THE BROOKINGS INSTITUTION

IMPROVING SCIENCE AND TECHNOLOGY INNOVATION IN THE UNITED STATES

THE INAUGURAL A. ALFRED TAUBMAN FORUM

Washington, D.C.
Tuesday, June 8, 2010

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P R O C E E D I N G S

MR. ANTHOLIS: Good morning. Welcome to everyone. I'm Bill Antholis. I'm the managing director here at Brookings and I'm delighted to welcome you to the first inaugural Taubman Forum thanks to Al Taubman and his wife Judy, daughter Gail, who are here today. This is a terrific new series that we're launching here at Brookings. And as the name Brookings itself suggests, this institution couldn't be possible without the support of farsighted philanthropic leaders who understand the importance of solid public policy research and the ability to have impact. And, in fact, also here today is Ezra Zilkha, one of our trustees who has endowed a chair in governance studies, the Ezra Zilkha chair, which is one of our most recent and most important chairs held by Bill Galston.

For those of you that know Brookings and have spent any time on our website, we are quite proud of our core values of quality, independence, and impact. And today's session I think really speaks to all three of those. Certainly, the quality and independence of the research that Darrell and his team in governance studies have done across a range of issues, particularly on technology policy, which has become a real centerpiece of their work on understanding where this revolution in our economy is taking our governance. And I think those of you that know Darrell and his colleagues' research would speak to the quality and independence of what they do, but also to the impact. Since the inception of the institution, but particularly in recent years, we have put greater emphasis on a number of elements of impact. Technology is certainly a part of that, but convening and doing things in person is also pretty important. And the fact that all of you would come out today for this I think speaks to that as well. And not just coming together, but talking to real important policymakers, both in government, in Congress, and in industry, which we've also done today.

And then just also a plug on the impact side. Darrell has a new book coming out on immigration policy which has connections to this set of issues called *Brain Gain: Rethinking U.S. Immigration Policy.* It's the second in our new Focus Series which are shorter, more accessible books on big issues of the day. And we're thrilled at Darrell's new offering which will be on the bookstore shelves in the coming weeks.

The subject of today's forum, technology policy, is a key element of one of our priorities at Brookings. We have just finished a new strategic plan and the first of our four all Brookings priorities we call them because they draw from all of the research programs across the institution, is called Growth Through Innovation. And it's clear that technology innovation infuses American efforts to try to recover from the current economic downturn and to grow out of it and past it. But tech innovation isn't just limited to economic growth. It actually cuts through all of the other priorities that we have here at Brookings.

Energy and climate policy, we were just talking earlier before coming out here today about the advancements in the smart grid and how that will lead to greater efficiency in our way towards a more energy independent and low carbon economy. Opportunity and well-being, issues of access and attention to technology issues for people all across the socioeconomic spectrum is a critical part of advancement. And then also global change, both the opportunities and downsides of technological innovation around the world from the opportunities of distance learning to the security advances that lead intelligence gathering and drones, but also to terrorist groups that use the Internet and other technologies to advance their causes and how that's a security concern that all of us need to pay attention to.

So the issues that we're looking at today are really at the cutting edge of the full range of public policy issues facing the nation and the world. We're thrilled to have the members of the administration and Congress and industry that are here and are going to be

speaking with you today, but also to have all of you here, an audience that comes from the nongovernmental community, industry, embassies, and congressional staff.

So with that, I'd like to turn it over to Darrell West, who will be leading our efforts today. (Applause)

MR. WEST: Thank you, Bill. I, too, would like to welcome you to our inaugural A. Alfred Taubman Forum here at Brookings. And this series has been established through the generosity of A. Alfred Taubman. And Al and his wife Judy are here today with us this morning in the first row, along with Al's daughter Gail, their son-in-law Michael, and Judy's daughter Tiffany. So please join me in expressing our appreciation to Al and his entire family. (Applause)

Now, our goal in this annual forum is to bring together leading experts to discuss difficult public policy challenges. The United States faces major challenges in education, health care, the economy, energy, and foreign policy. We have high unemployment, huge budget deficits, and major problems in terms of a variety of different areas. In our first forum we decided to focus on a topic with the potential to make a huge difference across a wide variety of policy areas and that is science and technology. Brookings has just established a new center for technology innovation, which I will be directing, and it will look at ways to boost innovation and to use technology to improve health care, education, energy efficiency, public safety, and public sector performance. We plan to undertake research in these areas, convene public and private sector leaders, and make recommendations on what we think we can do to improve the climate for science and technology in the United States.

And we're launching this center because we think it is a crucial time in terms of our country's economic development. For a long period of time America has led the world in science and technology innovation. Technology has created jobs, improved

prosperity, and led to new solutions to pressing problems. It helped our nation after World War II become the dominant economic power. It made the United States the great nation that we became. But yet now there are troubling signs of a downward trend in American innovation. Last year, for example, was the first time that non-U.S. innovators filed more patents than did Americans. That had never happened before. The United States, also, some people fear, is falling behind other countries in the percentage of gross domestic product spent on national research and development. There are some who are concerned that we are losing our edge and that therefore future generations will not experience the same level of prosperity and opportunity that many of us have had.

There are some promising signs. The House, for example, just passed the America Competes Act designed to increase money for research and innovation. And we will keep our fingers crossed that the Senate will follow up on that, although we all know it's always a tricky relationship over there in Congress. The administration also has ambitious plans that several of its advisors will talk about today in terms of what it wants to do to boost technology innovation.

So to discuss the future of science and technology today we are bringing together a number of different experts who will offer their thoughts on our current situation and what needs to get done. Our first panel is going to outline the administration's new vision for technology innovation. And we're delighted to have three of President Obama's top advisors with us. They're going to give us a state of the union on technology policy.

The first person I'd like to introduce, and he can come up and join me on the stage, is Aneesh Chopra. Aneesh is the U.S. chief technology officer. He also serves as assistant to the President and associate director for technology within the Office of Science and Technology Policy at the White House. He works to advance the President's technology agenda by developing new ideas and encouraging government-wide

coordination. And prior to this position he served as the secretary of technology for the Commonwealth of Virginia.

Our next speaker who can also come up is Vivek Kundra. Vivek is the U.S. chief information officer in the Office of Management and Budget at the White House. And in that position he has worked on a variety of issues, including strategic planning for IT investments, the oversight of federal technology spending, data transparency, the IT Dashboard for Federal Agencies, and cloud computing, among other things. Prior to joining the White House, Vivek was the chief technology officer for the City of Washington, D.C., and assistant secretary of commerce and technology for the Commonwealth of Virginia.

Our third panelist is Phil Weiser. Phil is senior advisor at the National Economic Council in the White House and director for technology and innovation. Previously, he was professor of law and telecommunications at the University of Colorado. He is a co-author of *Digital Crossroads: American Telecommunications Policy in the Internet Age,* and then also telecommunications law and policy. He's also the author of a Brookings monograph, so it's nice to see a Brookings connection here, entitled "The Untapped Promise of Wireless Spectrum," which was published a couple of years ago.

So what we've done is to ask each of them to offer their thoughts and then we will have time for a short question-and-answer period. So with that, I will turn it over to Aneesh. Thank you very much for joining us.

MR. CHOPRA: Thank you, Darrell. It's a real pleasure to be here at Brookings. And on behalf of the three of us I want to extend my heartiest thanks to you, Mr. Taubman, for the lecture series that allows us to be here and provide for you a little bit of a window on the administration's commitment to technology, data, and innovation, both in terms of its prospects for economic growth and in terms of its ability to empower everyday Americans.

What we'd like to do today in the spirit of the President's call for more collaboration is provide for you a holistic approach to these issues from the perspectives that we all bring: I, as serving as the nation's chief technology officer; Vivek as our chief information officer; and Phil bringing the technology and innovation policy perspectives within the National Economic Council. This morning we'll each be providing for you the foundation of our technology policy and look forward to engaging with you on questions as the time arises.

So let's begin with a bit of the background. We have a colleague in the administration. Her name is Katie Stanton. She now works in the State Department and she joined the administration from Silicon Valley where she had worked at Google. And she remarked to us early in her tenure that there seems to be a big culture gap which we acknowledge and wish to share with you today in graphical form. The culture gap that we experience as individuals -- you saw earlier, I believe, the use of the iPad for the communications notes. As consumers we have embraced all of these emerging technologies in record numbers. And in a sense our society has emerged to a culture where we are celebrating the fact that there's an app for that. In light of yesterday's announcement of the new iPhone, we celebrate that culture. But in Washington, we still reside in an environment where we believe that there should be a form for that. And as you can see graphically depicted, if you can attempt to see at least, you'll see what's an operational file cave that's in the mountains of Pennsylvania. This file cave contains the records for all federal personnel and it's run by the Office of Personnel Management. What's not so exciting about this graphic is that there are countless other examples of rooms throughout the country that are actually in some cases fire marshals have been brought in because the weight of the rooms are so great given all the paper that's stored.

This culture gap is an issue that the President tackled literally on day one,

his first full day in office, when he issued a memorandum on openness and transparency in government where he called for a set of recommendations that embodied three principles that are near and dear to his heart. That is a government that's more transparent; a government that's more participatory; and a government that's more collaborative in the execution of public policy. These are the principles that we used as we came into the administration to think about the role that technology, data, and innovation might play to close this gap and to ensure that we're delivering a government that works.

MR. KUNDRA: And to feed into the cynicism that the American people have about their government, think about what we do as consumers, whether it's booking a flight online or making a reservation at our favorite restaurant or sharing pictures around the world. Yet, when we deal with the public sector we have to stand in line, wait on the phone, or show up with a form filled out made out of multiple pages. Now, part of what we're trying to do in the administration is look at how we're spending information technology dollars. And it's not due to a lack of investments in public sector IT. Over the last decade we spent over $500 billion in information technology.

Yet, as Aneesh pointed out, there's a huge gap between the experiences society has in the consumer life versus interaction of the public sector. That is why one of the first things we did, consistent with the President's vision, was to actually launch a dashboard that would shine light into every single investment in the federal government. And not only that, but we decided to put up the picture of every CIO right next to the IT project that they're responsible for and where it is in terms of cost, where it is in terms of schedule. Then what we did is we stood up a model where we were actually creating an office of analytics where we would analyze these investments across the board because it wasn't sufficient just to shine light on billions of dollars of federal IT spending.

Analyzing these investments, what we began to do was conduct these

TextStat accountability sessions. And these sessions are rooted in what has worked in the laboratories of democracy which is at the state and local level, whether it was the CompStat model in New York City or the CitiStat model in Baltimore or the CapStat model in Washington, D.C. Literally, within 60 minutes what we do is we bring in the responsible officials within agencies and all the parties within the White House to focus on these IT investments to make sure that we're relentless in terms of making sure that we're advancing the interests of the American people. Already what we've been able to do at the Veterans Administration, we hope that 45 IT projects out of which we terminated 12 of those projects, and redeploy that capital towards the most efficient.

In a TextStat session we did with the SBA, we found out that the Small Business Administration was paying $1,614 per Smart Card. And this is an identity card that's used within the federal government. Yet, the same exact card cost $240 at GSA. And we immediately halted that investment and said, look, we need to redeploy this capital where it's most effective and make sure that we're spending taxpayer dollars more effectively.

Across the board what we're trying to do is make sure that we close this gap between how the American people interact with technology in their personal lives compared to how they interact with the public sector.

MR. WEISER: So there's a great Yiddish tradition of let me say a few words before I speak. (Laughter) And there are a couple of words I do want to say here.

First, again, thanks to Brookings. Darrell's understanding the importance of that Hamilton Project paper I worked on. It's the first time I met Aneesh, by the way. And that's been a great partnership and a good friend. I do owe that to this institution.

Secondly, Jason Furman, who helped bring over the NEC. So Brookings' role in helping to convene and bring people together is something that I personally am grateful for. I also think forums like this and the support that the Taubmans are giving for

technology innovation policy really matters because a lot of people don't take as much time to step, look at the big picture, to think about ideas, and that's where a lot of great ideas come from. And one thing that this slide underscores is the Bill Joy aphorism, which is the smartest person about your organization is probably not working for you. And often we get stuck in different silos. And what both Aneesh and Vivek are doing at different fundamental and profound ways is trying to take a new look, bring innovative thinking into how government does its important work. And with respect to public policies, like the Healthier Choice eating -- and in terms of health and wellness, my wife is a health care researcher. She's underscored this point. If we can eat healthier as a country, the impact on our national well-being is enormous.

I don't know if people saw the New York Times' article about women who are obese and the impact that's having on pregnancy. So eating healthier is something that's critical to our country's future. And using technology and the sort of apps for healthy kids here is a pretty powerful tool to engage children and to think about their choices for eating healthier in a, you know, fun way that may work a little bitter than the nudging that parents often do in this regard. And as a parent of young kids I think all three of us have this experience. My six-year-old has yet to start getting into the apps for the healthy kids, but I look forward to that. And just to get a sense, I don't know if people here appreciate that the judges who came to this competition -- does anyone here -- I'm not sure people will admit it -- play Farmville? (Laughter) I didn't think anyone would admit it. Has anyone here heard of Zynga? (Laughter)

So people here aren't admitting it, but there are actually millions of people who are playing Farmville and other Zynga games online. This is an incredibly powerful medium. Getting people who are using this medium to think about, you know, core public policy concerns is a critical challenge. Getting outside ideas in is a critical part of the

administration's effort.

MR. CHOPRA: So what we've just done in the beginning here is provide for you the context for how we are trying to instill greater trust through technology, data, and innovation in the workings of government.

What we'd like to do at this point is transition into a conversation about the long-term economic prospects for the country. As Darrell had mentioned, we believe that technology can be an important infrastructure component in our goal towards long-term sustainable economic growth and quality jobs.

What we'd like to do in this slide is to provide for you the President's overall framework for economic growth with particular emphasis on the role that technology is playing in that regard. This is going to be another Q&A session if I may.

How many of you by a show of hands had seen the President's strategy for American innovation that was released in September? Excellent. Good for all of you.

MR. WEISER: By the way, this is a great audience. More people have seen this slide than play Zynga games.

MR. CHOPRA: Yeah. There you go. (Laughter) Hey, that's terrific. Great insight.

What I'd like to do is put the strategy in the context of how -- the role that technology would play in this regard. And we're going to spend a few minutes on each of these pillars in this next round of conversation.

For those of you that are following the President's strategy, it begins with the acknowledgement that our nation is at its best when we invest in the building blocks of innovation. And the building blocks of innovation include a commitment to research and development investments, a commitment to ensuring we have an advanced information technology ecosystem, and a commitment to ensure that we have a workforce

commensurate with the 21st century's needs -- one that is much more focused on science, technology, engineering, and mathematics. So what I'd like to do is provide for you a little bit of context around the building blocks. We'll do that in a moment.

Second, we have a similar commitment to ensuring that we have a functioning, open and competitive marketplace, one that's focused on productive entrepreneurship. Here, we'll be very focused on the role of open government, in particular as a catalyst for spurring -- empowerment, if you will, of everyday Americans. The comment that Phil had just referenced, the notion of our prizes policy to bring outside ideas in -- in that case, to help develop applications to inform folks about the nutritional values -- is just the beginning of a larger conversation. You'll hear more about our brooder set of policies in this domain in the slides that follow.

And then last but not least, we'll come together as the President has called for on a few issues that really require an all hands on deck approach. That all hands on deck approach today has been really focused on ensuring we've got a commitment to a sustained clean energy technology economy. And you'll see a lot of work that we're doing in that regard. A focus on bending the health care cost curve using information technology, and on addressing the grand scientific and technological challenges of our day.

So with this framework, let's now dive into each of these building blocks, beginning with how we're using emerging information technology infrastructure in the government itself.

MR. KUNDRA: There's one area that I spoke about last time I was here at Brookings, was cloud computing. If you look at the cost of compute power, coupled with the ability to access bandwidth across the country, what's emerging here is a very interesting one-way street in terms of how we're going to be leveraging technology in the coming years and the coming decades.

Across the federal government, unfortunately, what we've done is we've made investments in technologies of yesterday. For example, since 1998, what we've seen is a number of data centers grow from 498 to over 1,100. We keep laying infrastructure, building buildings, buying computers that are used, at best 7 to 10 percent in terms of processing power. Yet, what we're seeing in some of the most advanced countries across the country, is leveraging the power of cloud computing. A company called Animoto, for example, which stood up a solution that would actually allow you to create literally your own MTV channel, sharing video and data and content, essentially allowed thousands of consumers to be able to share real-time video and animation. And they didn't go out there and spend millions of dollars building infrastructure. What they did is they leveraged the Amazon cloud platform. And what that allowed them to do was scale very, very fast.

In the same way in the public sector, one of the interesting areas that we're pushing very had on is actually a shift towards cloud computing without compromising national security or the privacy of the American people. In the same way that every house used to have a well or you used to have an engineer dedicated in every company to maintain electricity, now what we're looking at is the ability to actually leverage whether it's electricity or water through utilities. We see a world where the cloud is going to serve as a utility for compute power. Couple that with mobile computing now, all of a sudden you have a very interesting world. You have more power in your hands, whether you're using an iPhone or Android or an iPad that it has more computational power than the earlier missions we sent to the moon in terms of the technology that was baked in across the board.

So what we're seeing is the ability to have massive innovation. Somebody with a great idea doesn't have to invest heavily in infrastructure, but the power and the force of their idea can transform the world. In the same way in the public sector we're making investments across the board, whether it's at Health and Human Services in electronic

health records or its NASA looking at scientific computation, or Department of Interior. Simple things like e-mail and literally figuring out ways in which we can shift power to the end-user.

MR. WEISER: So the cloud computing infrastructure that Vivek has just talked about rests on broadband connections. And broadband is one of the great infrastructure challenges of our time. It's one of the great enabling technologies with enormous opportunity. For people that have broadband technology, lots of opportunities are at their fingertips, whether it's education, health, entrepreneurship, commerce, culture. And so enabling lots of people in all parts of the U.S., getting as many broadband connections deployed and adopted as we can, is a crucial challenge for the administration. This is something that there is a lot of focus on, and we are looking to celebrate, encourage, and look for all sorts of solutions to this challenge. It's not like there will be a one size fits all. One that merits note here is a project that Case Western is working on as part of a partnership with different stakeholders and universities to get one gigabyte connections. Now, this is a lot of bandwidth. Different people have different sorts of questions. How much actual use of this. And the good news is we'll find out. Google has got a project now also to deploy enormous amounts of bandwidth. There's lots of discussions to how much is enough, and this is going to be something over the next years that we're going to find out. The past, if it's prologue here, I think there was a famous quote about Bill Gates saying we've got more memory in this computer than anyone will ever be able to use. There was constant people being surprised. And that's something that may happen in broadband, too. We'll see.

There's a huge opportunity to look for strategies to get broadband deployed and adopted, and we don't know what's going to happen with it. I think we do know from what we've seen already that broadband is a transformative technology. The cloud

architecture is one exciting application that we're seeing, and we're likely to see others. And this is something that we're going to continue to be focused on. Obviously, the Recovery Act put down a real down payment in this regard, and the FCC is looking at a longer term strategy for university service reform. And it's an issue that we will continue to be addressing going forward.

MR. CHOPRA: Which leads us to the third pillar of our infrastructure challenges, the building blocks of innovation. And that is our commitment to research and development. Now, as Darrell actually mentioned in his opening remarks that there has been an ongoing debate about the health of a nation's competitiveness in part driven by its share of gross domestic product contributing towards research and development. I believe you made reference to that statistic. President Obama, in his speech to the National Academies of Science a little over a year ago challenged this nation, public and private sector, to achieve a three percent investment ratio of our nation's GDP into research and development. The public sector commitment to this regard has been an America Competes Act commitment that have called for the doubling of basic science research and development within three key agencies -- the National Science Foundation, the Department of Energy's Office of Basic Science, and the National Institutes for Standards and Technology, as you can barely see.

By the way, all these slides that are really hard to see we're going to make available online. I suppose Darrell will have it posted. So we can get you copies. Forgive the fine print. But we'll be describing for you the slides as we're doing our remarks this morning.

The commitment here, as you can see from the graphic, has been in the President's fiscal 2011 budget. Building on the dramatic investments in research and development that came out of the Recovery Act, which put us back on track towards that

doubling trajectory, followed by the commitment in the Fiscal 2011 budget to continue that great work. By the way, in that budget, which now is an aggregate that is not just these three agencies, but an aggregate, about $150 billion for research and development spending, but half of that is in the Defense Department and the other half across the rest of the agencies. The United States government is equally committed to a focus on translational capacity. How might we increase the rate at which those ideas born out of our universities and federal labs translate into the commercial marketplace?

And to that end we were pleased to announce just about a month ago under Secretary Gary Locke's leadership of the Department of Commerce, a new innovation competition. We call it the I6 Challenge. Opportunities are still available for anyone to participate. The I6 challenge in short asks communities around the country for the best ideas on how they would build capacity to listen to the ideas for universities and federal labs and to translate them in a more effective manner into the private sector. Those resources that the Economic Development Administration has made available in our spirit of collaboration are going to be matched by commitments at the National Institutes of Health and the National Science Foundation to provide supplemental resources in those communities that have research centers of excellence in that regard.

The I6 challenge is just yet another modest step forward as we commit to this effort of translation capacity. We are taking a listening tour around the country. It began in February, where Secretary Locke and I had participated in a commercialization forum hearing from university presidents and stakeholders. We'll be visiting across this summer a number of key sections in the country, from Michigan to California and elsewhere, to hear directly from the American people on what we can do to better connect our research assets and our economic prospects for growth.

MR. KUNDRA: So one area I'd like to talk about is an initiative that we

launched called data.gov. And it's grounded in a very simple philosophy. And the philosophy is based on the President's Open Government Directive that information that the American people have already paid for should be available for free. It should be available online. And we also recognize that the federal government does not have a monopoly on the best ideas. And that the best thinking isn't necessarily within the four walls of Washington.

To that end, last May, in 2009, we launched data.gov with 47 datasets. Today we have over 270 datasets on data.gov.

SPEAKER: Thousand.

MR. KUNDRA: Sorry, 270,000 datasets on every aspect of government operations, from health care to environment to education. And part of what we've been able to do with this platform is we've been able to spur innovation in ways we couldn't have even imagined. Since launching this platform, what we've seen is third parties create more value than we could have imagined. They are finding value at the intersection of multiple datasets. A team of eight students led by a professor at RPI, without the government engaging in any formal partnership, went out on their own and built over 40 applications on every aspect of government operations from looking at U.S.'s spending, to who was actually visiting the White House, to figuring out, you know, what innovative application would serve the American people. A developer who built a simple application called flyontime.us that actually allows you to see what the wait times are at every airport in the country by using Twitter feeds, to data that they used from the FAA on average delay times across airports.

We've also seen this model being scaled at the city-level from San Francisco to Boston; internationally from the U.K. to Australia to the World Bank. There's a global movement now to democratize data, and it's grounded in something else that's happening in the private sector. Think for a second the power of platforms. Apple didn't go

out there and build hundreds of applications. Today, the iPhone has over 200,000 applications. It wasn't Apple that actually built those apps, and some of the favorite apps I have were built by developers all over the world.

Think about YouTube. There are over 24 hours of video uploaded on YouTube every minute. And that content isn't created by Google. That content is created by people like you and myself. In the same way, the data.gov platform has the potential to fundamentally transform our economy in the same way that GPS did when the Department of Defense decided to democratize data on satellites. We couldn't have imagined the day when we could use our PDAs to navigate a whole new city or go to a rental car store and rent a GPS device for under $10. We hope, and we're already seeing, massive innovation happening outside the four walls of Washington as a result of this administration launching the data.gov platform.

MR. WEISER: So as you've seen, there's a very fine balance and complementary relationship with the role of government leadership and public policy and private sector innovation in what is undoubtedly the worst slide of the deck. This one right here. (Laughter)

I take responsibility, although part of it is the domain of standards. You can see Pat Gallagher, who -- for people who don't know Pat, he is an amazing public servant who has worked his way up from NIST. Jonathan Sal, who is in the back of the room, worked on the transition, helping to work with NIST and identify Pat as someone who is an extraordinary leader of an agency that is one of the sort of underappreciated parts of government. The role of standards is also underappreciated because often it's something that's ethereal and hard to sort of get excited about.

To give you a little bit of my basis for excitement, TCP/IP, the standards that created the Internet, was in part because there were some very thoughtful people about

how to approach standards at the Pentagon. And Vince Cerf and Bob Kahn were two of those involved in that enterprise. We don't always have the luxury of having extremely thoughtful people about standards at all the agencies. And one thing that having a niche in the role of chief technology officer is already delivering great benefits is to empower, build up leaders at agencies.

So for those who haven't heard about Todd Park at HHS and what he's doing -- I don't mean to steal your thunder, you'll get to it -- it's nothing sort of extraordinary. And so a challenge that we all have is the investment of human capital, the investment of ways of approaching the work of government so that we are institutionalizing levels of awareness that may not exist.

Now, there is a very important protocol in a different use of the context. Not necessarily technology, but how government operates, in an OMB Circular A-119 which commits to the approach of voluntary consensus-based standards. And that's something that the U.S. Government has really been a beacon around the world because many governments for a long time had the view that government should be setting standards. And this you could say issues a prime directive, which says, no, governments should not be issuing standards; governments should go to the private sector, should maybe play some role convening, but certainly should play a role of establishing a public policy priority and allow private sector innovation in an open fashion to help develop the technology. And that is indeed the approach set down to 119-A.

However, the infrastructure throughout government doesn't necessarily exist at the highest levels so that sometimes people may not realize what is the standard setting problem and how to go about doing it? And so to address that, Aneesh helps spearhead and I'm working with him along with Kasson Steve from OIRA, an approach to an interagency standards process being led by Pat Gallagher. And this is to in a sense create a

playbook so that we invest in the government awareness and approach on standards so that we're able to replicate the best approaches of the past and avoid of what has been some of the more ignominious failures in standards policy.

MR. CHOPRA: To round out our conversation about openness and competitive markets, I wanted to share with you our attempt to convene and spurn entrepreneurial activity without taxpayer dollars at the center. In fact, without taxpayer dollars at all. And this is the story of our most recent endeavor in the Department of Health Services announced by Secretary Sebelius on June 2nd. And that was the launch of our community health data initiative and, more specifically, the Health 2.0 Developer Challenge.

A word about this in context. As part of the President's first full day in office, Memorandum on Openness and Transparency, which led to the development of data.gov and some of the conversations we've had about transparency. The President called on each cabinet secretary to publish in his or her own words how they would embody the principles of transparency, participatory democracy, and collaboration. Everybody took their own approach in the spirit of instilling the culture change we need to see in Washington, we designed it in that spirit.

And Health and Human Services under Secretary Sebelius -- and by the way, you can look at any one of their open government commitments by going to the agency website /open. So in this case hhs.gov/open. Secretary Sebelius said, folks, the mission of the Department of Health and Human Services is to improve the health of the nation. It is not necessarily just about the provisioning of insurance or various investments in biomedical research. Those are all strategies and tactics against the broader goal, which is to improve our nation's health. And it turns out that we have literally thousands of datasets focused on the health performance of our country at the community level.

How many of you know the smoking rate in your community against the

smoking rate in a neighboring community? Or the infant mortality rate? When we have a debate in our communities at the local town hall, how informed are we about the actual performance of our community on a whole range of these indicators? Well, the reality is that information exists in file cabinets or in reports, but they're not accessible in a way that actually informs a lot of the public debate.

So Secretary Sebelius said what I'm going to do is three things. Part A, I'm going to organize all of this information. Part B, I'm going to convene or in our technical speak, a mash-up of public health professionals and techies to see what happens if we bring the two of them together. And C, unlock this potential, tapping into the creativity and the entrepreneurial energy of the country by building a national grassroots movement to improve health performance powered by information.

How have we done this? On March 11th -- literally, March 11th, at the Institute of Medicine we had 25 public health professionals. People like Don Berwick, who the President has now nominated to run CMS and 25 web 2.0 experts, people like Tim O'Reilly, who many of you know as the father of the term "web 2.0." And literally brought these folks together who had never met before and asked them over the course of one day to outline a set of challenges that we could see some application development around to close that gap. They identified a dozen, maybe two dozen ideas and we issued a very simple challenge. In three months, Secretary Sebelius is going to want to see what you all have done. Not a meeting to have a meeting about a meeting to have a meeting, but to prototype applications that are developed across the next 90 days, born out of the information that we made available that day.

Oh, there's no procurement. There's no money. There's nothing. There's just calling on your entrepreneurial spirit and energy in advancing our nation's health performance. And folks stepped up to the plate. We showcased on June 2nd nearly 20

applications that were new or improved by our provisioning of health data. Just two simple examples and then I'll shift to our last priority.

Example number one, Microsoft Bing. Microsoft has a search engine that more people will use than would probably visit a government website. And if you type in a hospital, like New York Presbyterian Hospital in Bing's search engine, today the default results page will incorporate the quality data from hospitalcompare.gov, a website built several years ago that capture information about patient satisfaction and quality performance.

Now, I don't know how many of you -- okay, here's another test. How many of you have been to hospitalcompare.gov? More like the Zynga thing; not many. A couple. (Laughter) But how many of you have been to Bing? More, right? There you go. So the point is we don't have to have you visiting the government website. We don't need to chest thump that our websites are better than anybody else. That's the wrong approach. The right approach is we release the information and you have it in your way.

The second example of this phenomenon was an entrepreneur who lacks broadband Internet access because he lives in rural Wisconsin, who used to drive 45 minutes just to have his office set up, said one of our challenges in health is that asthma attacks come and we don't have the information about when there's an attack or when the weather changes that we put ourselves at risk; high rates of emergency room visits and the like. He built a very simple technology. A sensor that sits on top of inhalers, so people who volunteer to do this, when you subject your inhaler to your compressor it records the time and location of that compression. So you'd have real-time public health surveillance maps. So in collaboration with the Centers for Disease Control, he's supplementing public health data with almost real-time alerts so that people can be forewarned if they opt in, all with privacy protections. This solo entrepreneur, who didn't have a big, fancy RFP-generating

machine, just said, hey, I want to help and do this.

The Health 2.0 Developer Challenger is our statement for how we will convene this grassroots movement for change powered by data, informed by emerging technologies, and calling on our best angels in our country to step forward and make a difference. And some of these ideas are going to commercialize and make money; others are going to be available free of charge. That's the spirit of how our open government philosophy, we hope, will empower everyday Americans and address the economy.

Our last pillar before we close out for questions is now how we think about this construct in the notion of our national priorities and breakthroughs that we need to convene. As I transition to Vivek on this last slide, the last set of slides, I remind you in that strategy for American innovation the President had a very specific chapter dedicated to grand scientific and technological challenges that we as a nation should address, challenges like how we can produce solar cells that are as cheap as paint or if we could produce prosthetic devices that would allow a double amputee returning home from Iraq or Afghanistan to once again play the piano. These scientific and technological challenges we wanted to get public input on and here's the results.

MR. KUNDRA: So as we try to catalyze breakthroughs when it comes to our national priorities, it's not just important what those breakthroughs are and the information that we've collected, but it's also how we do that.

To give you an example, as we were looking for public input we went down the traditional approach, which was to post a notice in the *Federal Register* over a six-week period. And we didn't receive as much input as we would have liked to. In the last 48 hours of the deadline what we decided to do was to actually leverage new media, to leverage the platforms that are native to the American people, from Twitter to Facebook to a number of other platforms. And what was fascinating is that in the 48-hour period we got over 1.5

million people engaged in this process to give us feedback. We've seen this across the board. For far too long what we've relied on is platforms that we've built that are limited to a small set of people inside Washington. And part of what we're trying to do in the administration across the board, the philosophy of the Obama Administration is to shift power to the American people, whether it's with data.gov, whether it's the way we go about getting input from the American people, recognizing as I said before that we do not have a monopoly on the best ideas. We saw that with the Save Award, which was an award for the best ideas in the public sector to save money. We got thousands and thousands of ideas across the country from people all over the federal government coupled with third parties that were giving us input in terms of how the federal government could actually be more efficient and effective in terms of how it spends money by cutting waste. And we've implemented a number of those ideas in the budget itself.

So what we're seeing is a fundamental transformation of society, the use of technology. People can engage with our government in ways that were structurally impossible before. Whether you're in the suburbs of Washington or you're in Ohio or in Boston, you for the first time have access to your government in ways that were impossible structurally before. And what this administration plans to do and will continue to do is leverage the power of technology in our policymaking process and also in terms of how we try to solve some of our grant challenges, whether it's in energy, education, health care.

MR. WEISER: So, in energy, and clean energy more particularly, we have a huge national opportunity and obligation. And one of the most promising clean energy technologies is energy efficiency. And there are still vast untapped opportunities to enable all Americans to use energy more intelligently and more self-consciously. And so bringing the power of information technology to people's, in some cases fingertips -- there's an app for that -- is something that the smart grid revolution is looking at. And we as administration

are committed to using this opportunity in the most effective way possible. To that end, working with Aneesh, the folks in the Council of Environmental Quality and also at OMB, we're setting up an interagency effort around smart grid to look at what a comprehensive policy framework in that space is going to be. And at the end of September we will have completed our investment through the Recovery Act of around $4.5 billion into this technology. There's ongoing good effort by NIST, helping to develop a standard architecture for smart grid. And we have to look forward in this area, understand better how consumers interact with this technology, understand where the best opportunities are, and we were very grateful to Brookings for hosting a session here that's going to be in mid-July -- July 14th ¨ to talk about smart grid policy after the Recovery Act. And that's going to be part of our efforts to work through what is a very important challenge of our time.

MR. CHOPRA: A few more, just a couple more. Darrell, I know we're running a little behind schedule. Forgive me for that.

I want to take that same spirit, our attempt to bring innovation in the smart grid, to our health care sector with just a set of observations about the role of government in spurring change. As you may recall, in the Economic Recovery Act, the President did commit some $20-plus billion to support providers, that is hospitals and doctors, who can achieve the notion of being a meaningful user of health information technology, to lower costs, improve quality, and increase patient satisfaction. There has been a public policy debate about what it is that we can do to be defined as a meaningful user of health IT. And commensurate with our policy debate about that question has been a technological evaluation about what we can do to spur those kinds of breakthroughs.

If you look at the background, the American economy has seen productivity gains in nearly every sector, but the health care sector, much like the public sector, has really lagged behind in productivity gains. So here are just two examples of policy outputs in

the technology domain that are really focusing on that productivity gap in the health care system.

First, and this was particularly obvious to us in our spirit of open government, we convened public hearings and got testimony from folks who don't normally come to Washington. A physician from Virginia said here's my problem. I've got a patient moving to Arizona. She's chosen a doctor in Arizona, who, by luck, happens to have the same software that I have. Patient asked me if I could send an electronic copy of her record to the doctor in Arizona so that the information will flow without having to be faxed or transcribed or something to that effect. Well, the doctor said I looked on the software and there was no button "Send to Colleague." So he asks us in this testimony. He says, folks, I don't know what highfalutin things you're working on, but why can't I just send a simple e-mail securely with respect to patient privacy to my colleague with my patient's information that she requested? And we said, yes, sir, that is our charge.

So literally weeks after the testimony, we embarked upon the National Health Information Network Direct Project to complement what had been a five-year technological effort, the Nationwide Health Information Network to spur information exchange. While we continue to do the larger visionary work, we said to solve this doctor's problem we want a very simple set of technical specs that would allow the Internet to be used for the transmission of health information. But because of the concerns about security and privacy we want to ensure with great confidence that it will deliver results. We launched the NHIN direct initiative in March. In three months we've developed four technical spec options. We will select those technical specs this month, and this fall we will have implementations in hundreds, if not thousands of physician offices. Literally within the year the doctor asked us to see this change, we will be delivering the technical framework that would enable all of this simple, cheap, and secure exchange of health information.

By the way, it also happens to be the simple, effective means to achieving meaningful use because one of the key provisions of it doesn't exist today, and that is we called for a patient is entitled to an electronic copy of his or her medical record. Hello. Pretty obvious. The tech community went up in arms and said that's never been in the requirements document before. We don't have that in our nation's hospitals or physician offices. It's just not something that we do. Well, now it will be a key factor in defining meaningful use and now that this platform will be available you will have access to it. So knock on your physicians' doors and demand access to this in the very near future.

Secondly, we acknowledge that there is this challenge in the information technology world that is shifting more and more power to the end-user, whether it be a doctor or a patient. I don't necessary want what you're going to share with me in terms of how I should know what medications to use or no. I might want to choose from hundreds of options. The notion here is how do we allow for the substitutability of applications based on the end-users' interests and needs? We invested a very modest amount of money, about $15 million, in a R&D center at Harvard run by Professors Mandel and Isaac Kohane to look at the substitutability of applications and the need for an open platform called the iPhone app store, although that's not really the right analogy by close, for the health care sector. And again, in the spirit of open collaboration, all of this is publicly available. You can all participate and collaborate. They'll be convening summits over the summer and have implementations literally within the year to demonstrate the power of substitutability of applications focusing on the nation's health care system. That's part of our commitment to drive change, not measured in budget cycles or legislative cycles, but literally in tech cycles, in 90-day turnarounds, 6-month turnarounds, one-year turnarounds.

Which leads to the final slide of putting this altogether to give you the context for how this technology policy ecosystem we believe will both transform the nation's

economy and help empower all Americans. And that's the final story about the 40th anniversary of the Internet. As Phil mentioned a few moments ago, it was DARPA that birthed the key infrastructure that we now know to be the Internet. And in celebration of last year's 40th anniversary, DARPA issued the network challenge. They didn't really know what was going to happen. They had a simple proposition. We're going to float 10 red balloons anywhere in the country. They're going to go up on one day and down at the end of the day. The first team that registers the latitude and longitude for each of the 10 balloons wins a whopping $40,000 prize. First, they had no idea if anyone was going to participate. Then they had no idea how they would actually organize themselves. And third, they had no idea if this could actually work.

Well, two days before the deadline when the balloons went up, an MIT team said I think we should do this. Just a small group of people. Overnight they built a 5,000 person network, and within 9 hours on the day of the launch they found every balloon. Two days. They thought of the idea to participate and they did it. How? They innovated on the design of the program. They created a tiered incentive model. If Vivek found a balloon, he'd get 2,000 bucks, which is half the fair value of the balloon finding. But if Phil invited Vivek to the network, then Phil got paid 1,000 bucks. And if I invited Phil who invited Vivek, I'd get 500 bucks.

SPEAKER: This is an Amway model. (Laughter)

MR. CHOPRA: Exactly. Well, over a million people tapped into their Twitter networks and Facebook networks to turn on this system. The person who organized this was a postdoctoral fellow, who, by the way, Darrell, I would argue that postdocs tend to be our most underleveraged asset in the innovation economy parenthetically.

This postdoc said, I will take what I've learned in this funny little competition and apply it to what I care about, and that is to build a global movement to address the billion

people today in chronic hunger. So in partnership with the U.N., he launched a petition drive with the same principle. But he didn't have 40,000 bucks, so he said you get special points if you actually recruit a lot of folks that sign the petition. And using that same tiered structure he's now built a global grassroots movement to focus attention petitioning governments on this issue of hunger.

This is the ecosystem that's converged. It was a research endeavor that led to DARPA to do the work on the Internet. It was a research pilot project, a prize or a competition in the spirit of open government that got this postdoc in turn engaged. And it got that postdoc's entrepreneurial spirits to then take it in an area that he cares about, and others on his team are now starting economic ventures built on mobile platforms.

MR. WEISER: If I can just jump in. One thing here, this is a key theme, is that often technology policy is about creating conditions for things that we don't know what's going to happen with, whether it's open data, whether it's a competition, whether it's smart grid. We don't know how these platforms get used, these opportunities get developed, but one of the exciting things about technology policy is all three things can happen.

MR. CHOPRA: And so we end with this observation: We are hungry for work. We are hungry for your ideas. We're passionate about using these tools to establish platforms for innovation. And you're going to see this as we see agency after agency with the 21st century technology and innovation focus that the President has called for, and we look forward to your active participation.

Thank you. And forgive me for going beyond our time, Darrell.

MR. WEST: No. Thank you very much. (Applause)

I actually like that tag team approach. I think you guys are ready to go on the road with this. It sounds like that's exactly what you've been doing.

We have a few minutes for questions, so if you can raise your hand, give us

your name and your organization. I think what I'd like to do is take maybe three or four questions and then each of you can pick out and answer particular ones. Right there is a question.

MR. FRASER: Mark Fraser with EADS North America.

MR. WEST: There's a microphone being passed over to you.

MR. FRASER: Mark Fraser. I'm the CTO for EADS North America. I'd like to applaud all the presentations.

It's very, I think, relevant to this discussion that you brought up DARPA, one of the leading innovative institutions in our R&D infrastructure. They've just initiated an industry summit outreach because they recognize even as being the most innovative organization in perhaps the federal government, they still need a lot of input from out of the box thinkers and from industry. And so my question to you is how are you doing that kind of outreach to industry to get more, better ideas and how to solve this problem cradle to grave?

MR. WEST: Okay. Let's take a couple more questions. Right there.

MS. WALKER: Hi, Molly Walker from Fierce Government IT.

I understand you don't want to massage the data too much; you want the raw data out there. But has there been any emphasis to agencies about responsible data release? Like, a lot of government documents are over 65,000 data cells and that can't be read very easily. Or let's say the data was collected one way in 2007 and differently in 2008. How do you provide context or make these more readable so that they can actually be used by developers? And has that been emphasized to agencies?

MR. WEST: Okay. We'll take one more question. Right here on the aisle and then we'll give each of you a chance to answer.

SPEAKER: Thank you.

MR. ABRAHAMS: Ed Abrahams, Personalized Medicine Coalition.

I understand that generally you want us to collect information and make it more available to, actually, if I understood you correctly and I confess having been trained in humanities I may not have understood you correctly, that you want us to be a better nation of consumers. My question is -- using better data. My question is what are we going to do to create a better future? I understand the electronic medical records, the doctor in Virginia wants to communicate with a doctor in Arizona, but how are we going to get to a better medicine of the future? How are we going to harness the power of research to create something that doesn't now exist so that we might also work on the supply side?

MR. WEST: One, two, three.

MR. CHOPRA: Yeah, absolutely.

MR. WEISER: So let me start with the first question. This idea of outreach and getting ideas out to the government is essential to all that we do. If governments sit and we talk amongst ourselves, that's not a very effective process with respect to looking for the best ideas. And particularly insofar as almost any policy domain you can think of, particularly in the technology policy, the actual implementation is not going to be within government. It's going to be within the private sector: states, communities, all sorts of different organizations. And so you need to get that engagement. Ideally, finding ways to go on the road to where people are, and also using technology to get people's ideas. So with respect to the standards effort I referred to, we start off with ANSI, you know, American National Standards Institute, talking to some of the standards professionals trying to get their ideas. We're continuing that dialogue as part of that process, and that's going to be critical to getting all the ideas that we can.

A critical reason why we're here and why we're so excited about what Brookings is doing is because it provides that form of engagement. And if you all say, hey, you're missing something. We don't see in your state of the union to use your metaphor, the

following ones, it may be because we've already gone over our time or maybe because there are some ideas we're not thinking about. So I would agree completely that we should never ever, you know, live in a cocoon and talk to ourselves. We need to be committed to outreach as a core part of what we do. And to the extent you all have those ideas, please talk to us afterwards.

MR. KUNDRA: In the context of data, one of the things we have to recognize is that there are two faces of technology. The same technologies that allow you to stand up a blog on a real-time basis, leverage GPS, socialize through Facebook, are the same technologies that can also be used when it comes to identifying people, thinking about privacy in the context of democratizing data. That is the reason when we release datasets they have to go through a very rigorous process at the agency level to make sure that the datasets are de-identified, that no two datasets could lead to an individual being identified. In the context of privacy, it used to be that we looked at privacy through the lens of personally identifiable information which was name, social security number, address, and so forth. But now with the advent of technology, that completely changes that context. And that's part of what agencies go through.

The second part of your question, which was around metadata, as data changes how are you identifying that data? Agencies actually fill out a very detailed template about the dataset itself, not just about, you know, the name of the dataset, but also get into when was it collected, how was it collected, the statistical elements around the dataset itself and the frequency of the collection itself. And so the combination of metadata and making sure that we're very rigorous about evaluating how these datasets could be combined, one, leading to privacy implications, and two, national security. So we go through a national security review also at the agency level and across government before the datasets are made public.

MR. CHOPRA: And data quality.

MR. KUNDRA: And the same thing with data quality. One of the things that we did as part of the Open Government Directive was that every agency now has a senior accountable official that's responsible for data quality. And part of what we're also seeing is as we put out these datasets, we've built into the data.gov platform feedback loops so that people are getting back to us and ranking and rating datasets so they can tell us very quickly which datasets don't have good data quality. And what we're seeing is our feedback loop is having an impact at the agency level where this greater transparency is leading to an improvement in data quality coupled with the senior accountable officials at the agency level.

MR. CHOPRA: And I want to make sure that I -- one of the challenges in a presentation like this is that we may have muted certain aspects of what we were trying to say today and emphasized others. The slide that highlighted our commitment to research and development absolutely is focused on the industries and jobs of the future. So let me just share with you a couple of examples.

Number one, that's where we had in the strategy for American innovation what should the big challenges be of our time that we could catalyze energy, an all hands on deck approach to address them. That's what we're going to be doing in developing our proposal for what those grant challenges should be born out of public input.

Two, one of the key themes every year is a letter written by Peter Orszag at OMB and Dr. Holdren, the President's science advisor, that issues a framework for where the thrusts should be for R&D investments and the go-forward budgets. And that's a terrific document to engage on the intersection of bio info and nanotechnologies as an example as we believe that would be an opportunity for growth. More on each of those domains highlighted in that annual letter that's published that will come out hopefully in the not too distant future.

But third, this is precisely why the President has renamed his innovation advisory panel. We have a program called PCAST, which is the President's Council of Advisors for Science and Technology, which has more Nobel Prize winners on it than are seated on this stage. And in that PCAST --

SPEAKER: (inaudible)

SPEAKER: Yeah, that's not saying too much, though.

MR. CHOPRA: That's true.

SPEAKER: No offense. (Laughter)

MR. CHOPRA: Well, fair enough. Numbers of people. We have more than four Nobel Prize winners on the PCAST.

Within PCAST the President established the President's Innovation and Technology Advisory Committee, which is a component of PCAST. Now, why do I say all this alphabet soup? June 22nd, PITAC will convene its first strategy session looking at the 10-year horizon and beyond for what bio, nano, and information technology-based businesses will look like. Today the price of a human genome sequencing might have dropped from 100,000 to 50. Maybe it's on its way to 1,000. What does it mean in a world where we have a $100 genome? What does it mean if you have the manufacturing capability through nano-manufacturing to actually introduce unique materials into airplanes? The gentleman here is from EADS. Right? The role of nanomaterials and nano-manufacturing into the supply chain, you have a modeling assimilation infrastructure component. You have a nano-manufacturing component. So you could take a look at each of these disciplines -- nano, bio, and info, in particular -- project out what their growth trends will be over the next decade, and to look at what the critical infrastructures will be necessary in order for us to support those industries of the future.

Just in your example of personalized medicine, if we get to a $100 genome,

what does the infrastructure of the nation's health care system have to look like? Does every physician need to have a gene sequencing device? Do we have to analyze information in the cloud in a more sophisticated manner? This is going to be the discussion. It will be publicly available on webcasts and so forth June 22nd, chaired by the two co-chairs Eric Schmidt and Shirley Ann Jackson, the president of RPI and the CEO of Google.

So, very much focused on the industries of the future. And forgive me if I had underplayed that in my commitment to R&D.

MR. WEST: So, Aneesh, if we have $100 genomes for 300 million Americans, Vivek, you really better get to work on cloud computing. (Laughter) Because the data storage implications are huge.

We have time just for one or two quick questions. One there and then Bill.

MS. STERN: Thank you. Paula Stern. I guess today I'm representing the National Center for Women and Information Technology, so I'll ask the women's question first.

And thinking about Brookings, having been a guest scholar here a gazillion years ago, the intersection of economics with the technology we're talking about today and the megatrends with regard to women in participating in information technology and science. We've seen dramatic changes in the U.S. economy as a result of more women participating and therefore the household incomes being greater as they've worked in the workforce.

I'm wondering if there's been any thinking done or considered to be done that what, if you will, megatrend implications there might be for increasing the intensity of participation of women, particularly in information technology and in engineering, and what that might mean for our future that you're spelling out today.

My second question is as a consumer. Medicare, the whole patient's transferability of information has always been the biggest issue from the consumer's point of

view for the last 15 years, 20 years, as long as we've been even thinking about information technology. And that has been -- this physician, thank God, he finally got to you all. But with regard to Medicare, I think there are a lot of consumers, many of them are going to be the poorest as well in this economy, who are still hampered because they have to rely on our services, insisting that things be sent by mail, which is ridiculous in this day and age. So I hope you've got at least an intern this summer working as -- pretending that --

SPEAKER: Got you covered.

MS. STERN: -- she is a 65-year-old woman that has just gone on Medicare and walk -- have them, as a consumer, walk through what is needed. Oh, my God. The money that could be saved.

MR. WEST: Yes. Thank you very much for that.

Hold onto that. Bill Antholis has one last question and then you can respond to it. Thank you.

MR. ANTHOLIS: Quick question, which is --

MR. WEST: We have a microphone coming up.

MR. ANTHOLIS: The volunteerism or the sort of low-cost network of public interaction is very impressive. But any of us that have worked in complex organizations, particularly of the .org or .gov know that you're competing with the private sector for top-quality talent. You mentioned young postgrads as an important force, but give me a little -- give us all a little sense of sort of what the personnel -- what the IT personnel in the government looks like right now, your own efforts at recruiting, where you see the future of that in competing with the private sector salaries.

MR. WEISER: All right. I'll take the first one and a couple -- this was a softball for those who don't realize it. Lucy Sanders, who runs our organization is a friend; the chair of the organization, Brad Feld is another friend. It's a phenomenal organization,

National Center for Women and Information Technology. It's a great example of the type of social innovation that we've been talking about. People who out there are putting together coalitions to grapple with public policy challenges.

I would also add -- I know Lucy and Brad are passionate about this as well -- it's not only women. It's people of color. Because the extent of the workforce in IT, this then takes me to the final question, you know, has been predominately white male. Now, that, given the demographics of this country, you know, is not a great equation. We need to change that equation. If you look at this pyramid that we referred to earlier, at the bottom education is a critical piece of it, more particularly STEM education. For those not in the acronym world that's science, technology, engineering and math. And the Education to Innovate Challenge -- Educate to Innovate, for those who haven't heard about this, it's an unbelievable program. We'd be remiss if we didn't recognize Tom Killalea, who has really been the mastermind behind that. Tom also wrote a Hamilton Project paper here on the role of prizes in helping to spur innovation. And Educate to Innovate is basically saying it's a private sector challenge. Let's build a partnership. (inaudible) has been formed on this. Getting companies to say how do we grapple with the, you know, challenge of getting people excited about science and math in this country? We need to have a generation of, you know, people who are passionate, thoughtful, creative, well educated. To take on the jobs of the future they have to be across all demographic groups. And that has not been an area that we have thrived in.

Where the great ideas are going to come from, how to get people enthused is something that we are very much looking at. The level of innovation, by the way, in the Department of Education is off the charts. There's a lot of thought going on within that department on this and some very high quality people there. So, yes, this issue is very much on the agenda. I think it's in the category of things we didn't have enough time to do

justice to, but stay tuned on that. We're definitely focused on it.

MR. KUNDRA: So I'll respond to rapid fire. Number one, the President convened basically a workplace of the future summit maybe a month and a half, two months. My dates are off. But one of the key pillars of engaging more people under the nation's workforce is telework. We had at the job summit last December the CEO of ARISE, which has a global -- a national network of home-based workers who -- now 75 percent of them are women who choose to take hours that they are comfortable working. And what they're finding is extraordinarily talented women who have been disconnected from the workforce. Because of broadband to the home, they can connect at a pace that works for them and they're seeing tremendous results. And they've commented on that and the President acknowledged that at the job summit. Part one.

Part two; we are very focused on customer experience design. Next Monday on the 14th, I have the honor and privilege of chairing a working group the President has called for and the implementation of the Health Reform Bill. One of the principles of it is how are we going to enroll 35 million Americans into this experience? Do they want to experience DMV lines of the past or do they want to experience the iPad-like experience that they might see in today's economy? We are launching on the 14th a working group precisely to look at the electronic tools necessary to make that process a pleasant one for the American people.

And related to that, we're also empowering folks to say, in the case of Medicare, we were pleased to announce -- last week we announced Medicare and the Veterans Administration are rolling out a concept called Blue Button. That is if you visit Medicare -- mymedicare.gov or myhealthyvet.gov there will now be a blue button. Not only will you be able to see your data in the government application, which may or may not be a cool application. It may be lame. You can now push the blue button and download your

own data, or your family or loved ones with privacy protections built in, can then take it and present it to anywhere you feel more comfortable. So if you don't really want to visit mymedicare.gov because it's just not the way you want to engage, but you want to download that information and use it in another context, you will have that blue button. It'll be live this fall.

And last but not least, as I transition into the culture question, this president was very clear on having both a chief technology officer and a chief information officer to take a dual approach to the issue. One is essentially the chief technology officer HR position is really without portfolio. They're policy advisors to principles, either cabinet secretaries or to the President with a specific focus on external innovation that can be brought in and addressing our priority policy objectives. And we are recruiting people that come out of the entrepreneurial ecosystem. We have, for example, Todd Park, who had founded what is now one of the most successful health care IT companies, Athena Health. We're not competing financially, my man, with resources in the private sector. People are inspired to serve so they're coming in to new positions so that we could actually tap into their brain power. We have a growing cohort of innovation leaders throughout the administration run by presidential personnel to keep us together and to inspire and to recruit more. I'd say one of my top priorities for my job as CTO is actually to see Todd Parks in every agency. And that's something we're actively doing.

And I'll let Vivek say a few words about the rock stars he's bringing in on the CIO front.

MR. KUNDRA: Now, before I jump into that, you know, one thing we have to recognize clearly, ultimately the building blocks of innovation are people. And we face two challenges: One is a short-term challenge within the federal government, and second is a long-term challenge as a country. In the short-term, if you think about, you know, borrowing

the iPad versus the DMV analogy, working in the federal government in terms of getting the job itself was a DMV experience. That is why we've taken on hiring reform. And Director Berry is leading that at OPM.

In terms of the IT space, whether CIOs across federal agencies or more acutely this is a more serious issue in the cyber security space, we haven't been able to attract the top talent. And we're working aggressively and the President is committed to this as he talked about making public service cool again. And across the federal agencies what we're trying to do is make sure that we're bringing in the brightest people this country has to offer into public service. Whether it was making sure at the Department of Homeland Security. We streamlined the hiring process so you could make job offers on the spot. Or whether it was making sure that as far as the experience, in terms of coming into work day one, was far better than it ever has been before because that has a huge impact, long-lasting impact on moral. And then, of course, introducing game changing technologies, which is what inspires a lot of people to work on meaningful stuff that fundamentally changes the way this government operates.

The longer term issue that we're also investing in is making sure that as a nation we're focused on science, technology, engineering, and mathematics. That is why the Department of Education, Secretary Duncan, is leading the Race to the Top challenge with a focus on STEM with over $4 billion invested in that space. But we need to make sure as a country that we're investing in human capital, especially in STEM, so that we can educate the workforce of the 21st century to remain competitive in the global economy.

MR. CHOPRA: Wouldn't it be fun to work with the three of us? Now, come on. (Laughter)

MR. WEST: Well, it's been fun to be on stage with the three of you. And I like that line about making public service cool. That is a marketing campaign right there.

But we are out of time on this panel.

We're going to take a short, few-minute break to do the transition to the next panel. But I want to thank Aneesh, Vivek, and Phil for sharing your insights with us. Thank you.

SPEAKERS: Thank you. (Applause)

CERTIFICATE OF NOTARY PUBLIC

I, Carleton J. Anderson, III do hereby certify that the forgoing electronic file when originally transmitted was reduced to text at my direction; that said transcript is a true record of the proceedings therein referenced; that I am neither counsel for, related to, nor employed by any of the parties to the action in which these proceedings were taken; and, furthermore, that I am neither a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

/s/Carleton J. Anderson, III

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THE BROOKINGS INSTITUTION

IMPROVING SCIENCE AND TECHNOLOGY INNOVATION IN THE UNITED STATES

THE INAUGURAL A. ALFRED TAUBMAN FORUM

Washington, D.C.
Tuesday, June 8, 2010

PARTICIPANTS:

The Role of Higher Education:

RUTH SIMMONS
President
Brown University

EVA FELDMAN
Director, A. Alfred Taubman Medical Research Institute
The University of Michigan

PARTICIPANTS (CONT'D):

Issues in Innovation:

MICHAEL HOLSTON
Executive Vice President and General Counsel
Hewlett Packard

ROBERT BRAUN
Chief Technologist
National Aeronautics and Space Administration

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P R O C E E D I N G S

MR. WEST: Our last panel focused on public policy, and our White House advisors talked about the new initiatives that are being undertaken, but we know that much of the innovation actually takes place outside of government. And so our next panel is going to look at the role of higher education and innovation, and as part of this I am very delighted to welcome my old friend and former president from Brown University, Ruth Simmons.

Ruth is one of the most visionary leaders in higher education. Before coming to Brown she was president of Smith College, the largest women's college in America. She is a rare leader who can look around the corner and see where things are headed 5 and 10 years down the road. She is smart, thoughtful, and well respected all around the country.

She is the recipient of many honors, including a Fulbright Fellowship, the President's Award from the United Negro College Fund, the Fulbright Lifetime Achievement Medal, and the Eleanor Roosevelt Val-Kill Medal. And I should also point out over the last week she came down with laryngitis. Brown has its commencement last weekend, and you have to talk like for about three days in a row, and as a part of that she is now recovering I am pleased to report. But we're delighted that Ruth is here with us today. (Applause)

DR. SIMMONS: Thank you. Thank you, Darrell.

Good morning, everybody. Is it still morning? Yes. Good morning, everybody. Well, I have to say that I am really pleased to be here. I'm especially pleased to be here at the invitation of Darrell West because I can officially in this forum forgive him for leaving us at Brown. He was one of our most important faculty members at Brown and had a tremendous -- made a tremendous difference on campus. So I'm glad to see you in your milieu and to know that this is working so well for you.

I am delighted to see the Taubmans. Al and Judy, you have made such a difference in so many areas across the country. To be here at the inauguration of this effort is a great pleasure for me, understanding our friendship and the ways in which you have made such a tremendous difference.

I do want to say that when we think about the role of education in improving science

and technology innovation in the United States, I have to comment that the last panel is, I think, an enormously important evidence of why the United States even today, lagging as we do in the education of the number of scientists and technologists, why we continue to do well. And that is because the difference really is governance. That's why this program is so important.

I have an opportunity to talk with policymakers in many different countries around the world about this issue, and I have to say they don't have the forums that we have for this kind of discussion. I especially like the way that the panel, the last panel tried to explain to us the strategy that they employ and the way that they go about engaging the communities, the various communities in debating the issues, and I especially liked the fact that they're debating the issues.

You know, it used to be -- forgive me, those of you who are scientists and the enrollment used to be very hard to actually understand what scientists and computer sciences were actually saying and the fact that they were so articulate and doing so well impressed me. I have to say that I was really stunned. I was going to the University of Washington to give a commencement speech a few years ago, and I noticed that there was a young man at the carousel when I was picking up my bags staring at me, and he finally got up the nerve to come up to me and say, President Simmons, I'm so glad to meet you.

And I said, oh, are you a Brown student?

He said, yes, I am. I'm on my way to the University of Washington to see my sister who's graduating, and I understand you're going to be giving the commencement address there. And I'm very excited to hear you because this is the first time I will have heard you. I'm sure he didn't use the pluperfect tense, but he said something like, it'll be the first time I will have a chance to hear you.

So I said, very puzzled, well, how could that be? You're a student at Brown. I'm talking to students all the time. How could you not have heard me before?

And he said, very succinctly and very seriously, well, I'm a computer science major.

So, John, how do you like that? So they talk to each other, and it's wonderful to see them talking to us.

Now, I'm going to aim a little bit wider than higher education in my comment this

morning because I think the signs that the United States may be losing its innovative edge in the coming decades are apparent. But before we ask what to do, we should also look at the same time at why we are slipping and why we have slipped. And what is it that we in education can do to address the apparently waning interests among Americans in studying science and technology fields?

First of all, as we work with young people it's pretty clear that we have to find ways of capturing the interest and support of young scientists who are the most promising of their generation. Mentoring those identified as the best potential scientists is absolutely essential, and while this is something that depends on the quality of science education, of course, in middle school and high school, I'm focusing on the university part of this, and what should universities be doing to address the issue of attracting these young people to stem fields.

First of all, I think that universities can do an enormous amount by addressing lacuna of that come from inadequate education in the K through 12 sequence. We can do that more by offering programs to the most promising students. Federal and foundation grants, of course, often support outreach to K through 12, but it's really on, I think, too limited a basis. Should a larger concerted program by universities acting together to educate many, many tens of thousands of high school students each year be developed and coordinated? And how would we go about doing that, given the independence of all of our institutions, how would be build such a concerted program?

Of course, many of you probably benefited from a program like this in high school; I know I did. I had the opportunity to go to a math-intensive summer program, and coming from the inner city in Houston and being able to go to a university campus in the summer to do that was a pivotal experience of my young life. It encouraged me to think about going on to college and, certainly, studying more science and mathematics.

But we need a more consistent model than is afforded, I believe, by individual institutions deciding unilaterally to engage in this kind of program. And you'll see from some of the other suggestions that I have that I believe that, in fact, this is probably a very systemic program in higher education with regard to addressing this problem.

Brown faculty participate in a variety of K through 12 programs to enrich science

teaching in our K through 12 schools in Providence. For example, graduate students in geology work with elementary school children on science projects and teachers have training opportunities in the faculty labs. And this goes on in many, many different areas of the campus.

Secondly, I think that we need to address the curriculum. University science curricula too often serves as a deterrent to students who desire to focus on the sciences. Now, I know this is a very sticky issue for university presidents to address because there is nothing more sacred to scientists and mathematicians and engineers than their curricula. After all, they were trained a certain way, they were educated a certain way, and what was good for them must surely be good for their students. But the fact is, I think, we are at a very different moment in education, and we need to look very directly at whether or not the curricula that exists today are really the right curricula for the kind of future that we're facing.

There's one issue that I've long advocated is a particular problem for us. It's strange: I was advocating this 30 years ago; it hasn't changed much in the last 30 years, so it shows you my effectiveness -- I'm not having much luck at all -- the weeding out process that takes place often in math, science, and engineering. Is that really the way to capture the interest of all of the students out there who might want to major in these fields? I have long doubted that it is, and I still doubt today whether or not this is good strategy.

To what extent do students develop scientific interests in college without the needed high school preparation? If we rely on the foundation having been built by the time students reach grade 9, we again weed out a lot of potential scientists by cutting off the avenue for students to study science and to excel and innovate in these fields.

What of students whose high school don't even offer the requisite math level or physics, or other courses needed for advanced science and technology? Many, many schools do not.

I had a student who came to me at Brown who had been -- and he's such an extraordinary student, he had been admitted, and he was very embarrassed to say, you know, I really don't think that I can major in engineering because I really haven't had the right courses. Our faculty took him and worked with him, individually, to get him to the point where he could major in the

field that he wanted. But how often can we actually do that on a one-on-one basis? It's very hard to do.

With respect to engineering, Dominico Grasso and David Bartinelli have said that American higher education is in an unusual position to create a new kind of engineer, one for the 21st century. They argue that the new engineer has a kind of integrative background. They are able to indulge in holistic thinking. Their point is that this kind of integrated and a holistic thinking does not rest with increasing the number of the global engineering workforce, but rather, with engineers who go beyond solving problems through the application of math and science, which is the classic definition of engineering, solving math and science problems.

Further, the traditional engineering education model may continue to lose students unless we formulate a new engineering approach that is not based on manufacturing needs. If there's ever any evidence of there to hear the technologists talk in the previous panel about what the future is going to look like and try to relate that to the traditional engineering fields, and particularly curricula that we're familiar with, and you begin to see where that gap is.

The overhaul of engineering education is long overdue in my view, and universities that move to address this problem will be unleashing new possibilities for tomorrow's engineers as problem-definers as well as problem-solvers.

Now, one of the things that I did as president of Smith was to create an engineering program at a women's college. And part of the reason I did that was not simply to offer engineering to my students at Smith at the time but also to take advantage of the opportunity to innovate in the curriculum and to try to build an engineering program that really did something very different. Because what I posited from my own experience at Princeton and at Smith was that engineering loses a lot of students because there is a widening gap between what students today want, how they think, how they wish to innovate, and what the curricula actually offer them.

So to try to narrow that gap and to design an effective curriculum that will also retain and attract students, particularly nontraditional students -- I'll come back to that later -- was very important to do. And I had the help of the accrediting agency, ABAT, to try to do that, because ABAT has been saying for years that the engineering curriculum today is not needed for the kind of

engineering that we require in the future. And yet, it's very difficult to get universities to focus on something else.

Should we just focus on more financial aid directed to areas of national need? This is very controversial, but if the problem that we're having is dire enough, should we not contemplate at least breaking the paradigm that we currently employ? And what is that? Well, students in this country have virtually unlimited choice for the most part. They can go in their financial aid, is distinct from their area of focus.

We cannot compete with countries where they demand that students study in certain fields, and so if you're in most countries in the rest of the world and you're a student, you apply to a certain discipline, entry into a university in a certain discipline. If you are in this country, you apply to a university; then you have a choice. You can major in engineering or you can major in my favorite subject which is French. You have a choice, and you can move back and forth between -- but is that going to be realistic in the future? Should we organize financial aid around specific subjects and provide incentives for students to study these fields?

And, by the way, one fantastic thing that I see is that the most able students are capable of majoring in any field. They can do computer science, they can do engineering, they can do mathematics, and they can do many science fields. It is their choice. It's not that they can't do it, they choose not to. We have to look at the reasons they're choosing not to.

We have to provide more information to the public about the discoveries in science and technology. I was speaking to the group of women in engineering, and they asked: What could we do to encourage more women to study engineering?

And my simple answer to that is, well, you can be more excited about engineering yourselves. You do have to communicate to young people the excitement of a field. That's what enables them to visualize their own lives, their own careers, by understanding the excitement that you have for your profession. And so we don't see many examples of physicists who are really hip, really glamorous, really able to command the attention of young people today. Not many -- or any. So we have to get those images before young people.

Now, somebody mentioned in the last session this very important question and that

is minority students and women in these fields. We need more aggressive efforts to engage minority students in science and engineering. The demography of the United States today demands a different approach if we're ever going to continue to excel in innovative research. The overall enrollment of high school graduates and college has grown significantly since the '80s. Thank goodness for that. The major change in the makeup of college enrollment since then is the proportion of women and minorities in high education.

I don't understand why people don't get that. That is a major change in the last 40 years. In 2007, according to the National Center on Education Statistics there were 10,432,000 women in degree-granting colleges compared with 7,816,00 men.

Since 1984, the number of women in graduate schools has also exceeded the number of males. The proportion of students who are minorities has increased to 32 percent from 15 percent in 1976. So we identified decades ago the disparate interest in performance of women and minorities in science and technology, and while the profile of women's participation has changed somewhat in that period and is steadily improving, minorities still lag behind women. The holistic and inclusive approach may be the key to attracting an even greater diversity of students to science and engineering.

A significant number of minority students -- significant number of minority scientists and engineers are nurtured in smaller, more inclusive environments. Take the example of Xavier College in New Orleans, the number of African-American scientists produced by the sole college at the advanced level is telling, I think. And so again, programs that weed students out versus programs that nurture their continuation.

I think that the U.S. must remain open to attracting the best and brightest inventors, scientists, and innovators from around the world. This has been a problem for us recently, as all of you know. This means access in all categories of visa applicants: undergraduate students, graduate and professional students, faculty, researchers. We have to keep the flow of innovators and scientists coming into the country.

As you know, many of the most renowned scientists from our past have been immigrants to this country. We recently had a von Neumann seminar on campus, and Marina von

Neumann, the only child of von Neumann, was on campus and we were discussing this issue.

We recently had a von Neumann seminar on campus, and Marina von Neumann, the only child of von Neumann, was on campus, and we were discussing this issue. And her father was an extraordinary person in terms of the innovation that he led in this country, coming here as an immigrant and being welcomed as an immigrant and being able to create what he did as one of the founding members of the Institute for Advanced Study in Princeton is a remarkable thing.

We should never forget that we have to continue to do that if we're going to remain competitive. But attracting such scholars may become increasingly more difficult as political stability, research culture and academic freedom in their home countries improve. More recently, the outflow to other countries by leading nationalized U.S. scientists is a sign that our innovators are willing to consider returning to their homelands for less monetary gain, where there's a significant amount of support for their research. So a clear national strategy and commitment to funding is paramount to retaining these individuals.

Just to be controversial, my Vice President for Public Affairs is here, and she warned me right before I started not to be controversial, but here it is. Okay.

(Laughter.)

DR. SIMMONS: It's very difficult to break the current paradigm, but I think somehow with a large number of institutions, not all of the highest quality, being provided funding through the federal research process is ultimately perhaps going to be a problem for us as. As more universities expand their mission to research university status, resources could become even more diluted. Should this be addressed at the policy level?

I've been advocating more systematic sharing of resources across universities for at least 30 years, but I found this again to be very difficult as it rarely works to the financial advantage of institutions. Some funders insist on joint proposals. The shared institutional efforts tend, however, not to extend significantly beyond the narrow bounds of this kind of effort.

Incentivizing cooperation on a much broader scale could allow for more rapid development of new ideas. The Science Coalition Report linked 100 companies to federally funded university-based research, including Genentech, Google, Cisco, SAS, TomoTherapy and so on. On our

campus, such research funding has led to breakthroughs in brain science, and the development of a range of medical devices and therapies.

Policy should enable these developments rather than choke off their development. The calls for limiting the bureaucracy that discourages scientists from seeking funding are enormous. These calls are enormously important and should be heeded. Scientists complain of the bureaucratic burden associated with research today. Some wonder why are they bothering, actually. And some going to other countries recognize that by going, repatriating, they can dispense with the bureaucratic burden on their research.

Universities are under increasing pressure from agencies and Congress to comply with burdensome changes in policies and guidelines. This is something that we are trying to mitigate, but it's very, very difficult to do.

The competitive global environment is something we should pay a lot of attention to. Universities in the developing world are rapidly developing policies that allow for increased competition with U.S. universities. They are restructuring compensation, increasing required output for faculty and researchers, and building state-of-the-art facilities to support advances in research.

It's chilling every time I go to China and India to hear what they are doing contrasted with what we are now doing. The liberalization of education in China and India are examples of the aggressive efforts to bring American-style creativity to large rote-based systems. And if you think we're having difficulties with innovation today, just wait until they've reformed their systems. Just wait.

So what are they doing? I was recently in India, meeting in Delhi with their equivalent of a Better Business Council, and the questions they had really had to do with: We've got a rote system. How do we deconstruct the system and rebuild it on the American model? We want innovation. We want scientific advances. How can we do this?

China is doing exactly the same thing -- building. There's a new initiative in China that's coming -- I think it's not announced yet, I'm not sure -- where the Chinese government is sponsoring a certain number of institutions that are innovation directed, and they are being built

on the American style. I met with one of the university presidents a couple of weeks ago, who is in charge of doing one of these institutions, and his whole approach is to bring the liberal arts tradition to this university, so that they can build more innovative work.

These are some ideas that I think will make a difference if we can consolidate our efforts. I do believe that we have the capacity in this country if we take radically different measures, to increase significantly the number of students in STEM fields. It would take the mandate from the government to have universities redesign how we are admitting students, redesign how we are designing our curricula, in order to facilitate retaining more students, bringing more students into STEM fields and retaining more students in STEM fields. And I think short of that, we will continue to go along at very modest levels, and we will be overwhelmed by that tsunami out there which is truly a tsunami.

Recently, I was visiting IIT Bombay, and they were on a very aggressive building program, new buildings everywhere. When I inquired what was going on, they said the government had mandated that every IIT must double its enrollment within a very short period of time. That's how massive the effort is in India. It is massive similarly in China, and there will be other countries, like Brazil that is certainly growing in economic strength and beginning to consider what they need to do. So this is coming to us, as I say, like a tsunami.

I just want to give you an example of one person, and then I'll finish, on the Brown campus that is indicative of what can happen to encourage students to remain in science and technology. We have a minority faculty member at Brown who has received a presidential early career award, and he has an enormous number of honors as a young scientist. I'm not going to give his name because I don't want him to be poached, like Darrell was.

(Laughter.)

DR. SIMMONS: This young man was educated in a small college -- educated, mentored and nurtured in a small college before going on to graduate school. In discussing his success, he mentions the mentors he has had as crucial factors in his career. He has been working at the edge of a number of fields, and he leads one of our research initiatives. In a recent interview, he said, we need as many great minds as possible.

Fundamentally, this issue of innovation is about that. We need as many great minds as possible. As the lady said earlier, with all the women and minorities entering college today, who knows if that number will grow? If we don't begin to focus on a curriculum that appeals to this new demography, if we don't begin to focus on structuring our financial aid in order to draw them into these fields, if we don't begin to think about across universities, linking arms and committing ourselves to doubling the number of STEM majors in a finite, reasonable period of time, we are not going to have a chance of competing. And so that would be my thoughts.

Echoing this young man's thoughts, I would say we need to focus on developing more of these great minds, with focused and concerted efforts across institutions.

I'll stop there, and thank you.

(Applause.)

MR. ANTHOLIS: Thank you, Ruth. We really appreciate your honesty in tackling a number of tough issues.

But I'm not sure what is going to be more controversial out of her remarks. She called for the need to break current paradigms and redesign curricula, but then she also proclaimed that physicists are not hip.

(Laughter.)

MR. ANTHOLIS: Now I know some of those Brown University physicists. It's going to be hard for them not to take that comment personally. But we do appreciate your thoughtfulness in addressing all of these issues.

We're also please to welcome Eva Feldman with us. Eva is one of the most distinguished scientists in America. She is the Russell DeJong Professor of Neurology at the University of Michigan. At Michigan, she also directs the A. Alfred Taubman Medical Research Institute. So you're starting to see the theme of this forum here.

I talked with her yesterday. She is doing amazing work on stem cells and Lou Gehrig's Disease in particular. So please join me in welcoming Dr. Feldman.

DR. FELDMAN: Thank you very much. I really have the pleasure today of discussing with you a building block of medical innovation, and that's the A. Alfred Taubman Medical Research Institute.

So I'd like to begin by showing you what the mission of our institute is. It's to provide the University of Michigan's finest medical scientists -- so the minds, as Dr. Simmons just said -- the freedom, resources and collaborative environment they need to push the boundaries of medical discovery, to produce breakthroughs and cures and treatment of disease, and ultimately to alleviate human suffering. Truly, as you will see, I think a building block of medical innovation.

This institute was launched in the Fall of 2007 at the University of Michigan Medical School and was funded by a very generous endowment from A. Alfred Taubman, the sponsor of today's forum -- a true entrepreneurial spirit of science, a true philanthropist who understands that what scientists require for medical innovation is to have funds that are unrestricted, that will allow them to begin to broach the major questions in medicine. And he's here today with his absolutely wonderful wife, Judy and his daughter, Gayle Kalisman who chairs the Taubman Foundation.

As I indicated, the monies that the Taubman Institute has used is funding minds, again as President Simmons said, minds with ideas for medical innovation, with the idea that we will drive medical research and drive medicine towards cures.

The institute supports physician scientists with active clinical practices. I'm an example of a physician scientist. I spend three half-days a week seeing patients and the other seven half-days a week, which is how we divide our world; I am actively in the laboratory, doing science. So we are the foundation of this institute, and we are driven to be innovators really by our patients. Our patients give to us the passion to understand disease and to develop new treatments in our laboratory then to carry forward.

We fund, again in the institute, a wide variety of diseases, and we invest in the person and the idea, and we do concentrate on very innovative translational research. We provide funding; also I think it's important, for the very difficult last steps that innovators encompass when they want to take an idea from the bench to the patient.

So let me tell you a little bit about the success of this approach since in the last three years this institute, the scholars in this institute, have produced 122 publications in leading scientific journals. But more importantly than the publication record is that the risk, the challenge has been met, and we now have five clinical trials due to the unrestricted funding of the institute.

Three clinical trials are targeting human cancer stem cells. Indeed, the first clinical trial targeting cancer stem cells in breast cancer is being done via the institute by Dr. Max Wicha, the director of our cancer center. And if Max was here, he would tell you it was that investment allowing him to innovate, take that risk and challenge as a clinician scientist. It wasn't a sure bet at all, but that investment, that risk, that led to these clinical trials.

Dr. Valerie Castle, who is Chair of Pediatrics, is also in the Taubman Institute. She is a Taubman Scholar. She took the high risk of trying to treat resistant childhood cancer neuroblastoma with a new therapy, and the risk won, and she now has the first clinical trial looking at chemotherapy-resistant neuroblastoma.

And I would like to tell you today about my own clinical trial, and that is the first human clinical trial of direct intraspinal injection of stem cells in Lou Gehrig's Disease. I'd like to tell you before I begin that every piece of this story was funded by A. Alfred Taubman and that without, again, the entrepreneurial spirit of wanting to seek out innovative high-risk, high-reward medical research what I'm going to show you today would not have been possible.

So here is Lou Gehrig. He, of course, was a very famous baseball player in the 1930s and actually probably considered to be one of the best baseball players ever. But he noticed in the thirties, in the mid-thirties he had a spectacular year, and then the next year, as you can see, his frustration; his batting average began to decline. Indeed, he was getting a lot of bad press, and this is the last time he ever swung a bat, and he took himself out of the game at this point. He went to the Mayo Clinic where he was diagnosed by a University of Michigan trained physician with a disease that now carries his name, Lou Gehrig's Disease.

As a sideline, I will tell you that the transfer of information, medical information between University of Michigan and Mayo Clinic, which happens frequently, has not really changed except for the fax machine, since the 1930s -- so, a point that we discussed earlier.

Here, I thought you would find of interest. Here's the analysis of Mr. Gehrig's batting averages on a week-by-week basis. So you can see how well he did in 1936 and 1937, and here is his average in 1938 when he pulled himself out of the game.

And I'd like you to notice and look at his arms. You can see the profound wasting that he had in his arms due to the disease that carries his name.

So what is this disease? Well, what happens in this disease is the large nerve cells in the brain and spinal cord degenerate. What I'd like you to do is pretend that I have just cut myself in half here, and you're looking down on my spinal cord which is shown there in the upper right-hand panel, and you can see the large purple cells there with the arrows. Those are the large motor neurons in the spinal cord and the brain.

What happens in this disorder is that they slowly degenerate. Because those large nerve cells then have the nerves that connect to your muscles, the muscles then lose their ability to move. Eventually, people lose their ability to speak, to swallow, to breathe, and they eventually die.

Currently, the longevity of an individual diagnosed with Lou Gehrig's Disease today is no different than it was the day Lou Gehrig was diagnosed.

So our approach was to begin to try to use the new idea of stem cells for cell replacement therapy in Lou Gehrig's disease, and we developed this with a colleague, a surgeon, Dr. Martin Marsala. Here, I'd like to show you our idea.

So here now is the normal spinal cord here, and then in the middle you see a spinal cord, a depiction of a spinal cord with Lou Gehrig's Disease, with all the diseased cells.

Our idea was then to use cell grafting of stem cells, a new technology to directly place stem cells into the spinal cord of a diseased patient. But of course we could not begin with a patient. So we began with an animal model of Lou Gehrig's Disease, which we helped developed, and that is the Lou Gehrig's rat. We took the human gene for ALS. Ten percent of people who have this disease have an inherited form. It was placed into a rat, and the rat actually duplicates the human disease.

What I'd like to show you here then is the approach where we remove the bones from the spinal cord, so we have a clear vision of the spinal cord, the rat's spinal cord. Here, you can see the depiction where we would then inject stem cells directly into the spinal cord.

What we found -- and here's an example where we label the stem cells green -- an innovative idea to see how they would grow in the spinal cord. Here, you see the beautiful growth of these green stem cells in a spinal cord of a diseased animal, and indeed what you can see is that these green stem cells become nerve cells. They begin to put out the beautiful projections of the nerves. And what they do is they attach to the diseased -- those diseased nerve cells in the spinal cord, and allow them to remain healthy.

So, we're extremely excited about these results because we were able to show that direct stem cell injection in an animal model, allowed for preservation of function in the animal model. But, of course, we can't go from a rat to man, so we needed to use science and technology to develop a way to approach a larger mammal and we did that using the mini pig. And what we did is we developed a device as a group using, really, engineering to develop a device to stabilize the spinal cord. And in 3A what we're seeing here -- what you're seeing here is the device we developed that stabilized the spinal cord of a larger mammal, in this case a pig. And then we injected stem cells labeled with ferritin, again using technology and engineering, so that we could visualize the stem cells using imaging, MRI. And so what you see here in B is an MRI image, which you can also see in A, of the ferritin-labeled stem cells. So they survived in the spinal cord of a large mammal. And what was also very important is that not only do these stem cells survive, and they actually look quite similar to those stem cells I showed you from the rat, but that the pig actually did very well with the surgery. And here's an example of one of the 40 pigs that we needed to do in order to take this technology into man. And this is 6 hours after surgery and the thing the pig is most interested in is eating because this pig had to be what we call NBO, nothing by mouth, before his surgery.

This then led to -- from an idea to a rat to a pig to man. And the A. Alfred Taubman Medical Research Institute in collaboration with a small biotech company, Neural Stem, and our colleagues at Emery University, have begun the first FDA Phase I clinical trial using stem cells in the treatment of Lou Gehrig's disease. Initially, the patients we are entering had very severe weakness

and they continue to be relatively severely weak. Progressively, as we enter patients in this trial, they are going to be less affected. Initially, we did unilateral injections of stem cells on one side of the spinal cord. We are going to proceed to do bilateral injections.

And as you can see then, on the diagram to your left, you see really a depiction of our idea of direct injection of stem cells into the spinal cord. So, what we had done in the animal model, and we had shown safety in the large mammal, it was now time to take it to man.

So in my mind, this is really the medical innovation. This is taking an idea, as a clinician scientist, from what I did in my laboratory to a patient.

In order to know where to exactly inject the stem cells, we needed to call upon our radiology colleagues and our engineering colleagues, and we've used MRI to locate the exact area. I apologize that I don't have a functioning pointer so I'm going to step away for a minute because I want to show you something. And I can project, I have three teenagers.

So, I want you to see that, again, this would be if I was standing like this -- excuse me, like this, towards you, okay, so this is your vertebral column and the white here is your cerebrospinal fluid. That's the fluid that bathes the spinal cord, but the black that you see there, that is actually your spinal cord. This is exactly how you or I would look. So what we need to do then is actually get the dimensions of the spinal cord in man so that we can properly inject.

And here you see now a cross-section of that where, again, we've now measured the dimensions of the cord and, again, the dark area -- the dark area here, then, is where we will inject the spinal stem cells. But again, this was an innovation in order to use MRI to measure for injection.

Here is a picture taken in the operating room of a patient, and I'm going to actually show you a video of the patient. The surgeon here is Dr. Nicholas Boulas. He is the one wearing the M, for Michigan, cap. He is a neurosurgeon trained at the University of Michigan, who then worked in my laboratory as a fellow. He is an active clinician scientist, also, so -- and he's been very involved in working with the engineers to develop the correct stabilizing device needed for this surgery.

And here is a picture of Dr. Nick Boulas, and our other colleague at Emery

University is Dr. John Glass. Why Emery and not Michigan? Because Dr. Boulas currently is practicing at Emery and he was the surgeon that trained with me, that helped me develop these technologies, and I wanted his surgical hands to be the hands that did the first patients. And he also is the person who for the Taubman Institute we did the pig work with.

So, here I'd like to actually show you what the surgery looks like. So, this is the patient's spinal cord -- and again, I'm going to step away from the microphone -- so this is actually the spinal cord now. We've removed the bones. This is like a large blood vessel in front of the spinal cord. The silver on the side is the device we've developed to stabilize the spinal cord because as we're injecting, you know, the patient is breathing so we need to stabilize the spinal cord. Here is also a device we developed, and that was a -- we developed a rigid injector with a very thing stylus tube inside so we could find the correct -- again, using MRI -- the correct place to place our stem cells, and then we put the very thin stylus into the spinal cord.

So, this is the actual -- I took this movie in the operating room to share with you. What I'd like to do now is share with you the patient.

(Video played)

MS. FELDMAN: So, I want to thank you today for sharing with me what I think is really a building block of medical innovation. And as I was hearing today about President Obama's STEM Initiative. I think this is actually a very good example, stem, of course, for stem cell, but also, S for science, the science of stem cells, again funded by the entrepreneurial, high-risk, high-reward investment that is mandatory if we're going to have medical innovation. And again, I think the investment needs to be, in part, in clinician scientists who have the passion to take their discoveries into the clinic. For the T, in terms of technology, we had to develop the technology to do the intraspinal injections. E, for engineering, we had to engineer that platform that was pivotal in allowing us to do these injections in man. And M, for me, M, I think, is more mission, medicine, and I'll have to be honest, Michigan. Thank you so much. (Applause)

MR. WEST: Well, Eva, that was an amazing presentation, just kind of seeing the progress that that patient was able to make and the amazing way in which you were able to present that. I mean, that really is extraordinary, so our hats off to you for that. And it's interesting just

watching that both from a science standpoint as well as from a policy standpoint. The science, obviously, is starting to progress in a very impressive manner, but then we have all these policy issues associated with that type of research as well, and so it'll be interesting to see how those things develop.

Our next panel, I'm going to introduce Michael Holston, who is the executive vice president and general counsel at Hewlett Packard. In that position, Michael Managers HP's global legal functions and the company's compliance, ethics, privacy, and government affairs offices. Before joining HP in 2007, he was a partner at Morgan Lewis focusing on complex civil litigation and white collar criminal defense litigation. He is a former Assistant U.S. Attorney for the Eastern District of Pennsylvania, and he also is a fellow in the American College of Trial Lawyers.

So, we'll hear a little bit from Michael on some legal issues in terms of technology innovation. He is on the front lines of those types of issues.

And then after we hear from Michael, we will hear from Rick Howard, who is here with us. Rick is the deputy chief technologist of the National Aeronautics and Space Administration. In that position he serves as an advisor on matters concerning agency wide technology policy and programs. He has served in the past as deputy of the astrophysics division, but when Ruth made her comment about physicists not being hip, I told him not to take that comment personally as an astrophysicist. We think you're hip which is the reason we invited you here. He also has served in NASA's Office of Space Science. He's worked in the NASA headquarters since 1991, and so he'll be telling us a little bit about the innovations that are taking place at NASA.

So, with that I will turn the panel over to Michael and then we will hear from Rick. Michael, thank you.

MR. HOLSTON: Good morning. It's great to be here with such a tremendous group of panelists and speakers today. I'm going to follow up on a theme from Ruth this morning. If physicists are not thought of as hip, lawyers probably aren't your first thought for innovators, and to come behind Eva Feldman's presentation, I think, will underscore that point all the more.

I would just like to -- that was just spectacular. What I just saw there was amazing and I'd like to thank you and congratulate you for that work. It's just wonderful. (Applause)

What I'd like to talk a little bit about this morning is privacy and, to a smaller degree, cyber security, and their relation to innovation. I think probably my guess is everybody in the room has one of these with them. And if I asked everybody in the room who had one to raise their hand, we'd probably get 100 percent. And if I asked you how many people in this room felt 100 percent confident that their information was secure on that device, I think probably all the hands in the room would go down.

It's an issue that we struggle with at HP, and I'd like to talk a little bit at the end and then maybe on the panel we can talk some more about how we're tackling some of these issues. But really what I'd like to talk about today is technology and trust and how they converge to create issues for -- and opportunities for innovation.

We're living in a time, frankly, where our dependency on technology is growing every day. We're also seeing continued blurring of the lines between our business and our personal lives. There's a trend towards moving IT outside of the organization and into the cloud, and expanding interconnectivity of devices and people and an increase in expectations of organizational accountability for the risks that are being created. The new applications, the business models and techniques that have emerged with the Internet provide tremendous benefits to consumers and are critical to economic growth and prosperity, yet these same innovations create new issues for privacy and cyber security.

Last month, the University of California-Berkeley released a study showing that while participation in social media continues to be strong, more than half of young adults are more concerned about privacy now than they were five years ago. This means that for the first time, there's little difference across the age groups about online privacy concerns. The so-called tell-all generation, or the live out loud generation, is starting to change their minds and catch up, maybe, with the rest of us.

The Berkeley study shows that more than 88 percent of 18- to 24-year-olds agree there should be a law requiring websites to delete information stored about them, and 62 percent said they wanted a law that gives people the right to know everything a website knows about them. These trends signal, frankly, an erosion of trust and create a compelling challenge as we work to

balance innovation and the protection of data and individual rights. We have to get smarter and we have to ensure that we can provide meaningful protections.

As more and more processes and interactions shift to online transactions, there's a major trend toward devices and applications that are connected to each other and to the so-called smart grid. In a recent meeting with the privacy in cyber security community, Commerce Secretary Gary Lock sited research that global online transactions are currently estimated to total $10 trillion and by 2020 they will exceed $24 trillion. This is transformational not only in size, but in how we use technologies and the Internet. Cloud computing will become the central nervous system of this new, interconnected world. And as power as this interconnectivity is, it brings complex issues for innovators, for regulators, for users, and, frankly, for national security. The challenges in privacy as evidenced by recent studies show the need for new ground rules and frameworks that respect the legitimate rights of individuals.

Current laws and regulations struggle to keep pace with the new forms of data collection, use, and storage. This is one of the reasons we're seeing proposals for new privacy laws around the world today. In the United States a draft privacy bill was recently introduced and in Europe, EU Commissioner Viviane Reding has promised a redraft of the European Directive for privacy by the end of the year.

In both cases, they're trying to address the new challenges that come from Internet-based global economy with a focus on online tracking, data collection from sources other than the individual, consent processes, improved transparency, and permissions related to data use.

Given the length of time it takes to enact or revise such laws, legislative solutions invariably will continue to lag behind the next innovation or business model being adopted by consumers.

For instance, new data from the Pew Research Center shows that the share of Internet users that have reconnected with someone from their past using a social network now stands at 40 percent, doubling in less than 3 years. Individuals are placing more and more content about their personal lives, relationships, and interests, on the Internet. Many do not realize their data can often be accessed by just about anyone and everyone.

The June issue of *Consumer Reports* featured a story titled "Seven Things to Stop Doing on Facebook." They included using weak passwords, leaving your full birth date on your profile, overlooking privacy controls, posting your child's name in a caption of a photograph, mentioning that you'll be away from home, and letting search engines find you. The fact that these behaviors are prevalent highlights a lack of consumer understanding as well as the unanticipated effects that can result from new technologies.

But we've also seen a failure on the part of industry, frankly, to anticipate such issues. It's almost impossible to miss news articles about privacy or security concerns, and large and well-known companies frequently are in the spotlight. In two recent examples we find incredible innovation being delivered and adopted by consumers worldwide, but we also see illustrations of the unanticipated issues I've just mentioned.

In one case last month, privacy regulators came together in a joint letter and press conference to denounce a company's practices. They acknowledged the company's innovations and many accomplishments, but communicated an increasing concern that too often the privacy rights of the world's citizens are not being adequately addressed. The regulators referenced a social networking application where holders of e-mails accounts had their contact information automatically populated into their social network. They went on to say it was not the first time the company had failed when launching new services. In the letter and the press conference they called on the company and other organizations to incorporate fundamental privacy privileges and stated a minimum set of expectations. The letter was jointly signed by 10 leading regulators across all regions of the world.

While in this example the concern primarily came from regulators and advocates and NGOs, if we shift to recent Facebook concerns, we see more backlash on the part, frankly, of consumers. Last Monday, everyone knows, was Memorial Day. But for those of us in MySpace, we also knew it as Quit Facebook Day. And judging by the numbers of people who participated in this national movement, it could be viewed as a failure. Less than 50,000 users out of more than 400 million quit, but the fact that 50,000 people quit and national and international press covered the topic is significant and something not to be ignored.

The controversy was stirred by recent Facebook changes that included driving users to share more content publicly and making certain profile information publicly available without, in the view of the consumers and some regulators, adequate privacy controls. The negative publicity that resulted forced Facebook to modify their privacy controls and hold a press conference to reassure users.

In both cases, and maybe we can talk more about this on the panel, but, frankly, the biggest issue that we see is the gap between consumer awareness of what's happening and the protections that are out there. Traditionally, these kinds of gaps have been filled through education and industry self-regulation. But regulation -- but education is, frankly, sorely lacking in this area on the part of most consumers, and most self-regulation attempts have been seen as failures by the public and by some regulators.

As consumers, advocates, and regulators become more aware and more concerned about these issues, organizations will need to do more to consider the privacy risks that they create through their innovations. New organizational accountability frameworks are emerging that set expectations for companies to design privacy enablers and risk mitigation into every stage of product development. It's often referred to as "privacy by design." At HP we've put a lot of energy into working with regulators, other companies, and consumer advocates in the development of these new frameworks, including working with the binding corporate rules in Europe and cross-border privacy rules in Asia. And it's, frankly, been a fascinating work at watching cross-functional development where my privacy team of experts and lawyers, working with software engineers, to develop tools that can be used by our engineers at the time they develop the product to ask the questions that force people to take into account privacy rules and privacy concerns at the time the product is being invented and developed.

So, to avoid the situation where a product is invented and developed without regard to what the implications may be to people's privacies and to try and think about those issues and take those things into account at the time of creation of the product, to hopefully not stifle innovation, but, at the same time, take into account the very legitimate and real concerns that people have for the privacy of their data.

The internal program in technology that HP has created integrates the privacy operating model into an end-to-end program to better guide our employees about privacy requirements, risks, and considerations. It's meant to hold every one of our employees accountable for privacy and data protection. By using technology to engage employees and provide them with guidance for their specific program, we're better positioned to ensure they think about privacy in the right context and at the right time.

Let me turn for a second, I said at the beginning privacy is not the only issue that arises from innovation, our ability to keep data secure is growing in complexity and cost while threats and risks are, frankly, increasing dramatically. There's significant pressure on companies around the world to cut their IT budget as is evidenced by the attractiveness of cloud computing to many organizations, especially small- and medium-sized businesses. It's making it harder to justify new expenditures in security and yet the expanding threats to information security cause us to need to do more. The answer is to spend our money, frankly, in a smarter way and technology is needed to help us do this.

In Symantec's recent 15th Annual Internet Security Threat Report, there are some disturbing trends that I think go to the cyber security issues. Malicious activity and cyber attacks are increasingly flowing out of countries where broadband and IT penetration is growing the fastest, so think Brazil, think India. Second, advanced, persistent threats focused on large enterprises are becoming more common as thieves seek customer data, financial information, and intellectual property assets.

I can tell you that a large, multinational corporation will face more than 10,000 attempts a week to penetrate its firewalls from hackers trying to gain access to the data. So when you think about the offense that's being played, there is a true concern, I think, that we continue to develop security and that we continue to push organizations to force them to use that technology and to spend the money to protect the data. It's not just great to use the money to develop new technologies to advance the business, but we need to develop the technologies that protect us. There is an entire industry that exists for the purpose of getting that data and profiting from it, and when you think about the dollars being spent on the Internet and you think about $10 trillion being

spent today on the Internet, there's not an addressable market out there that looks more attractive to anyone. And so these issues are, frankly, something that need to be taken into account by organizations throughout the world of all sizes that are dealing with people's personal information.

The last one I'll mention is mass market attacks, like phishing and viruses, continue to evolve in their sophistication. This is an arms race with both sides escalating on a regular basis and, frankly, the attackers are just as sophisticated as the defenders. And with the ever-increasing power of IT and the sophistication and skills of cyber attackers, we need to apply more science, more innovation and technology to security challenges in the interconnected world.

The traditional view of security management has been very siloed. The assessment of risks, policy decisions, deployment of technologies and monitoring is not always done cohesively and can lead to significantly increased costs, but even more important significantly increased vulnerabilities. If we focus on an integrated life cycle view, we can better consider the risks, the tradeoffs, and strategies that will mitigate the security threats and vulnerabilities facing us. It also allows us to be more nimble, predictive, and responsive to the changing threat landscape.

Unlike privacy, we have much better guidance for security expectations from laws and industry standards, but we have to ensure that the principles and guidance transcend technologies. Accountability and security by design is just as important as privacy by design. The "what" that needs to be done is not changing, but the "how" is changing rapidly. The protection of data remains critical and we need to apply some innovative spirit and use new products and services to keep data secure in these environments and against these new threats. We need concepts that make our infrastructure smarter and give it the characteristics that we want, including the ability to react quickly and maintain business continuity.

What is common, frankly, between privacy and cyber security issues is that innovation is generating new risks as well as expectations for increased organizational accountability, but with all of these challenges and issues come huge opportunities to be smart about technology innovation and to strengthen trust. If industry does not focus on both, trust will erode and consumers will react negatively and regulators may have to step in. And frankly, this almost certainly will stifle innovation and growth.

So, I think there are tremendous challenges out there and I don't want to underestimate the work that needs to be done. But I do believe that if we can harness our collective capabilities and work across industry, governments, and consumer advocacy organizations, I think we can find solutions that will promote innovation at the same time as providing meaningful protections to everyone.

Thank you. (Applause)

MR. HOWARD: Okay. I guess we're not going to use the big screen up front, just the two side screens. Oh, it's coming down right now. All right.

While the screen is coming down, I did not take any offense at the comment about physicists, mainly because my background is astrophysics. And as Ruth pointed out to me, astrophysics are a little bit special. So, given that, I want to talk to you today about a new exciting direction that the administration has put into the FY '11 budget for NASA, for both human and robotic exploration. And I've got a package here that's available actually on the website -- our NASA website, if you want to look at it later on. It's got more charts in it than I'm going to actually talk to, but it's good background material. It's at nasa.gov/offices/oct, which is the Office of Chief Technologist.

So, with that, I'll talk a little bit about the budget that the administration has released, the FY '11 budget: top line increase of $6 billion over 5 years. That is a significant increase in NASA's budget and in an environment and era where a lot of agencies are struggling just to maintain. There's a reason for this and it has to do with the increased emphasis on science and technology and innovation and a change in direction, as I said, on expiration.

Increase in the science area is primarily in the Earth science arena to be able to do more global monitoring and get submissions that are high priority in the decadal that was just published a year or so ago, started and up and taking data. It reverses a direction that was not a good one on aeronautics, modest increase, but still an increase, and then this shift in exploration. The goals remain the same, but there's additional money for flying the shuttle flights out; extending the International Space Station through 2020, which we are looking at to maximize the utilization of this asset that we have, this national resource that we now have; rough 2020 for research in all areas, not just in NASA's interest, but in other areas -- National Institute of Health, for example --

access to commercial -- commercial access to lower Earth orbit is being worked; and a few other things there that I won't talk about right now.

The main thing I'm going to focus in on is the technology development that is refocusing activities both in exploration area as well as in a new program with a renewed emphasis on technology and innovation. Part of this, as I said, is the human exploration strategy, and then there's this new space technology program which is almost $5 billion over 5 years. That includes about a billion dollars of existing program content in the Innovative Partnership Program, which is where the small business of Innovative Research Program is, for example.

Okay. The path for human space exploration is, as I said, this renewed emphasis on technology. The approach here is not to just go to one place, go to numbers of places in the solar system for exploration, preceded by technology development and precursor missions -- robotic missions and human missions -- that try out new technologies, new approaches, new paths, to come up with more affordable ways to accomplish the objectives and goals of our human exploration initiative.

A lot of these things that you find in our technology area are not new. These are things that have been around for the last 20 years or so as critical areas of technology development that need to be invested in, in order to be able to afford and do the kinds of missions that NASA wants to do as far as space exploration, both robotic and human exploration. So this is just a mapping that sort of shows you that, you know, it's not that this was just invented last year, this has been around for a while and it's now finally being addressed with this new emphasis on technology.

Just as an example of how hard this is, and it's not easy to do, if you look at this chart, down here in this corner over here is what they call the Design Reference Mission V, which is one of the design architectures for getting man to Mars. Where we are today is if we had to do that today with current capabilities, we'd have to launch into low Earth orbit 12 times the mass of the International Space Station. That would take a little bit of time, a lot of money, and it's a huge effort to even think about trying to do anything near that in today's environment.

However, with significant advances in technology development and cryogenic boil off of cryogenic propellants that we need to take to orbit and then use that to get onto Mars, in air

capture and ways that we enter the Mars atmosphere and find landing places, close loop life support systems for the astronauts that are up there, we are hoping that we advance these technologies and go into some new innovative approaches; that we can get down to where this is much more realistic, closer to something on the order of a couple of times the massive International Space Station as to what we would have to get into low Earth orbit in order to get a man to Mars, safely there, explore, and then come back.

So, it's sort of a three-phased approach. We're starting now with this building the foundation. This is commercial sector becoming more involved in access to space and providing capability to deliver payloads and experiments to the space station and to other places eventually. The precursors -- robotic precursors need to be done to find out what you need to do to learn before you can go send humans on to other places in the solar system, and game-changing technology development, I'll talk about that little bit more.

Phase 2, of course, as we get on to this is design and build those capabilities that we need to be able to do that. And then Phase 3 is actually send the human explorations off to other destinations and not just be in low Earth orbit around the Earth.

So, this is just another way of portraying it. The potential destinations, again, it's not just focused on low Earth orbit, it's not just focused on the moon. It's other places also where we want to try and reach out and explore, understand things, expand man's awareness and involvement with the rest of our solar system, and also, you know, start looking for in situ utilization, what we can do there to maintain sustainability on another surface than the Earth.

There are common capabilities we have to develop, there's technologies that have to be developed, building blocks that go a long way. I've talked about some of those. Breakthrough technologies is a different path, and I'll talk about that in a second, but things like hypersonic inflatable air shells; revolutionary Earth-to-orbit launch capabilities or rockets; things like using nano-propellants, which is something which we've just started looking at over the last five or so years.

So, the value of robotic precursors, I think everybody knows all the success from the Mars missions that we've had and the other missions to the other parts of the solar system. These robotic missions clearly are needed in order to be able to see what resources are there that we can

utilize. This is an interesting picture taken high resolution from one of our orbiting satellites around Mars where what we have found is even at the mid-latitude regions on Mars; 43 degrees north latitude, for example, there is somewhere between a half-meter to a meter of ice, and it's pure water ice, beneath the surface. You look at recent, very fresh craters that we've seen, which we have evidence that there wasn't a crater and then all of the sudden there is a crater. So we see a crater and we can look at it. And you see this ice there popping up in the images and then it quickly, over a period of a couple of weeks, several weeks, sublimates back into the atmosphere, so it is there. And what this points to is the value of robotic missions to find this kind of information out and offer up the potential that these resources may be utilized, strongly can be utilized for in situ utilization by colonies and exploration missions to Mars.

As I said before, this is not -- a lot of this is not new and not surprising. It's been things that we've been trying to do for a number of years. More recently, there's been a number of reports coming out focusing very much on the fact that NASA has -- especially the second bullet there -- has gotten itself into a situation where it has done basically incremental gains and sort of what I would call enhancements in technology areas rather than leaping into new, innovative ideas, things that are completely game changing as far as how we would approach something, what we call disruptive technology development; and that NASA has gotten over the last 5, 10, 15 years into more of a mode of doing incremental capabilities and not putting the seed corn money into technology innovation, early ideas, and maturing them, and then having them infused into the mission lines.

So, within NASA there was established an Office of the Chief Technologist back in February. There are several main goals for this office. The chief technologist is the principal advisor to the NASA administrator on all things technology in the agency. The footnote at the bottom, the little bullet at the bottom, all things in the agency, yes, we are responsible for advising the administrator on that and knowing what's going on across the agency and establishing a portfolio and a roadmap. But also the mission directorate, the science mission directorate, the exploration mission directorate, aeronautics, and the operational space operations, which runs the shuttle in the space station program, they have what we call mission-focused technologies. They have specific goals, specific missions that they're going to be going after, that they have technology plans for as

part of their missions. The Mars program is a good example. They're doing a number of things getting ready for the next Mars missions beyond the next couple we're going to launch in the next few years.

So, they continue to do those activities. This program, third bullet there, is the space technology programs, and this is really to look at things that are cross-agency or what we call cross -- multiple use. More than one mission directorate is interested in it. It doesn't have to be another mission directorate, it could be another agency. Another agency in the government could be partnering with us on an activity that is of interest to both NASA as well as another agency; could be industry, could be commercial space. So, it's just -- the real keyword is more than a single user.

One thing I'm going to get back to and this has to do with the concerns of issues concerning innovation that we have that I'll talk about a little bit later on, and this is the fifth bullet on here, and this is the culture towards creativity and innovation. And this is not just in the NASA centers, it's across the entire board, and I'll talk a little bit more about that. But that is a major change in direction that we need to address in order to be able to take these leaps, take these chances, try new things, allow failure to happen, and accept the fact that failure is not a failure, failure is you've learned from all that information that you got to that point, it's time to terminate, stop it, and then move on with something else and that's perfectly fine. If you don't take those leaps and try to do those things, you're never going to get some of these new, innovative, game-changing technologies to the point where they have a huge change on the way we proceed with our missions and new capabilities.

So, within the division -- or within the Office of Chief Technologist there are 3 main divisions with 10 programs in them. They're broken -- I'm not going to go into the details of them here, but there's three main areas.

One is very early stage innovation. We at NASA have this thing called the Technology Readiness Level Scale that goes from zero to nine that defines the readiness of technologies to be infused into a mission. So this is the early level stuff -- concepts, ideas.

The next level is to take those things and prove out the feasibility, demonstration on a lab bench that the concept works, that it works at a system or a subsystem level, and then

ultimately getting to cross-cutting capabilities, which are where we take those things, fly them in the relevant -- or do the demonstration in the relevant environment -- in this case mainly suborbital or orbital flights -- so that those technologies have been proven, so that a mission manager, project manager, can sign up and say, hey, I'm going to put that on my next mission. It's been completely demonstrated and is ready for infusion.

Infusion, again, doesn't have to be just into NASA. This could easily be into industry, into commercial space, into other government agency applications, also.

So, this is a cartoon that -- we talk a lot about push and pull. And, again, this has to do with the mission directorates. This is an example for the exploration system mission directorate, which has a technology pull. They have objectives: We want to get to Neo with humans by 2025. They have requirements as far as how long they want to stay, radiation effects, things like that. Those are the pull side. From the Space Technology Office of Chief Technologist area, this is the push: Let's come up with these great ideas, see if they mature, push them forward and make them available, and, in this case, sort of disruptive approaches.

Meanwhile, the mission directorates are still focused on the best they can do on what the current technology is, some new technologies that see nearer term payoffs, because they have objectives and mission goals that are coming up relatively soon. And as we play those two games against each other, looking at their requirements flow down and the development of new, sort of disruptive approaches, we modify where they're going. We modify what we're doing and end up trying to get to the bottom end of that curve from Mars where we cannot have to put 12 times the International Space Station in orbit to get there.

So, this is a chart I wanted to spend a little bit of time on, getting back to that earlier point that I had as far as culture change. So, this is just another way of looking at it. But the entire program, the Space Technology Initiative that's in the '11 budget that the administration has laid out, has been scaled and structured in such a way to motivate innovation and accept failure, and then take those -- but take those successes that do move on forward, that are game changing and completely revolutionary ideas, and infuse those into missions. So, if we don't do lots of great ideas early on, take those things and mature them as best we can, realizing that some are not going to

work out at all, and them infuse them into missions, that's the whole purpose of this structure. So, lots of ideas early on, these would be solicited -- open competitions, hundreds of ideas, and also on ramps -- outside there's sort of a funnel there. Outside that funnel there's a couple arrows. There's also on ramps for the next stages so that there will be competitions for people who haven't gotten the early phase funding to come in with their ideas for something that could be completely game changing. They just need a little bit of money and a little bit of time to be able to develop those and mature those ideas, and also for the flight demos, who also have an opportunity to come in at size.

So, when I talk about size, the overall size of the effort has been sized correctly for, and structured correctly for, having a lot of ideas early on, taking those best and brightest ideas and new concepts that are out of the box. I mean, they're not what the mission directorates want, it's not necessarily the things that are focused on their next missions, but what the agency or national needs or other government agencies would like to see done to address some of these national -- these challenges that were on that earlier chart -- take those, mature those, but realize there's risk associated with that and that they're not going to all work out. The game-changing Technology Division program is modeled very much after the DARPA approach to things, which is pick a few ideas, go off and work them, and if they work, great, it's a completely different approach to doing things. If it doesn't work, monitor it and at the appropriate point decide enough is enough, we've learned some great stuff, but it's time to move on.

So, the sizing of these efforts are sized for a large number of activities. Failure is acceptable. And there's also limits to these activities, both dollar and schedule, so you're not continuing to say, well, okay, we got here, but it's going to take me five times more money, over five times as many years -- five or six years more to do it, and that's just not the right answer. That wasn't the problem you were trying to solve.

So, by monitoring those things and scaling those things, and sizing the overall picture, it's very important that you do this so that you can talk to and convince the stakeholders -- public and the Congress and actually the researchers doing this work, including the NASA folks -- that failure is acceptable, risk is okay to take, and it's okay to have things that don't mature on, and to reach limits, either physical limits or that can't be applied to space, whatever the stumbling blocks

are, and move forward with it.

So, this change in culture within NASA is not just within NASA, it's within stakeholders as well as the entire industry. You've got to be willing to take those risks. One reason you want to have this large number and the sizing of the overall program is so that everybody can accept that, once in a while, things will not work and not pan out, and that you can still proceed forward with those other things that will have significant new ideas and new capabilities to allow us to move down that curve on the total payload weight that we have to put in orbit to get to Mars.

So, that's the cultural change. We have to do it within NASA; we have to do it within the industry, and certainly within all the stakeholders to understand that.

There's another element that's tied into that, also, and that's stability. It's very difficult to convince, even within NASA, the NASA centers, to invest in early fresh outs, get people coming out of the education program, and who have creative new ideas about doing things, unless they see a stability in the program. It's very difficult to get partners from other agencies to agree to work on a two- or three-year effort to mature a technology that's high risk, but is high payoff, unless they see stability in the program, too. So I think the two issues in terms of seeing this out are one of a culture change in terms of how you value risk and failure, and the other is stability in the program. I think those are two main elements.

I think I've talked about most of these bullets, at least hit a few of them, so I'll skip that.

Potential grand challenges. This is a list of things that are across the board for the entire program, the entire NASA program as to what we may want to go forward with. These are, again, not surprising; they shouldn't be surprising to anybody. These are things that have been there for a number of years as challenges that we want to try and achieve and attain, and that we can only achieve and attain through innovation, new technology, and completely different approaches to the way we do our missions.

These are some of the ideas that we're talking about that are being kicked around as far as technology demonstrations. The middle picture on the top, inflatable decelerators is something that we have; is at a very low level of maturity. We haven't used these before. If you

want to try to land something on Mars that's bigger than what we've currently landed up there, you can't use the current techniques or, if you do, you need to require a huge amount of mass that you've got to get up into orbit in order to be able to decelerate and slow down when you get there. So, inflatable decelerators, which also have aeronautics applications, too, so there are other parts of that that may pan out.

And this is, I think, just my last chart. This is the -- as you would expect, this is part of a broader national strategy on innovation and technology to get the agencies and the country more involved with technology and innovation, stimulating the economy and building on our national goals. NASA's budget is aligned with that strategy and it is a critical element of both promoting new ideas, new concepts, and exciting the next generation of scientists and engineers. (Applause)

MR. WEST: Thank you, Rick. And thank you, Mike, for your comments.

THE BROOKINGS INSTITUTION

IMPROVING SCIENCE AND TECHNOLOGY INNOVATION IN THE UNITED STATES

THE INAUGURAL A. ALFRED TAUBMAN FORUM

Washington, D.C.
Tuesday, June 8, 2010

PARTICIPANTS:

A Congressional Perspective:

THE HONORABLE BART GORDON (D-TN)
Chairman of the House Committee on Science and Technology
U.S. House of Representatives

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P R O C E E D I N G S

Our last speaker is Congressman Bart Gordon. The Congressman represents the 6th District in the middle of Tennessee. He was first elected to Congress in 1984. He's one of those legislators who loves to describe himself as a problem solver. By that he means he likes to actually find solutions that solve problems. Such a novel concept here in Washington, D.C.

From his start in Congress he's risen to chair the House Committee on Science and Technology. This will be his last year on Capitol Hill because he already has announced his retirement. I guess by definition that makes you a statesman -- a retiring politician.

But he already has had a huge success just a couple weeks ago when the House passed the America Competes Act. That bill is designed to improve U.S. scientific leadership, increase support for basic research, create jobs for small and medium sized businesses, and strengthen regional economies through regional innovation clusters.

So, I want to thank you for your tremendous leadership on that legislation, and I'm keeping my fingers crossed that the Senate will appreciate the wisdom of all of your hard work in that area.

So, please join me in welcoming Congressman Bart Gordon to the Brookings Institution. (Applause)

MR. GORDON: Thank you, Darryl. Twenty-six years have been a pretty good run, and so I'm grateful to have had that opportunity.

Part of the jurisdiction of the Science and Technology Committee is oversight of and reauthorization of NASA, and NASA clearly is a great inspiration for our youth in what we're talking about here today.

Let me first thank the Brookings Institute for really putting on this important seminar and for -- I know you've had some interesting panels already this morning. I feel honored to be a part of those.

And I want to thank Darryl, too, for your kind introduction. I have to say it was an improvement on one I received from a senior senator from Tennessee, Lamar Alexander, recently. Lamar and I have been working together on a project and he asked me to come over to the Senate

and bring them up to date. And he introduced me by saying, this is my friend Bart Gordon -- this really did happen. He's the dean of our Tennessee congressional delegation. But then he quickly added, dean doesn't mean he's the smartest, just means he's been here the longest. (Laughter)

But I do know that I am -- or at least smart enough to know that it's not a very good place to be between you and lunch. And so, also I have an appointment with the Speaker shortly after 1:00 to talk about really some technology for cleanup in the Gulf and research for future mitigation. So, I'm going to try to be brief here today.

But the charge that I was given was to outline concrete steps that the United States should take to improve the climate for science and technology innovation. And this is important, because 50 percent of the U.S. economic growth since the World War II can be attributed directly to the adoption and adaptation -- or rather, the development and adoption of new technologies.

So the path forward is really simple. Research and education lead to innovation. Innovation leads to economic development and good-paying jobs, and the revenue pays for more research. So my message is really let's stop talking about it and let's have some action.

I have been to seminar after seminar, meeting after meeting about, you know, what do we need to do for the future for technology, for our international competitiveness. Well, we know what to do. It's time to act upon that.

Now, rising above the gathering storm, diagnose a problem, and gave us a remedy. America Competes is the blueprint, so we must move forward with its reauthorization and then future funding.

Now let me -- this is not an intelligence test because if it was I'd probably fail. But just -- I want to know, how many of you have a fairly good understanding of the -- rising above the gathering storm? Raise your hand if you do. Okay. And then if you have a fairly good understanding of the American Peace Act, raise your hand. Okay.

Well, this is a very informed group, so let me just -- for those of you that didn't know quite as much let me give you just a real quick primer. In 2005, I asked the National Academies of Science to do a report on competitiveness in America in the 21st century. The report really was pretty grim. They said that there were almost 7 billion people in the world, half of those that are

working make less than $2 a day. Which means that in our global economy that my nine-year-old daughter and her generation -- your kids and grandkids -- could very well inherit a national standard of living less than their parents unless we take action. And basically that was built around improving our science and technology, STEM education, basic research, and at that time -- this was before the oil shock -- they recommended that we must become more energy independent and gave us recommendations to that.

So being the good legislator that I am, I plagiarized their work with their permission. You can understand that -- which actually was a compliment to them -- and put that together in the Americans Compete Act. So let me give you an overview of specifically what this bill does.

The Competes Act aims to maintain and to strengthen our nation's global economic competitiveness by improving science, technology, engineering, and math -- or STEM education -- at all levels so that all students are prepared for a highly technical, high-paying jobs of the future. This includes provisions to expand and strengthen STEM education, training and broadening participation programs at two-year, four-year, as well as at the graduate level.

Unfortunately, students are not performing up to their potential, especially when it comes to international standards. According to a program for international students' assessment result, U.S. students compared with contemporaries -- or they compared U.S. students with their contemporaries in 49 industrial countries. In that we ranked 19th in science and 24th in mathematics. And in other studies we do even worse. And what's even worse is that the longer we're in school, the worse we do in terms of comparing with other countries.

And one way we try to address that -- and the issue really goes back to -- and this is -- my mother and father are both teachers, so I'm not -- this is not a bad comment on teachers. But what we found at that time was about 50 percent of our math teachers had neither a degree or a certification to teach math. Almost 90 percent of our physical science teachers had neither, again, a certification or a degree to teach that subject. And it's hard to be able to teach and inspire on a subject, no matter how good a teacher you might be if you don't have that core understanding.

And really my father is a good example of that. My father was a -- excuse me -- was a farmer. He went to World War II. And when he came back, like many of his generations, he

went back to school on the GI Bill. He wanted to be a better farmer, so he got a degree in agriculture. I come along and my mother loses her job, and so he has to get a second job. And so he applied to teach school, and he received the last teaching job at Smyrna High School, which was the high school in our county. And so since he was the last one hired, he was required to teach high school science and coach the girls' basketball. And I'm not sure which he knew the least about. (Laughter)

And so 60 years later, basically we're doing it the same. And so we have to have, again, an increased corps of teachers that better understand those core subjects.

And so what we did, rather than try to do a lot of new things we scaled out some existing programs that we know that works. One of those within the National Science Foundation is the Robert Noyce Teacher Scholarship Program. It was modeled after a You Teach program which was at the University of Texas; it's been there for more than 10 years. And Noyce really rewards the universities for bringing together their STEM programs and their education programs, so that you have to put together a program that double tracks you. And it also provides scholarships for those students that will go into either math or science and education, and agree to teach for five years. And the five years is important because we find that half of teachers leave in those first five years. So, we're scaling out the Noyce program.

In addition to that there are good teachers that are already there that, again, that need that core work. And so we are expanding stipends to bring those teachers back into school in the summers so they can get their -- either their certification in that area or hopefully AP or advancements. Those are very important.

The Competes authorization also includes programs like Innovation Technology and federal loan guarantees that will address the immediate needs of small and medium sized manufacturers to retool for new innovative products and manufacturing innovation.

The bill will strengthen regional economies through programs like regional innovation clusters. These clusters will support regional economies by leveraging partnerships and communication between businesses and other entities. The bill also includes a reauthorization of the Advanced Research Projects Agency for Energy, or ARPAE. ARPAE is modeled after DARPA when

the Department of the Defense -- where the Internet was developed, GPS, and many other breakthroughs. It will identify and fund high risk, high reward transformational energy research, not just incremental improvement. That won't get us -- we can't get from here to there in terms of energy independence with incremental improvements. We have to have some transformational type of technology and we have to have a program that will reward us. As we move to a cleaner, more efficient, and more balanced energy portfolio we should not depend -- or trade our dependency on foreign oil for foreign technology. That's why ARPAE is so important to us.

Competes will also foster innovation by directing the National Science Foundation to invest at least 5 percent of the research budget into high-risk, high-reward research. The bill will continue to keep funding on our non-medical basic research programs at a 10-year doubling. That's a very modest doubling, but in these economic times it's a difficult thing to do.

Basic research allows us to discover new technologies that will help maintain our nation's economic strength. Even if scientists don't necessarily know what they're looking for or what they're going to find, it's important that we gain this knowledge. Breakthrough in quantum mechanics contributed to the creation of the iPod, for example, and no one could have predicted that that would be the outcome there.

The legislation also includes support for early career researchers through fellowships for graduate students and postdoctoral research. The legislation also includes a provision to help researchers bring the results of basic research over the valley of death, and commercial application by awarding grants to help universities develop tools and resources required to connect new science discoveries to practical uses.

And we found that the public-private partnership can bring out the best in both. Public investment helps the private sector take risk they might not otherwise and speeds the pace of innovation. And the private sector involvement helps to ensure that new technologies get to the market.

In conclusion, the America Competes Act was designed to bolster basic research, spur innovation, create jobs in the 21st century economy, and to create a workforce for those jobs. I'm very pleased that, as was mentioned earlier, that my colleagues in the House, after a little bit of

razzle-dazzle, we were able to finally get a reauthorization of the Competes last week. Now it's on to the Senate, where we have been really in close contact with them. Our hope is that we're going to see a bill out of their committee by the end of this month.

And my former colleague in the House, Harry Reid, I'm going to be groveling with him to give us a little bit of time in July to get this passed. We then, hopefully, will do somewhat of a pre-conferencing so it won't be too different and we can get something done before the August recess.

But as they say, you know, the tree doesn't fall if you don't hear it. Then it's going to be difficult but important that we get funding in the fall. It's going to be important for all of you to join in with this, so I hope that you will continue through as individuals, through your organizations, whatever it might be to keep pressure on the House as well as to promote the Senate and moving forward, and then our appropriators in the fall.

So, with that let me -- that overview, I'd like to really hear any kind of questions. But, more particularly, any suggestions and answers that you might have. And we'll just have a discussion here before we have to leave and before your stomachs growl too much.

Yes, sir.

MR. MANTI: I'm Dale Manti from EPA's Office of Research. ARPAE is an exciting program.

MR. GORDON: It is.

MR. MANTI: Up until now it hasn't had much of the other E, the environmental consideration. How do you see energy and environment playing out in the America Competes previsions?

MR. GORDON: Well, I think that -- well, first of all, I'm going to just say I'm on my way to talk with the Speaker. And then tomorrow we have a hearing in our committee concerning technologies for mitigation within the environmental concerns in the oil spill. So we are on that process.

I think Competes is going to help in a variety of ways. Certainly ARPAE, as we become more energy independent, is going to have to be clean alternative energies, which is going

to -- again, I think will help us in that regard. As I mentioned earlier, we don't want to trade our dependency on foreign oil for foreign technology. And we've got to get out in front on that.

So I think as we come forward with new clean types of energy it's going to help the environment. I think as we go into basic research, we don't know what the outcome is going to be, but clearly there's going to be some outcomes that are going to be important for us. Nanotechnology, I think, is an area, synthetic biology. These are a couple of areas where we're going to have to lead the world and where we can really have some breakthroughs.

For example, with nanotechnology, in terms of combining nanotechnology with solar it could be much more deployable. Synthetic biologies, we might have algae and other kinds of elements that can help produce alternative energies. But we need to make sure that as we do this that we're looking into the health and safety issues. We do not want to have another Monsanto kind of situation where they were introducing the genetically altered grains in Europe before there was good science and before they were ready to accept it.

So, a part of Competes is something called the National Nanotechnology Initiative, which really is a model for what we've done in solar and water in a variety of different areas. So I'll just tell you quickly.

In nanotechnology, the federal government invests about a billion-eight in that. There are 15 different agencies that are in into the research area, spending money on research, another 10 that are looking at regulation, things of this nature. And so what we did is we have an umbrella that better coordinates this research. One way we can make -- we can get more bang for our buck is to coordinate, so we want to do that.

The other thing that we want to do is make sure that we bring in a private sector advisory group to tell us what are the breakthroughs they need. Not to dictate, but we need to know, you know, what do they need. And then finally, what are the workforce needs? We can have all this new technology, but if we don't have a workforce that's ready to go, then we've got a problem. So what do we do there?

So, we've done this in a variety of areas. Nano is one of them. But the other component of that is that we have put a mandate that a lot of the research goes to health and safety

issues. Not only because if something isn't health and safety we want to get it out of the way, but if it is we want to prepare the public for that.

So I think that the environment is always going to be a beneficiary of basic research and more research.

Yes, ma'am.

MS. WAGNER: Maggie Wagner from the German Embassy.

Could you tell us a little bit more about these regional innovation clusters, and what kind of incentives would be provided for the different stakeholders to form these clusters to generate innovation?

MR. GORDON: Well, we're going to have -- it gets a little confusing. We're going to have hubs, clusters, and a variety of things.

There's something called also "frontier centers," where we are going to incentivize financially a variety of frontier centers where they will be looking at a specific breakthrough that's necessary to sort of get from A to B in some of the -- particularly in the energy areas. Hubs will be longer term where we'll bring together -- whether it's universities, the public sector, the private sector in a broader type of issues, maybe solar, in general.

There'll also be incentives for communities to bring together the assets and communities to be able to, you know, take on different challenges. So it'll approach it in different ways.

But since you're from the German embassy, let me also make this suggestion, too. I just got back from an inter-parliamentary dialogue with some of the EU parliamentarians. And I'll repeat what I said there or generalize what I said there, and a variety of other places. When it comes to really the some of the major scientific breakthroughs that are going to be necessary -- particularly in the energy area -- we can't do it alone. When the United States went to the moon, the first time in the Apollo mission it was all U.S.-financed, U.S. intellectual power. Now we see the model of the International Space Station where it's a combination of variety of countries both contributing resources, financial, and intellectual.

And some of the really tough environmental and energy issues -- like coal, for

example -- the United States, China, Poland, there's a variety of countries that are going to be dependant on coal for a long time, whether we like it or not. And so we're going to have to have new technologies in the use of coal, one of which is carbon capture and sequestration. So, we're going to have to look, I think, at international demonstration, international collaboration in that area.

There's already the ITER reactor in terms of fusion there in France. You know, we have a combination. The Hadron Supercollider in Sweden. I think nuclear energy is going to be, you know, again, like it or not, a part of our future. But we need to have the next generation of nuclear energy, where we're looking at new designs that help us to be able to get reactors built much less costly. We've got to have new types of reprocessing so that we can do away with proliferation problems and which in turn will make storage easier in the future. Once again, I think it's going to take international collaboration.

There are those areas where first to market is important, but in terms of those big, expensive breakthrough type projects -- particularly in the area of energy -- we're going to need to do this on an international basis and we're working on legislation now that will really help coordinate our international collaboration here in this country. But we need to reach out to other nations that have our similar concerns. And quite frankly, that have similar workforce issues that have our similar type of, you know, wages. So, I think that's going to be an important part of these breakthroughs.

Yes, ma'am.

MS. STERN: Thank you. Paula Stern, originally from Memphis. And I'm very proud to say from Tennessee. And I thank you so much for your statesmanship.

My question relates to your discussion about education and the great emphasis that you have in your bill. And it relates a bit to a conversation that started earlier before you came when we were talking about STEM education, women, and diversity.

MR. GORDON: Yeah.

MS. STERN: And the degree to which -- and you mentioned advanced placement courses in your opening remarks. The fact that there is fewer women participating in computer science studies in the high school level and, in fact, there's just less computer science testing going on, and as you know, there's one less advanced placement exam being offered as a result, reflecting

this diminution.

So, my question is, the degree to which your legislation decomposes the STEM field to recognize the particular problems that we're having in the curriculum, particularly for diverse populations, but for all, boys and girls, in computer science and the degree to which we are addressing that particular piece of the STEM demand for workforce that is trained in these areas.

MR. GORDON: Okay. Let me first just -- on a side note. I don't know whether you had a chance to read the New York Times this morning --

MS. STERN: Yes.

MR. GORDON: -- but they had a very interesting subject on that. It hits me somewhat personally. I have a nine-year-old daughter.

MS. STERN: Yes.

MR. GORDON: And, you know, to say that she hates math, I don't know, you know, but she just grimaces about math. And so I -- you know, I was sort of worrying about that. And then they took a test the other day, and I'm really not supposed to tell this, but she had the highest score, you know, in math. But she will -- you know, but she will just grimace at it. And you know, unfortunately, I guess I somewhat reinforce that and I say, you know, I'll -- like, you know, what are we going to do tonight? Well, let's have some fun; let's do some math, or whatever. (Laughter) So, but that is a real problem.

And our committee has been sensitive for that for -- really, for some time. When we start talking about STEM education, STEM professionals really coming out of there in the workforce, you know, it's sort of a cliché. The -- you know, the cleanest energy is that you don't use. The best place that we can make bumps in our workforce in the STEM area is women and minorities. They are the most underrepresented. And so just by bumping them up, you know, again, that's the best bang for our buck. And so we have put -- not just in this bill, but in the past, we have put in a variety of incentives for women and minorities. We have not calibrated that just to computer sciences. You know, it is, you know, in the broader STEM fields. But we certainly need to do that.

And what we're doing in this reauthorization, which I think is important, is, you know, we've been casting a lot of bread on the water, but we want to find out, so what works? And so we

are having, you know -- now we've got all our information out there. We want to know which ones of these programs that we've set up are really demonstrating that they work. And so let's put more money in those and then, you know, we'll let the others sort of atrophy out.

MS. ORCHOWSKI: Thank you. This is kind of a good segue. I'm Peggy Orchowski. I'm congressional correspondent for the Hispanic Outlook in Higher Education.

I (inaudible) in several stories recently on minority engineers and scientists who are saying when they get to the graduate level, they're not getting places, especially research grants. They're not getting postdoc fellowships, they're not getting chances to work with professors because -- and this is the politically sensitive thing -- almost all of those kind of grants that are funded by American public money are going to foreign students. And here we go with, well, the foreign students are the best and the brightest. Are they really better and brighter than our kids or they're paying three and four times more tuition and some institutions, which those grants cover? Is that an advantage they have? Do they have an advantage having majored in math since about the fifth or sixth grade?

You know, is there a level playing field for our minorities? And maybe there are universities -- including my own in California -- where some departments, including computer engineering, all the research grants and all the teaching assistants' grants are all given to foreign students. In fact, they're all from one nationality at one university.

So, there is a feeling among minorities that engineers that they get to this level and then there's not a level playing field for them. And maybe one or two grants out of a department should go to an American?

MR. GORDON: Well, what we have done -- again, in the reauthorization it's not -- there are incentives and requirements with -- from the National Science Foundation, the Department of Energy to partner with Historically Black Universities as well as the minority serving Hispanic and minority. So, there are specific requirements for that.

But let me -- I want to -- again, as I said earlier, we -- I want to encourage that. And that's where we can get our bump up. But also, I want to encourage the best and brightest from all over the world. And not only to come here, I want them to stay. And, I mean, I wish that we could --

you know, every time that you get a -- you know, a math or a science advanced degree that we could give you a green card, you know, to go with that if it -- you know, you demonstrate that you had a job here. So, you know, we need a big tent. And so -- but I think you'll find -- and we spend a lot of time, and it was a difficult political issue, tell you the truth. But we were able to breakthrough on all of this.

You will find that I think both the Hispanic Caucus and the CBC are pleased with what we have done in that area. But, you know, again, this is -- I'm not trying to kick others out of bed here, you know? You know, we can provide those incentives for all.

MS. ORCHOWSKI: It's sensitive, but American boys aren't going in -- and now we're talking white boys, white boys and girls -- aren't going into engineering either. And you know, maybe they're not feeling they have the opportunities that foreign students hold.

MR. GORDON: Well, I think what you're going to find is that there was a generation of engineers that were inspired by Sputnik and our space program. And you're seeing that generation start to really -- to sort of -- to atrophy out.

I think that the clean energy challenge is going to be the next Sputnik moment, and I think it's going to really inspire a lot of all colors and all sexes to want to be involved here. And we need to provide the platform for them to do so.

I mean, this is about sustainability for the -- really, for the world. And you'll see the same sort of thing, I think, in water and in other areas. And we are -- it was interesting. We have an opening on the Science Committee. We've moved some folks around and so we're hiring another lawyer. And when we had this previous one, I really wanted to get some really bright folks that we could multi-train, they could go into other areas. And so I said, you know, we need to have the same kind of model.

And we were concerned. You know, here we are, the little science committee. You know, can we keep bringing in, you know, these folks? Well, it's extraordinary the caliber of people that have -- you know, that have applied that are leaving. I mean, we're looking at one woman that, you know, was Stanford and then to Harvard. She's leaving a law firm. She wants to come with us because she wants to get into public policy.

So I think, you know, we have that opportunity now. We have to provide, you know,

the platforms to bring them in.

Yes.

SPEAKER: Thank you so much. Continuing the controversial theme of immigration, I actually teach at George Mason. It's one of the most diverse universities in the United States, and immigration is a sensitive topic for me because I am an immigrant myself.

So when we talk about STEM education, the majority of students, I believe, in this country -- in Stanford, MIT, and other universities -- are international students. What does it mean for them? It means that after they graduate they have to either get employed via H-1B work visa with the American employers or they have to leave this country or they can stay in the academia, which is also challenging. And talking about postdocs, for postdocs it's for -- it's challenging because of salary requirements to actually stay on the H-1B.

And we all know the limitations of the immigration policies in this country and how the first component, education, is being fulfilled. How these students receive financial aid, research assistantships and teaching assistantships to stay here and to get the education. And then they have to struggle to stay and actually get assimilated, get utilized, and contribute to innovation in this country.

And my question is about the new initiative that was brought by Senators Kerry and Lugar. It's called StartUp Visa EB-6, to actually encourage innovation and use immigration as a medium of innovation and actually allow entrepreneurs in mostly probably high-tech industry to create their companies, attract U.S.-based innovation, and stay in this country and contribute.

So, what is the link between your committee and probably -- and the immigration reform? And how does this EB6 proposal -- and possibly other proposals -- feed into your innovation agenda?

Thank you.

MR. GORDON: You know, I have seen statistics -- I don't have them at my fingertips now -- about the number of jobs that have been created in this country by immigrants. Whether it's, you know -- whether it's Google, Intel, you can go on and on and on and on about different -- so, its -- you know, we benefit ourselves.

9-11 was a tremendous barrier and threw up a big block to a lot of our best and brightest being able to stay here. I remember shortly or some time after that the head of the Irish college system came to see me. And he really sort of summed it up when that -- he said, you know, for a long time we didn't even try to compete for those kind of students because, you know, we all knew that they were going to the U.S. so we just conceded that. 9-11 comes along; you throw up barriers, so by default we start getting some of them. And then, well, we said great. So then we start competing for them. And then on top of that you're finding that -- you know, India and China are providing incentives for their own folks to stay there or to come back.

So, again, the -- I think it was -- you know, there is an entrepreneurial spirit in the United States that has allowed these best and brightest to come in and to prosper and they help, you know, everyone to prosper.

To try to get to immigration and our link, to some extent, our committee specifically more is a cheerleader for what's going on. And we had been having hearings and have on trying to -- the process of students going back and be able to come back and all that. But the immigration is a delicate issue right now. For lack of better term, let's talk about what we might call "high-end immigration." Again, those best and brightest or those folks that are coming over to go to our schools. Then you have lower kind of immigration, those people that aren't coming here to go to school, but just coming here to make a better life.

You really have -- I mean, you know, they bring also an energy to this country and work ethic that we need. And -- but it -- particularly in a downturn economic situation, every mother and every father has to have some reason why their child is not getting, you know, the best job. And so you have to blame it on somebody. So right now it's -- you know, it's always been illegal immigrants. I guess whether it was Jewish, whether it was Irish, whether it was Italians, you know, now by and large it's Hispanics. And so you're not going to be able to get a high-end immigration kind of solution. The low-end folks are going to hold that hostage.

So, we're going to have to work together. You know, some of that is starting now. But I think it's important that we did -- I saw, interestingly, the -- in the -- read some of the papers at home in the morning. And the Nashville Tennessean had a story this morning where the head of the

Southern Baptist Convention was promoting an immigration path now, which I thought was good. And hopefully, they'll be -- again, we'll be able to have this synergy and get something done. But you're not going to have a high-end immigration until there is a low immigration solution.

Yes, ma'am.

MS. RIZER: Thank you. Mindy Rizer from the United Nations Association of the National Capital Area.

In terms of international work, I wonder if you and your committee have thought at all about links, resources, synergy with the work of UNESCO, with the work of the UN University which has nodes all over the world. Some of the interesting work of the UN agencies in terms of work in science and technology and international exchange. I wonder how that figures into the broader picture of international collaboration on science and technology.

MR. GORDON: You know we have not done that, in all honesty, in that specific area. What we're trying to do -- there was -- and it still is, it's just become dormant during the Bush years, but there is an agency within OSTP that coordinates the State Department, coordinates the Energy Department, and all the various international collaboration in terms of research, education, those sorts of things. We want to see that reactivated. We want to see that sort of coordination come about, again. And certainly the UN would be a part of that.

I think we have to recognize that we are in a period of limited resources, so let's try to, you know, spend that money in a more collaborative way that we then can get more bang for our buck. But we have not looked at the UN specifically.

Any other suggestions or questions? Well, if not let me, again, maybe just close by saying this is an important issue. I'm glad to see that you're here and that you're focused; do more than just keep talking about it. You know, let's act upon it. You know, it may not be perfect, but it's pretty close to being perfect. But we have the America Competes Act. It is on the table now; it has passed the House.

You know, we had -- you know, I thought -- well, I'll just -- I want to give you an example how tough things are right now and why, really, we need you to help. When I first introduced the America Competes Act, we passed it within the first six months of -- in 2007, with the

new Congress that came in. We've got something like 367 in the House. Lamar Alexander, to his credit, got 68 co-sponsors and it passed unanimously in the Senate.

Now, I told him the other day that if he can do that again, I am going to nominate him for the Nobel Peace Prize and special envoy to the Mid East. (Laughter)

So, here we come back again for the reauthorization. It failed the first time in the House because there was a motion to recommit that combined it with pornography. You know, it was just an effort to try to, you know, to beat it. And people didn't want to vote for pornography, so it went down.

So, then I bring it back on suspension. Suspension you have to have two-thirds. And again, 367 members voted for this, you know, the previous time. We couldn't do that. I tried to -- and I guess part of it was my fault in trying to do it the right way rather than do it the quick way. We had 48 hearings; we had 3 bipartisan subcommittee markups, and a bipartisan full committee markup. The first hearing that we had, we had Donahue from the Chamber of Commerce, Castellani from the Business Roundtable, as well as Engler -- Governor Engler from the National Association of Manufacturers come and talk about how important it was.

So I thought, well, you know, this ought to help us, you know, with those folks that, you know, aren't as interested. We had, you know, almost 1,000 different companies, universities that endorsed it. But in this environment even that wasn't enough. So we had to do again this little razzle-dazzle that got the pornography thing out of it.

So, you know, do not wait for the perfect year. There may be some (inaudible) you won't. We're going to -- we have our hands full trying to get this passed. So you as an individual, you within whatever organizations that you might belong to, need to be promoting this bill again in the House to buck them up. We've got to get through the Senate, and then the funding.

Again, thank you for letting me spend some time with you. And I enjoyed being with you today. (Applause)

Bon appétit.

MR. WEST: Thank you, Congressman. That was terrific. I also appreciate our other speakers from this morning: Ruth Simmons, Eva Feldman, Mike Holston, and Rick Howard.

They were terrific in explaining their views on what they think needs to happen.

We have a buffet lunch out in the hallway, so please help yourself to some food. This closes our Taubman Forum, and we want to especially thank Al and Judy for all of their support. And thank all of you for coming.

Thank you very much. (Applause)

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