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DISRUPTER SERIES: ADVANCED ROBOTICS

WEDNESDAY, SEPTEMBER 14, 2016

House of Representatives,

Subcommittee on Commerce, Manufacturing,

and Trade,

Committee on Energy and Commerce

Washington, D.C.

The subcommittee met, pursuant to call, at 10:30 a.m., in Room 2322 Rayburn House Office Building, Hon. Michael Burgess [chairman of the subcommittee] presiding.

Members present: Representatives Burgess, Lance, Blackburn, Harper, Guthrie, Olson, Bilirakis, Brooks, Mullin, Upton (ex officio), Schakowsky, and Kennedy.

Staff present: Gary Andres, Staff Director; James Decker, Policy Coordinator, Commerce, Manufacturing, and Trade; Graham

This is a preliminary, unedited transcript. The statements within may be inaccurate, incomplete, or misattributed to the speaker. A link to the final, official transcript will be posted on the Committee's website as soon as it is available.

Dufault, Counsel, Commerce, Manufacturing, and Trade; Blair Ellis, Digital Coordinator/Press Secretary; Melissa Froelich, Counsel, Commerce, Manufacturing, and Trade; Giulia Giannangeli, Legislative Clerk, Commerce, Manufacturing, and Trade, Energy and Environment; Paul Nagle, Chief Counsel, Commerce, Manufacturing, and Trade; Mark Ratner, Policy Advisor to the Chairman; Olivia Trusty, Professional Staff, Commerce, Manufacturing, and Trade; Michelle Ash, Minority Chief Counsel, Commerce, Manufacturing, and Trade; Lisa Goldman, Minority Counsel, Commerce, Manufacturing, and Trade; Caroline Paris-Behr, Minority Policy Analyst; Matt Schumacher, Minority Press Assistant.

Mr. Burgess. Very well. The Subcommittee on Commerce, Manufacturing and Trade will now come to order. The chair recognizes himself for five minutes for the purpose of an opening statement and good morning, and welcome to our witnesses.

Welcome to our hearing on advanced robotics, technology that has made its way into the United States in a variety of sectors.

This is the latest installment in our disrupter series covering technologies that are redefining our lives and improving our economic condition. It is 2016 and so many people my age will, of course, remember the cartoon "The Jetsons" and coming home to Rosie the robot who always had George Jetson's stuff all aligned for him and many of us ask ourselves where is Rosie the Robot today.

Well, maybe today we are going to learn how if we are not perhaps a little bit closer. But we are living in a world where you can actually use your iPhone to ask Siri, Alexa or Cortana any question and get a real time, accurate and perhaps a whimsical response.

Already advanced robotics are integrated into our economy with increasingly complex application from manufacturing floors to surgical suites to fashion shows, as we learned from the lead on Drudge this morning.

Smart prosthetics are changing the lives of amputees and the elderly. Even some technologies that have -- we have explored

in previous disrupter series hearings leveraged advanced robotic technology including the Internet of things and drones.

I look forward to hearing from our panel of witnesses about the real world advances -- advanced robotics applications that students, academics and industry professionals are all working toward.

Each of our witnesses today can give us a different view on the emerging trends and challenges presented by advanced robotics and technology.

The future workforce trends are particularly interesting. If it is true that more jobs will include some automation component in the coming decades, understanding how our students and professionals of all ages able to acquire the skills necessary to adapt to this changing landscape is important to us as policy makers.

As with any new technology, it is critical to examine the benefits of the technology in weighing important consumer protection questions. Throughout our history Americans have adopted and adjusted to economic shifts presented by new technology.

In our examination of these issues, it will be important to understand how consumers and businesses will be using the technologies and how they will be protected while preserving the

flexibility and ingenuity of innovators that are driving this market forward.

Again, I want to thank your witnesses for taking the time to inform us about the exciting applications and the future potential benefits of advanced robotics.

So we look forward to a thoughtful and engaged discussion and I would like to yield the rest of the time to the gentlelady from Tennessee, Mrs. Blackburn, vice chairman of the full committee.

Mrs. Blackburn. Thank you, Mr. Chairman.

I do want to welcome our witnesses. I had the opportunity to meet Mr. Kamen a few months ago and talk with him about what he is doing in the field of robotics and the importance of that specifically to my district in Tennessee.

Brentwood Academy, which is in my district, the Iron Eagles are the international champions. They're putting an emphasis on robotics and not only is BA but Vanderbilt University is developing some robotic devices for utilization of children with autism.

We are seeing other schools in the area begin to integrate robotics and the utilization of robotics, the development of this technology into core curriculums in science and math -- the STEM activities.

It is a wonderfully exciting for our students. I think it's so appropriate that we have this hearing that we look at this as a part of the disrupter series and not be fearful of it but engage what it is going to bring to productivity in the manufacturing marketplace to our communities to everyday tasks.

I talked with a couple of my fast food franchise owners about the utilization of robotics in mechanization in the fast food industry -- fascinating, the opportunities that it opens.

It does mean that we have to put an emphasis on the education so that we have a workforce that is excited about working in this area.

And Mr. Chairman, I will the time back to you or to whomever would like it.

Mr. Burgess. The chair thanks the gentlelady. The gentlelady yields back and the chair recognizes the subcommittee ranking member, Ms. Schakowsky, for five minutes for an opening statement, please.

Ms. Schakowsky. Thank you, Mr. Chairman.

Today we are continuing our disrupter series with a hearing on advanced robotics. Robots are becoming increasingly sophisticated and at the same time robot technology is becoming cheap enough that people can actually bring those -- bring robots into our homes whether we are talking toys -- that's been for a

long time -- but vacuum cleaners or other consumer products.

The potential for robotics is really great and I'm interested in how we can help develop that potential. In June, I met with four girls from Mount Prospect, Illinois who were part of a robotics team through Girl Scouts. They were in D.C. for the Global Innovation Challenge sponsored by the U.S. Patent Office.

If we want to continue the advanced -- in advanced technology then we certainly need to provide young girls and boys opportunities in science and technology.

FIRST Robotics has been a leader in encouraging students to pursue robotics and I look forward to hearing more about that organization's work and from Mr. Kamen.

Some of the most innovative work in robotics comes out of our major research universities. For instance, Northwester, which is in my hometown of Evanston, Illinois, has been collaborating with the Rehabilitation Institute of Chicago to research bio-inspired robotics.

They look at how fish swim and how the human hand moves and how animals use their whiskers and then use it to build robotics that can really improve the lives of persons with disabilities.

This research has tremendous promise, particularly for improving health care. Robotics also has significant implications for federal policy. We need to invest in research

and education that continues the technological progress that we see.

And as Mr. Burnstein and Dr. Kota noted in their written testimony, robotics has changed the nature of American manufacturing.

We need to make sure that today's workers are prepared for this transition and that we are training today's workers for tomorrow's manufacturing jobs -- really, today's manufacturing jobs.

As robotics become more commonplace in daily life we have to consider the implication for consumer safety and privacy.

Robots often collect and respond to information in their surroundings, how is that information used and how is it stored, who has access to that information, what does the consumer need to know and what does the consumer -- when the consumer provides -- and when does the consumer provide consent.

These are questions that designers and consumer watchdogs must grapple with, and the answer may not be the same for all technologies. Robotics also raises questions of ethics and responsibility.

Let's say an accident occurs. This is a very real concern when we are talking about self-driving cars, for example. When does the fault rest with the manufacturer, when does it reside

with the user.

Dr. Jones mentioned several of these issues in her written testimony and I look forward to hearing more from her on ways our government can respond to this technological innovation. Dr. Jones defines robots as technologies that sense, think and act.

Congress is not robotic but I hope we will do the same thing in our subcommittee -- take the information, process that information and then take action based on what we've learned.

I look forward to hearing from our witnesses and to working with my colleagues to ensure that federal policy keeps pace with technological change, and I thank you, Mr. Chairman, and yes, I will yield to my colleague, Mr. Kennedy.

Mr. Kennedy. I thank you colleague, Ms. Schakowsky.

I want to thank the chairman for calling this hearing and for continuing this series. Really interested in that prospect of and the testimony from our experts today.

Clearly, the opportunities for innovation around advanced robotics are almost limitless and so I think for -- from my perspective anyway trying to understand how Congress can continue to support that innovation and support that progress is critical.

It does potentially bring up some interesting ethical questions and profound questions about the economic impact and questions about data and privacy and, potentially, jobs and the

economy as well.

And Dr. Jones, you touched on that in your testimony -- written testimony. So I'd like to start to explore just the broad base of those concepts and any guidance that you all might be willing to lend to us as innovations in this field continue to unfold at a pace that actually far exceeds, I think, that of experts even a couple months or years ago.

We are making tremendous progress in fields of advanced robotics, artificial intelligence and others and what does that really mean, given the fact that we are moving more quickly than people even expected.

So with that, I yield back and I thank the chairman.

Mr. Burgess. Chair thanks the gentleman. Gentleman yields back.

Chair recognizes the chairman of the full committee, Mr. Upton, five minutes for an opening statement, please.

Chairman Upton. Thank you, Mr. Chairman.

So today our disrupter series turns to advanced robotics, what I know will be an interesting and thoughtful discussion. I'm particularly excited to welcome my good friend, Dean Kamen, back to the committee. He has appeared a good number of times, adding his valuable insight to our 21st century cures effort and to those who don't know he's often referred to as the dean of invention

and has been at the forefront of disruptive technologies his entire career.

His decades of leadership and imagination have undoubtedly changed the face of advanced robotics from the invention of the Segway and iBOT electric chair to the drug infusion pump and so many others. His inventions and entrepreneurial spirit have led to the growth of the FIRST competition -- FIRST, of course, stands for inspiration and recognition of science and technology. His passion for innovation inspires kids from kindergarten to high school and encourages them to get involved in engineering and other STEM fields.

The program has grown from 20 teams to over 45,000 teams nationwide since it was founded in 1989. I've got a great relationship with FIRST Robotics -- very proud supporter.

My home state of Michigan is becoming robot central with by far the highest number of FIRST teams per capita in the country.

To describe what this competition is like FIRST teams receive a box with 120 pounds of components. They've got six weeks to design and build a functioning robot and what they come up with in those six weeks is nothing short of amazing.

I've been to a number of competitions across the state. While I was impressed with what the kids are coming up with, it's inspiring. I want to stay there all day.

From the St. Joe Average Joes -- this team -- to the 2767 Striker Force team in Kalamazoo, innovative STEM programs like FIRST allows for kids in our communities to dream big and inspire to become inventors, engineers, small business owners, community leaders. It's also refreshing to see kids excited by science and I would note that Dean was treated like he was Bruce Springsteen, walking into St. Joe High School a rock start or sure.

I'm also proud to co-sponsor bipartisan legislation with my colleague, Debbie Dingell, that would use the sale of commemorative coins for astronaut Christa McAuliffe, who was, of course, tragically lost in the Challenger disaster, to raise money for FIRST around the country and I look forward to hearing even more from Dean and all of our witnesses about their recent efforts, whether it be FIRST, how the industry -- government had grown involved -- gotten involved with the program and I also note that the Robotics Industries Association is headquartered in Ann Arbor -- go blue.

Dr. Kota, among his many projects is a professor at the University of Michigan. Understanding how industry approaches advances in robotic technology, whether in capital investments or new partnership opportunities, is so critical to understanding how we move disruptive inventions from the lab into commerce to create jobs and economic growth here at home and better quality

of life for all.

I thank Chairman Burgess for continuing the series. I yield the balance of my time to my friend from Mississippi, Dr. Harper.

Mr. Harper. Thanks for the high degree. So just no doctor. Well, doctor of jurisprudence. Does that count?

Chairman Upton. Yes, it does.

Mr. Harper. Okay. Thanks. Thank you, Mr. Chairman, for calling this hearing today and I'm excited to continue this subcommittee's work on the disrupter series and looking forward to our discussion on advanced robotics.

In my district, Mississippi State University is actively conducting research and making advances through a number of projects in the robotics arena including a National Science Foundation award to develop the Therabot, a therapeutic robotic support system in the form of a Beagle dog that is responsive to touch through multiple sensors.

The Therabot will be used for therapy sessions with the clinician as well as for home therapy exercises, especially for individuals with post-traumatic stress disorder. Another project that's been funded in the past by Army Research Laboratories focuses on improving the integrations of robots into law enforcement SWAT teams to develop new tactics and investigates how robots can be used more effectively in a real world scenario

to increase safety and information-gathering capabilities.

And those are just two of the many projects that are going on at Mississippi State. Additionally, at Mississippi State University they work with a number of organizations including 4-H to put together opportunities and competitions and for students of all ages to learn about robotics and have some fun along the way.

With that said, I would like to welcome all the witnesses here today, in particular Mr. Kamen. It is good to hear from you and to have you be here and to explain these things to us and know how clearly committed you are to teaching children around the country technology skills that will prepare them for a bright future.

With that, I yield back.

Mr. Burgess. Gentleman yields back. The chair thanks the gentleman.

Seeing no other members seeking an opening statement, we will conclude with member opening statements. The chair would like to remind members that pursuant to committee rules, all members' opening statements will be made part of the record.

And we do want to thank all of our witnesses for being with us here today, taking the time to prepare and to testify to the subcommittee.

Today's witnesses will have the opportunity to give an opening statement followed, of course, by questions from the members. Our panel for today's hearing will include Mr. Dean Kamen, founder of DEKA Research, Dr. Sridhar Kota, Herrick professor of engineering at the University of Michigan, Dr. Meg Jones, assistant professor of communication, culture and technology at Georgetown University and Mr. Jeff Burnstein, president at Robotics Industries Association.

We appreciate you all being here today and we will begin the panel with you, Mr. Kamen, and you are recognized for five minutes for an opening statement, please.

STATEMENTS OF DEAN KAMEN, FOUNDER, DEKA RESEARCH; SRIDHAR KOTA, HERRICK PROFESSOR OF ENGINEERING, UNIVERSITY OF MICHIGAN; MEG JONES, ASSISTANT PROFESSOR, GEORGETOWN UNIVERSITY, COMMUNICATION, CULTURE AND TECHNOLOGY; JEFF BURNSTEIN, PRESIDENT, ROBOTICS INDUSTRIES ASSOCIATION

STATEMENT OF DEAN KAMEN

Mr. Kamen. Thank you. So I was told I have only a few minutes and I decided, since a picture is worth a thousand words and a video is worth a thousand pictures, I took two videos. Trust me. They are each under two minutes long. One is sort of a general overview of FIRST and it ties everybody together because it's the voice of God. It's Morgan Freeman from Mississippi who, after coming, agreed to help us with the video because people trust the voice of God, and also said he will help us put FIRST in every school in Mississippi.

So we need to talk. We work with, of course, in Chicago RIC. We develop -- my day job is medical stuff and robotics and we built the arms that they are using for their optic stuff there and, of course, we work with Texas in many ways, Massachusetts.

You heard about how tired we are. But I'm going to show two videos. One is an overview of why robotics are going to be so valuable to the next generation and to this country in preparing to be competitive in the world.

The second one is a minute long and it's not the voice of God. It's a seven-year-old girl that helped prepare a video for the international version of FIRST because we are seeing, for instance, incredible growth in 86 countries.

So another reason that you need to get serious about giving kids the skills they get through robotics is its -- and you'll see in that second video it's not robots -- it's not robots. It's all the skill sets for the 21st century and I hope you listen to the seven-year-old. Let's hear from the voice of God.

(Video is played.)

[The prepared statement of Dean Kamen follows:]

**********INSERT 1**********

Chairman Upton. Mr. Chairman, if I might just ask that -- Dean, if we can -- is it okay if we put that on the committee's website?

Mr. Kamen. I would be proud to have you put it there.

Chairman Upton. It's there. All right. Thank you.

Mr. Burgess. Thank you, Chairman. Kr. Kota, you're recognized for five minutes for your opening statement please.

STATEMENT OF SRIDHAR KOTA

Mr. Kota. Chairman Burgess, Ranking Member Schakowsky, distinguished subcommittee members, thank you for the opportunity to appear before you today to discuss issues of critical importance to American economic competitiveness -- robotics, artificial intelligence and manufacturing.

My name is Sridhar Kota. I'm the Herrick professor of engineering at the University of Michigan and also the director for a new think tank called MForesight, the Alliance the Manufacturing Foresight.

MForesight works to bring together government, industry and research institutions to scan the horizon for emerging trends and promising opportunities for American manufacturing.

We help to build public-private partnerships related to manufacturing innovation. We respond to long range technical questions from government and industry and we work to identify best practices for training the next generation workforce.

Our ultimate aim is to enable the United States to gain a long-term edge in economic competitiveness by strengthening domestic manufacturing.

Thirty years ago when I was a graduate student in mechanical engineering, robotics was already a topic on everybody's mind but

back then the dominant vision of robotics was of machines replacing human labor, taking over manufacturing tasks like welding and painting.

Today, researchers and firms tend to think of robots in a different light as collaborative tools to enhance productivity of factory workers as a means to assist soldiers on dangerous missions, as co-drivers to enhance automobile safety and efficiency and as co-inspectors to enable continuous monitoring and maintenance of high-value assets such as bridges and wind turbines.

As artificial intelligence matures there is promise that intelligent machines can augment certain types of human decision making in fields ranging from medicine to manufacturing.

In short, robotics is now about augmenting and improving human work rather than replacing it. While robotics and AI innovations hold incredible promise, it's an open question whether the resulting technology products will be manufactured in the United States.

Despite federal annual investment of over $140 billion in science and technology, America's trade deficits in advanced technology products moved from a surplus in 2001 to a deficit of over $90 billion in 2015.

To strengthen America's competitiveness in the age of

advanced robotics and AI, we need to build the knowledge, skills and infrastructure to anchor production here. Put concisely, we need to be thinking about translation research and workforce training.

I would first like to discuss translation research -- how government and industry can ensure that existing investments in basic research turn into useful new products including robots and AI technologies that create wealth for Americans and advance our national interests.

What I believe we need right now is a whole of government approach that leverages the strength and missions of different federal science and technology agencies to help ensure that we can translate promising discoveries and inventions into successful manufactured products.

This need not be costly. A national innovation foundation could be created by consolidating relevant offices at a dozen or more existing agencies.

Such an agency could be tasked with identifying the most promising basic research being undertaken across the government and building public-private partnerships to invest in transforming that research into American-made products. The idea would be to maximize the return on taxpayers' investments in R and D.

The second policy matter I would like to discuss is education workforce training -- how federal, state and local governments, working with the employers, can ensure that Americans have the requisite knowledge and skills to build great products in the age of advanced robotics and AI.

In spite of our manufacturing losses in recent decades, there are now a large number of open positions in manufacturing and about 415,000 unfilled manufacturing jobs in the United States, according to the Society of Manufacturing Engineers.

I believe the biggest long-term risk to U.S. manufacturing isn't foreign competition. It's too little awareness and interest in engineering and manufacturing careers starting at an early age.

While high schools commonly require students to dissect a frog, few require students to dissemble a power tool, let alone a robot. This needs to change.

Primarily, the programs like FIRST Robotics -- we all just saw this wonderful videos -- it's an innovative program that challenges students to work together to build game-playing robots in a atmosphere of professionalism and it is the roadmap to engineering.

It is the roadmap to innovation, and right now it's currently done as an after-hour, after school extracurricular activity.

This is the kind of program that we need to bring to the mainstream in order to mainstream curricula in K through 12 and that's the only way we can build a foundation for that next generation of innovation in the advanced manufacturing community.

So through smart research investments and sustained focus on education and training programs like FIRST Robotics, we can help ensure that these innovations truly improve American lives and livelihoods.

Thank you.

[The prepared statement of Sridhar Kota follows:]

**********INSERT 2**********

Mr. Burgess. Chair thanks the gentleman.

The chair recognizes Dr. Jones five minutes for your opening statement, please.

STATEMENT OF MEG JONES

Ms. Jones. Chairman Burgess, Ranking Member Schakowsky and distinguished members of the subcommittee, thank you very much for putting on this disrupter series and for inviting me to testify before you today.

With all of the excitement that comes with these ingenious advancements in robotics are ethical, policy and legal questions.

Robot ethics and robotics policy conjure problems like how we avoid creating our mechanical overlords and when AI should have rights. These are questions for the future.

But what I'm going to talk about today is a really, really simple problem and that is that robots don't have screens, and this is incredibly disruptive to privacy protection in the United States.

For the last 50 years, screens have been how we interacted with our information and communication technologies.

You engage with the cloud or a colleague or a retailer through the interface on your desktop, your laptop and then your smart phone and your tablet and then for the last 20 years the Internet age has used that screen to create, collect, process, trade and use your data and it's through that same screen that you can figure out how your data is collected and used. You go to the bottom

of the page and you click on the blue link that says privacy policy.

And this is the notice and choice regime that information exchange around the world had been built upon and the idea is, of course, is that the data controller notifies you what they are going to do with your data and you can choose to engage with the system or not.

There are, of course, problems with relying on this form of consent in the information age. People can't dedicate all of the time it would take to read all of those policies. Even if they could they can't necessarily understand them and even if they could read and understand them they wouldn't necessarily be able to assess the future uses and harms of their information.

Participating in one's data is increasingly difficult as screens get smaller and we have seen this with smart phones and wearables already. But robots often don't have any screen at all.

Robots are categorized within -- some robots are categorized within the Internet of things and as you are aware from previous hearings the Internet of things is catch-all for the movement to connect everyday objects to make them smart using sensors, Wi-Fi and the cloud.

Like most technologies in the Internet of things there is no screen. So if you want to know the terms of use for the privacy policy you can't scroll down on anything.

So how does one figure out what information is being used -- collected and used and why.

There was a 2015 Federal Trade Commission Report on this subject and they suggested using video tutorials, setup wizards and privacy dashboards.

Treating the Internet of things like an extension of the Internet these are tools that provide notice and participation for the good old days of personal computers and apps.

At Georgetown, we bought a bunch of Hello Barbies to figure out how we would know what she was collecting about us and what she did with the information just by interacting with her.

Now, to set up Hello Barbie you have to click a bunch of accept buttons, like most things, but we really wanted to know what she would tell us.

So we asked her a number of times if she could keep a secret or we would tell her something and then we would say you're not to share that with anyone, are you, and she couldn't really process the questions that we were asking her.

But when you asked her about her privacy policy she said that an adult could find details about privacy on Page 2 of the booklet that came in the box.

So this is essentially the same problems that exist with relying on notice and choice in the Internet age except you have

the extra step that you have to go find this booklet or the box.

More importantly, what if it's not your Barbie? We are moving beyond the days of personal computers with smart objects, smart people and smart environments.

When you get into someone else's driverless car or you see a drone flying overhead or you walk into someone else's smart office what information is being collected?

How would you know? Whose drone is that? What company makes it? Do they collect information? Do they map your face for facial recognition? Where is the booklet that came in the box?

And even if you did know the answer to those questions what can you really do about it? Notice and choice even beyond the practical problems breaks down at a theoretical level in what I call the Internet of other people's things of which many robots will be a part.

So I know some people think that privacy is dead and in my written testimony I noted a few statistics. But one of them is that in January 2016 more American adults were worried about losing their -- about their privacy than losing their main source of income.

So people care and I think that if we want to usher in the type of advanced robotics that we want we have to start by

innovating some of our policy approaches including privacy.

Thank you.

[The prepared statement of Meg Jones follows:]

**********INSERT 3**********

Mr. Burgess. Chair thanks the gentlelady.

Mr. Burnstein, you are recognized for five minutes for your opening statement, please.

STATEMENT OF JEFF BURNSTEIN

Mr. Burnstein. Thank you, Chairman Burgess, Chairman Upton and Ranking Member Schakowsky and members of the subcommittee.

I want to really thank you for having the Robotics Industries Association here to participate in this series. RIA has been around since 1974 and we are based in Ann Arbor, Michigan -- go blue -- and what's interesting about RIA is that it represents 400 companies that are driving innovation, growth and better, safer and higher-paying jobs in manufacturing service industries.

Now, I have been there for over 30 years and I have to tell you this is the most exciting period for robotics and American innovation in robotics in the entire time I've been there.

We think that the key to staying competitive in manufacturing in particular is to implement advanced robotics. We see what's happening around the world. RIA is in China, we are in Korea, we are in Japan.

We see the efforts that are going on there and in Europe and we think we have an opportunity here to create more jobs and to save jobs that are already here.

I'd like to, if you don't mind, highlight some of our member companies and the innovations they are working on. In the Boston area, Rethink Robotics is developing collaborative robots.

These are a new kind of robots that work side by side with people that don't require safety fences between them. Or Soft Robotics, also in Boston, who's taken on a challenge that's kind of plagued the industry for many years of how to grip different parts.

So you have very fragile things that have to be picked up by a robot, like produce or vegetables and tomatoes, peaches -- all the things that agriculture cares about. You have these hard parts -- rugged, on assembly lines. Used to have the change the gripper, the hand on the robot. But now, thanks to companies like Soft Robotics, you might be able to do it with just one gripper.

Aethon in Pittsburgh, Pennsylvania, creating an autonomous robot that delivers and tracks medical supplies in hospitals, allowing the staff to focus more time on patient care, which is really what we want.

And how does this all play out at user companies? When, there is a company we work closely with called Vickers Engineering in New Troy, Michigan, a precision machining company that provides solutions to automotive, oil and gas, agriculture, defense and industrial markets.

They had trouble keeping people in dull, repetitive and dangerous jobs. They had to keep hiring and retraining. It was hurting productivity. They said why don't we take a shot at

robotics, and they did. Their business tripled, bought more robots and at the same time they increased their head count and we are seeing this across the country with small and medium sized companies as well as large ones.

One thing the U.S. is fortunate to have is the greatest group of system integrators in the world. Now who are these companies?

These are folks that put together the systems that actually make the robots work on the factory floor that integrate with other machines and equipment and tie into the Internet of things.

Companies like Genesis Systems in Davenport, Iowa, and Matrix Design in South Elgin, Illinois, Schneider Packaging Equipment in Bremerton, New York, Tennessee Rand from Chattanooga, Tennessee. These are just a few of the certified robotic integrators that RIA would like to acknowledge.

Today's robots offer U.S. manufacturers improvements in efficiency that are driving profits and employment. As we said, we issued a white paper on this called "Robots Fuel the Next Wave of Productivity in Job Growth."

You may read otherwise, that robots are job killers, but our data doesn't support that. What we see is that whenever robot sales rise, unemployment fall. And when the opposite happens -- when robot sales fall, unemployment rises. You don't hear that in the media too often.

We understand the importance of education, STEM education and training and retraining to make sure that we've prepared our workforce for the future jobs and for the present jobs.

There are groups like RAMTEC in Marion, Ohio -- a government and industry supported collaboration that provides training to high school and college students along with incumbent workers to support industry's needs for training in robotics and automation equipment.

And we hope that programs like this will proliferate because by working together industry, government, academia can help make sure that our workers are prepared for the future.

I personally appreciate this opportunity to highlight the important role that robotics is playing in advancing our economy in creating not only safer, better and higher-paying jobs but also improving society and our health and our livelihood and our long-term ability to be productive members of society.

I hope that those of you who aren't involved will join me at House Robotics Caucus with Congressman Rob Woodall and Congressman Mike Doyle, and we value their work and look forward to continuing the dialogue on advanced robotics.

Thank you very much.

[The prepared statement of Jeff Burnstein follows:]

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Mr. Burgess. The chair thanks the gentleman and the chair would note that Mr. Doyle is a member of the full committee of Energy and Commerce.

So I thank you all for your testimony and we'll move now into the question and answer part of the hearing.

And Mr. Burnstein, let me just ask you, because in your written testimony you referenced using robotics to do jobs that perhaps would be inherently too dangerous for a person to do -- a hazmat situation.

We're all familiar with the bomb-disabling robots that several of our police departments use in Dallas, Texas this July -- July 7th. So kind of a unique situation where there was a shooter who had killed several Dallas police officers and an officer with the Dallas Area Rapid Transit and the individual was contained in a garage but could not be controlled and ultimately he -- Chief Brown made what I consider a very courageous, a kind of unique decision to use the bomb-disabling robot to actually deliver a bomb to this individual and end the problem.

I am sure, from your association, you are -- are you aware of that instance?

Mr. Burnstein. Yes, I am.

Mr. Burgess. Are there -- are there thoughts that the association has on the use of the robot in that situation? Again,

I think Chief Brown was courageous I am grateful that he made the decision. I'm grateful he prevented any further loss of life. But, obviously, it poses some new questions.

Mr. Burnstein. It does pose new questions and I think, ideally, robots wouldn't be involved in harming people. It's one of the first laws of robotics that Isaac Asimov laid out.

However, in this particular case, if you take the word robot out of the equation, we sent in equipment that would save police officers' lives. And so whether it was a robot or some other way to get that in there, if we could have got a person in there we would have taken that shooter out in that way.

So, in my opinion, that was the right choice and it was a good use of the technology because it was saving police officers' lives.

Mr. Burgess. Very good, and I appreciate your answer.

So, Dean Kamen, earlier this week the 100-year study on artificial intelligence received a report titled "Artificial Intelligence and Life in 2030".

So the good news, the panel found that there is no cause for concern that artificial intelligence is an imminent threat to humankind or the United States Congress. Actually, I just added that.

In fact the findings of the group of academics from the

University of Texas at Austin, MIT, Harvard and others concluded that increasingly useful applications of artificial intelligence with potentially profound positive impacts on society and the economy were like to emerge between now and 2030.

So, simply, do you agree with their assessment? You spend a lot of time in this space.

Mr. Kamen. Well, I think that the whole term artificial intelligence or for that matter robotics means different things to people, let's say, within that industry and to the public.

I would almost define robotics as seen by the public as any piece of technology that wasn't around when you were a kid because the fact is we've been robotically doing more and more and more since the industrial revolution and before that, you know, knitting machines made things robotic and artificial intelligence, a machine that is programmed to do a function -- the calculator you have was considered, you know, a mathematician 30 or 40 or 50 years ago.

I think we should always be concerned, as you heard from Dr. Jones about unintended consequences of applying technology to anything, but artificial intelligence, like most good tools, will just support the real stuff and we could all use a little more of the real intelligence.

And I think as long as humans with good judgement and good

ethics are deploying these tools for the betterment of the world, we are okay. It would be naive to assume that you can never do damage with it.

But, again, the first tool -- the rock -- could help you build a house or break your thumb. That first use of fire could make us have a life and could burn down your house. Every new technology bears the potential to be misused.

But putting your head in the sand is just going to allow somebody else to dominate that technology and I'd rather be the ones that decide how to develop it and how to use it.

Mr. Burgess. Thank you. Could you -- you know, my background is in health care. Could you talk just a little bit -- I think some of your work has been in the health care space and, of course, we are all familiar now with robotics in the operating room. Could you speak to that just a little bit, what the -- what the future might hold for us?

Mr. Kamen. So you mentioned in your opening remarks Rosie and I think, again, the word robot, coming originally from the world of science fiction,

I think of all the things that robots will evolve to. The least likely is that, because we are pretty good at being what we are.

We like being what we are and we are not going spend a lot

of time and money making something else to do what we are and what we like to do

I think robots will be used like other technologies that are developed, to augment, as you heard from Dr. Kota what we do. They will be robots much bigger than us, like bulldozers. We don't like digging ditches. There will be robots much smaller than us, one's that will travel through your vascular system, go in there and tweak that heart valve so you don't need to have it removed or replaced.

Robots will get very small. Robots will get very big. Robots will not look like humans. But in the health care field they will change so dramatically the process of taking care people that a doctor 50 years from today will not recognize and certainly a hospital will not look like it looks today.

Nanotechnology, proteomics, genomics, the ability to use robotic technology to get to critical places without destroying vital tissue, it's going to change virtually every concept we've had in medicine more than you've seen medicine change so mar in your lifetime.

Mr. Burgess. And it has changed a lot, even in my short lifetime.

Chair thanks the gentleman for his answers. The chair recognizes Ms. Schakowsky five minutes for your questions,

please.

Ms. Schakowsky. Thank you, all of you. It's been a fascinating panel and really excellent testimony.

I wanted to ask you, Dr. Jones, a couple of questions. In all our exuberance, I'm happy that you raised some issues that we, you know, also need to pay attention to -- privacy and data security.

Robots, almost by definition, collect a vast amount of information because they need to sense the environment they are in and process the information and take action based on that information. And as you pointed out in your testimony, many robots are or will be Internet connected.

And at the subcommittee's hearing on wearable devices, we heard about notice and choice like those you mentioned earlier. We generally rely on screens to provide the interface that allows for notice and choice but, as with wearables, robots generally don't have those screens.

So let me also say for household robots that are already on the market, let me ask you, what is the mechanism used to provide notice to consumers and are -- is it always a question of the privacy policies are just included in the box -- you better take them out and save them?

Ms. Jones. Yes, for the most part. When you buy a device

for your home you're still at least within the Internet of things, not other people's things.

And so when you put a nest system, for instance, in your home you go through -- you click a number of boxes and you can find out more information about what's collected. And sometimes you have to to -- just to set the thing up. And so there is sometimes increased amount of notice in the Internet of things.

However, if you walk into someone else's house that has, say, a personal assistant robot that wires the home and does voice recognition or facial recognition, you don't have a way to express to that system hey, I don't like that -- don't do that to me -- I don't want you to map my face and store it somewhere. And I think that that is really the next hurdle and it's a wonderful interdisciplinary problem.

It requires a lot of technical considerations as well as policy and ethical considerations. I don't think that it's necessarily a regulatory change.

That being said, I do think that reliance on notice and choice will have to take a secondary seat to something.

Ms. Schakowsky. You know, at one of these hearings I brought a privacy policy that was included in the box and kind of unfurled it. It was very long. It was very legalistic, very small prints -- challenging.

But you also mentioned that online how many people -- let's be honest -- read all the words before they push "agree", because you know that you're not going to get in unless you agree.

And so, you know, I think these are challenges that we need to -- need to figure out. But let me ask you this -- you mentioned a study by the Pew Research Center that found that a vast majority of adults felt it was important to have control over what information was collected about them and who could get that information.

And do you agree that most consumers would prefer a more customizable approach?

Ms. Jones. So this, I don't know, and I don't think that -- there is a lot of surveys on privacy and I think that they are not tailored to regulatory answers a lot of the time.

So you'll hear people say they really care about privacy. But it's not clear whether they want a set standard like the European version of privacy or they want an adjusted type of notice and choice -- a more sort of libertarian privacy integrated into the way they engage with ICTs.

So I can't say for sure. I think that Americans probably don't care. They just want privacy.

Ms. Schakowsky. Okay. When legislators -- when we discuss privacy and data security issues some agree -- have argued that

we should only be concerned about a narrow set of data of personal information, specifically personal financial information.

However, consumers have more than financial concerns and I'm just wondering if you could discuss the privacy concerns that robots have beyond the financial and how do we broaden the discussion to ensure we understand the emerging technologies and the privacy concerns that come with those new technologies.

Ms. Jones. So for anyone who cares about their physical safety, a robot could easily be something to be concerned about because if a robot registers that you're near them, for instance, someone could know where you're at.

We have seen a number of apps that have shown the location of women, for instance, that have been not held positively by Congress or the public at large but physical location data is one thing.

The idea that you can figure out a lot of things about someone that they don't want you to know by putting together a few pieces of information.

We know that that is also true. So right now we have a ton of little pieces of information that gets put together that can show basically your route to work, where you work, what you do, where you go to lunch, who you go to lunch with and by putting sensors in the environment you just increase that dossier on every

individual that's moving through those spaces.

And what's interesting about robotics is they are not just in public spaces. They're in private spaces. They're in semi private spaces. And so you can link these together in really troubling ways.

Ms. Schakowsky. Thank you very much.

I yield back.

Mr. Burgess. Chair thanks the gentlelady. Gentlelady yields back. The chair recognizes the gentlelady from Indiana, Ms. Brooks, five minutes for questions, please.

Ms. Brooks. Thank you, Mr. Chairman.

I've always really enjoyed the disrupter series and pleased to be here to talk about robotics today.

Fortunately, our former mayor of Indianapolis, Mayor Greg Ballard, had the foresight in 2012 to start Indiana Stat Robotics Initiative to help build that skilled workforce in the pipeline of students and it is that cross section -- cross sector partnership between government, corporate and nonprofit organizations to make robotics accessible to all Indiana students.

And I might say, Mr. Kamen, I have visited the Carmel TechHOUNDS. Carmel High School has a first robotics team that's been competing for quite some time. And now, actually, in

January, over 160 teams competed in the Indianapolis VEX Robotics Competition.

But throughout Indiana over 40,000 students are being exposed to robotics and, hopeful, will continue that interest into the future because I do believe that we need to start this exposure very young.

What I am very curious about, Mr. Kamen, is based on all of your experience what is the one thing you would like us to walk away from in this hearing with respect to how we continue the growth of the first program and of robotics in this country.

What is one thing you'd like for us to remember?

Mr. Kamen. So when I was first -- when I was first asked to come I thought it would be hey, let's celebrate figure out how to grow the robotics program because we know it works and I was told Dean, that would be optimistic -- you should know that part of this hearing is going to be to deal with real concerns, by the way -- some real concerns -- but other concerns that some people have that, you know, robots will take jobs. You heard Mr. Burnstein said and I said it's hard for me to believe that in the 21st century people will think that advanced technologies are going to do anything except grow this opportunity.

In that regard, I took a slide. I visited Beijing with the president of the U.S. National Academy of Engineers and our

chairman for the first ever coalition meeting of the Royal Society in London, the National Academy and the Chinese Academy of Engineers, which by the way is way larger than ours.

We get to Beijing to talk about the grand challenges but I'm whisked away by somebody who takes me to a local school in Beijing. By the way, China, he tells me, has 4,000 FIRST teams.

They use FIRST because it inspires kids to get of the we are good at learning engineering but now we learn how to be innovators like you Americans.

And he takes me in there and he shows me this picture on the wall of the president of China. She -- could you put that slide up? And I asked him will you please tell me why there is a picture of the president of China in this school where I was looking at a first FIELD in Beijing and he translated it for me and said robotics will become and entry point, an impetus for growth of the third industrial revolution.

What I want you all to go away understanding is if America wants to remain a leader in the world economically, in every other way -- our security, our economy -- it's going to depend on us remaining leaders in the technologies that result from learning how to design and build the next generation of technology, which we generally all call robots now because it's actuators. It's sensors. It's the collection of everything that will allow

humans to keep moving.

And if anybody thinks that that's not the case you're going to be a drag on the future of this country. That's what I think. We need to focus on giving kids the tool sets for the next century and robotics is a great vehicle to do it.

Ms. Brooks. Thank you.

Dr. Kota, what would you say are the most significant barriers to investment in advanced robotics? What are the challenges that you are seeing?

Mr. Kota. Barriers to investment in advanced robotics, you know, we have this national robotics initiative and actually there is a new solicitation out for a manufacturing innovation institute in robotics, which is all very positive, and I think we should continue to work along the lines of generating -- creating next generating robotics -- you know, collaborating with humans.

But I don't see any -- more than that, I think the biggest barrier -- I want to pick up on what Dean Kamen said -- the biggest challenge and the biggest opportunity we have right now is really the robots. It's -- you know, it is a gateway to engineering.

It is a gateway to designing and building things and this is the way where we can really get kids excited about going into engineering field and manufacturing because that's what -- that's what it takes to convert an idea into product.

Ms. Brooks. I agree. But are there barriers that are causing us that are stopping our -- you know, what are the barriers?

Mr. Kota. Well, the barriers to -- are you talking research or actually educational workforce development?

Ms. Brooks. Yes.

Mr. Kota. Okay. The workforce development side, the barrier is -- okay, the question I'll turn it around and say we have right now this program is an after school extracurricular program.

Those kids were already motivated and doing incredible things. Why can't we expose -- we should expose them to every kid in school and just like we ask every student to dissect a frog, just about. Why not ask them to work on these FIRST robotics?

Now, the barrier could potentially be more than the funding is actually the requirements for schools to check certain boxes to meet the curriculum requirements.

But there is a way we can actually -- we know it's working. We can actually map this, what they are doing for robotics experience, into some of the core curriculum requirements in terms of creative activities in science and math. That's where the barrier is, to actually bringing key stakeholders together and having a discussion.

Ms. Brooks. Thank you. Thank you.

I yield back.

Mr. Burgess. Chair thanks -- the gentlelady yields back. The chair thanks the gentlelady. Chair recognizes the gentleman from Massachusetts five minutes for your questions, please.

Mr. Kennedy. Thank you, Chairman.

Thanks again to all the witnesses for coming in and for your testimony earlier.

I know that this hearing isn't about specifically autonomous cars but autonomous cars are a type of robot that will soon be entering our daily lives and they, clearly, present some of the ethical issues that come up in the realm of robotics.

Science Magazine recently highlighted a series of surveys to determine consumer attitudes towards autonomous cards.

Their researchers found that survey participants generally support the idea of autonomous cars that might sacrifice passengers to save people outside the vehicle but they don't actually want to ride in those cars. In other words, people generally choose to save themselves -- I'm sure it isn't a huge shock to anybody.

The survey illustrates, though, the so-called trolley problem when faced with two negative scenarios. How do you choose?

So Dr. Jones, with the example of autonomous cars, without artificial intelligence a person is going to have to make the decision on how to program the car.

Should it be programmed to protect the passenger at the expense of others? The other way around? How do you make that judgment call? It's a difficult question. But what's happening now with autonomous cars and the types of robots and if you play out that hypothetical, if you will for me, I'd love to get your guidance on the judgment.

Ms. Jones. I think that right now is the perfect time to answer how we answer that question, which is a great policy problem and there are two really innovative ideas that I've heard recently. I love the trolley problem. Even a two-year-old can make a choice about a trolley problem.

There is a YouTube video where he moved all of the people to one side and then runs over all of them. That's one way you could. But the --

Mr. Kennedy. Which two-year-old was that?

Ms. Jones. Not my two-year-old. The other idea is that why do we -- why is this a decision that is automatic in every vehicle? The trolley problem asks that individual to look at a moral situation and decide what are your ethics here and now we say how do we put this in every single car.

And so Jason Millar argues that that should be a setting. When you get a driverless car it is your setting just like a trolley problem with the -- it is a setting that said you want to run over the kittens or do you want to, you know, drive off the cliff.

So that is one idea is to keep autonomy in the hands of the user for ethical questions, which in itself is an ethical design choice.

The other is a website called Moral Machines from MIT that is crowd souring people's ideas, what they should do, how the car should be designed, not based on the ethics of the engineer but based on what the general public's idea of ethics are in any given moment and then those would be embedded into the car.

And so you have less of the ethics of Silicon Valley and the choices of Silicon Valley and other places -- I don't mean to -- as sort of a computer robotics that's not really true -- washing into the -- into D.C. and asking D.C. to respond to it.

And I think that what these innovative ideas are doing is say let's all participate in the design and ethical choices that are going into these technologies. And so those are just two alternatives, because there is no right answer to the Tally problem. That's why it's a great -- that's why it's a great question.

Mr. Kennedy. Dr. Kamen?

Mr. Kamen. I think you can reduce these to philosophical esoteric discussion which are fun and maybe there is no perfect answer.

A more basic question might be in reality this year will kill 42,000 people on the highways with drivers that are tweeting or not paying attention or are drunk.

We all know that if a single autonomous vehicle tomorrow hurt or killed somebody there would be a major national debate about whether there should be another vehicle like that for the foreseeable future.

Yet, every year for decades we kill tens of thousands of people. We hospitalize millions of people. It's the devil we know.

Instead of solving a very esoteric question, you might ask how soon will it be that at least augmented systems would make cars so much safer that instead of arguing about whether they should be allowed we should start arguing about whether we should be able to sell vehicles that don't have these systems. Because we know how many people we are killing all the time.

Mr. Kennedy. And at the risk of getting into that philosophical debate, I don't -- I would agree with you that we say let's move forward because, look, if we can reduce that from 42,000 to one, obviously, that's an extraordinary, or to zero or

to whatever it is, to less than 42,000, that's an extraordinary innovation and we want to incentivize that.

The question, basically, and perhaps you can say little bit of expertise in the seven seconds I'll give you, but if it comes down to essentially an algorithm of saying if then, right, in a complex if-then decision tree for a computer code that is then scaled up across every single card, that is a choice that somebody's got to make.

So I'm not, you know, asking so much what that right decision is but how would you -- what's the right way for evaluating how we make those decisions, understanding that if we can make progress on this that's tremendous and we don't want to stop that innovation. But it does bring up ethical issues that we haven't had to confront in this scenario before.

Mr. Kamen. And I guess all I would say is those are fantastic debates to have and, as we all know, the good is the enemy of the great.

I guess what I would come back to say, however, is we should discuss those issues and what the available technologies are in the context of the real alternatives and we should be accelerating the use of these technologies that overall will hugely reduce injuries and deaths because these technologies don't get distracted.

Inevitably, as we said before, every powerful technology can have mischievous and nefarious uses. Every powerful technology will eventually show a weakness or need to be improved.

But the day we start saying because of those issues we will slow down or stop progress is the day we are in big trouble.

Mr. Burgess. Gentleman yields back. Chair thanks the gentleman.

I believe we are going to have time for a second round if anyone wishes to stay. When we initiate that then, Mr. Kamen, I'm going to stay with you on that same concept.

And we had a tragic accident in our district with a distracted driving situation where four women -- two in one car, two in the other -- head on collision. They all died.

And so lane departure warning device that -- you know, you're right. You almost had -- there should be, like, anti-lock brakes. There should be, like, a supplemental restraint device or an airbag or a seatbelt.

It almost should be standard equipment especially in the day and age where we all have a device that could potentially distract us while we are driving.

So I think that is a powerful concept and one which, of course, in this subcommittee we'll continue to explore because we have the National Highway Traffic Safety Administration under

our jurisdiction.

So I appreciate your comments there. Just more broadly, and you now have touched upon something that I kind of debated whether or not I should bring up. But just let's talk -- we have got a panel of experts.

I mean, we have got -- we live under the tyranny of federal agencies that -- at least that's my opinion. Mr. Kennedy may disagree. Federal Trade Commission, Consumer Product Safety Commission, National Highway Traffic Safety Administration is just this subcommittee's jurisdiction.

But there is also the Department of Labor, Health and Human Services, Department of Energy, Department of Education, Department of Energy -- I'm sorry, Department of Commerce. I almost had a Rick Perry moment there for a minute. Department of Commerce. So how do you see the intersection of all these federal agencies and they don't make anything neat or cool like you all do. They write regulations. They regulate the neat and cool stuff that you all do.

So just -- I know it's a big discussion but as briefly as you can, could you just kind of give us some sense of the direction of how the regulatory environment should proceed in this very -- this very new area?

Mr. Kamen, we will start with you and just work down the

-- work down the table, if you would.

Mr. Kamen. Well, I can give you one very relevant to the self-driving car, I think, because you have a regulatory agency, NHTSA, and you have one called the FAA. And there is a lesson here.

When I learned to fly you had simple auto pilots. They weren't very good and they could get you wings -- they could do a few simple things.

But you were very clearly told when you go take your flight test you many not turn that on. It was a crutch. They want to make sure you could really fly that plane. You're not allowed to use it.

Over the decades, as those things got better they started requiring them in their sophisticated aircraft because when you're doing mach point eight and you're coming in to a very low ceiling, no human is as good as that autopilot and then they went to allowing you to use it, then testing you on how you use it.

Then they made it part of what's called the MEL, the minimal equipment list. You are not allowed to fly this airplane under these conditions unless that thing is working and is on.

I think we shifted. The FAA has demonstrated we went from people have to fly to it's not safe unless that thing is working and you legally can't do it and you wouldn't want to get on an

airline and traveling around this country if that autopilot on minimum conditions that was going to land coming out that fog and touching down two seconds later. It's not legal to do it. It's not safe to do it.

I think, certainly in your lifetime, the question is going to be with somebody sitting up there, should we allow people to drive cars?

I know they think it's fun, but this is so dangerous that allowing them that privilege of running around at 60 miles an hour with a 3,000-pound machine and we can't be sure they are not drunk and tired, I'm not sure we should allow that anymore.

That's why we have autopilots, and you're going to see that change happen. But human understanding always lags the rate at which technical opportunities arise and it's always the next generation that adopts it.

You know, what was indefensible to your parents was indispensable to you and what your kids will think of as normal you will be concerned about. Technology really is anything that wasn't available when you were a kid.

But I think NHTSA should take a lesson from FAA. They both regulate critical activities but as we see technology developing we know there are loopholes.

We know there are disasters. We know things can go wrong.

But that shouldn't present an alternative that we don't aggressively go after improving.

Mr. Burgess. Very well. Dr. Kota.

Mr. Kota. A different context -- I was making a similar statement about how FDA could potentially take some ideas from FAA.

I have had a little bit of experience working on aircraft designs and what I was surprised to note is that, which many of you probably know already -- and you do -- if you are designing any new component or system -- what are released for an aircraft, there are a clear set of guidelines and regulations for what's safe and what's not and by the way, NHTSA, FDA, FAA -- they all care about safety. I'm glad they do.

But the way the FAA works, if -- then you probably know -- DERs, they have experts who are -- who are authorized --

Mr. Burgess. DER is designated engineering representative?

Mr. Kota. Designated engineering -- yes. DER is for FAA. So if you are a small business or a large business, they work with you to make sure you are following the proper regulations so you are not spending three years designing, building and going and finding out that all that and at the FAA it wasn't accepted.

These regulations are mean for the right reasons and also they actually help accelerate innovation if they do it right. So

on that note, if similar DERs we can have not only with NHTSA but also with even FDA and others too I think that's a very good practice.

Mr. Burgess. I'm going to suspect that question temporarily and go back to Mr. Kennedy for five minutes for questions, please.

Mr. Kennedy. I'm happy to yield you another three minutes if you want.

Mr. Burgess. Very well. We'll continue on the regulatory environment going forward.

Dr. Jones.

Mr. Kennedy. I'd just like the record to reflect that he said that innovation accelerates -- regulation accelerates innovation. So there you go.

Mr. Burgess. I wish it could. I was asking the panel.

Ms. Jones. I can repeat it if that's helpful.

I think that it is important to remember that like Mr. Kamen said, when we talk about robotics AI, we are talking about technology. It's just a really broad term and so the ethical issues with drones are not the same ethical issues as with driverless cars.

So it would be very hard to sit down and say how do we solve all of the ethical problems with robotics with using the same mechanism.

And so I think inevitably these technological advancements occur within sectors.

Mr. Burgess. I will interrupt you just for a moment because so many times at the federal agency level it is putting the square peg in a round hole. I mean, that's what they do.

Ms. Jones. So the FAA handling drones and the transportation people handling driverless cars causes lots of problems and I was at a Department of Homeland Security round table, I guess you would call it, that was also sponsored by NSF and what it did was brought these people together and we realized that okay, a lot of these drone problems are not the same problems as the driverless cars and that's fine.

But there was -- there was some shared problems and there was some policy innovation that was happening in the driverless car that had not occurred in the drone area.

And so it think that there were huge benefits to bringing everyone to the table and I think that that is one of the federal government -- a great role for the federal government is saying you guys have to keep talking to each other -- you have to keep coming to the table -- we don't want redundancies that I think can occur across agencies.

And this was a two-day event where vocabulary was shared that we realized we were talking over each other and using different

words for the same things. And so it was a great use of time and I think that a really simple what can we do -- it just continued to create these deliberative spaces.

Mr. Burgess. Mr. Burnstein, either your thoughts or your association's thoughts on the regulatory environment going forward and its ability to facilitate or impede development.

Mr. Burnstein. Well, in preparation for this hearing, I talked to some of our members about that and they don't see regulatory issues as a major problem in preventing them from advancing robotics.

They did talk about some of the issues related to safety. So our association developed the American National Robot Safety Standard and when you got to this area of collaborative robots, right, so the OSHA inspectors knew about when the robot was behind a fence how to treat that.

But now we have these collaborative robot installations that are there and it's different from region to region and it's also different from country to country.

And so our members are saying look, we set up a safe application here in the U.S. but then when we go to Canada we got to deal with changing it to meet another safety regulation.

Is there some way that these international applications that are safe in one country can be seen as safe in the others? Is

there something the government can do on that?

But that's as far as it went in terms of the regulatory discussion.

Mr. Burgess. Very well.

The chair recognizes the gentleman from Massachusetts five minutes for questions, please.

Mr. Kennedy. Thank you, Mr. Chairman.

Just keep it, if I can, to 30 seconds for each of you. Given that the issues that you underscored in your testimony and the questions, 30 seconds each.

What recommendations would you give to Congress as we try to balance these issues and Incentivize the innovation going forward? What should we be thinking about? What should we be talking about and what should we do and what shouldn't we do? Thirty seconds. Dr. Kamen.

Mr. Kamen. If you wanted the answer related to regulation, I think any rational person realizes well established regulations that allow people to interact consistently -- there would be no Internet.

Clearly, a regulatory environment can be hugely useful. Unfortunately, the time it takes to get clarity and get some of these regulations in place as technology is moving faster and faster is making the time difference between when the thing is

possible to when the regulation has clarity is slowing things down and there is a natural incentive of business to move faster and faster and there is a natural incentive of regulators to be more and more conservative and concerned and that gap is getting so large that it's slowing down access to medical miracles.

It's slowing down opportunities. So I would urge you to find a way to make sure that all the regulators are highly incentivized to do things quickly, even if it's incrementally -- to do it quickly and do it with certainty.

Mr. Kennedy. Thank you.

Dr. Kota.

Mr. Kota. Again, sir, well said. I'd just add one more point. Just going back to things like DER is what FAA does. Let's find analogous components in other NHTSA and FDA and what have you, from a regulation point of view.

One more thing I want to add is that the strategic and coordinated investment by the federal government, not each agency running in different directions, if you want true innovation we need to connect the dots.

So the best ideas coming at a national science forum, from NASA and the Department of Defense, you know, leveraging the procurement capability of the Department of Defense.

So these are the things we can connect the dots and accelerate

innovation including regulation -- that's one important thing I want to suggest.

Mr. Kennedy. Thank you.

Dr. Jones.

Ms. Jones. I would suggest that the balance of pros and cons is adjusted. I think that people are left out when technology advances and often the policies that we put choose.

We just say here is the pros, here is the cons. The pros outweigh the cons and so we are making this choice. But instead to embrace the cons as part of the policy solution itself and I think we've heard a lot about not just job displacement today but also what do we do with the displaced.

That's all part, I think, of the same policy. Not a choice to say well, these factories have these benefits but to make sure that people who don't design and don't have these technologies are also part of the policy equation.

Mr. Kennedy. Thank you.

Mr. Burnstein. I would say continue to support the National Robotics Initiative. That had a major impact around the world in drawing attention to the importance of robotics.

And in the U.S. I think that stimulated innovation. I think that we need to continue establishing centers that get the technology that's being developed in the U.S. into the hands of

small and medium sized companies.

We have some mechanism in place now. I think we could do more and I think the training issue is very important. We have to prepare the workforce for the jobs of the future and, as I said, the jobs today.

The number-one challenge our members face, they can't fill all the jobs that they have open today.

Mr. Kennedy. Thank you.

Mr. Burgess. Gentleman yields back.

Seeing that there are no further members wishing to ask questions from this panel, I do want to thank our witnesses for being here today. It's been a very good and lively discussion and I look forward to further discussions on this in the future.

So pursuant to committee rules I will remind members they have ten business days to submit additional questions for the record and I ask the witnesses to submit their response to those questions within ten business days upon receipt of the questions.

Without objection then, the subcommittee is adjourned.

[Whereupon, at 11:56 a.m., the Subcommittee was adjourned.]