

All Things Research 2014

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Mike Waring, Moderator: Good afternoon everyone, I'm Mike Waring and on the behalf of The Science Coalition and the Association of American Universities, I want to welcome you and our audience to "All Things Research." TSC and AAU are comprised of some of the nation's top public and private research universities. Collectively we share the goal of maintaining America's leadership in science and technology through strong and sustained funding for scientific research across all disciplines. We are looking forward to this afternoon's discussion between the senior research officers and the media here. Just a couple announcements before we get started, obviously for those of you there, if you haven't already done so, please mute or turn off your cell phones; we'd all hate to have those little bells ringing during our program here today. We've decided to break our discussion into three topics today, to try to cover three things we think are useful discussion areas. One is the connection between U.S leadership in science and U.S. global competitiveness. The next is technology transfer, and the role of universities in driving regional economic development. And the third is the intersection of science and politics. Now there will be other topics people will want to bring up and we will have time at the end. We'll surely make time at the end for a sort of "grab-bag" of other topics people want to bring up during the discussion. And while my job is sort of directing the discussion, I don't want to ask all the questions, so hopefully our journalists will be here ready to jump in with your questions or comments as you go. Might be useful if you want to get into the discussion, either making a comment as an SRO or asking a question, if you just give me a little sign and I'll call on people as I see them throughout the discussion. One last piece of business is we are recording, obviously, this discussion so please use the microphones so we will get everybody's comments for the record. And again this is all on the record, of course. We thought about having the Senior Research Officers sort of introduce themselves, but we got their bios. We thought it might be more useful to have them go around one at a time, and talk very briefly about one of the most exciting examples of research they have going on at their particular University. So I'm just going to start over here with Gloria Waters from Boston University, we'll go right around the table. Thirty, forty-five seconds. Gloria, what's something really exciting happening at Boston University you can tell us about?

Gloria Waters, Vice President and Associate Provost for Research, Boston University: So Ed Damiano who is a faculty member in our college of Engineering has just developed a wearable artificial pancreas that is referred to as the Bionic Pancreas. And it automatically manages type 1 diabetes, it pairs a smart phone with a continuous glucose monitor and then two other pumps that deliver precise doses of hormones and the results of the first studies with outpatients and a mobile device were published recently in the New England Journal of Medicine and they're doing their final pivotal study before FDA approval.

Glen Laine, Vice President for Research, Texas A&M University: So at TAMU we have established an emerging program in vaccine development. WE have a contract now with the federal government to generate 50 million doses of a vaccine against any particular infectious agent that may occur naturally or be man-made, within a six month period. Along those same lines we've been doing some genetic engineering in goats and now have a model where we can generate malaria vaccine from the milk of goats and this has been important because of the child death rate around the world associated with malaria and the fact that the malaria vaccinations have to be refrigerated and can't be distributed worldwide. If each one of the villages had one of these goats, they need only have their children drink the milk and they will be protected from malaria.

Robert Clark, Senior Vice President for Research and Dean of the Hajim School of Engineering and Applied Sciences, University of Rochester: We have a faculty member, Henry Kautz, who is now the director of our newly established institute for data science which really started as a partnership with New York State and the federal government. We have about 50 million that we put into the computing resources and another 50 million planned for investment, but Henry one of the areas I thought was particularly interesting was the convergence of the blending of social sciences and linguistics with computational sciences in the tracking of the outbreak of influenza based upon tweets. So they could download tweets from social networks, and using some basic semantics and linguistics figure out how influenza's moving through a city and use the same technology actually to predict at which restaurants you may be most likely to encounter food poisoning.

Mike Waring: That sounds like very useful information.

Dawn A. Bonnell, Vice Provost for Research, University of Pennsylvania: We have an exciting result coming out of an interdisciplinary team led by Charlie Johnson and the Physics department, that is bringing people together to design proteins from scratch. So de novo proteins that are designed to have particular function, and in this case they have the function to be able to recognize molecules in vapors. In addition, they have the function to be able to connect to something like a carbon nanotube or a piece of graphene and therefore can be incorporated into devices. So these devices have the capability of sensing then chemicals and vapors with a thousand times higher sensitivity than has been demonstrated to date and it's a platform technology so it has the potential to detect bio-markers for cancer from the human breast, and it has detected things like toxic chemical leakage in industrial environments. So it's a very broad range. The fundamental science to the application of devices is pretty broad and in the context of enabling this to make inroads as real devices, they have started a startup company called Graphene Frontiers which has found an economical way to mass produce graphene that will allow this platform technology to be marketable as well as other kinds of device technologies.

Caroline Whitacre, Vice President for Research, The Ohio State University: So at Ohio State there's a team of researchers out of neuro surgery who are working on deep brain stimulation. This technology involves basically a pacemaker for the brain, where it can essentially stimulate or suppress neurotransmitter release. While this is well known for treating things like Parkinson's and basic tremors, it's now being expanded much more than that to Alzheimer's, to migraines, to multiple sclerosis. Recently, and it was written up in the Washington Post actually twice about treatment of quadriplegia

where a young man actually could move his fingers for the first time after the implantation of a brain microchip. Very exciting, and the state of Ohio was just awarded \$21 million to this research team led by Ali Rezaei and that's partnered with \$140 million with industry scholarship.

Robert Bernhard, Vice President for Research, University of Notre Dame: Well there's a lot of very interesting things happening at Notre Dame as we work very hard to advance our research programs, but probably the one most relevant to today's discussion is an announcement we made two weeks ago where the university announced we were, with five partners, putting together a \$36 million facility to do turbo machinery research. The facility is going to be located in downtown South Bend in the area which used to be the Studebaker corridor, which hasn't been developed in the 50 years since Studebaker has been dormant, or closed I should say. The university is now going to build this facility. Partners included General Electric Corporation, General Electric Aviation, who has guaranteed that they are going to do a certain amount of research and that allowed the rest of the partners to come forward and put together the package to build this facility. The State of Indiana, the City of South Bend, and a couple other partners are involved and we are looking forward to building the programs that over the years have been federally funded now into the programs that the corporations will have access to the facilities that are pretty unique and are able to advance their technology.

Alex Cartwright, Vice President for Research and Economic Development, University at Buffalo: We have quite a few things going on in materials and also in genomic medicine, what we've actually focused on is how do you work across disciplines? So a few of the things I would like to mention is our recent announcement of a genomic medicine center which is a \$50 million investment from the State which builds on our computational capabilities and allows us to expand research in that area, but for some specific examples we have the distinguished professor Paris Prasad who's actually had some of his technologies for nano clinics make it all the way into a company where nano-biotics actually recently went public and we were able to divest from that company. But also we have some exciting things going on where our junior faculty Jonathan Lavelle, who is also working on materials for medical applications, where he's doing nano balloons to actually treat cancer.

Sandra Brown, Vice Chancellor for Research, University of California, San Diego: UC San Diego has embarked in January on the largest comprehensive clinical trials coordinating center for the study of Alzheimer's disease. Now many of you may know that Alzheimer's is the 6th leading cause of death in the U.S. and the rates are expanding rapidly. This is a great example of a federal institution, the NIH, coming together with industry partners Eli Lilly and Toyama to produce a study that will involve 60 sites across the nation and with a focus not just on understanding the process of the development of Alzheimer's but actually designing or evaluating the effectiveness of a drug that is an anti-amyloid drug that is involved in the progression and development of Alzheimer's. So this is a very exciting opportunity for us and we think that there will be new technologies, early diagnostic technologies that will emerge from this study as well.

Richard McCullough, Vice Provost for Research, Harvard University: So NIH funded research has led to discoveries of some basic scientific molecules. There is a protein called REST and this particular protein was only thought to be important in developing children, and it turns out that REST plays a huge role in

preventing neuro degenerative diseases and the discovery of this is really important because it turns out that teenagers don't really have this because they aren't really stressed out like we are. When you're older you get really stressed out and this rest protein kicks on and they figured out that once it kicks on it actually prevents the formation of plaques, and prevents neuro degenerative diseases. So this is the kind of basic discovery that is very important and leads to therapies once we understand how these things actually happen.

Prem Paul, Vice Chancellor for Research and Economic Development, University of Nebraska -Lincoln:

We have a number of projects that I could showcase but one that has gotten a lot of press is that the food borne pathogens, e-coli, sugar toxin producing food bornes that kill about 265,000 people become ill annually, a couple years ago we put together a collaboration with 13 other universities and the FDA and this team competed for \$25 million USDA competitive NIFA grant. That team has really been working very hard to find ways to better detect e-coli, to better classify them, type them, and then trying to determine where this bug hides and then can we come up with some ways to prevent it and control it. So this team is very exciting, they've already been able to advise methods to detect that were not available before.

Mike Waring: Well that's great; I thank all the SRO's for the various examples of what they're doing on their campuses and in various disciplines that are of interest, and exciting research that's going on. It's kind of a good Segway to our first section where we will talk about disconnection between U.S. leadership and science and our global competitiveness. I want to start our first question regarding the innovation deficit; this is the difference between what we are currently investing in research in higher-ed and what we probably should be investing in those disciplines in those areas. Sandra Brown, from UC San Diego's perspective what does this deficit mean in practice as it effects the research and education that you do on your own campus?

Sandra Brown: This is such an important and compelling issue these days. I think as we reflect on the federal funding for research we know that in the National Science Foundation for example there has been a reduction in the number of RO1 grants that have been awarded and we if we look at the statistics from the National Institute of Health it is clear that 40% of those students that we invest years of graduate training in bio medical education are leaving the basic science arena. This is an incalculable long term consequence for the U.S. in terms of the human capital loss. Fewer students are motivated to continue on in the research arena. I would like to say though it does not take much to create motivation for that, for people to continue and to see a future in basic science. Obama's Brain initiative is a great example, we had several graduate students who were participating in a discussion session just a few days after the brain initiative was announced and they had calls from four different family members from four different countries around the world saying oh and now there' a future for the research you are doing and that you're conducting at UC San Diego. So I think it's a human capital issue.

Mike Waring: From your perspective how this might cause the U.S. the most harm? There are certain areas of research that might be more affected by this than others, maybe from your own campus perspective?

Gloria Waters: So I think the real focus these days is on the idea that people should be involved in doing applied research and I'm terribly concerned that the lack of respect for and focus on people doing basic science is really going to lead us to a place where we are really losing in terms of coming up with new ideas, technologies, developments, etc. Basic science is critical to the applied work that follows it, but if we don't invest in basic science and follow it, it will result in a horrible situation for universities.

Caroline Whitacre: I would agree with Gloria that basic science will suffer but what we need to understand and one concept missing is that there is pipeline of research. Basic research can ultimately lead to more translational or applied research that can ultimately be commercialized. It's not as if we, at universities, are sitting on a pile of intellectual property; it really is a pipeline that develops from basic to applied to commercialization.

Richard McCullough: I think one of the things that's very interesting about all this, is there is a big push to do first strike science. So to have very quick outcomes that we make an investment and we expect that there will be 3000 jobs that comes out of the first NSF grant. I got my first NSF grant in 1990, I started a company in 2002 which created 50 jobs when it was sold in 2012 in Pittsburgh, so it takes a long time for these things to take place. No one would've thought, measuring the magnetic moment of an electron would be an important thing that someone should find, but without that we wouldn't have magnetic resonance imaging, and so these things take 30 50 years to realize the outcomes and so that's one of the dangers, not only to human capital, where we will lose our competitiveness as a nation in the future, but the idea of will we build the basis for the future?

Dawn Bonnell: This is perhaps mundane, but an important point as well. With the innovation deficit, we have lower success rates on proposals, for example this results in increased administrative load on the scientists who are creative scientists who are generating all these ideas are spending 40% of their time to maintain support for the activities. And so, we need to pay attention to that as well.

Mike Waring: Looking to our reporters, does anybody have a question in this area about innovation, competitiveness?

Reporter [Sam Stein, Huffington Post]: I'm wondering if any of you at specific universities have had to put the brakes on a specific science project because of lack of funds and if you can tell us what that project was doing at the time you had to put the brakes on it.

Robert Bernhard: At Notre Dame we're involved with a project that extends probably over a decade, and began with the nuclear physics community getting together to talk about what their priorities were, and they invested a great deal of time and energy and you can imagine this is hard work for them to go through the different options of facilities that they could invest in, or that should be prioritized as the best. Also, ultimately they came to an understanding that one of the facilities they thought would yield the best science was a deep underground accelerator project for nuclear astro physics, so that project started into the design phase and so forth. Notre Dame was chosen to lead that project consortium of multiple universities and because of it we had invested ourselves in the cost share of that program. The program actually went into the design phase and actually in the one year design phase they did a lot of work to a point where they were ready to start construction and this happened to be right at the

moment of sequester. In fact, that particular project was stopped just at the point where the decision was made to move forward with construction. So that whole project has been put on the shelf, we're hopeful it will start again but there are no guarantees that it will. I would note that our faculty was contacted by the Chinese Government not long after the project was stopped and there has been the potential now, that a foreign government can come in and take advantage of all of the design work and decision making that has been done on that project. So far, we are moving forward with a small scale example hoping that the U.S. government will move forward.

Robert Clark: To answer your question, less of things than we might close, but competitive grant renewals that aren't made as a result of caps on funding and sequestration, the real issue is that some of the very talented faculty in the labs, if they have to close a research program, you have a significant momentum with building your program in the labs and once you close the program, even if the funding opportunity returns in 3 or 4 years. You've lost the intellectual capital that was in the labs, you've lost the ability to quickly respond and do the work. So to restart that is a significant investment far more than sustaining the program.

Glen Laine: It's not only if a program is discontinued, but if there is a hiatus in the program you end up with the same situation of the personnel that have the expertise in the laboratory continue the research, if they are furloughed then the ability to reinitiate the progress is compromised as well. Not just if a project goes away, I think there may be fewer of those than those that are put on hiatus and very difficult to reinitiate.

Reporter [Goldie Blumenstyk, The Chronicle of Higher Education]: His question was not necessarily what is the threat but has anyone actually closed things down in the wake of the sequester or something, because it sounds like one project. We all understand the issues involved but has anything actually happened?

Richard McCullough: First of all these grants often run 3 to 5 years and then people will often have discretionary funds that have sort of sacked away from various small gifts and things and so there's a lag effect on what's actually going to happen. So what we're seeing now is that in the first year of sequester there were a few things that got impacted but things are starting to be impacted, so at Harvard I have on a daily or weekly basis some of the best and brightest scientists in the entire world coming to me to say "I'm running out of money now," "what is it I should I do," "can you help me raise money for this?" And projects like, there's a guy who discovered new antibiotics and he has no money to continue to create new antibiotics, and some might say well drug companies do that but drug companies don't do that as much because there's less money in antibiotics but this will be important to us in the future. So we try to fund him internally as much as we can but these programs are staying. I can name a half dozen projects where people are saying please help me, my NIH grant just ran out, I got in the top 3% of my NIH grant and it was not funded, so can you come up with \$500,000 a year or \$250,000 a year so I don't have to get rid of half of my people and start over and these are people that are competing at the highest levels. So I think there is a lag effect that is coming that you are going to see, it wasn't like there was sequester and then we shut down several projects in the chemistry department. We are now trying to weather the storm for the next 3 to 5 years and if it doesn't turn

around, then you are already seeing groups cut by 25%, research groups that are already being reduced by a post-doc here a grad student there. So it's already happening but it's chipping away at the foundation it's not obliterating the foundation.

Reporter [Jeff Mervis, Science Magazine]: How many people were in your position 5 years ago? Several. I pick this because of the stimulus. There has been a lot of discussion after the fact that the stimulus was actually harmful. Did any of you or your universities speak out at the time about concerns that this 10 billion dollar injection was going to have a deleterious effect on the slow and steady support for science? And if not, why not?

Robert Clark: I have to admit I did not speak out, but we, internally knew that there was going to be an issue that we were gonna have to plan for. WE couldn't sustain some of the programs funded in the stimulus program and we knew we were going to have to plan for that. I think to the intro that you made, the fact that our funding predictions, that things are not very predictable for us, impacts very significantly our planning. We do generational planning; we hire a faculty member for a thirty year career, we build laboratories with the expectation that the staff will be there for 10 or 15 years. We knew with the stimulus money that we were not going to be able to do that kind of planning. So we had to make different choices, who we hired, what we did, what we bought and so forth.

Prem Paul: At our national meetings of our colleagues we talked about that, there were definitely concerns, and we individually tried to express that to our delegation. There was some of the funding was used for infrastructure development which definitely helped. We at University of Nebraska Lincoln had two facilities funding that if we did not have stimulus funding, those would not exist. One is a NIST competitive project, a nano material science building, and the second was from NIH facilities grant for a urology research. So those investments are paying off definitively, so it's not that stimulus money didn't help, it is in the area of competitive grants we knew that there would be a cliff. So we actually had a lot of discussions at national meetings and tried to make a case.

Mike Waring: I have a follow up. We hear about this international competitiveness, China, India other countries really ramping up their research. Are we doing things the same way we've been doing it, are they doing it differently, is there anything we can learn from the ideas they are developing as they advance their own science enterprises? Are there approaches that we might think about using here that maybe are being successful there?

Richard McCullough: I think a number of, we in the US are looking at these countries and trying to see what we can do as universities to try and copy some of those models. In the UK for example if you look at Oxford, Cambridge and a number of the universities there, they receive about 13-15% of their research comes from industry sponsored research. If you look in the United States the best universities are around 7%, Harvard is about 4% approaching 5%. Even MIT and Stanford more engineering based are close to 8%. So there are issues in terms of regulatory issues that stand in the way of Universities and corporations partnering together. Europeans in particular and Chinese and Indians and others have done a really good job of working on that and realizing that is a important part of the future going forward. And so, that's one area I think we could really use some help. There's a lot of government

sponsored laboratories like IMAC where corporations invest in the infrastructure of these manufacturing areas and then the universities and small companies can use that and partner to create innovation within the countries and we don't have a model like that here. I think the advanced manufacturing initiative is trying to do that but that's an area where we need to work harder. It's not going to be a substitute for federal funding because it's just not large enough, but it is really important that we continue to work on those models.

Prem Paul: We had a national technical small group meeting on lasers, extreme light science, and we had representatives of several top universities around the country and national labs. So these are the leaders around the world in this area and what was really got our attention, they talked about how little investments the US is making in the extremely light and laser area, and how many billions of dollars European countries and Asia and China are investing in this area. This certainly has implications in national security and environmental implications.

Dawn Bonnell: I can't point to a particular country or region in the world to this specific point, but one of the things we need to do in the United States is to ensure that we have the infrastructure to carry out the research that we need. Our national labs system does this in some of the areas, in some of the tech sector areas and basic science areas, but there are vast needs that individual universities and even sometimes regions can't afford to do that would facilitate research across the board. And some of those areas, manufacturing, advanced manufacturing is one, midsize instrumentation is another one, and the San Francisco example was talking about a centralized compliance for clinical research. That would help to facilitate as well, cyber infrastructure and so forth. There would be others that would come up but this is an area we have routinely under invested in, in a manner that other countries haven't under invested in. One can point to several national academy reports that make this case as well.

Glen Laine: We should at least consider the fact that if countries like China are going to surpass our R+D investment maybe by 2020 as the latest report, that there is a different type of research being done in some of these countries which is more top-down than it is in the United States. Certainly here, if you take a faculty member and try to apply a top down approach to research it has been historically successful. So even though they're investing money I think that our system has a greater return on investment than they will have.

Reporter [Sam Stein]: Have any of you lost faculty or researchers to a foreign country? I know we talked about one who was approached by China.

Robert Clark: I would say it's a double edged sword. There's an opportunity even on the loss side. We have had several faculty members who carry appointments at international institutions in addition to our own. They spend time at each place and so you lose the human capital for some part of the year, but the gain is that you can build partnerships with those institutions abroad. The piece that's interesting to look at, since 2001 we've seen the major Asian economies grow their research expenditures to exceed that of the United States. If you travel, and I do a fair bit with our partner institutions, whether it's in Hong Kong or China or Singapore, you see incredible infrastructure in the labs. You see university rankings; you look at endowment and research expenditures, the rankings

pretty much follow the money. And so if other governments are willing to invest more in fundamental research, then we're willing to invest then we'll see those ideas follow the money. That's essentially what happens. Our faculty has allegiance to their research and wherever they can best fund those ideas that is where they are going to work.

Robert Bernhard: One of the other elements of this that I would like to emphasize is that the pool of students that immigrate to the United States for their education programs are vital to us. When I visit a lot of companies and national labs and so forth, the number of people that are at high technology and science positions that were not born in the United States but were educated here and stayed here, is huge. The numbers are a preponderance of foreign born. About 10 years ago, I started to notice that graduate student applicants to our programs, people working on their bachelor's degrees had access to better facilities than we could offer our graduates. So you started to ask this question how long will they keep coming? I ask that question when I visit Asia and I'm told they won't keep coming. They're going to have enough opportunity at home at high levels with the importance for them to stay home that talent pool is going to dry up for us. It's another piece beyond the fact that we might be losing faculty now.

Richard McCullough: Just a quick direct answer, in my field of chemistry and materials it is famously known that lots of very famous Chinese American researchers built very big institutes in China and have left and moved to China, Switzerland, I could give you a handful of names of people that have moved to the Swiss universities from the United States to the point where they are set up that they don't have to write any NSF or NIH grants at all. That's the promise and so they leave. We always lose people to Germany to the Max Planck system; we just lost one of our best chemists to the Max Planck system. So this is a very common thing, and they're set up very well and a lot of it has to do with that they have sustained funding.

Reporter [Goldie Blumenstyk]: Reading about the European economy doesn't make it sound like their economy is that strong for this kind of funding; also people spoke before about basic science and I've also heard consultants talking about the era of mega-gifts and philanthropy. People saying that research universities are the institutions best suited to be recipients of such grants, so I'm wondering what anyone is doing in the areas of philanthropic support for sciences and even for basic sciences?

Sandra Brown: think we're all aggressively pursuing philanthropy, that goes without saying. I would like to mention that there is a science philanthropy alliance of the six largest funders of basic science that has emerged over the past year. The focus for that science philanthropy alliance is to fund scientists, not specific projects and the reason for that is just what you've heard it has to do with the continuity that's necessary for basic science. Even though we pursue philanthropy, we pursue industry funding for research, it will never fully compensate for the value of the long range stable support that federal funding for research can provide. At UC San Diego, for example, over the past four years we've increased our industry sponsored research by 81%, that 81% over just this brief period of time is less than half of the funds that were lost from the federal agencies as a result of sequestration. So even though we've aggressively pursued these things, the nature of the funding, and I'm sure we'll talk about this in the technology transfer side of things in a moment, is extremely different and it does take stable

funding to move down that pipeline from the most basic research out to science that produces social good and solves global problems.

Prem Paul: All universities are trying to raise funding from multiple sources, we at the University of Nebraska; one area that we felt was very important was water. Because 75% of the water we use for agriculture and food is very important to Nebraska, and the world. So in 2020 9 billion population, how will we feed the world? As a result of that we have had a lot of conversations and initiated a new institute, Water for Food Institute. In order to really kick that off you need a lot of investments, to be able to hire new faculty, to be professorship chairs and some operational funds and we were able to make a case to a donor for a \$50 million gift. The Doherty Water for Food Institute, because of that gift, has allowed us to put together a critical mass, but still, in order to address the issues we still have to go and obtain grants and funding to address issues. But it's a great success, early success, we have been able to get funding from USAID, the Bill and Melinda Gates Foundation and are competing for National Science Foundation funding and others.

Richard McCullough: I'd like to speak to this as well. One of the reasons I was brought to Harvard from Carnegie Mellon University is to take on exactly this problem. In the last few years we've increased our corporate support by 350%, we've increased our foundation support by 50%, we've increased our international support from other countries by about 100% but that only adds up to be about \$250 million. Harvard invests about \$300 to \$400 million a year to research from our own coffers and the federal government invests about \$650 million a year to Harvard research. We're running as fast as we can, but it's just not enough. We've raised lots of money, Harvard's pretty good at raising money and so we're doing everything we can to do that. We just raised \$60 million to support taking research from the lab to commercialization so we can create more jobs and more companies. So we're working hard to do what we can, but the scale is really important to remember.

Mike Waring: I just wanted to follow up on that. Richard you've talked about this new focus on foundation money and industry funding, has that become a different type of research than we've been doing? Is there some concern that that will redirect the Universities energies in other ways that would be not as well served? What do people think about that?

Richard McCullough: That's a great question. Sandy eluded this already, or somebody did, that these things come with strings attached. So a gift is fine, and if it's a no strings attached gift that's fine, but often foundations are driven by various incendiary things that they want to do. Some of that sponsored research, I wouldn't say deliverables, but has directional expectations in the research. If it's a pure gift, that's great and that's fine. Corporate research is very different altogether, they have some of the best problems in the world and we have some of the best tools in the world and combining those two things. But then there's IP and it's often very directed. So it's hard to get money from a corporation to measure the magnetic moment of an electron. So it's pretty obvious when you characterize it that way. It does sort of direct the research and that's fine, it can be applied to basic all the way through, we are not afraid of doing applied research. We embrace that, but we don't want to shift the pendulum too far.

Glen Laine: It's also important to remember that everyone's playing the same game. So I just came back from the Weisman institute in Israel and I was looking at some very impressive research and was talking to people about this, about funding. They said all this research was funded by dollars raised in the United States.

Reporter [Tracy Jan, The Boston Globe]: Richard if you could elaborate on some other countries that are investing in our Universities for research and whether any of your other universities are also being invested by other countries? Is it private industries in other countries or is it foreign governments?

Richard McCullough: No it's foreign government, so often it has to do with building the personal infrastructure within their own countries. So it's generally research and education at its basic core and that's our basic mission is research and education, but it is funding often students coming from those countries are helping professors from those countries or partnerships with those countries, so they can build up. And so different universities do it in a different way, some make pure partnerships with countries where they are actually having research that is taking place in those countries and others are when the research and education is at the mother ship, as we may call it. So there's a whole group of models out there and I can only speak for Harvard but we are more on the side of doing things at Harvard although we do have partnerships, locations, and offices in other countries.

Gloria Waters: So at this point in the conversation we've really been focusing on the actual level of research funding that we get, but an important thing to recognize is that research dollars do not go as far these days than they did previously because of the increased regulations and compliance that is in place. So faculty spend much of their time, some studies have shown that up to 42% of faculty time, is spent on compliance and regulations as opposed to actually using that money for the research that we want to have carried out. So it's a really large decrease because we're actually putting less money in and actually less money goes to the research. The government has just come out with a new OMB circular that has many more regulations in it and is going to make the situation even worse for our faculty and has many regulations that are really going to be difficult to comply with. So that's also a factor, other than just the overall level of funding that's available.

Mike Waring: Unless people have other questions or comments I would like to switch gears a little bit. There was an allusion earlier to tech transfer and the growing role universities have in regional economic development. Dawn, at University of Pennsylvania why is tech transfer important and what are some of the things you're trying to do to make it more efficient more effective on your own campus.

Dawn Bonnell: I think a good place to start with that is to remind ourselves what the academic mission is and that is to educate the students and to create new knowledge and to do that in a manner that has some positive impact on society. So in the context of that positive impact on society we feel an obligation to move the discoveries into a mechanism in which they can contribute and sometimes it's a treatment or cure for disease, sometimes it's your artist's artwork, but in terms of technology that pathway is to take it to the marketplace so it can make more of an impact. So what we've been doing at Penn recently is we've established the Penn Center of Innovation which we're changing the model by which we do that translation. Instead of having the traditional tech transfer operation be licensing, fees

and royalties and that sort of thing we're evolving into a new kind of interaction in which we focus on corporate alliances, alliances with the university and private partners as well as venture startups and that sort of thing. One example of that sort of thing recently that's been in the public news is an alliance we have with Novartis that's over \$100 million dollars and that has to do with a therapy that's developed by Carl June in which immunotherapy, using your own cells to fight cancer for example is showing great promise. So we've launched that new approach, it has components of having teams of the professionals that do all of these activities in remote locations at the faculty access points and then investing in something like new startup companies. A part of that component is called the Upstart program and it's a concierge service for faculty on campus, for startup companies, it's been really successful so far in its four years and I think that there are 17 campuses emulating it now, even in that short period of time. The final component of this is that we're developing an innovation campus in collaboration with the city of Philadelphia and we call it the Southbank Campus in which we are going to spend around \$50 million dollars on an innovation called the Pennovation center. That'll be a physical place where these activities can come together. So we're bringing all of those things together with the hope of encouraging those jobs to be local within the Philadelphia area.

Mike Waring: Caroline I know that Ohio State, like Michigan, big state university, publically funded in some sense, there's an expectation now that we are going to become bigger players in the economic region that we live in and try to spin off, talk about how that works at Ohio State.

Caroline Whitacre: Well I think that there is that expectation, particularly among land-rent universities, that you give back to the local environment and I would just cite really one example. We've just set up an industry liaison office that really represents a portal. It's a single point of entry for industry to access the university. This has been a tremendous change because when I started in my position there was really a queue at the door for industry wanting access to faculty and what I came to realize is it wasn't just industry folks wanting access to the faculty, they really wanted access to the students. We set up some expectations for that access to students, there must be an investment back to the university in the education of those students and that has been fairly well received. Investing in career fairs, not just showing up and accessing students, but investment in scholarships, investment in career fairs, support of student clubs, volunteering the time of those industries to come and actually speak to those student clubs. So it's actually giving back to the university, to participate in those students' education. That's actually been very well received. One of the different things we've actually tried at the university that I think is fairly innovative is coupling the industry liaison service in the office of research together with development. Together with career services, together with contracting so that when industry comes to the university, they see one face and that is that access to students and that is the same face of the university as access to facilities and access to research. It actually makes us much less siloed within the institution and presents a much more fluid face to the industry.

Alexander Cartwright: I'd like to follow up a little. We have a similar structure, we have an office of Economic Development which actually is charged with reaching out to industry and working with industry, but one of the things that I'd like to mention is that in New York State, Governor Cuomo has actually been very proactive about positioning the university's centers and actually driving some of the economic development. I'll give you a few examples of that. He established the Regional Economic

Development Council, it's across 10 regions in the state and with each of those regions there are co-leads of the regional economic council. In our region in western New York our president is the co-lead of the regional economic development council. That has allowed us to be very active in the whole process of how we build the economy. The governor also announced the Buffalo Billion, which was an investment in Buffalo of a billion dollars to change the economy and it's seen that the University of Buffalo is meant to be a part of that, moving us from a rust belt manufacturing economy to a knowledge based economy. And he's done that in real ways. That is we've announced a genomic medicine network, which is a \$50 million investment from the state and that is actually in collaboration with companies where we are actually going to be delivering about 600 new jobs over the next five years. That's a substantial building of our community around western New York. The other key things he's done is he's allowed us to partner with EWI for a Buffalo manufacturing works 501c3 that's separate from the university which allows us to more readily connect with industry through a separate entity so that there can be some sort of delineation between which problems can be solved where. The last one I'd like to mention is really quite innovative and that is Startup New York. Startup New York is an effort whereby all universities in New York, SUNY systems and private, are allowed to actually have companies on their space and that space is designated as a tax free zone for 10 years. Tax free for the company and tax free for the employees. This is a way of promoting economic development and tying it directly to the academic mission and so we have to think about how that works but it's a very interesting time.

Robert Clark: As you've covered the regional economic development council and Startup New York and such, I will say our president is also the co-lead for our region. I just want to take a minute to distinguish between the economic development piece and our role in terms of transferred knowledge and translation. The reality is that in a city like Rochester, and we are a private institution, I think the communities look to public and private universities for leadership in these domains, and the reality is that in a community where Kodak used to employ a 60,000 people and now is as few thousand people, and Rochester is the largest private employer in all of upstate New York with almost 22,500 people. So they look to us for jobs. And they look to us to generate innovation for new jobs. So one of the things we've really focused on in similarity to what you're doing at UPenn is establishing URventures. So we took our tech transfer office and basically created a venture creation shop. So we're really looking at all the ideas at the university at the potential for startup companies or for the potential of licensing and we are investing some funds internally that we raised through philanthropy and through our own dollars but a very small portion compared to the amount of federal funding that comes through. I liken it to the example that the community wants fruit, they want to go to the grocery store and buy fruit, we have seeds. No one is sure of what fruit these seeds will bear, so they're not really willing to buy the seeds, so we have to do a little bit to grow the plants that actually make this a viable ongoing venture. That's where the investment, that bridge funding, is lacking from fundamental research investment to actually translation side. So we've been trying to bridge that gap and I think that's critical, that will drive economic development but that's different from just being a resource in the environment. It's about just creating new opportunities.

Prem Paul: We also have a very exciting project we call it the Nebraska Innovation Campus, it's a 250 acre land right next to the university and actually our first phase of building has just been completed.

Our focus has been based on the recommendation of others, of food, fuel and water and our first major corporate partner is Conagra which is going to be co-located with our scientists. And the model that we are pursuing, like mentioned earlier, is that we don't want them to be just landlord but actually be really in collaboration with the scientists, scientists working side by side and having our students access through the collaborative research. We are early in the stage but the future looks very exciting.

Robert Bernhard: First of all, what Rob mentioned earlier, it doesn't matter if the university is public or private, when you have a community like South Bend or a region like Northern Indiana; they're looking to the universities to help. And so we have great engagement with the region and city to talk about what opportunities there were. This is not a throw it over the fence model, they are very much interested in collaborating with us in any way they can, they help recruit and so forth. I would say purposefully we've worked on two strategies that have both been mentioned but I'll try to frame them a little bit differently to give you some things to think about. From the corporate perspective, we've begun to look at our interactions with corporations as co-innovation labs. The model in the past has been a research contract to do a specific piece of work. We're recognizing that these companies can go anywhere in the world, the Max Planck in Germany that was mentioned earlier, these are outstanding research programs and the corporations we deal with have access to them, they don't have to come to us if we're not world class. So we're realizing that we have to be world class and we have to create the environment so that we are working together with their scientist in the same laboratory. On the startup and entrepreneurial front, we've recognized, we've done a lot of benchmarking. Your geography makes a big difference, where you are and what access you have to capital, but particularly what access you have to talent is huge. I think we're hearing things from the federal government now that they're starting to recognize that having an facilitating this identification of talent that can lead these entrepreneurial efforts forward where it's just a seed to begin with and there's a big risk that has to be taken, we can find some people to do that and bring them, in our case, out of the silicon valley or the Boston area to help us it would be a key for us moving things forward. There are other things for us to create this ecosystem for entrepreneurship but we recognize that we've got to be a player; we've got to get in that field with the community and do it.

Sandra Brown: We mentioned the pipeline of science earlier and I think there have been a variety of examples given already similar to some of the things we do at UC San Diego, but one of the things that hasn't been mentioned is that really as our students come to us, they are the business people, they are the science pioneers of the future, and so we are focusing on ways to interact earlier in their academic careers at an undergraduate level with industry and corporation partners. So for example, we developed what we call the Undergraduate Research Portal which any business can come to articulate opportunities for placements for students and we do essentially a match.com with student interests and the industry interests. This has been remarkably effective. So industry partners don't have to comb through hundreds of students applying for jobs but only those who fit their criteria, and similarly students who are looking for placements in industry as important experiences or prerequisites for their job training can sift through all of those business and find just the ones that are the right fit and the right direction for them to try on. So I want to mention that our model is that we start this technology transfer all the way from the undergraduate level on up to our most senior scholars. We now even have

launched the Moxie center which is an undergraduate innovation center on our campus. I think all colleges and universities are really appreciating the idea that good notions and good disruptive thinking doesn't just occur with senior investigators but it starts all the way with those who are entering our campus.

Mike Waring: Research dating...who knew?

Richard McCullough: I just want to pick up on Sandra's point. I think that all universities over the last several years have really spent quite a bit of time promoting entrepreneurship and trying to catch up with the undergraduates, because the undergraduates are already there. There's been a complete paradigm shift. The undergraduates used to think about going to big finance firms or consulting firms now, their first job – given the economy and the difficulty finding a job – is to start a company. And we see now that more students probably are actually thinking about their first job as starting a company. And we're actually trying to provide portals for them to do that. So at Harvard, we created the iLab in 2011, there's about 100 little companies that are incubating in that space. There's been over 35,000 visits a year since it opened. And you know we didn't do anything in particular that's super creative. There's a building, there's cheap furniture, and we put some smart people in there. It's just the human capital, and the students and the brilliant people that are coming there, and the ideas that generate its own momentum and excitement. Our new campus at Allston is an innovation campus, and an academic campus, but one that's going to try to capture that momentum and expand upon it even further. I think that's a really great point that Sandy was making that it's really undergraduates driving [?].

Mike Waring: I wanted to see if there's any reporter questions in the realm about tech transfer, innovation, entrepreneurship, that we want to lead into...Yes, Alan.

Reporter [Alan Kotok, Science & Enterprise]: You heard early on here about the brain drain, how we're losing scientists because of the lack of funding. Isn't there also a risk that you might lose scientists to industry and startup companies also, with this emphasis on tech transfer?

Robert Clark: The young faculty who we hire at the university, one of the questions they talk to us about is the universities policy on intellectual property. I used to not hear that question at all some years ago. I think it's a healthy thing. We are in the business of transferring knowledge to society as a whole; sometimes that requires an individual to take a company forward, sometimes it doesn't. I don't think we ever, at least at the University of Rochester, we don't think of that issue as something that we're worried about. If we find someone who needs to move out with a company, then they will do that. We would fully support that. And certainly the students, the post docs, graduate students, are an integral part of that. So it's the transfer of knowledge we prioritize first.

Dawn Bonnell: So part of that you might be referring to the people who come out of the university instead of perhaps going to what you might call basic science jobs, would end up going to start jobs and doing things like that. And I think that as long as we keep the core of our basic science activities healthy, there's nothing wrong with that; with some of our people graduating and going out and making this impact by creating, by taking these discoveries into the marketplace. I think in fact, that's exactly what we want to have happen – is for some fraction of our graduates, for us to be training the people who

will be the intellectual capital, who will be the people we'll rely on 20 years from now to solve the new problems that come up, whether they're in the context of a company, a start-up or residing right at the university. So with the caveat that we need to maintain that basic science, that the pipeline is always there, it's not negative that our people are graduating and going out into these different avenues.

Caroline Whitacre: There's a much more fluid relationship these days between universities and companies. I know when I was a graduate student 100 years ago, if you left the university and went to industry, you couldn't come back. So that is very different today. Let's face it; many of these companies will actually fail. Not all start-up companies succeed. Often we see people coming back to the university and that is much more common place these days, to actually go back and forth between industry and universities.

Robert Bernhard: For me this is sort of personal. My son is a PhD student in biomedical engineering. I biased of course, but I think he would be a great teacher and researcher at a university. He's already been involved in three start-up companies, one at Columbia and two at Purdue. And he's looking at this idea that there are 7% success rates for grants. This is going to be a tough decision for him when he graduates.

Reporter [Paul Basken, The Chronicle of Higher Education]: Robert Bernhardt talked about the idea of trying to attract people into the area of either Silicon Valley or Boston, so one of the questions I've had in general on the whole notion that universities can serve as a job creator for a region, is what else it takes to get people to stay there. If you're a university in a place that people just don't want to live, for whatever reason. I'm just sort of wondering what the university's job is in that regard; to make the community or the region a more desirable place to live, beyond what the university does in its own backyard.

Robert Bernhard: It absolutely is one of the motivators for us to be interested in and we invest in it because to recruit faculty and their spouses to the university requires the region to be economically vital. We put that hat on, that good neighbor hat on, in large part because we need to have a vital community to recruit people to the region.

Dawn Bonnell: And we have some tools that do that, some big tools that do that. With Penn as an example - the budget for Penn is about three billion dollars, if we don't include the health system let's say, that's 30,000 jobs in the region. And Penn took on a policy about 15 years ago to say, to well with that kind of a budget, to help the local community, the local region, just economically develop, not with start-ups or anything, but just by virtue of enacting policies such as a certain percentage of the procurement that we have, the services that we have, have to come from within five miles. Not within that state of Pennsylvania, but within five miles. This activity was directed toward West Philadelphia, and it transformed West Philadelphia from an extremely struggling, economically struggling region, to a vibrant community right now. It really was a transformation. And that's really a demonstration about how we can use these other aspects of our institutional size or resources to do exactly that. And we do it for a couple reasons - to be a good neighbor of course, to partner with the city, but also so that the environment improves and people will want to live in the region.

Reporter [Goldie Blumenstyk]: Companies get formed and they often move. They pick up and go somewhere else. I guess I'm wondering, are some of the economic expectations you're getting from your states, or I guess other public places, are they realistic?

Prem Paul: You know, it's been a very interesting experience, starting innovation capital and dialogue and then getting some support from the state. Kicking off the state fair two hours away. That turned out to be a very political issue. At the time, our chancellor went had a lot of meetings. Lots of us had a lot of meetings and tried to communicate to the general public, it's going to take time. It's not going to happen overnight. And that's the major question once you start a project in something like this. We are working very closely with the city. We are working with private developers. And the progress that is going on behind the scenes you cannot talk about. And everybody is anxious, 'What's going on at the innovation campus?' And they are looking for the building and they are looking for the occupants. So that's really the part we had to deal with quite a bit. Other than that, once they learn about it, we can feed them some information and they're happy.

Sandra Brown: I think that's a wonderful question. I think we need to think, just as we've been talking about the universities as being broadly partners with the community, multiple industry partners. We can help the economic development by talking sort of a cluster perspective. And let me give you an example of what I mean by that. We heard illusion to the Silicon Valley; well everybody knows that it's a great biotech arena. We have a similar one in San Diego, and we've actively fostered - through our 200 start-up companies, active companies that are in and alive in San Diego today, I say alive of course because many have move on to other pastures - but fostered this notion that competitiveness is an advantage. We want multiple biotech companies in San Diego. We want multiple clean-tech, clean energy companies in San Diego because you attract the talent to an area best when they know, jeeze if this job doesn't work out, there are other alternatives in this city, in this community. I can build my family here. I can be successful here, if not with this company, with another top notch company.

So we see part of the job in the university to spring those start-up companies out and to foster this sense of connection in an area. And I think that has helped us be successful in the relatively short time that UC San Diego has been in existence. Its 50 years were a billion dollars in our research enterprise now, and I think it's been because of that sort of cluster perspective we've taken.

Richard McCullough: I'd like to pick up on Sandy's point. I think the universities, the stewards and the taxpayers money, we create technologies or things and then all we can do is help the students and faculty members to start the companies and if we can give gifts to kind of help get the company launched, we can do that. And we can provide whatever; find some space for them of something. But we can't do a lot to help them be successful. Because that's just not what we do for business. So we just try to stand out of the way, as much as anything, and just promote these companies.

I've lived both scenarios. I lived in Pittsburgh for 22 years. I spent 5 years developing an innovation ecosystem in Pittsburgh that helped attract Google and helped create, probably, hundreds and hundreds of jobs there. And not I live in Boston. And so this idea of trying to...I used to say 'Pittsburgh's not like Boston and San Diego and Silicon Valley, it's like the rest of the country. So we represent the

rest of the country. And so what we just tried to do is create a lot of start-up companies [60% failure rate] but create some wealth within that area and some excitement within the Pittsburgh region to attract capital, attract talent to the region. And in the end, there were a number of companies, Google is a great example, that moved to the area. And, what would they move to Pittsburgh? Well, my favorite story is that there was a sign in California, in Silicon Valley, that said '4 bedroom, 3 bath house' and it shows a beautiful picture of a nice colonial house - \$350,000. And then it says, 'Google Pittsburgh'. You know it does have some advantages and it did attract some people there. [inaudible] It did at some time and then moved out. But the notion of just...I think it's a great question. People use to say, 'ugh, all of these companies they're being successful and they're all moving to San Francisco'. And I said, 'fantastic!' We're creating companies, we're creating jobs, and we're doing what we're supposed to do. We'll do the best we can to keep them here, but if we can't keep them here, you know, they'll move and they'll be successful and hopefully they'll give us a big gift one day. Because that's really what we hope. And then that can fund research that will help us out!

Reporter [Sam Stein]: Sequestration was obviously crippling for you all, but in the last budget deal, part of it was the NIH funding was restored – not all of it but part of it. I'm curious if people can talk about whether that's had a soothing affect, whether that's helped you all, whether you've seen the impact of the restored money. And if so, in what ways has it helped.

Richard McCullough: It would be too soon to tell I think is the answer. I mean, we're in the lag period. It takes six to nine months from submission of an NIG grant to getting it funded. So I think we don't know yet. Maybe that's not the answer you're looking for but that's the honest answer.

Dawn Bonnell: Also what I would point out is that yes, we were all very relieved to see that the sequester is still not there and some of the funding levels have come back up, but we have to have a reality check and realize that it's still not up to the levels it was in 2003 and we've had inflation since then, and as was pointed out the cost since then has gone up. So it doesn't look like an optimistic outcome being flat funded for a decade. That's causing us some challenges.

Sandra Brown: So what we don't know yet. What we're currently facing now is; we don't know what the scientific loss is by not having that full recovery, if you will, of funding. We don't know that yet. We do know that reduced funding impacts us on a day to day basis at each of the universities that are here and universities across the country. And I see that in two different ways: one is that individuals who are able to maintain their laboratories and continue their science are in many cases, based on the federal institutions that they're funded by, are doing so at lower levels. That means there's a difference in the funds they had to direct specifically to research projects. And we don't know the long term impact of that, but that's not a great trajectory. If we spend more money on administration and less money on the actual conduct of the research, we will see that. That impact will be evident down the road as Rick said through this lag effect. The second way that we face this on a day to day basis is for individuals who do not have the continuity in their funding. It's created a disruption in their science, in their staff, in their facilities. We face every day, requests for bridging funds for senior scientists who are doing top notch, stellar research but now have a disruption that's unprecedented. It's really hard for me to believe that

funding below 10%, as it is in a number of institutions, isn't going to leave a lot of good science on the table that other countries are going to be interested in picking up.

Richard McCullough: So very briefly, just to touch on the talent issue, I had a young woman working in my lab, an African American post-doc who is a superstar, working on developing the pipeline for diverse talent in academics. And she's just one example, but she said, 'I can't see doing this. It's too difficult to go into academics.' And so she went into industry. And that's great, you know, she's working for a great company, doing great things. But the idea of her focusing her talents on basic science and also contributing to society as a whole and academics is something that I personally worry about. And the reason is that she said, 'I just can't see doing what people do'. When you have to write 10 grants a year and the hit rate with NIH is two or three percent, you know I'd rather go into industry and have a day job and get paid and don't have to worry about this.

Glen Laine: So I too worry about the continuity of those who will backfill for us when we retire. And instead of worrying about primarily about the senior investigator who might be able to undergo a funding hiatus and perhaps teach more of whatever, it's the junior faculty member who is working on promotion and tenure, who has a fine window in which to do so. And if they don't, they're going to be looking for employment elsewhere.

Gloria Waters: The low funding levels means that we're really only funding outstanding science. But there's a lot of very good science. And outstanding science only happens on the back of a lot of very good science. We need to do all of that work. So just because the sheer amount of research that's getting done is much less than it would be if funding levels were higher, we're not just going to reach the level of outstanding science.

Reporter [Gene Russo, Nature Magazine]: My question kind of relates to the last two questions. There was this notion of the cluster perspective and the cluster approach, and I guess I'm wondering to what degree tight budgets are affecting the ability to have robust clusters? In particular, I'm interested if you have any thoughts, I don't know how directly this affects you but probably something you're looking at, of independent institutes that are really dependent on soft money. Like Scripps has been in the news lately, and in those cases they're really dependent on NIH funds. So I wonder if you have any comments on their future, how they're being affected and how this might affect collaborations at your universities, for example clusters?

Gloria Waters: I think increasingly even states are requiring universities, or asking universities to work together for large projects. So a good example in Massachusetts is the Mass Green High Performance Computing Center which is out in Holyoke. So the state asked five universities to collaborate together in order for them to put money into the MGHPCC. That has turned out to be extremely successful because those five universities are now collaborating on other research. For example, a faculty member at BU headed up an initiative for the Massachusetts Open Cloud which resulted in the state of Massachusetts putting in \$3 million and industry putting in \$16 million towards the creation of this Mass Open Cloud. So I think states are requiring universities to collaborate and I think that's a good thing.

Caroline Whitacre: So I think this is a large problem and just at certain private institutions, as Gloria mentioned, the state institutions are faced with this as well as our funding declines from the state. So it really calls into question, I think, really innovative funding strategies. And I would cite a couple, actually from my own campus. One, and don't laugh at this, is we monetized our parking assets, and we are not in the parking business, we're in the education business and the research business. So what that did is it generated a check for \$480 million that was then put into the academic mission of the institution. Part of this went into the endowment, part into hiring faculty, and we've done a similar thing with affinity deals. Affinity deals are deal with insurance companies, with the banks; they are the official bank of the Ohio State University, so that comes with an expectation for dollars. So I think these really innovative financial funding strategies, we've really got to think out of the box these days.

Glen Laine: So along those same lines as we look at more and more expensive core facilities, Texas A&M University has linked with University of Texas and Rice and the other AAU schools in Texas to pursue joint purchases on things it is not reasonable for each of us to have a new widget.

Reporter [Jeff Mervis]: I had a question about the last category, the intersection of science and politics. The organizations sponsoring this AAU and the Science Coalition have come out against the first bill which is legislation I think you're familiar with regarding reauthorization of NSF. I wanted to get your perspectives, since several of you are from red states, what does it say about the community's ability to get its message across if not a single republican on the House Science Committee voted against that bill? Do you feel that there's this political gap in trying to get your message across and if so, is there anything you can do to try to narrow that?

Caroline Whitacre: That is a great question. I'm from actually a purple state, sometimes we're blue sometimes we're red. I think that one of the things is that I think we've done a lousy job actually communicating about science to our legislators. I think we can do a much better job and I see that we've tried over the years to actually do a much better job of actually talking about outputs of research and one of my house members said to me "you're giving me input measures," so I was talking about funding, I was talking about the inputs to research and he kind of refocused my thinking and he was absolutely correct. We need to talk much more about the outputs of research, what are the publications, what are the patents, what are the companies? That's what he's talking about in terms of outputs. There's a new project out there called U Metrics that actually is about the outputs of research. It's about things like where are federal dollars spent? This project has created a map by county of the United States and where the federal research dollars are spent. That has actually resonated much more with the representatives that just about anything else has.

Glen Laine: I suppose I should comment since I'm from Texas. We tend to view this as kinda we're all in this together, and that everything I do on a daily basis is for the good of the citizens of the state of Texas. We're also a land grant, space grant, sea grant university, so the congress certainly has oversight of research and they need to know what's going on. But at the operational level, I think most of the people around this table, whether at land grants or privates or whatever, are trying to operate in the best interests of their localities and the nation in general.

Reporter [Anne Kim, Roll Call]: Aside from the funding issue, what are some other policy issues that you're concerned about these days?

Glen Laine: I think many around this table will have compliance issues, and whether it's a use of humans in research or select agents, certainly we need to hold people's feet to the fire so they operate at the highest possible standards, but if it grinds the research operation to a halt it's probably not in anybody's best interest.

Alexander Cartwright: I think it's important that we attract and retain some of the best minds in the world and that means we need to think about immigration reform.

Robert Bernhard: I think we definitely need to have on the table, as I mentioned earlier, the administrative load that our faculty faces and our universities face. It seems to be continuing to rise, despite the fact that we're showing 42% of the time spent by our faculties doing administrative work. Ten years ago, still the same number now.

Mike Waring: So we've got just a few minutes left, let me throw it open to anybody.

Reporter [Tracy Jan]: Regarding immigration reform, what is being done now given; I mean do you have any hope now that the senate bill is dead from last year, and our focus is so much more on the border?

Alexander Cartwright: That one I'll have to ask my government affairs guy exactly where that is. I actually don't know where it is, but I do know it is dead from last year and I hope it is reconsidered and that we start thinking about how to keep those people in the country. People come here and contribute to this economy, as a world leader and we are investing heavily in educating these people. We don't want to lose them, it's a significant investment, and we should take advantage of that investment and build on it.

Reporter [Tracy Jan]: So as the Science Coalition are you doing anything more right at this current time period or are you waiting until the next congress?

Mike Waring: Let's follow up with that afterwards, if no one has a comment, and we can get some specifics about that immigration issue. Other questions on any topic that we want to over here as we bring this effort to a close here today? Any last points that you wanted to make that you haven't had a chance to make? Any research officers if there's anything you were dying to say this is it now really before we wrap up here.

Sandra Brown: There's one last point I'd like to make and that is I want to underscore the value of the media having well trained technically knowledgeable reporters. That can go a long way in serving as a megaphone or a microphone for the voice of science. Having people who really understand science and being able to articulate that to the lay community is something that's important to us. Not all of our scientists are great public speakers for a lay audience; almost all are great in terms of speaking to their scientific colleagues. I just want to make that point that we can't do this alone and we really value the technical knowledge of the media reporters.

Caroline Whitacre: There's a topic that really hasn't come up here and I'd just like to throw it out there. This is an area where I think universities are really going to play a major role and that is in the area of data analytics, where we are surrounded by data and we are struggling with how to interpret that data. You've got expertise in computer science you've got expertise in statistics, mathematics, you know there's no better environment than a university to bring all of these disciplines together with how to deal with the mass of data that's out there. I think you're going to be seeing some brand new, metadata analyses, I've got several examples I could give, but there's lots of analyses in climate, in crime control, in food and water analyses, in genomics that when you look at many many publications together, and that's what kind of meta-analysis is. You're going to find just jaw dropping conclusions and I think that's an area that you're going to see dramatic advances in data analytics. And I think that that technology is going to really be coming out of the universities.

Glen Laine: I think we should probably keep an eye on the National Research Council Report which would indicate, and I would agree with this, that many of the breakthroughs in the coming years will come at a point of convergence of the physical and the biological sciences.

Richard McCullough: I think that a higher level point is that universities play a role in solving really hard really long term problems. That's what we do. Corporations don't often do that, because they have quarterly reports to deal with as an example, maybe some do, some don't. That part of the sector has dropped off. That's what we do, we take on really hard problems where we're not bound except about getting enough funding to do it, to solve these big problems and the impact that comes out of that is often profound and takes a long time to get there. I think that's sort of one of the messages that we do research, we do education, but we have the advantage of taking on these long term problems without worrying about having to get it solved next week. If that paradigm changes then that's an issue.

Robert Bernhard: I would also add to that, that we also represent a repository of knowledge and resources for the nation. We stick with problems because we're making generation long decisions and we become the resource when this thing becomes hot. I remember early in my career, nobody stayed with batteries. All of a sudden batteries became important and that's where universities came in. In the social sciences, nobody was paying attention to central Asia and those people who persisted in Central Asia now became really important.

Robert Clark: We are in a situation where our higher education industry, if you will, has been the envy of the world. I think we're all here because we're committed to making sure we stay there and that includes welcoming people from other parts of the world to study here. But it takes a collective commitment and a collective communication on the part of the people who are here today.

Mike Waring: Well on that not, I'm going to take the prerogative of thanking you all for being here today. I think this has been hopefully useful and informative, and on behalf of AAU and the Science Coalition I would like to thank all of you, both reporters and senior research officers, for being here. I know that some of our SROs will be available after to talk one on one and you can follow up with Barry and Sue with any additional questions you may have.