination of factors have been combined in such a way that an unsafe condition could occur. Big data analytics will allow us to monitor equipment health over time, over geography, and across railroads, and ultimately assist in extending asset life, improving capacity and safety.

As you can see, the current breadth of technology and the potential here is tremendous as long as we have a regulatory framework that encourages innovation. The technologies and the advanced analytics themselves are very complex and evolving at a very fast

pace. This means that the regulatory focus should be on safety outcomes that they focus on producing.

One of the most significant things Congress can do for us is ensure that we have the right overall regulatory framework for railroads. If it does, the rail industry will continue to deploy technology in support of risk reduction and invest adequately in infrastructure maintenance and renewal.

Thanks for your opportunity today to testify. I look forward to your questions.

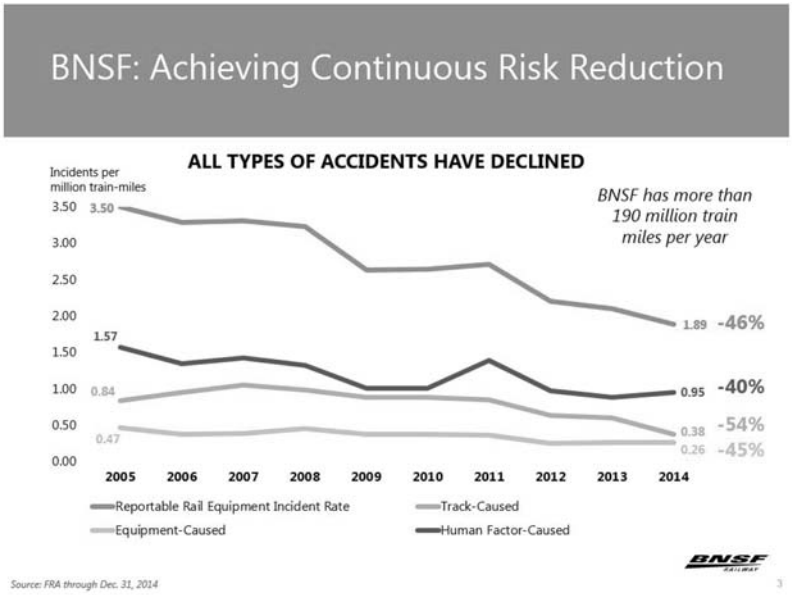
[The prepared statement of Mr. Fox follows:]

PREPARED STATEMENT OF GREGORY C. FOX, EXECUTIVE VICE PRESIDENT, OPERATIONS, BNSF RAILWAY COMPANY



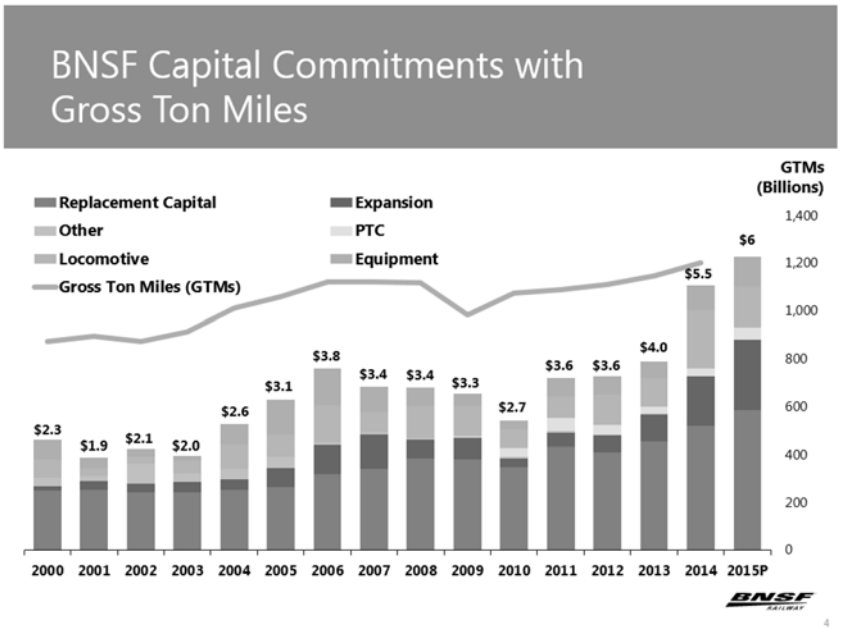
Good morning, Chairwoman Fischer, Ranking Member Booker, and members of the Subcommittee. My name is Greg Fox and I am the Executive Vice President of Operations for BNSF Railway Company (BNSF). Thank you for inviting me today to share how BNSF uses technology to help drive risk reduction and continuous safety improvement on the railroad. As you can see from this slide, BNSF is a large Western Railroad with over 32,000 route miles operated and employing 47,000 employees.

My team at BNSF, runs the railroad, and of all the things that go into running the railroad on a daily basis, safety is the most important thing we do. In my 31 years at BNSF, I have seen the safety of our operations improve significantly.



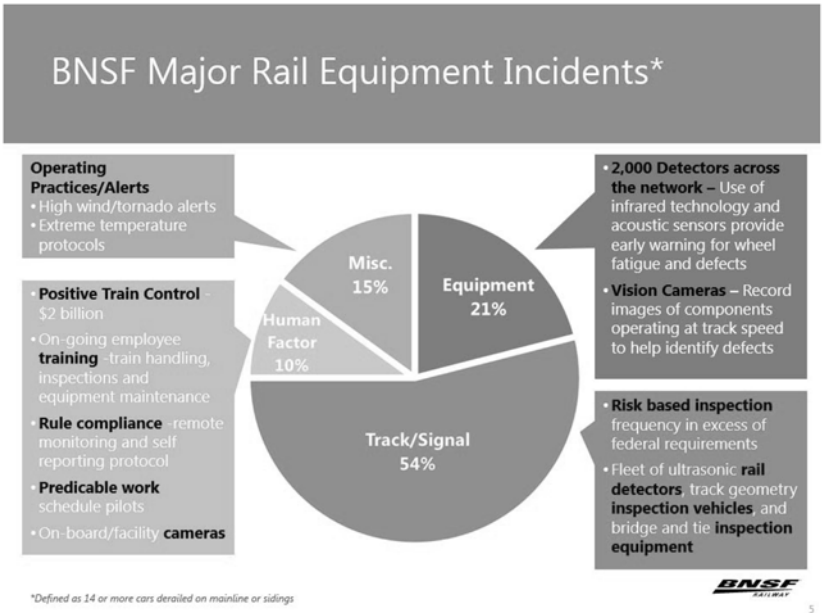
In 2014, BNSF and the rail industry achieved the best-ever safety results and has shown continuous improvement in safety over the past decade. Technology has played a significant role in this success.

While technology is the focus of today's hearing, investment in rail infrastructure and development of a Safety Culture of Commitment by all BNSF employees, are all critical elements of our approach to overall risk reduction.



With respect to investment, BNSF is investing record amounts of capital that contributes directly to operating a safe and efficient railroad, as well as ensuring that we're positioned for growth with our customers.

In 2015, BNSF announced a $6 billion capital investment plan, with the largest component allocated to renewal and maintenance of our network infrastructure and assets. This marks the third year in a row that BNSF has invested a record amount of capital back into our Network.



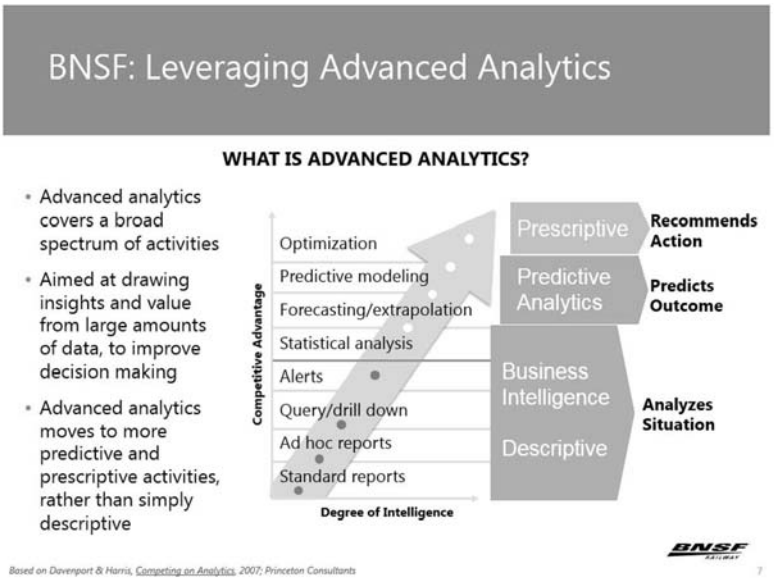
The scope and complexity of the Nation's rail operations—basically, operation of a 140,000 mile outdoor "production line", means that infrastructure and equipment sometimes fail, or that human error can occur.

Because of this, BNSF has a broad-based risk-reduction framework that we utilize to reduce risk in all aspects of our operations. This slide shows categories of incident causes and examples of the kinds of countermeasures we have in place. These countermeasures include a combination of both critical safety processes as well as technology.

[Shows BNSF Video]

While the members of this subcommittee are familiar with the enormous industry undertaking to implement Positive Train Control technology, I would like now to share a brief video that illustrates the numerous other technologies deployed on the railroad to reduce risk and drive continuous safety improvement. You have heard less about these technologies, but each produces significant safety benefits. These technologies include:

- Track geometry vehicles that utilize sophisticated electronic and optical measuring devices to monitor all aspects of our track infrastructure
- Rail defect detection systems that utilize ultrasonic technology to detect internal rail defects
- Wheel temperature detectors, using infrared technology, to identify wheel bearing fatigue
- And, Machine Visioning systems to inspect freight cars in passing trains for defects BNSF is also now preparing to deploy Unmanned Aircraft Systems (UAS)—drones—for supplemental visual track & bridge inspections in a variety of conditions. Also, earlier this year, we were one of three companies awarded Pathfinder Program status by the FAA for extended track integrity flights. The FAA has been a valuable partner who has worked well with us to advance this game-changing UAS technology.



Leveraging the tremendous amount of data generated by all these technologies is where we are headed next. Advanced Analytics covers a broad spectrum of activities, but is aimed at drawing insights and value from large amounts of data, with the ultimate goal to improve decision making.

BNSF is currently working with IBM on a "Big Data" Advanced Analytics initiative to take the information that we already use to detect deviations from safety standards to ultimately using this same data to drive further understanding of the factors that cause these deviations in the first place.

Our goal is to drive proactive maintenance practices that ultimately prevent incidents from occurring in the first place.



Let me quickly walk you through one example of how BNSF is utilizing advanced analytics to improve safety.

BNSF currently has over 2,000 equipment detectors located track side along our 32,000 mile network. These equipment detectors continually monitor the overall equipment health of passing trains, utilizing a combination of Thermal, Acoustic, Vision Systems, and other technologies.

Today, these systems identify defective equipment and action is then taken to address these defects as they are identified. In order to move from today's reactionary-type of environment to more of a proactive and preventative response, our Advanced Analytics initiative is combining all this equipment health information into a single source and we're then utilizing it to predict future component and equipment fatigue and failures. Our ultimate goal is to improve railroad safety by leveraging this data to reduce service interruptions and derailments.

Conclusion

As you can see, the current breadth of technology and its potential going forward is tremendous as long as we have a regulatory environment that encourages innovation. I would respectfully suggest that *safety outcomes* should be the focus when government regulation is necessary, not the technologies and the analytics themselves, because those are complex and evolving at a very fast pace.

Ultimately, the rail industry will continue to deploy technology in support of risk reduction, and ensuring railroads can continue to earn the revenues necessary to invest adequately in infrastructure, maintenance and technology will be one of the most significant things that Congress can do. Thank you for the opportunity for BNSF to testify today and I look forward to responding to your questions.

ATTACHMENT



BNSF: An Industry Leader Committed to Safety

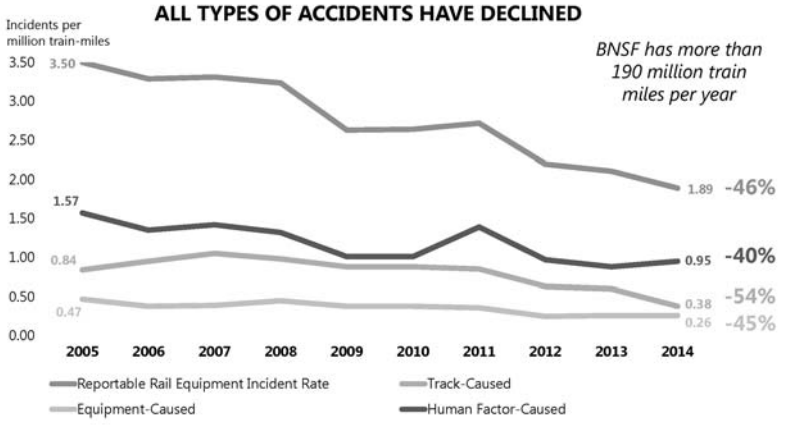
- Company-wide commitment to safety
- Approximately 47,000 employees
- 32,500 route miles in 28 states and operating in three Canadian provinces
- Moves one-fourth of the nation's rail freight – 10 million carloads in 2014
- Serves over 40 ports
- Operates over 1,600 freight trains per day
- Over 8,000 locomotives
- Over 200,000 freight cars
- 13,000 bridges and 91 tunnels
- Capital Investment in 2015: $6.0 billion
- A Berkshire Hathaway company



BNSF RAILWAY

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BNSF: Achieving Continuous Risk Reduction

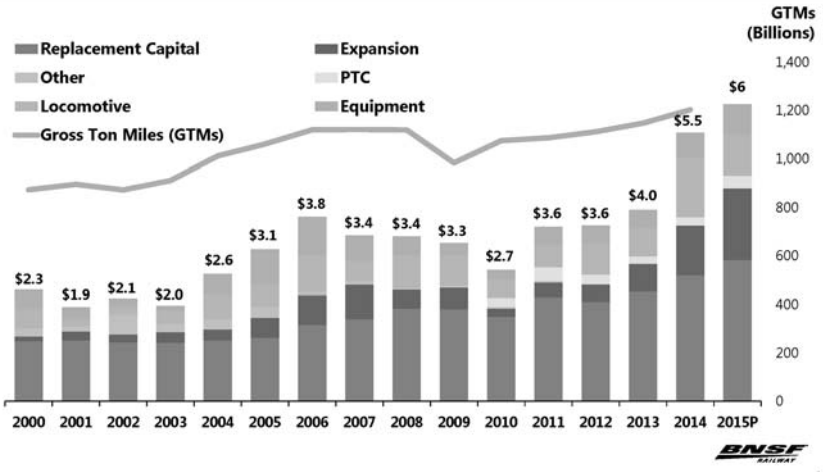


BNSF RAILWAY

Source: FRA through Dec. 31, 2014

3

BNSF Capital Commitments with Gross Ton Miles

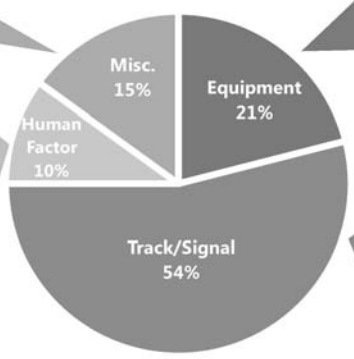


4

BNSF Major Rail Equipment Incidents*

Operating Practices/Alerts
- High wind/tornado alerts
- Extreme temperature protocols

- **Positive Train Control** - $2 billion
- On-going employee **training** - train handling, inspections and equipment maintenance
- **Rule compliance** -remote monitoring and self reporting protocol
- **Predicable work** schedule pilots
- On-board/facility **cameras**



- **2,000 Detectors across the network –** Use of infrared technology and acoustic sensors provide early warning for wheel fatigue and defects
- **Vision Cameras –** Record images of components operating at track speed to help identify defects

- **Risk based inspection** frequency in excess of federal requirements
- Fleet of ultrasonic **rail detectors**, track geometry **inspection vehicles**, and bridge and tie **inspection equipment**

*Defined as 14 or more cars derailed on mainline or sidings

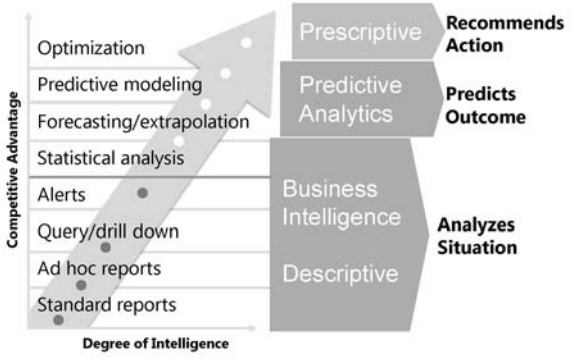
5

Rail Technology

BNSF: Leveraging Advanced Analytics

WHAT IS ADVANCED ANALYTICS?

- Advanced analytics covers a broad spectrum of activities
- Aimed at drawing insights and value from large amounts of data, to improve decision making
- Advanced analytics moves to more predictive and prescriptive activities, rather than simply descriptive



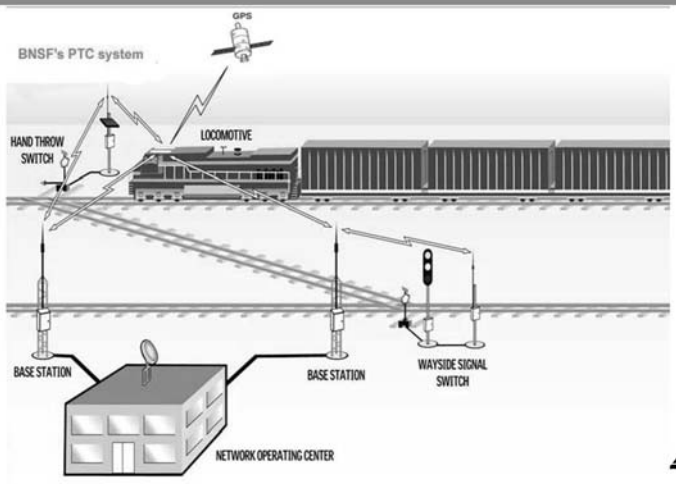
Based on Davenport & Harris, Competing on Analytics, 2007; Princeton Consultants


Advanced Analytics Help to Proactively Identify Rail Equipment Issues
DETECTORS
Thermal / Acoustics / Pressure / Vision
Wheels / Axles / Bearings / Brakes / Trucks / Couplers
PREDICTIVE ANALYTICS
Defect Alerts
Composite Alarms
Predictive Analytics
SAFETY
Prevent Derailments
BNSF RAILWAY
6


BNSF RAILWAY
9



Positive Train Control Technology

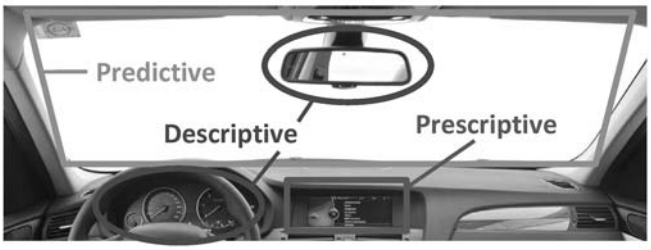


Advanced Analytics

Definition: Advanced Analytics is the scientific process of transforming data into insight for making better decisions

Types of Analytics:

- ***Descriptive*** – What happened? Where? When? How much?
- ***Predictive*** – What will happen next? How likely is it to happen?
- ***Prescriptive*** – What should we do to achieve the best outcome?



BNSF RAILWAY

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Rail Equipment Health Detection Technology

Prevention Technology

- Over 2,000 trackside detectors
- Hot Box Detector (HBD)
- Wheel Load Impact Detector (WILD)
- Trackside Acoustical Detector (TADS)
- Sonic Cracked Wheel/Axle Detector (CWAD)
- Machine Vision Systems
- Magnetic Particle Inspection
- Warm Bearing Detection System (WBDS)
- Hot Wheel Detectors (HWD)
- Truck Performance Detectors (TPD)



Rail Equipment Health Detector Examples



- ***Acoustic Bearing Detector (ABD) –*** acoustic systems used to evaluate sounds generated by specific bearing component defects



- ***Hot Box Detector (HBD) –*** evaluates bearing temperature history for statistical outliers; brake issues, burned off journals

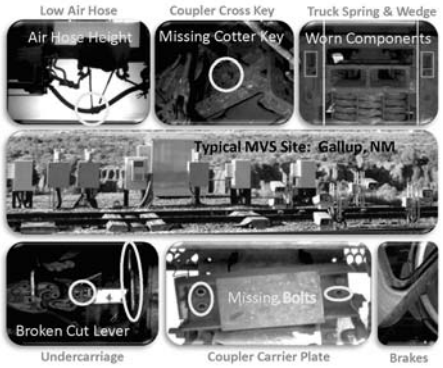


- ***Cracked Wheel/Axle Detector (CWAD) –*** rail mounted sensors capable of detecting the difference between tones generated by normal vs. flawed wheels and axles

BNSF RAILWAY

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Rail Equipment Health Detection – Machine Vision Systems

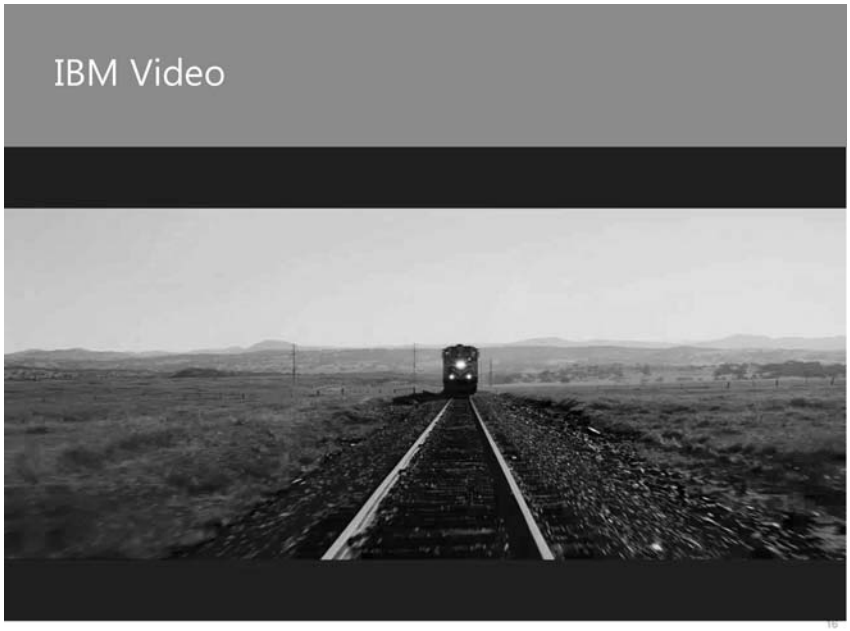


Defect identification in transit at +70 mph, 24 hours per day at 10 sites/47 modules

- **Coupler Carrier Plate & Cross Key** – Coupler securement, e.g. missing fasteners
- **Spring and Wedge** – Truck side inspection, e.g. worn truck components
- **Undercarriage** – Complete under frame inspection, e.g. structural integrity
- **Brakes** – Brake system health, e.g. worn brake shoes
- **Wheel Profile** – Wear limits, e.g. flange thickness
- **Hopper Door Lock** – Door securement, e.g. rapid discharge outlets

BNSF RAILWAY

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IBM Video
16


Future Technology Plays a Key Role in Driving Safety Improvements
BNSF
17

Unmanned Aerial Systems

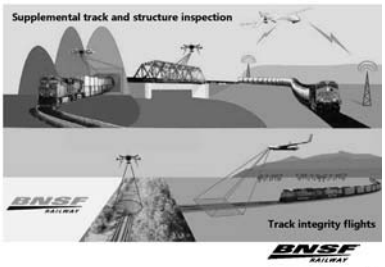
Supplemental track and structure inspection

- Small multi-rotor aircraft
- Operations governed by FAA Section 333 Exemption
- Will enable supplemental bridge and track inspection, and service interruption support

Track integrity flights for key train operation

- FAA Pathfinder Program: BNSF Partner
- Larger fixed wing aircraft





BNSF RAILWAY

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BNSF RAILWAY

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Senator FISCHER. Thank you, Mr. Fox.
Mr. Christensen, welcome.

STATEMENT OF MICHAEL R. CHRISTENSEN, SENIOR EXECUTIVE LEAD, SUPPLY CHAIN OPTIMIZATION, PORT OF LONG BEACH

Mr. CHRISTENSEN. Madam Chairwoman, members of the Subcommittee, thank you for the opportunity to speak with you today.

Technology will help us address the precedented challenges that are facing our industry, which I believe are as revolutionary as the advent of containerization was, 50 years ago. Big ships and ocean carrier alliances are game-changers. I'll spend the next few minutes talking about specific technologies and strategies that we're implementing to meet these challenges.

Modernizing our infrastructure is the first strategy with—and no port in the United States is investing more than the Port of Long Beach through our $4 billion capital improvement program. Our $1.3 billion Middle Harbor Terminal is the port of the future. It's the greenest, most sustainable container cargo terminal in the United States that can accommodate the world's biggest, greenest ships up to 22,000 20-foot equivalent units, or TEUs. Middle Harbor will strengthen our ability to compete against Canada and Mexico for the trade that sends cargo to every congressional district in the United States and supports a million and a half American jobs.

The terminal—this terminal by itself would be the fourth-largest port in the Nation, and it will boost the capacity at the Port of Long Beach by 20 percent. Longshore jobs at the terminal will also be modernized and will shift to technical occupations, with longshore labor actually increasing over current levels when the terminal reaches its full capacity. Now, these advanced technologies will help improve efficiency and reduce air pollution, but they will also demand a great deal more electricity. So, how will we deal with this increased demand for reliable electric power? The answer is our Energy Island Initiative, a technology-driven strategy for transitioning energy at the port to resilient and sustainable self-generation systems and renewable power sources.

So, I've talked about the infrastructure, or let's call it the hardware, strategy, but what about the software? Well, it will not be possible to meet the challenges we face without changing the way the port operates. We have joined our neighbor, the Port of Los Angeles, in a Federal Maritime Commission-sanctioned Joint Port Initiative that will be aimed at enhancing the velocity and the reliability of shipments that come through the San Pedro Bay Gateway. And we're making progress on this active—with the active involvement of stakeholders, which include the full range of beneficial cargo owners, ocean carriers, marine terminal operators, licensed motor carriers that dray this cargo to destination, chassis pool operators, our railroad partners, labor, and management.

Now, a few things have already come out of this Joint Port Initiative. The supply chain optimization will largely be data-driven. The current highly proprietary and siloed supply chain suffers from a inadequate data-sharing. The San Pedro Bay Port authorities are examining new roles to gather, filter, and distribute reliable data,

to the benefit of the entire supply chain. Promising entrepreneurial software is also appearing and holding great potential. One example is software—is a software called "CargoMatic," operates on a smartphone. It's an Uber-like application that's being used as a pilot study in the San Pedro Bay. And, under their systems, drayage truck drivers move imported containers from the ports to inland destinations, much as a taxi driver would move passengers from an airport.

U.S. Department of Transportation's Freight Advanced Travel Information System, or FRATIS, as we call it, is also showing great promise in transferring information between real—in realtime between marine terminals and drayage trucking operations. So, stay tuned for much more that will be coming from this Joint Port Initiative.

In conclusion, our supply chain optimization efforts are all heavily reliant on technology in order to meet our objectives of not only good, but world-class, velocity and reliability. As local public agencies, the San Pedro Bay Ports are shifting from our traditional landlord role to one of active supply chain participant. We hope to see the Federal Government support us in this new role by engaging with us and in setting effective goods movement policy that recognizes the value of seaports and by creating infrastructure and energy funding that support the land and the waterside investments required to accommodate much needed growth in international trade.

We look forward to working with our Federal partners in this exciting venture. Thank you for attention. I will look forward to answering any questions.

[The prepared statement of Mr. Christensen follows:]

PREPARED STATEMENT OF MICHAEL R. CHRISTENSEN, SENIOR EXECUTIVE LEAD, SUPPLY CHAIN OPTIMIZATION, PORT OF LONG BEACH

Madam Chairwoman, Members of the Committee. Thank you for the opportunity to speak before the Committee today at this important hearing.

The Port of Long Beach has long stood at the forefront of innovation in international trade and transportation. From the rise of containerization, through the growth of Pacific Rim commerce and now into the huge steps forward in ship capacity, facility modernization, and advanced technology, Long Beach has been at the epicenter of change.

As a premier, deep-water port, Long Beach strives to be a leader in goods movement safety, supply chain optimization and environmental stewardship. In service to its neighboring community, its city, its region, the State of California, and the entire United States, the Port of Long Beach has become a major economic engine. Now, together with our neighbor, the Port of Los Angeles, Long Beach is collaborating with our supply chain partners to further strengthen the ability of the ports to facilitate trade that benefits not only the region, but the entire United States.

Cargo that moves through the Port of Long Beach sustains 30,000 jobs in Long Beach, 300,000 jobs in the Southern California region and 1.4 million jobs in the United States. Cargo hauled across the docks in Long Beach touches each and every congressional district in the U.S.

At present, fast-changing economic realities in the shipping industry along with the advancement and application of technology are bringing leading seaports to the dawn of a new age of shipping. This age promises cleaner, more efficient and safer transportation of international trade, with exciting opportunities for growth and innovation. Technology is affecting all links in the trans-Pacific supply chain.

Big Ship Era

So exactly what are the changes to the shipping industry? It begins with the formation of international ocean shipping alliances and the size of the ships they are acquiring. These are some of the most significant developments in the maritime in-

dustry in decades. Until a few short years ago, the biggest ships calling at the Port of Long Beach could carry a maximum of 8,000 container units or TEUs. TEUs are the twenty-foot equivalent unit long cargo containers. These ships were already twice as big as the vessels able to fit through the old Panama Canal, which meant that trans-Pacific trade—the rapidly growing commerce between the U.S. and East Asia—came to West Coast ports like Long Beach. In fact, 40 percent of all imported containerized cargo moves through Long Beach and Los Angeles.

But in 2012, the biggest container ship ever to call at a North American seaport came to Long Beach. That ship had a capacity of 14,000 TEUs. Ships of this size now regularly call in Long Beach and Los Angeles. These ships are already too big to pass through the expanded Panama Canal. In 2016, the expanded Panama Canal opens and will be able to handle vessels with capacities up to 13,000 TEUs. A 14,000 TEU vessel is as long as the Empire State Building is tall, and as wide as the 10-lane 405 freeway in Southern California. And we expect to see further growth in ship sizes. Vessel technologies (hull design, hull coating, engine and propulsion technologies) have advanced at break-neck speed resulting in the delivery this year of Very-Large Container Vessels that carry over 20,000 TEUs. The advent of big ships has reduced the cost, the amount of fuel used, and the air pollution created in shipping each container. The four major international ocean shipping alliances have embraced this "big ship" strategy and have now captured over 90 percent of the worlds ocean-going containerized cargo trade.

Larger ships, coupled with a new level of vessel-sharing dynamics created by the carrier alliances, have created congestion issues at most ports because the existing container terminals and operating practices are simply not geared to handle the discharge of containers from these vessels. To help deal with the impacts of these bigger ships and alliances, the ports of Long Beach and Los Angeles sought and received permission from the Federal Maritime Commission to create a joint Supply Chain Optimization project. Supply Chain Optimization is an effort to find and implement ways to make the supply chain run more efficiently, maximizing velocity and reliability of goods movement through the San Pedro Bay gateway. The industry—accustomed to working in "silos" with minimal communication and information sharing—has responded enthusiastically and cooperatively.

The ports' joint effort started this March. Already, nearly a dozen meetings have been held. The list of stakeholder participants is all-inclusive across the industry, with a port executive-level steering committee, seven collaborative "Working Groups", and a stakeholder Core Advisory Group. These teams have identified new technology and data flow as major parts of the potential short-term and long-term solutions. And, as the supply chain runs more efficiently, one would expect to see environmental and economic benefits as well as increased job creation.

The Supply Chain Optimization umbrella also includes the terminal efficiency strategies including advanced terminal operations systems and software, modernized terminal infrastructure and equipment, "peel-off" operations and on-dock rail optimization. Drayage trucking improvements include an interoperable chassis "pool of pools" and state-of-the-art traffic information systems. Other enhancements in on-dock and near-dock rail operations, including short-haul rail, will be discussed as a means of improving the velocity of cargo flow through the San Pedro Bay and within Southern California.

Supply Chain Optimization will be largely data-driven. The current highly-proprietary and "silo'ed" containerized marine cargo supply chain suffers from inadequate data sharing in terms of quantity, quality, and timeliness. The San Pedro Bay ports are examining new roles in gathering, filtering, and distributing supply chain data that will facilitate better terminal, drayage trucking, and rail operations along with greater levels of transparency. Information technologies will be key to this effort. Additionally, promising entrepreneurial software applications are already appearing and hold the potential for significant supply chain improvements. For instance, CargoMatic, an "Uber-like" application, is being used in a pilot study in the San Pedro Bay. Under their system, drayage truck drivers move imported containers from the ports to inland destinations in a highly-efficient manner much as a taxi moves passengers from an airport. Other software applications optimize the movements of empty containers and chassis by matching empty equipment with potential users of that equipment, avoiding costly and wasteful repositioning. And the U.S. Department of Transportation's Freight Advanced Traveler Information System (FRATIS) has shown great promise in early trials in sharing critical information in real-time between marine terminal and drayage trucking operations.

Middle Harbor Redevelopment

When it comes to modernization to improve competitiveness, no port in the U.S. is investing as much as the Port of Long Beach. With a $4 billion capital improve-

ment program this decade, the Port is making major investments in waterway, terminal, roadway, rail, security, and information technology infrastructure. For example, our $1.3 billion Middle Harbor Terminal Redevelopment's first phase is being completed this summer, and when terminal operator Long Beach Container Terminal (LBCT) starts moving cargo across the docks in early 2016, it will mark Long Beach's first foray into advanced terminal technology.

Middle Harbor is the "Port of the Future"—the greenest, most sustainable container-cargo terminal in the United States. The terminal is equipped with all electric, zero-emission cranes and cargo-handling equipment. Advanced technology incorporated into the terminal boosts the Port's competitiveness in an age when seaports around North America are trying to protect their market share from capture by Canadian and Mexican ports.

This terminal is not only big ship ready, it's "biggest ship ready"—with a wharf, crane and cargo-moving systems that can accommodate the world's biggest, greenest ships up to 22,000 TEUs. Middle Harbor will allow the Port to strengthen its ability to compete for the trade that sustains jobs in Southern California.

LBCT—the terminal operator—will start test operations later this year once the first phase of the project is completed, and ships will start calling at the new Middle Harbor terminal in early 2016. Ongoing construction of Middle Harbor is generating about 1,000 construction-related jobs. At full build-out in 2019, the terminal will be able to move more than 3 million TEUs of containerized cargo each year, and that trade will generate an additional 14,000 jobs in Southern California. That means that this terminal by itself would rank as the fourth-largest port in the Nation. The project is the most ambitious container terminal modernization ever undertaken by any port in the Nation. The new Middle Harbor terminal will boost the Port of Long Beach's capacity by over 20 percent, adding not only significant numbers of new terminal jobs but also creating new categories of skilled terminal labor that will operate and maintain this groundbreaking technology.

In addition to the Port's considerable capital investment, LBCT is spending another $600 million on the equipment for this terminal. The Middle Harbor Redevelopment project is consolidating two aging terminals into one 304-acre mega-container terminal. When the entire 4,200-foot wharf is completed in 2019, the terminal will be able to simultaneously accommodate three ships as large as 22,000 TEUs.

The rail yard on the terminal is increasing from 10,000 to 75,000 linear feet of track to vastly increase the share of on-dock rail to serve the terminal. Each on-dock rail train takes hundreds of trucks off the road and speeds cargo to destinations throughout the Nation in the fastest and most efficient manner possible.

All major buildings on the terminal will be Leadership in Energy and Environmental Design (LEED) or "Green Building" certified in order to reduce power and water use, reuse materials, encourage use of low-emission vehicles by staff, and reduce water runoff. The North Operations/Information Technology Building, the first building to be completed on the site, has already received its LEED Gold Certification.

Like the Very-Large Container Vessels it will service, Middle Harbor is a major leap forward in technology and Long Beach's first automated terminal. At the new terminal, a crane operator at the controls of one of the world's biggest ship-to-shore cranes—which can reach out to 180 feet—will take the cargo containers off the ship, two at a time, and place them on a platform. From there, the advanced technology places the containers on driverless electric vehicles that move the containers to the stacking cranes. These cranes automatically sort and stack the containers in highly dense rows. At the other end of the row, a person in the control room will lower the containers onto truck chassis via remote control.

In the terminal's battery exchange building, driverless vehicles will enter when directed by the terminals operating system and have their batteries replaced by robots as their batteries become depleted.

Longshore labor will operate the cranes and the vehicles that move the containers from the stacks to the on-dock rail yard, and will plug in the refrigerated boxes in the reefer stacks. Technicians are also needed to keep the machines maintained. Long Beach Container Terminal is working with the longshore labor to provide training for these new jobs. Jobs at the terminal will shift to technical occupations, and the longshore union membership will perform this work. Due to increases in terminal capacity in the modernized Middle Harbor terminal, longshore labor is expected to increase over current levels when the terminal reaches full capacity.

Of Long Beach's six container terminals, Middle Harbor is the only one that is automated. Only one of the Port of Los Angeles' eight container terminals is currently automated. By the time Middle Harbor is completed in 2019, it will have taken 15 years for planning, approvals, design and construction, and $1.3 billion in Port of Long Beach funding.

Automation is just one way that the Port of Long Beach is working to modernize and strengthen the Port's competitiveness. For example, other terminals are raising and extending their water-side cranes, adding modern terminal equipment, upgrading operating systems, and dredging to accommodate the larger container ships. Road, bridges, and the rail system are all being modernized and expanded. With its $4 billion capital improvement program, the Port of Long Beach will be able to continue to attract the cargo that supports jobs both in Southern California, and across the U.S., including the jobs of the workers who move the cargo on the docks.

Every element of the Port's capital program utilizes technology to the maximum extent in its design, construction, and operation. New technologies are needed to keep pace with the larger ships, and improve productivity. Technologies big and small will help improve productivity and velocity. The advanced technologies that will help improve efficiency and reduce air pollution will move away from conventional fossil-fueled equipment and will demand a great deal more electricity. For example, shore-power systems that connect ships to land-side electricity have matured and are in widespread use in California, significantly reducing emissions for vessels at berth while at the same time controlling costs. And high-speed electric stacking cranes and battery-powered container movers will also add to the demand for electricity. This advanced technology will greatly add to the Port's dependence on the grid for ample high-quality electric power.

Energy Island

In anticipation of the increasing demand for electricity, the Port in 2013 implemented a Port Energy Policy. And just as Long Beach's 2005 Green Port Policy made it clear that environmental protection is a top priority at the Port, the new Energy Policy makes it clear that sustainable energy use is a top priority. We are committed with our customers and key stakeholders to deliver unprecedented energy conservation, operational efficiency and enterprise resiliency.

We are now working on the next step. At his inaugural State of the Port address in January, Port of Long Beach CEO Jon Slangerup unveiled our Energy Island Initiative—a comprehensive strategy for transitioning energy at the Port to resilient and sustainable, self-generation systems and renewable power sources. Along with creating the ability for the Port to operate independently from the grid in times of emergency or other need, the initiative's objectives include stabilizing power costs and increasing the competitive advantages of doing business at the Port of Long Beach.

Energy Island captures a number of measures that Long Beach has already been developing, and it creates a framework for exploring the larger universe of possibilities to advance real energy solutions.

Under the initiative, the Port has established five goals aimed at ensuring an ample supply of reliable electricity, alternative fuels and other energy sources as the Port moves toward near-zero-emissions operations.

- Advance green power: The Port will pursue solar, wind, geothermal and the viability of tidal energy to generate its own electricity. Solar panels that provide a clean source of electricity are already a key feature of the Middle Harbor Terminal Redevelopment project and the Port's new Maintenance Facility.
- Use self-generated, distributed power with micro-grid connectivity: The ability to generate power independently of the grid is crucial to business continuity in the event of an emergency. Micro-grid controls that are connected to the grid also allow the Port to contribute to the regional power supply, help lower the city's emissions, and supply power to vital services in an emergency.
- Provide cost-effective alternative fueling options: The Port will explore options that include liquefied natural gas (LNG) as fuel for ships and locomotives, hydrogen generation, fuel cell technology and related infrastructure. This goal builds on the existing progress the Port has made under its Clean Trucks Program and Technology Advancement Program (TAP) to support drayage trucks that run on LNG, compressed natural gas (CNG), and hydrogen fuel cell technology.
- Improve energy-related operational efficiencies: The Port will explore strategies for maximizing available energy resources, including upgrading equipment and consumption controls, offering energy-efficiency guidance and leveraging available incentives for operational efficiencies.
- Attract new businesses, incubate transportation-oriented technology, create jobs, increase revenue and reduce costs: By advancing new technology and innovation that support the maritime, transportation and energy sectors, stimulating the economy is part and parcel of the Energy Island Initiative. In the area of innovation and job creation, the effort will build upon the Port's existing

Technology Advancement Program for demonstrating promising new clean air technology, to accelerate the commercial availability of relevant and promising energy technologies.

Transforming the Port into an "island" of renewable energy technologies and self-generation systems is expected to take about 10 years. The Middle Harbor terminal, which will operate almost entirely on electricity, is on track to become the world's greenest marine container terminal and a model for cleaner seaport operations throughout the world.

Taking a hard look at specific energy projects includes a comprehensive assessment of their feasibility. In each case, the Port will consider the potential benefits in a marine environment; capital and operational costs and benefits to the Port, the community and stakeholders; operational burdens on Port tenants; positive and negative environmental impacts; the need for additional infrastructure and related costs; and foreseeable technology improvements and obsolescence.

Conclusion

Technology touches every link in the marine cargo supply chain. Our Supply Chain Optimization efforts, Middle Harbor Redevelopment and related projects, and our Energy Island Initiative, are all reliant on technology, both "hardware" and "software", in order to meet our objectives of greater containerized cargo velocity and reliability. As local governmental agencies, the San Pedro Bay ports are shifting from our traditional "landlord" role to one of an active supply chain participant. We hope to see the Federal Government support us in this new role by setting effective goods movement policy that recognizes the value of seaports and the economic engines they represent and by creating infrastructure and energy funding that supports land and water-side improvements needed to accommodate growth in international trade.

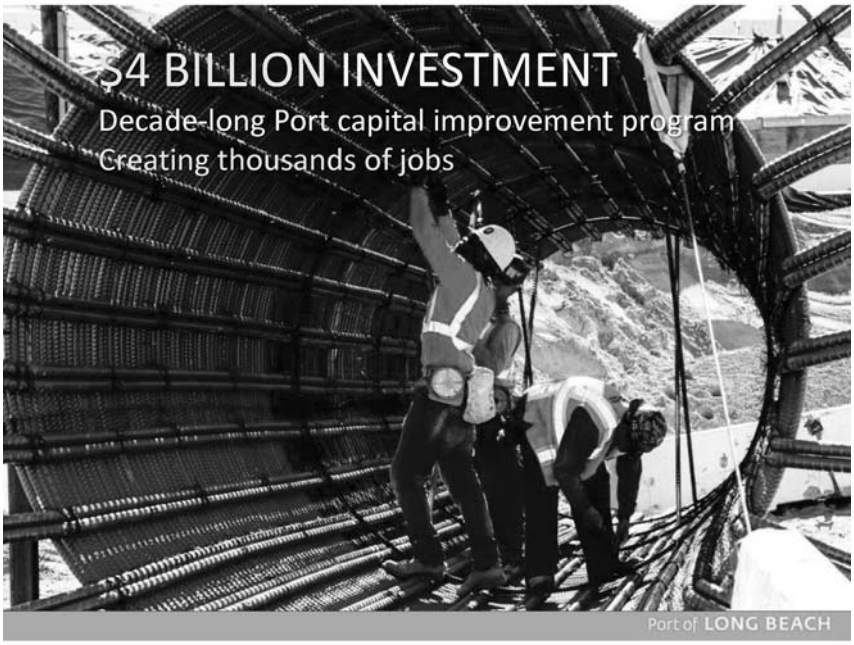
We look forward to working with our Federal partners in this exciting venture.

ATTACHMENT




MAJOR CHALLENGES
Big ships and alliances spur operational optimization
Port of LONG BEACH


HANJIN
MSC
BIG SHIP READY
14,000-TEU vessels began calling in Long Beach in 2012.
Port of LONG BEACH


$4 BILLION INVESTMENT
Decade-long Port capital improvement program
Creating thousands of jobs
Port of LONG BEACH


Coming soon: MIDDLE HARBOR
Advanced technology for world's greenest terminal
Port of LONG BEACH


$1.3 BILLION INVESTMENT
305-acres, 3.3 million-TEU capacity in 2019
Port of LONG BEACH


BROMMA
HARD HAT AREA
ZERO EMISSION
030
LBCT
ZERO EMISSIONS
All-electric, remote-controlled yard tractors
Port of LONG BEACH


SHORE POWER
Vessels plug in for electricity while at berth
Port of LONG BEACH


ENERGY ISLAND
Advancing green power, clean fuels, energy efficiency
Port of LONG BEACH


SUPPLY CHAIN OPTIMIZATION
Joint Long Beach and L.A. initiatives to improve velocity
Port of LONG BEACH


COSCO
THE FUTURE IS BRIGHT
We can capitalize on key opportunities to bring a promising future to the Port of Long Beach.
Port of LONG BEACH

Senator FISCHER. Thank you all very much.

We will begin our round of questioning at this time.

Ms. Alt, some research on the autonomous truck market estimates that, by 2020 to 2022, we're going to see level–3 autonomous truck technologies introduced in certain states. And, at level 3, a driver is still required to be in the vehicle, but the truck can be switched into an autopilot mode when circumstances permit. When do you think that we're going to see trucks equipped with that level-3 driving technology on American highways? And can you go into it a little bit more on how that all works?

Ms. ALT. You said that you read something that it was going to be available in 2020? So, we are in—so, it's 5 years from now. And you said "in certain states."

Senator FISCHER. Right.

Ms. ALT. That's possible. There are states that have more flexible laws to allow for testing. The challenge is, of course, the products we build go across the State, so we really need to have some sort of a Federal standard.

The technology's actually leading the society. I mean, the technology for two vehicles to talk to each other, where the lead truck or the pilot truck is leading the trucks behind it, and that—that's your level 3—that technology is not that far away, in terms of the actual technology. The challenge is then, How can it be accepted? Which roads can it be driven on? And are you going to be comfortable, in your vehicle, with 160,000 pounds of freight moving beside you, with a driver that's not—they're in control, but they're not fully in control? So, I think that the technology is possible, but the societal changes are going to have to be much more alerted to us. And then, also, we're going to need, again, a standard across all the nations, because our vehicles don't operate in one state at a time.

Senator FISCHER. I understand, in the United Kingdom, they have the least restrictive regulations with regard to the autonomous vehicles. Within the United Kingdom, they're not restricted, then, by the boundaries, right?

Ms. ALT. I don't think so, though I don't know the answer to that fully. Sorry.

Senator FISCHER. Do they—it's my understanding they don't need special permits or even special insurance in the United Kingdom to be able to do that. I know that many companies are planning on doing some testing in the United Kingdom on British roads, for that reason specifically. What do you think we need to do here in the United States? Is it possible for the Federal Government to move forward with regulations if society is not ready for it yet?

Ms. ALT. Yes, so it's a balance, isn't it? I mean, you don't want to be forcing—or identifying which technology to use, and then putting that into some sort of Federal regulation. You want the market to establish that. But, there are—it's a new world that we're in. You—in the regulations, even putting terms like, What is a driver? Is the driver the system that's moving the vehicle? Is the driver the guy or gal that's sitting behind the truck—or the driving wheel? What is a system? There are so many semantics that we have to think about differently as we put this legislation into place.

So, what do we have to do differently is looking at, What can we do across all the states so that, when we design these vehicles, they can operate in all of the States? So, we need standardization of simple things, like the terminology, I think, is one step.

Senator FISCHER. How close are we?

Ms. ALT. We're a long way away from that.

Senator FISCHER. OK.

Mr. Fox, in January, this committee heard testimony from the UP regarding the importance of encouraging performance-based standards in regulation. In performance standards, they move government away from design-based standards toward a goal of oriented approach to achieving that outcome. For example, the FRA mandates that intervals between certain types of locomotive inspections. Do you believe that performance-based standards could help foster innovation and technology-drive safety advances better than the design-based standards?

Mr. FOX. Yes, we absolutely believe performance-based standards are the way we need to progress. Because performance-based standards are really focused more on the outcome versus the method. And by focusing on the outcomes, we're free to innovate with technology or process changes. We've had some great examples of working with our safety regulator on performance-based standards through waivers. The predecessor of the PTC system was an example of that on the BNSF. So, it can work, and it can drive innovation, absolutely.

Senator FISCHER. And how effective have they been?

Mr. FOX. We've made some progress on waivers. And, at the same time, going through the waiver process does take time and, at times, is pretty frustrating.

Senator FISCHER. OK, thank you.

Senator Booker.

Senator BOOKER. Thank you, Chairwoman.

Ms. Alt, I'm concerned that you—well, first of all, I'm confident that you and I share the goals—the same goals of increasing safety on the Nation's highways. And I appreciate all your work, and I really appreciate the things your company does. But, I'm really just kind of concerned, when I read your written testimony. You refer to the legislation I introduced with Senator Rubio in it, and I was actually pretty shocked at what I read. The Wi-Fi Innovation Act, which is a bipartisan—in both House and Senate—piece of legislation. Our bill, for those who have read it, places timelines and guidelines in place for the FCC to test the 5-gigahertz spectrum band, in consultation with the Department of Transportation. Some of this testing has already happened, and we're excited about that. But, our bill simply provides further structure for testing alone.

I can understand why a lot of people in the industry want to attack this, as you did in your written testimony, and maybe even mislead people, because the industry has been sitting on this spectrum since about 1990. But, I want to be very clear about what this bill actually does, for you and for others.

For over a decade, the industry has been working on new technology while, at the same time, other technologies—using radar and sensors—have evolved without using dedicated spectrum. Over a billion dollars of taxpayer dollars has been spent on this R&D.

And our bill simply asks for testing to see whether this limited resource, this precious resource that you indicated, can be shared. It is a fact-finding bill, and that is all. It's not—if it's not safe to share, I agree, and the bill clearly says, there will be no sharing. But, if it can be safely shared, now as the other technologies are evolving, I'm sure people would agree that it should be.

So, I'm disappointed in the portrayal of my and Senator Rubio's legislation in your testimony. I'm shocked. I've been in the Senate for a short time, but I've never seen something clearly so misleading in the short time I've been in the Senate.

I've worked closely with stakeholders on this from all across the board, from Secretary Fox to Advanced Safety. And as supporters of V2V technology, Senator Rubio and I were steadfast advocates of highway safety. Safety should come first. But, I'm disappointed by these exaggerated attacks.

And so, the first question I simply have is, did you read our legislation, yes or no?

Ms. ALT. No.

Senator BOOKER. OK. So, if you didn't read the legislation, but yet you say—"The Wi-Fi Innovation Act would open up 5.9 gigahertz frequency spectrum to Wi-Fi access," that's not true. That is a false statement. And that is very frustrating.

And so, encountering something that—you know, when I was Mayor, I used to always say, "In God we trust, but everybody else bring me data, bring me the facts." Everybody wants to obscure them, but the truth should come through. And so, a fact-finding bill that simply looks to understand, what is the best way that we can achieve the safety goals that your company puts first, that this Senator and I'm sure the whole panel puts first? And so, I'm just curious. My last question to you is—I believe consumers should have all options on the table, but should advocate safety. And I'm wondering if you agree that our transportation policy should be actually technology-neutral, that should be about what is best to ensure that policy and safety don't lag behind the best cutting-edge technology. Do you agree with that?

Ms. ALT. Of course I agree with that.

Senator BOOKER. OK. So, again——

Ms. ALT. And may I respond to some of your comments, then?

Senator BOOKER. You certainly may.

Ms. ALT. So, I think we're on the same page with that. The unlicensed Wi-Fi doesn't have a governance structure like a licensed frequency does. And the IEEE, which is the Industrial Electronic Engineers Group, that is the group that has put two proposals forward. They have not come to a conclusion. So, our position is that the legislation is simply premature.

Senator BOOKER. Ms. Alt, I'm sorry. I can believe your testimony, that you submitted to the United States Senate, which doesn't say what you just said. It says—it indicates that you are against this bill because it would, quote—and I quote, "It would open up 5.9 gigahertz frequency spectrum." That is not true, and you have—agree with that. What the bill does, when you read it, which I hope you will—what the bill is simply saying is, hey, let's begin to have a fact-finding endeavor that better understands the usage of this spectrum and the question—this is a precious asset; this is why I

know your company wants to protect it—can it possibly be shared without infringing on safety? That's all we're looking to do.

So, attacking the bill on clearly false standings is insulting.

My time's run out.

Senator FISCHER. Thank you, Senator Booker.

I welcome our Ranking Member today from the Committee. Senator Nelson.

STATEMENT OF HON. BILL NELSON,
U.S. SENATOR FROM FLORIDA

Senator NELSON. Thank you, Madam Chairman.

Well, what about that, Ms. Alt? What about what Senator Booker said?

Ms. ALT. Well, I—we've come to an agreement that we do not want to see that that spectrum is shared with other technologies until and unless the governing bodies are sure that there is no interference from other technology.

Senator NELSON. Do you think that technology is practical to—basically, the spectrum—do you think the spectrum is practical to be used by the automobile industry anytime in the near future?

Ms. ALT. I don't know the answer to that, if it can be shared. And that's really the—the position is, can it be shared with other technologies? The governing bodies have come to a—have not come to a conclusion after putting forward two proposals.

Senator NELSON. There are 4,000 crashes—no. There are 4,000 people that are killed each year from serious truck crashes. How would you suggest technology is used to lessen that?

Ms. ALT. The more that vehicles can speak to each other, vehicle-to-vehicle—this is trucks talking to trucks and/or trucks talking to cars—the more that they can talk to each other to let the other one know, "Hey, I'm here. You need to stop"—that is a technology that would help reduce crashes.

Senator NELSON. Over the last week, I met with a grieving mom whose daughter, on her honeymoon, when the traffic had stopped on Interstate 95, and it had literally come to a stop, and her new son-in-law and daughter were in the traffic, stopped, but a truck, with the driver not having had a lot of sleep because of his company requiring a roundtrip trip within the state of Florida in the same day of 16 hours, the truck driver was, basically, sound asleep. And so, she is a grieving mom because of that truck plowing into the back of all of those stopped vehicles.

How would you think technology could address the issue of truck driver safety?

Ms. ALT. Yes, it's a great question. I'm a mom. I would grieve with her. Obviously, that's horrible. There are electronic onboard recording systems that would record the hours of service that the driver can drive. Perhaps if there were a technology that would actually shut down the truck if he went beyond his hours could be something. But, requiring that trucks have these onboard recorders—this technology is available, and I believe it's close to being legislated. Those are things that can help.

Senator NELSON. And this particular truck was intrastate, not interstate, so what rules that we have up here—for example, we don't allow the tandem trucks, in our rules, more than 28 feet, but

they are allowing two tandem trucks on intrastate, inside the state, of 33 feet, which is an issue that will be in front of this committee with regard to truck safety.

Let me ask you, Mr. Christensen. You all have accommodated the big ships from Asia. And soon, in a year or two, when the Panama Canal has completed its expansion, they'll come to the East Coast. You want to give any quick pointers what we could do that you've learned—lessons learned on handling those huge, huge container ships?

Mr. CHRISTENSEN. Senator Nelson, thank you for the question.

It is—they are a game changer. But, the term of "big ship" is a changing term. When I started working in the port, about 10 years ago, a big ship was 8,000 TEUs. In 2012, the Port of Long Beach started handling 14,000-TEU ships, about the same time the new locks in the Panama Canal were going into construction, which can accommodate a 13,000-TEU ship. The ships we're handling now in the San Pedro Bay ports will not fit in the new locks on the new Panama Canal. We are—customers at the Port of Long Beach are now ordering 20,000-TEU ships. So, it is a—very much a moving target.

To our colleagues on the East Coast, they're already dealing with this with ships that are transiting the Suez Canal, and it really has to do with depth of channel to get them there, but, once they're there, dealing with how those ships are stowed and how those ships are unloaded. And that is exactly the focus of our Joint Working Groups, is to figure out a whole new way to operate our ports so that we can deal with a very large amount of relatively unsorted containers coming across the wharf and hitting us in ways that it's never—we've never had to deal with before.

Senator NELSON. The question was, what are the lessons learned that you could share with the other ports?

Mr. CHRISTENSEN. The lessons, we're still learning, Senator. And they really have to do with having adequate supplies of chassis, which has to do with an interoperable chassis pool. It has to do with working closer with the steamship lines and putting more discipline in their stowage of the vessel, which has been thrown aside because of the way that those vessels are calling on the Asian ports and the way the shipping alliances are working. And it has to do with working much, much more closely with the communication of data, which we're again finding extraordinarily siloed within the supply chain, being able to provide a marine terminal operator with information more than 2 days before that vessel hits their terminal so that they can plan their moves adequately. These are all lessons we're learning. I'm not sure that we could tell much more to our friends on the East Coast as to how to deal with that issue beyond that.

Senator NELSON. Thanks.

Senator FISCHER. Thank you, Senator Nelson.

Senator Cantwell.

STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON

Senator CANTWELL. Thank you, Madam Chair. And thanks for holding this hearing.

And thank you, to the witnesses.

Mr. Misener, congratulations on 20 years. It seems just like yesterday. And definitely I would say that the transformation of delivery of goods and services has been quite impressive. We didn't—I didn't hear in your testimony a discussion about the drone issue, from a technology perspective, but clearly this committee, the larger full committee, has had testimony on that, and it certainly is one area continuing to move forward on technology and delivering the product.

And, Mr. Christensen, I loved everything that you said, except for it would have been great if you would have said it was about Seattle-Tacoma instead of L.A.-Long Beach, but still very happy to hear your description of the economic opportunity before the United States, that we actually can increase the cargo shipments, because there is that demand and product to be shipped, but that we have to continuously make improvements. And this is something we see in Seattle, as well, that, somebody estimated, instead of 3 million cargo containers, we could do something like six. It's not out of the question. So, you described that, you described that that would actually be good for longshoremen, even though you're making technology investments. So, we're talking about both—you're talking about efficiencies.

OK. So, my question to you and Mr. Misener, anybody else—Mr. Fox or Ms. Alt—is, even though we're talking about technology that helps us move and be more knowledgeable about the product, do we still need to make investments in freight mobility from a Federal perspective to make sure that, as those products are being moved around, that our technology just isn't measuring, stuck in congestion, and then making us less competitive?

Mr. MISENER. Well, Senator Cantwell, if that's partly to me, I appreciate that very much. And thank you for the congratulations. I've only been here for 15 of those 20 years, but——

I think we are looking for innovative policies. You've introduced a bill with Senator Booker that proposes such policies. And we congratulate you for that bill. If anything, it could be broader. It could be applied to more than just multimodal freight. But, that kind of thinking and that kind of communication—Mr. Christensen mentioned communication of data. There's also a need for communication among stakeholders. And I think that's a big part of your bill, is to get the stakeholders talking with one another to figure out innovative solutions.

We also are fans of communication of data, as Mr. Christensen mentioned. That's something we're doing with the USPS. A big component of our interaction with them is making sure that they get forecasts of what we're seeing, what we're going to be shipping. And that is particularly important for Sunday delivery, so that they can have the—use the most efficient routes for driving their trucks and delivering parcels on Sunday.

Senator CANTWELL. Well, you're a global business. And Mr. Christensen has fixed cost, if you will. So, he mentioned the magic words, as far as I'm concerned: Panama and Canada. And this is about competition. So, this is about if we're going to make the improvements necessary to move our product cost-effectively or

whether that business is going to go to, you know, Canada or via the Panama Canal.

Mr. CHRISTENSEN. And it's——

Senator CANTWELL. So, are you—do you support further freight efforts at the Federal level?

Mr. CHRISTENSEN. Yes. And, Senator Cantwell, the—just as surely as we're sitting here, as we see international trade continue to increase—and we are now at levels that are peaking over the pre-recession levels of containerized traffic moving through our ports—we will surely be seeing bottlenecks develop that are infrastructure-related. As I mentioned in my testimony, the strategies are both infrastructure efficiency with technology infused along with operational efficiencies. And I believe that the legislation you're proposing is timely, it's critical to the future of our supply chain optimization, to be honest, and we would hope to be able to continue to collaborate with you and your team on that, because it is so critical to be looking ahead, recognizing that infrastructure bottlenecks don't go away a year after you recognize them. It takes years and years of focus and funding and policy to make them—to solve these bottlenecks as they come up.

Senator CANTWELL. And how do you—your testimony—as I said, I really appreciated it, because you describe what the future opportunity was, and that it was growth opportunity in jobs, as well, not just in automation—how do you think we tell this story on a national basis? Is this data that the supply chains from other ports have?

Mr. CHRISTENSEN. It's data, but it's fractured data. Right now, and as I mentioned in the testimony, it's critically important that we bring this data in to a—through a reliable gateway and make it transparent in public. We have challenges ahead of us. We're working on those very, very hard in our working groups, in our joint port effort, as Seattle-Tacoma has worked very hard on their joint port efforts, as well. And we watch and benchmark what's going on up there very closely. So, there are opportunities, but there are a lot of—opportunities ahead of us, but there's a lot of work to be done.

Senator CANTWELL. Thank you.

Thank you, Madam Chair.

Senator FISCHER. Thank you, Senator Cantwell.

Senator Klobuchar.

STATEMENT OF HON. AMY KLOBUCHAR,
U.S. SENATOR FROM MINNESOTA

Senator KLOBUCHAR. Thank you very much, Madam Chair. Thanks for holding this hearing.

Thank you, to the witnesses.

Mr. Fox, a December 2013 Government Accountability Office report found that the FRA faces a lot of challenges—rail safety challenges, including the fact that the inspectors only have the capacity to inspect less than 1 percent of all railroad activities. I come from a state where we are a bit of an entry point for oil from Canada, as you know, and oil from North Dakota, and then agricultural products from everywhere. And so, we've had an enormous increase in rail and a number of accompanying derailments.

And, as you know, the FRA partners with states to oversee the inspection of signals, tracks, and mechanical operations. And in April, I sent a letter to the Appropriations Committee urging increased funding for more rail inspectors. I'd like to hear more about what technology BNSF uses to prevent derailments. Do you think there's better technology that could get us through this?

Mr. FOX. I think we've shown, as an industry and BNSF, that we've leveraged, and continue to leverage technology, and the results have clearly been best-ever safety results last year, from an employee safety and derailment perspective. Beyond that, though, there's opportunity. There's tremendous opportunity. Again, I think—as we talk about regulation, part of our challenge today is regulation based on a design standard. And as we look at—focus on outcomes, again, I think that will allow the industry to innovate, innovate with technology, with process changes——

Senator KLOBUCHAR. And how would—like, what kind of technology would help with this?

Mr. FOX. As we look forward, as I mentioned in my testimony, I think this drone technology, very early in practice, has a real potential. This pathfinder program with FAA will move beyond line of sight to where we could utilize drones to travel along our private 32,000-mile network for hundreds of miles a day, taking high-speed images, high-definition images of our network, down to a quarter-inch accuracy.

Senator KLOBUCHAR. I see.

Mr. FOX. Post-processing that data then would help us understand exceptions.

Senator KLOBUCHAR. OK.

I was just, in the last week, up in International Falls, Minnesota. This is not a Burlington Northern issue, where a——

Mr. FOX. I thought I was in trouble.

Senator KLOBUCHAR. I know. But, it's where a bridge collapsed, a small bridge—a railroad bridge. But, it happens to be Ranier, Minnesota. It's the biggest entry point on the Canadian border into the U.S., and it's right by International Falls, which is the larger town. And so, one of the things we talked about, in addition to some issues—this was a Canadian national rail issue—and, in addition to the bridge collapsing and some issues they've been having with that railroad and the workers not allowing us to cross the railroad, the issue was that they've been having a lot of grade-crossing issues there. I think 8 to 10 hours a day, the trains are in the middle of the town, so you can imagine, that's a lot of time, and people have to drive two and a half miles around the town.

So, what I wondered about, even though this is not a Burlington Northern issue, is that the Railroad Safety Institute at the University of Minnesota is studying train delays to more accurately estimate train arrival times at grade crossings. And one of the things the mayor of this town said is, if they could even have a signal for the people as they're deciding whether to take the two-and-a-half-mile route or go into the town, about if trains were on the tracks before they made that decision, with some kind of technology so that it would empower drivers to know what to do, that would be helpful.

But, I just wondered if you had any ideas about that crossing issue. I just did an amendment on the rail bill that we just passed through on this issue. And it was certainly brought home to me this week why I did it. So——

Mr. FOX. I think, when we talk about Federal funds supporting freight projects, grade separations is—clearly needs to be—clearly needs to be part of that. And, obviously, we've been active in that area, with contributions against those grade separations.

I also think, when we're talking about train headlights at the crossing, we also have to be talking about taillights and looking at the complete equation.

But, more Federal funding for grade separations seems to be part of the answer.

Senator KLOBUCHAR. And this sidetracks, is that—that was another thing they brought up, is, if the trains could wait somewhere else—and I think they're building one—then they wouldn't be waiting in the middle of the town.

Mr. FOX. We all have requirements around how long we can block crossings. And obviously, we spend a lot of energy on——

Senator KLOBUCHAR. Right.

Mr. FOX.—ensuring that doesn't——

Senator KLOBUCHAR. No, you've been very——

Mr. FOX.—happen.

Senator KLOBUCHAR. I've called about a number of issues, which I've really appreciated. So, thank you.

And just, if I could, Madam Chair, just one more question on distracted driving.

Right now, only one state received our funding for the Distracted Driving Grant, which we would really like to have change. There's a ton of money sitting there, and we have emerging problems, and that's why Senator Hoeven and I have sponsored a bill with Senator Booker to actually change some of the criteria so we can get that money out to the states for education efforts on distracted driving. It's called the Improving Driver Safety Act.

And I thought I'd ask you, Ms. Alt, on what kinds of technology—we know that drivers are doing things they shouldn't do in the cars. A lot of them have admitted to this in surveys. And it's killing people, to the point where we've had, you know, 424,000 people injured in 2013, and more than 3,000 people killed, that we know of, from distracted driving. And again, these are individuals making decisions on their own. But, are there any technologies, you think, from the car companies, that could be helpful with this?

Ms. ALT. Well, I can speak not from the car companies. The group that I'm with, we don't make cars; we make everything but cars. I can speak from the heavy-duty truck side, and that is where we do have alerts that are built in for a driver, to wake them up if their eyes begin to dim. And it's through either some sort of vibration in the seat or some loud sound. So, you know, it's from a heavy-duty perspective.

And, of course, then there are lots of regulations, because they're commercial drivers, about what they're allowed and not allowed to do, regulatorily, behind the wheel.

Senator KLOBUCHAR. OK. Well, I think, as we know—and I appreciate your words on trucks—but, this is an issue for all vehicles

as we try to figure out if there's anything to create shutdown of technology when people are in a car, so they stop doing it, or certain—when someone's driving, that they stop doing it. Because it's just a growing problem. So——

All right. Thank you very much.

Senator FISCHER. Thank you, Senator Klobuchar.

We're going to have a second round of questions, in case any other Senators are still trying to get here to the Committee hearing.

And I would like to begin with Mr. Misener. First of all, I think, on your video, if you could have had the teddy bear delivered to Nebraska or New Jersey, that would have been a great ending for the little guy.

[Laughter.]

Senator FISCHER. But——

Mr. MISENER. We're happy to do cameos, if you would like us to be——

Senator FISCHER. Yes.

Mr. MISENER.—hugging a teddy bear at the end of the video.

Senator FISCHER. We can do this. That—we're multi-talented up here.

[Laughter.]

Senator FISCHER. As we look at more efficient logistic networks out there, how do you think that that will benefit consumers?

Mr. MISENER. So, thank you, Madam Chair, very much.

That logistics—the improvement of logistics infrastructure, along with the more broad transportation infrastructure, is very important to consumers because it affects how they receive the goods that they purchase online. And, on behalf of our customers, we've been trying to improve this for, well, oh, at least 20 years. And automation has always been a big part of the Amazon solution to this challenge. And increasing automation certainly is going to be very helpful to making sure that consumers get the goods when they need them. But, they have a choice. And that's what we've always tried to provide them, as a choice as to delivery speeds. We've talked a little bit here about drones. Drones was really the only way we figured out how to get goods to consumers in less than 30 minutes. But, for longer periods of time, there are many alternatives. And we are also offering our customers now a slow delivery alternative that gives them additional benefits at Amazon if they're willing to accept it whenever it comes. And so, if you're ambivalent whether it comes in 2 days or 2 weeks, then it's—they can get an additional benefit from us. And so, it's all about providing our customers the choice. And this obviously applies more broadly to American consumers.

Senator FISCHER. OK. Thank you very much.

Senator Booker.

Senator BOOKER. Mr. Misener, how I would love to talk to you more about drones. You know, we share a passion for that and a desire for the United States of America to catch up to the world and other countries that are going ahead of us. It has transformative possibilities. But, sadly, I'm coming back down to earth to talk about trucks.

So, your testimony recommends the use of 10 feet longer trucks, known as "Twin 33s." The Department of Transportation recently came out with a study showing that it takes these trucks about 22 feet longer to stop. The length—that's a car length and a half. The larger and heavier trucks are greater—are the greater destruction—where the greater destruction occurs when accidents happen. And so, I just have a couple of questions on that.

One is, has your company done an analysis of the impact of safety? How will these longer trucks impact the crashes—the number of crashes and fatalities?

Mr. MISENER. So, we've been persuaded by the carriers that we work with, Senator, that the 33-foot trucks are going to be safer because there will be fewer of them on the road, driving fewer miles. Any policy choice like this is a balancing of factors. I totally get that. And I'm not sure there's any particular magic to 33 over, say, 32 or 34. And I'm not sure there's any particular magic to the current number, which is 28. What we're trying to do is find a solution that will improve efficiencies, for sure, and that can be done, but, at the same time, if we can drive down the number of miles that are driven and the number of trucks on the road, that is a safety improvement. We are persuaded that the right balance was the increase in length without increasing the weight capacity or the total weight of the trucks, because the weight, of course, is what goes into the inertia and the kinetic energy on objects like this. And so, it's a—weight times velocity is the inertia, not the length of the truck.

Senator BOOKER. And I appreciate that. There are a lot of things to balance. Safety should be the first. But, it's also the impact on the infrastructure, as well. And so, with those—those heavier trucks, would they tear up more of our local roads?

Mr. MISENER. We don't support heavier trucks. To be clear, our support is for a longer truck. It's not increasing the weight limits at all. And so, increasing the length of the truck should not affect the infrastructure adversely; in fact, it can help it, because—well, going over a bridge, for example, the weight is less concentrated and, therefore, easier on the bridge.

Senator BOOKER. I appreciate that.

And then, just last, really quickly, the—another balancing act is, you want greater and greater safety, but you also want to see what the—put the least necessary burden on businesses and how they operate. And so, the big issue of minimum insurance is one that I have some concerns about, and I'd love for you to just give me your thoughts.

With the truck size and weight, we realize that trucks are getting bigger, causing bigger accidents, as well, over the last 20, 30 years. And the minimum insurance has not been raised since the 1980s. And so, I'm wondering do you think that there is a needed minimum insurance level increase, or at least pegging it somehow to—that is elevated regularly on an ongoing basis?

Mr. MISENER. Well, Senator, it seems very reasonable to me. I mean, we—the carriers that we use are the ones who are going to be directly affected by that. And so, the carriers that we work with are reputable ones. We certainly would not want our products traveling, you know, over problematic or difficult carriers. And so, I'm

not sure I have a direct answer for you, simply because that wouldn't be directly affecting us at this point.

Senator BOOKER. OK. Thank you very much.

Mr. MISENER. Thank you, Senator.

Senator BOOKER. You can meet me out by the Capitol with a drone, if you'd like.

Mr. MISENER. I'll be there.

Senator BOOKER. All right.

Senator FISCHER. Thank you, Senator Booker.

I would like to announce that the hearing record will remain open for 2 weeks, and, during that time, Senators are asked to submit any questions for the record. Upon receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible.

I would like to thank the witnesses for being here today, and I thank my colleagues who attended the hearing. Thank you all.

We are adjourned.

[Whereupon, at 2:40 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO SUSAN ALT

Question 1. Our society and economy rely on technology, and it's enabled tremendous economic growth and efficiencies. It's exciting to watch these innovations move from the virtual world to the real, physical world. However, advances in technology and their widespread adoption also raise potential new dangers. The increasing use of automation and reliance on hardware and software in transportation networks raises serious questions. To what degree are rail, trucking, marine cargo, and others in the transportation sector accounting for the security of new systems they adopt?

Answer. I can only speak for Volvo Group, but I would say we are accounting for the security of new technology systems to a very high degree. We understand that cybersecurity is absolutely critical to the success of new technologies in the transportation sector that connect vehicle systems internally to each other and externally to other vehicles, infrastructure, and the cloud. If the public does not trust the robustness of a new technology, especially one being applied to an area as critical to public safety as transportation, it will not be embraced. At Volvo Group, safety is one of our three core values and is built into the design of our trucks from the start. As computer and communications technologies begin to play a larger role in the design and functionality of our trucks, cybersecurity is an absolutely necessary element to ensure overall vehicle safety.

Question 2. There are a number of Information Sharing and Analysis Centers (ISACs) that provide their members with actionable and relevant information for cyber risk mitigation, incident response, and information sharing.

Currently we have an Aviation ISAC, a Maritime Security ISAC, a Surface Transportation ISAC, and a Public Transit ISAC. How would you rate the overall communication and coordination within and between these ISACs, as well as others outside the transportation sector who may have relevant expertise?

Answer. In addition to the ISACs mentioned above, the automobile industry recently formed an auto cybersecurity ISAC composed of members of both the Auto Alliance and Global Automakers industry groups. While focused on passenger automobiles, this may be an important venue for the trucking industry to engage as well in communication and coordination around vehicle cybersecurity issues.

We have also talked to our industry trade groups, and according to the American Public Transportation Association (APTA), the Transportation sector is closely connected and the individual ISACs are part of and engaged with each other and the National Council of ISACs (NCI). The NCI includes ISACs from the critical sectors who meet on a regular basis to share intelligence and prevent threats. The surface transportation ISACs (Surface, Public Transit, Over the Road Bus) utilize many of the same analysts who immediately analyze and disseminate cybersecurity information and threat intelligence with their members including the NCI and interrelated sectors, ISACs.

Question 3. In your testimony, you said that states are developing different, and sometimes inconsistent rules and regulations to promote autonomous vehicle testing. How many states have produced different rules and regulations related to autonomous vehicles, and to what degree are these different rules hindering manufacturers?

Answer. In response to public interest over autonomous vehicle testing and in anticipation of the proliferation of this technology, many states have already moved to address autonomous vehicles through legislation, regulation, or executive order. Thus, we (those companies developing autonomous vehicles or autonomous vehicle technology) work within an ever growing patchwork of definitions, allowable vehicle standards and requirements in order to develop and bring technologies to the U.S. market as a whole.

Without the standardization of regulations in the areas of testing and deployment of autonomous vehicles, as well as establishing liability issues and data collection

allowances, it will add cost, time, and complexity to the development process, slowing the introduction of technology that can help solving some of the most intractable transportation infrastructure problems of our generation.

According to the National Conference of State Legislatures, six states (California, Nevada, Michigan, Florida, North Dakota, and Tennessee) and the District of Columbia have passed one or more specific laws addressing autonomous vehicle technology. Sixteen additional states are currently considering legislation.

In addition to laws, regulations, and executive orders dealing with the broad concept of vehicle automation, there is additional public policy complexity and uncertainty around supporting technologies, such as V2V and V2I communications, and specific applications of automated driving, such as vehicle platooning.

Question 4. Can you elaborate whether there's potential to increase safety on our Nation's roads and interstates if we have a single, consistent national standard for autonomous vehicle testing?

Answer. I believe the public stands to benefit from streamlining the regulatory environment and making it more receptive to new ways of accomplishing longstanding goals such as transportation safety. As such, a single, consistent national standard for autonomous vehicle testing would foster innovation and smooth the pathway to market in a much greater way than the current patchwork of state policy approaches.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO PAUL E. MISENER

Question 1. As you discussed the important role of automation helping companies ship more efficiently, is there also a growing role for the Internet of Things (IoT) to help improve the transportation ecosystem, for example with autonomous vehicles and fleet management?

If so, what kinds of roles are you seeing now and do you envision in the future? Specifically, should Congress look to leverage the benefits of IoT as we develop our next highway bill?

Answer. Technological advancements that help create safe, real-time distribution operations, including those that deploy highly automated ground and airborne infrastructures, will have profound impacts for our entire transportation system. Specific to Amazon, our future Prime Air service will deliver packages five pounds and less to customers in 30 minutes or less using small unmanned aircraft systems (UAS), or drones. Flying below 500 feet, and generally above 200 feet except for takeoff and landing, and weighing less than 55 pounds total, Prime Air UAS will take advantage of sophisticated "sense and avoid" technology, as well as a high degree of automation, to ensure safe operations, including at distances of 10 miles or more, well beyond visual line of sight.

Once operational, Prime Air will increase the overall safety and efficiency of the current ground transportation system by allowing people to skip the quick trip to the store or by reducing package deliveries by truck or car, which will ease congestion. For the same reasons, Prime Air will reduce buyers' environmental footprint. If a consumer wants a small item quickly, instead of driving to go shopping or causing delivery vehicles to come to her home or office, a small, electrically-powered UAS will make the trip faster and more efficiently and cleanly.

There is absolutely a growing role for the Internet of things in all modes of transportation, and Congress should encourage Federal agencies to work collaboratively with industry to ensure technological advancements are not unnecessarily impeded by regulations, which were often written around an onboard human operator. Government agencies should take a performance-based approach to regulating rapidly evolving technologies, setting a target level of safety and allowing industry to innovate to meet that requirement.

Question 2. Our Society and economy rely on technology, and it's enabled tremendous economic growth and efficiencies. It's exciting to watch these innovations move from the virtual world to the real, physical world.

However, advances in technology and their widespread adoption also raise potential new dangers. The increasing use of automation and reliance on hardware and software in transportation networks raises serious questions.

To what degree are rail, trucking, marine cargo, and others in the transportation sector accounting for the security of new systems they adopt?

Answer. At Amazon, our guiding principle is customer trust. We use information in a responsible, appropriate, and secure manner to innovate and improve the customer experience, and we are constantly striving to exceed our already high levels of software and hardware reliability, as well as guard against cyber intrusion. In

order to ensure the continued safety and security of the transportation space, we need willing government agencies to work with industry to better understand rapidly developing technologies and how they will connect into our current transportation system. For example, we need the Federal Aviation Administration and the National Aeronautics and Space Administration to work expeditiously with industry to create an Unmanned Traffic Management (UTM) system to safely coordinate the activities of the increasing numbers of small drones flying at low altitudes. Much of the success of UTM will rely on establishing the identity of vehicles and on secure reliable information networks. This will ensure the safety and security of the airspace, while not impeding existing manned aircraft operations.

Question 3. There are a number of Information Sharing and Analysis Centers (ISACs) that provide their members with actionable and relevant information for cyber risk mitigation, incident response, and information sharing.

Currently, we have an Aviation ISAC, a Marine Security ISAC, a Surface Transportation ISAC, and a Public Transit ISAC.

How would you rate the overall communication and coordination within and between these ISACs, as well as others outside the transportation sector who may have relevant expertise?

Answer. Amazon has not traditionally been considered part of any of the transportation sector ISACs, although we would welcome an opportunity to participate. For the vast majority of our deliveries, we rely on our carriers, including the U.S. Postal Service.

Specific to Amazon Prime Air, we have met with the U.S. Department of Homeland Security (DHS), and other Federal agencies, and welcome future collaboration on drone security issues; however, rather than the ad hoc manner in which meetings between DHS and industry have occurred in the past, we believe DHS should stand up a formal committee under the Federal Advisory Committee Act for drone industry input.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. STEVE DAINES TO PAUL E. MISENER

Question. Mr. Misener, many people in my home state of Montana as well as many around the Nation appreciate the products and services provided by Amazon. It enables people in rural communities to access a wider spectrum of products that may not be available in their immediate markets and have them delivered the next day. In your testimony, you discuss Amazon's pursuit of delivery via drones. As someone who spent 12 years in cloud computing, I am an advocate for innovation. I also deeply appreciate privacy concerns and safety. Drones have the ability to collect massive amounts of data as they fly. I have asked the Federal Aviation Administration (FAA) similar questions. As Amazon considers utilizing drone technologies, how will it ensure the privacy and safety of customers and innocent bystanders?

Answer. At Amazon, our guiding principle for privacy is customer trust. We use information in a responsible, appropriate, and secure manner to innovate and improve the customer experience, and we know we must get privacy right to meet our customers' high expectations of us. We will use this same privacy-by-design approach for Amazon Prime Air, our future drone package delivery service.

Consumer privacy is an area in which the U.S. approach to drone regulation already is particularly strong. We recognize that drone technology could cause privacy infringement if commercial or private use is not undertaken in a sensible, privacy-conscious manner, so we welcome and support the National Telecommunications and Information Administration (NTIA's) leadership in developing best practices in its current multi-stakeholder process.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO GREGORY C. FOX

Question 1. Our society and economy rely on technology, and it's enabled tremendous economic growth and efficiencies. It's exciting to watch these innovations move from the virtual world to the real, physical world.

However, advances in technology and their widespread adoption also raise potential new dangers. The increasing use of automation and reliance on hardware and software in transportation networks raises serious questions.

To what degree are rail, trucking, marine cargo, and others in the transportation sector accounting for the security of new systems they adopt?

Answer. At BNSF Railway, security is key to our overall risk mitigation efforts that support safe rail operations. The various technologies deployed to operate BNSF Railway—hardware, software and the networks they connect to—require deliberate focus to avoid or mitigate security risks. We adjust as needed from an offensive and defensive security posture as new risks surface in deployed information systems by working with our vendors and industry partners to ensure our security posture meets industry standard best practices and is capable of protecting our complex, distributed network. We continue to invest in and strengthen our security posture via equipment, software, and skills. The complexities lie in the myriad of technologies of various ages and capabilities (hardware, software and networks) developed in house and from vendors that are needed to function as a given system and our business need to ensure connectivity both internal to BNSF and at times with external partners via the Internet.

With regard to new systems that we adopt, if developed in house, the code is tested for potential risk. We leverage third party products and internal processes to test software looking for those high risk vulnerabilities and if found to exist, will require the application developer to remedy the code prior to moving said code into production. We also leverage various technology to protect our system's data, manage accessibility and system software changes as well as 24/7 monitoring. For third party hosted software such as cloud, we perform a security assessment during the product evaluation period. We also routinely audit processes, system changes and accessibility routinely.

Question 2. There are a number of Information Sharing and Analysis Centers (ISACs) that provide their members with actionable and relevant information for cyber risk mitigation, incident response, and information sharing.

Currently we have an Aviation ISAC, a Maritime Security ISAC, a Surface Transportation ISAC, and a Public Transit ISAC.

How would you rate the overall communication and coordination within and between these ISACs, as well as others outside the transportation sector who may have relevant expertise?

Answer. I would rate the communication and coordination within modal Information Sharing and Analysis Centers (ISACs) as very good. We also partner with the AAR and other government agencies for information sharing as well as leveraging several third parties in the cyber industry. The process has proven to be invaluable as we are able to understand the current vulnerabilities and at times provide each other with potential forewarning of suspected issues as they surface. ISACs also provide the platform for additional opportunities to share best practices that may have worked well or not worked as intended which helps all modes reach a desired result more expeditiously. In these cyber instances, time can be of the essence.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. STEVE DAINES TO GREGORY C. FOX

Question. Mr. Fox, Burlington Northern Santa Fe (BNSF) has over 1,900 miles of railroad across my home state of Montana. They do a great service in transporting Montana's agricultural and energy products to markets across the Nation. In your testimony, you discuss the use of drones for carrying out inspections.

I commend the innovative efforts to increase safety. How will this continue to be developed and how is BNSF addressing personal privacy of unintended data collected?

Answer. BNSF has started to deploy Unmanned Aircraft Systems (UAS)—or drones—for supplemental visual track and bridge inspections in a variety of conditions. Earlier this year, we were one of three companies awarded Pathfinder Program status by the Federal Aviation Administration (FAA) which will permit a focus on beyond-line of sight operations for extended track integrity flights. The Pathfinder Program concept of operations are still being developed and we will continue to work with the FAA on this effort.

BNSF's interest in the use of UAS has been driven in full by the potential safety applications and benefits we hope to demonstrate through our partnership with the FAA. We have begun to identify numerous opportunities to supplement our existing track and infrastructure inspections. In regards to track integrity, this technology can help to assess safety concerns that could cause a derailment, such as landslides or washouts, and help BNSF understand the track conditions for some of our more remote assets.

BNSF's UAS program operates under the Section 333 Exemption Number 11206 which BNSF was granted by the FAA and only allows us to operate on or above BNSF owned property. In order to operate on other property prior approval from

surrounding land owners must be secured and includes data collection protections. BNSF further interprets this exemption to mean that BNSF cannot collect data from assets not owned by BNSF.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO MICHAEL R. CHRISTENSEN

Cybersecurity

Question 1. Our society and economy rely on technology, and it's enabled tremendous economic growth and efficiencies. It's exciting to watch these innovations move from the virtual world to the real, physical world.

However, advances in technology and their widespread adoption also raise potential new dangers. The increasing use of automation and reliance on hardware and software in transportation networks raises serious questions.

To what degree are rail, trucking, marine cargo, and others in the transportation sector accounting for the security of new systems they adopt?

Answer. Each segment of the marine transportation supply chain is taking cybersecurity very seriously. At the Port of Long Beach, our cybersecurity security teams are pouring significant resources into continuously improving our program and governance. This includes increased security, and monitoring for applications, information, and networks. We currently have business continuity plans in place, and emphasize training for end users.

Ocean carriers, marine terminal operators, and railroads are likewise continuously reviewing and strengthening their own cybersecurity technologies and capabilities. Particular attention is being placed on the new automated container terminals to be sure they are protected from intrusion.

Question 2. There are a number of Information Sharing and Analysis Centers (ISACs) that provide their members with actionable and relevant information for cyber risk mitigation, incident response, and information sharing.

Currently we have an Aviation ISAC, a Maritime Security ISAC, a Surface Transportation ISAC, and a Public Transit ISAC.

How would you rate the overall communication and coordination within and between these ISACs, as well as others outside the transportation sector who may have relevant expertise?

Answer. Given that ISAC has only been in existence for 18 years, cybercrime has a head start. The ISACs have created a nationwide collaborative platform that did not exist before. So there has been a lot of progress in the way of information sharing, and threat mitigation, good and better practices. Cyber threats evolve along with technology, so there must be an asserted effort and dedication to continuous improvement.

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