PROF. BENGT SUNDELIUS: Welcome back to our plenary. We have had two intensive sessions with breakout discussions, seminars, workshops and a light lunch in between. I'm pleased now to turn to the subject of success stories in collaborative science and technology research, and it's a privilege indeed to introduce the first speaker here, Dr. Detlof von Winterfeldt, who is sort of a walking success story when it comes to international collaborative research, being the founding director of CREATE, one of the just funded Centers of Excellence in Los Angeles but with part rollover in United States. Running that successfully now many years, now being the director of the National Institute of Advanced Studies in Luxembourg, pan-European Advanced Research Institute that you not only have to manage a number of American faculty members, scientists, but try to coordinate a number of European faculty members, disciplines and scientists, and also getting funding

from many European parts. I'm sure that challenge is even greater than the challenge of running CREATE together with DHS. So Detlof has experience working with DHS, helping to build homeland security in the United States and also being a European now back in Europe, having considerable experience and knowledge how to build research institutes and centers of excellence on this continent. Most he likely can tell us about some of the pro and cons, differences and how to turn them into success that he's been able to do twice. Please Detlof.

DR. DETLOF VON WINTERFELDT: Thank you very much, Bengt. It's kind of like coming home to me, both in terms of coming back to Europe in Luxembourg -- Austria where I'm residing in a beautiful castle -- and also coming back to homeland security which I haven't really worked on for the last eight months, nine months or so. I will talk primarily about CREATE and some of its experience related to international work as well as some of the substantive work that we did, and occasionally I might touch on my new experience at IIASA, but I can tell you that managing an international institution is a lot tougher than managing a national institution. And it's not only those pesky Europeans that I have to deal with, but I also have to deal with Russians and Japanese and

Koreans and Chinese and Indian and Pakistanis and South Africa and Egypt. Now, "having to deal with" is maybe a little pejorative. I enjoy it tremendously.

So what I'm going to talk about today is some of the activities that occurred at CREATE over the last six years. CREATE is, as you may know, was the first Center of Excellence funded by the Department of Homeland Security. Actually about six years ago exactly we submitted our proposal for CREATE in response to a basic ordering agreement -- a basic agency announcement that was sent out in August of 2003. And there were 72 competitors. 72 universities wanted to get into the homeland security research business. And I actually had thought at the time that I would do this only for practice to write this proposal, because I was really interested in the fourth call which was for a behavioral center. By background I'm a psychologist and a mathematician, so that interested me. In any case, much to my surprise, we won. We had an interesting mix of engineers, economists, social scientists, and I don't know if you all remember the gentleman to the very left, but he was the first Secretary of Homeland Security, Secretary Ridge. Then Secretary Chertoff, who was secretary during most of my directorship of CREATE, and then I passed the baton to Isaac Maya as interim

director on 1st of January, to move to IIASA, and here he is shortly after he got the job with new Secretary Napolitano. So CREATE actually survived or went through three secretaries, which is quite remarkable by itself. And we are going to recompetition at the end of the year, and with some luck and some skill I hope my colleagues will manage to win the recompetition. So the theme of CREATE was risk and economic analysis and why is this an important theme for research. Here's a quote by Secretary Chertoff. We have to identify and prioritize risk, understanding the threat, the vulnerability and the consequences, and then we have to apply our resources in a cost-effective manner. I used to have a very complicated mission for CREATE, and these days I say the mission for CREATE was and is to help the Department of Homeland Security do this job better by providing the science, the research, the risk assessments, the economic assessments to do this task. CREATE is an interdisciplinary center. We have quite a few social scientists, lots of economists. I'm not an economist, so I was surprised how many different types of economics there are. If you put five economists in a room, you get about ten different opinions, I understand. We have political scientists, international relations folks and so on. We have a good component of

engineering, and I'm actually pleased that operations research, which is primarily an engineering discipline, is on the list of topics for the recompetition, and computer scientists, public policy, decision science and so on. Here is a list of our current partners, and CREATE officially is a national center. We call it the National Center for Risk and Economic Analysis of Terrorism Events, but we also have four international partners. We have a very important partner in Australia at Monash University. Peter Dixon, who is one of the foremost economic modelers of major interruptions and changes using computer role generalized equilibrium models. We have a partner at the London School of Economics, a partner in Israel. This was one of the projects that we bid on through the international venue of science and technology and one of the first ones that they founded. And here we're dealing with our skills in risk and Technion's risk in Israel with liquid explosives, and we're studying how can we detect liquid explosives and how can we manage the flow of liquid explosives better. And then IIASA is of course my new institution, and I managed to snip off a small piece just to keep my interest in terrorism, and this is a subcontract from FEMA. This is not coming out of S&T but from FEMA on emergency preparedness.

IIASA itself does not do terrorism research or security research partly because it is such a wide far-flung international institution. I was not trying to introduce that at this stage of the game into the topics. The main research topics at IIASA are, in the new strategic plan that we just passed, energy and climate change, food and water scarcity, and poverty. So global problems and how to tackle those. CREATE is -- coming back to CREATE, our research framework at CREATE was a focus on risk assessment, economic assessment and risk management. Risk assessment is essentially determining in a quantitative way the threat, the vulnerability and the consequence of terrorist attacks. Economic assessment looks at the direct economic impacts in terms of business interruption, losses to structures, losses to lives. But, most importantly -- and this is where I think CREATE has developed its skill -- indirect economic impacts due to behavioral changes in consumption patterns, demand patterns, et cetera, and often that we find, as you'll see in a minute, the indirect impacts often overshadow the direct ones. Risk management deals with the questions, well, now that we know what the problem is, what can we do about it? And that's actually often a liberating step that I will mention at

the end. We do a lot of risk management work.
In August of 2006 the science and technology division was reorganized, and these are the three -- the directorate was reorganized, and these six divisions were created, and we were asked to align with one of the divisions. And I really tried. I tried very hard, and I reluctantly came to the conclusion that we're really serving all the divisions and proposed, and this was eventually accepted, that we ought to be able to support all six divisions of the Department of Homeland Security Science and Technology Directorate in risk assessment, economic assessment and in risk management. And we do and we did, and if you look at our projects they splatter through this whole table. And we have at any given time about 30 projects, and they're all over the place.
The kinds of models that we build in risk assessment are based on probablistic risk analysis, game theory, economic assessment, impact models, also economic analysis of terrorist behavior, and then resilience is an important topic. And in risk management we have some advance tools of defender/attacker decision trees, game theoretic models for inspection and controls -- I'll talk about that in a minute. The three that I bolded here I will chat about in a little bit more detail.

First let me talk about risk analysis. There is about 30 years of experience in risk analysis, so this was nothing new when 9/11 occurred, but many people like myself, many researchers in risk analysis, thought that terrorism is different in many ways but also similar in many ways to other risks in the world. So we look back at the sort of analyses that were done in nuclear power plant risk, environmental risk, natural disasters. We also see of course the bridge between natural disasters and terrorism in organizations like FEMA which are part of DHS, and that was kind of a natural transition. There were many attempts to apply risk analysis to terrorism. Our focus is primarily on probablistic risk analysis. I'll talk about that in a minute. We also have a game theory team at CREATE and so on. The hardest part of risk analysis is threat analysis. We mentioned earlier threat vulnerability consequences is triplet. Threat analysis is the most difficult one, and initially I shied away on doing threat analysis because I thought it was too complex and I wanted to get my footing first with the CREATE team in terms of vulnerability analysis and consequence analysis. Turns out that consequence analysis is very well covered by the national laboratory, so we went out of that business. We'll just buy it from them when we need it.

And they give it to us, quite frankly. Vulnerability analysis with (unintelligible) tools. And then I think it was sometime in, oh, I think it was 2006 or so, maybe early 2007 that I saw a report that was issued by Senator Lugar, and he had asked about 90 people, 80 people for probabilities of terrorist events occurring. And my first reading of the report I was very critical of it, but here are some of the results so just to give you some thought. The question was, what is the probability of a major nuclear, biological, chemical or radiological attack in the next five or 10 years in the world. It wasn't in the United States. It was in the world. But it wasn't quite clear what "major" meant and so on. It's one of the big issues with these analyses. If you're not clear about the question, the answer can't be all that precise either. So there are some issues with this.

So, for example, the median response, the 50 percent above/50 percent below response for nuclear attack was ten percent in the next five years. Seems outrageously high to me. I really worry about this. So I have some issues about this, and the next question I asked myself was, who are these people who gave these answers? And here are some of them. You probably recognize almost everybody on this list. But one time I gave this talk

at the Rand Corporation a few years ago, and somebody raised their hand right then and said, these are not the right people to ask. And I would agree with that. I think these are people who probably do not know at this time or even in 2007 when they were out of their respective jobs what terrorists wanted, what terrorists could do. And so I returned question to my Rand colleague and said, who should we ask? And he said, well, you should ask the terrorists, and that's of course a little bit difficult. But you can do the next best, and the next best is two types of people, actually three types of people. You can ask the intelligence analysts, and that's what we ended up doing. We went to the intelligence community to ask these sort of questions. Much better questions, but these sorts of questions. You can ask social scientists who study terrorists and radicalism and so on like in the START Center that we have or you can ask journalists. For example, what's the CNN journalist? He actually came to our meetings a couple of times. The guy who interviewed Osama bin Laden. You can ask them and -- yeah, exactly. Peter Berg. So we ended up trying to get a better handle at threat by asking intelligence analysts, and I was kind of emboldened because I thought we can certainly do better than the Lugar study. And we

started off a few years ago with looking at the threat of bioterrorism, and we used a very structured process called expert elicitation to estimate the threat or the relative likelihood of use of 28 agents. We had in the experimental phase only four bioterrorism experts, and we developed a protocol to do this. Here's sort of a typical result. This is very hypothetical. The only thing that's real about it is the shaded areas. These are the top 20 I think agents, and the numbers on the right column are the relative probabilities that this one expert gave to this agent being used in a terrorist act in the next ten years. And the shaded ones are anthrax, botulism, Ricin and Yersinia pestis. Turns out that any way you ask this question, many experts you ask, the shaded ones tend to flow to the top. This is no secret. There are reasons why this occurs, and I'm not going to go into that. So I developed a sense that there's some stability there so I felt a little bit more comfortable. And we concluded that ranking and rough relative judgments of threats are possible. Few biological agents flow to the top and so on. And this type of procedure was then later used with some of our help in 2006 for the biennial presidential report on bioterrorism and also again in 2008. And it was attempted in the DHS-wide Risk Based Resource

Allocations, as we call RABOT, and then I left and I had some issues with RABOT also, and this is something that is still under discussion.

Let me very briefly talk about the second leg of CREATE, the economic assessment. We have about 15 economists. One of our mainstays is very simplistic or very simple input-output models. These are very standard models. The nice thing about them is they're off the shelf and you can run them very quickly. It doesn't take a lot of effort. But we have also more advanced models, computable generalized equilibrium models and developed behavioral models. And we have one innovation at CREATE which is the economic modeling impact forum where we bring different modelers together to do the assessment of the economic consequences on the same topic. So we did the last one on 9/11 and there's a new one that occurs this year. You might think that the economic consequences of 9/11 are well understood. Trust me, they're not. There are still arguments about what exactly they are, although I think our last economic impact forum did pin that down as I will show in a second.

Here's some of our -- we did about 20 of these kinds of studies. Indirect economic impacts, for example, of a dirty bomb attack on Los Angeles and Long Beach due to

the port shut down is about 34 billion for 120 days. As it continues, it's approximately 10, 20 billion a month until the system has restabilized by having ships sent to other ports, which by the way does turn out to be difficult because L.A./Long Beach have about 40 percent of all container goods in the United States.

The MANPADS study was a study of the economic consequences of a MANPADS attack, surface to air missile attack on a commercial airplane. There the consequences come primarily from the reduced passenger volume, and we used as a benchmark the reduced passenger volume of 9/11 as a comparison. And the input-output model came up with a result which was quite staggering to me, about 2 hundred billion to 420 billion in indirect economic losses. Now, if you think about this, this is primarily through the ripple effects of tourism industry to the hotels, to travel and so on. Anything that's connected with travel is affected. So this number, by the way, in the economic impact forum was down-revised to about 150 based on a number of discussions that the folks had. We're now down probably somewhere between 100 to 150 in indirect economic impacts of 9/11, so we've pretty much narrowed this down. The first time we reached a trillion dollar area, 2 trillion, 2 and a half trillion or 1.24 trillion -- these are the first two rows -- was

when we looked at a complete border shutdown due to pandemic flu attack, either terrorist induced or natural. And somebody apparently had the idea -- I'm glad that I don't know who had the idea, but somebody had the idea that the solution to a pandemic would be to shut down the borders of the United States to people coming in, to people going out, to goods coming in or to goods coming out, except oil from the Middle East and electricity from Canada. Otherwise we would just completely fall apart. And there was an initial study that said this is not a big deal, and when we heard this we just thought we couldn't believe it. So we did a study, and our input-output model showed that it was well over 2 trillion and certainly 30, 40 million in this analysis of unemployed. And then a second study showed this was 1.4 trillion and 22,000 -- 22 million unemployed. These two numbers were two different models, one input-output model which doesn't make any adjustments to prices and changes and the other one an equilibrium model which does. Typically equilibrium models are about half the impact because they take into account more changes of prices, price signals and consumer behavior. And down at the bottom we see also the September 11 attack. We estimated about $108 million GDP loss. That's kind of a pretty stable

number now, between 10,150. And the last element I want to briefly touch about -- I know I'm running out of time here -- is risk management. And there I wanted to give you just one example how science can turn into technology and technology can turn into rapid runaway application. And this was an idea that a Ph.D. student had to randomize security measures and patrols, randomize them to make them unpredictable, but to do smart randomization and mainly based on the value of the targets that you want to protect. It's a mathematical algorithm behind it. It was implemented in a technology called Armor, which is a computer program. This computer program works together with the researchers who developed it and police officers at Los Angeles Airport to generate the randomized schedules. There is some interaction process that can be done. There's a template that the police officers use. They can put it into their weekly schedule. They can make adjustments if they want to, but my understanding is they never did. They just accept the randomized schedule, and then the bottom line is basically it becomes very unpredictable how you conduct your inspections and patrols. Newsweek picked this up. This is September 28, 2007. "The elements of surprise. To help combat the terrorism threat, officials at the Los Angeles International

Airport are introducing a bold new idea into their arsenal: Random placement of security checkpoints. Can game theory keep us safe?" This is one small example of how you can get from rather esoteric science -- this was based on a game that I didn't even know called the Stackelberg game to something that is implemented. TSA is using it now to schedule their air marshals. There are other users of it already. We've got about five or six users of this type of tool.

So, in conclusion, I'd like to make a couple of comments in looking back on the CREATE work and reflecting a little bit on it, now having been away for eight months. I think looking backwards by far the toughest job is still the risk assessment job. In particular in the threat assessment part, because adversaries seek vulnerabilities and high impact, and they're looking for the surprises, and the surprises by definition are not something that we expect. And, moreover, probabilities of threats and attacks shift with our defensive action, and that's a very big problem. Once you secure one building or one aircraft, then terrorists will move to a different path. Economic impacts are critical. The indirect economic impacts often overshadow direct ones. 9/11, 50 billion direct, 100 to 150 billion indirect. Shut down the port, the direct impacts are very little,

just contamination and possibly some health effects; but the indirects are enormous.

Also public responses are often the vehicle to large indirect consequences. Like not flying, for example.

Risk management focus can help, and here I feel very strongly that when you focus on what can be done you can make some progress. If you just keep on worrying about the problem, there won't be any progress. So identifying options, identifying decisions and implementing the good ones is important. There can be also what some people call paralysis by analysis. We analyze, we do research, but often I tell my scientists, my researchers, my analysts, don't try to optimize this problem to the Nth degree. Just make sure that you identify the real losers and get rid of them. Often it's as important to identify those options that are not good as it is to identify the real good ones because if you have eliminated the real bad ones, you're probably going to be relatively safe with the remaining choice. And, as usual, it's not up to the decision theorists, the analysts and the researchers, but often to politics what the ultimate choice is. So thank you very much. This was a bit of a tour de force. In all of these projects we had international help. LSE helped us with the economic analysis. We're working closely with IIASA

on threat. And we have been working with Australia on the economics. The way this works is we're identifying all partners in the international arena, come to us, develop projects, and it can be funded through CREATE. So thanks very much. It was a pleasure to be here. And happy to answer questions, but I also don't want to steal the time from Starnes Walker.

PROF. BENGT SUNDELIUS: Sit over there for now. Thank you very much. Excellent. We had a question on the web this morning I'm going to pick back up I hope. But first I want to call a veteran to the podium, Starnes Walker. Starnes has some success stories to relate. What is interesting with Starnes is he has bridged other boundaries. Not only good work at DHS, as we heard about, but also many years in Office of Naval Research and in the private sector. Sometime you should talk about tales from Oklahoma. (Unintelligible.)

DR. STARNES WALKER: Thank you. Well, actually this was a good segue to talk about some of our success stories and the importance that the work that CREATE has been doing to scope out the areas of vulnerability and, as we just heard, the areas of seams where vulnerabilities occur. And understanding that gives us at least a measure for what areas we ought to try to focus on that are extremely important for enhancing the nation's

security and global security. So I think the -- I continue to look forward to see more and more work coming from CREATE that will help guide us in the future in the areas that we would like to look at. And also we could overlay the discoveries in science and technology that we would see that we perhaps could have solutions in a reasonable time frame to address these vulnerabilities, but also what areas of investment we should make in phenomenologies that are beginning to mature, become exciting, where we see things that would be derived from those discoveries. So think that's an area that we're excited about, and I brought forward a few examples.

The other thing that I think that we had just heard too that -- the complicated areas of how society works, when you think about within the United States and within Europe, the Baltic areas, you have the -- in the United States we look at 18 different sectors of how our society operates and the overlaying of electrical power and natural gas distribution, energy, water, all of these things. And each of these systems, maybe it's a simple way to look at it, but I've always looked at each of those infrastructures as being kind of a two-dimensional plane, let's say, and they have critical nodes of how they operate and those vulnerabilities of

those nodes. And then if you were to then construct a three-dimensional model where you overlaid 18 different planes and then you look at a ripple effect of if I attacked one node of industry or economy and how does that ripple and affect the other sectors? And then you begin to define maybe there's more of a strategic thing that you have to make investments in that if we could solve that problem, then make it reasonably what we'll call a hard target where it's difficult to breach that and cause a disruption of society and harm for our populations, then that would make good projects to look at and see if we can move forward with. I brought forward a couple of examples that we have underway, and we have many more. And from an organizational standpoint it's kind of an overlay across all three sectors of transition, innovation and I'll call it basic research, or research, where we find there's an opportunity for all of this to come together as we address some of these critical vulnerabilities that come from the analysis that we have just heard about. See if we can call up the -- I've got a few slides here if we can bring those up. If not, I can walk you through these verbally. Doesn't look like they're going to be able to find that, so I'll start off talking about each of these individually then. One is our program we call

resilient tunnel detection. Or demonstration rather. All across the world we have a lot of tunnels that are used in different modes of transportation. And the construction and materials used make them sometimes vulnerable to both either a natural disaster or a man-made disaster where explosives, as an example, could cause a breach of the tunnel. If that were to happen, then how would it be possible for us to retard the flow of water into those areas? And this is an area that we have a program underway right now where we've been working with international partners, with West Virginia University, where we could take a look at some of the advancements in materials science, and sensing of course of a breach, where we could provide a plug that could be expanded volumetrically very rapidly so that it would stop the impeding flow of water into this area so we could restrict the amount of damage and the loss of life that would occur as result of this breach. And of course I'd like to remind everyone that as we make further advances in materials science, then the ability to withstand or withhold higher back pressures of materials and water, it's only going to become better. So having a demonstration where we could see how rapidly a plug could be deployed and how effectively it would be in retarding any type of fire and water, smoke and other

things, then this would be a very useful thing to have in our arsenal of reducing vulnerabilities of some of these critical nodes. So this is I think something that we'll probably see products being developed rapidly, but also improvements as we make more discoveries in materials science.

The second one that I would like to talk about is again with international partners, and I started my discussion off with the fact that we do have to worry about both natural and man-made disasters. One of the things that's very difficult is in the areas of hurricane science. As you know, we've all seen the disaster that occurred with Katrina. And with the other areas of typhoons and hurricane predictions, we don't really have everything understood well enough from the basic science that allows us to predict with a much higher degree of confidence either the strength or -- the growing strength or subsidence of hurricanes or typhoons. Likewise, I'll call it the cone angle of onset onto a shoreline, being able to say where that is going to hit a shoreline. We could do a lot better job. But here this is an example of where we can be working with international partners, with NOAA, other government agencies that we can take a look at how we could get more sophisticated measurements and better models that

would allow us to understand these issues. And this is only going to come from better atmospheric and ocean measurements. As you probably realize, the growth or subsidence of storm many times depends upon the temperature of the ocean, but then you have to worry about the mixing that occurs, the wave action. There's all sorts of very complicated phenomena that go on that really control the amount of energy that is going to be placed into that storm and how it's going to be retained or dissipated. So we have a very good program underway now for making more sophisticated measurements, running these into the models, and then going through -- I'm sure that these type things from a CREATE standpoint, you begin to do what we call parametric systems analysis, and you do sensitivity studies to understand what are the critical parameters that control the growth or subsidence of storm. Likewise, if we were able to better predict that and the onset, then if you have very precious resources to be deployed, government agencies, state organizations then would be able to more effectively safeguard both the infrastructure and save lives, because you only have a limited amount of resources. If we can deploy that more effectively, then that would be very good. So that's the second program we have underway that we're very pleased about.

The third one, example is of course I think we've all heard about the issues of border security and being able to either be able to control and understand the movement of elicit goods or the movement of human people, of people moving back and forth in a covert manner. If we could -- and many of these occur through tunnels. Many times, as you know, it's very difficult to discover these, and we surprisingly see these show up, but if you could imagine being able to look at a clandestine type of tunnel that has been structured, then all of a sudden you have to worry about the soil composition, moisture, technology such as ground penetrating radar or very sensitive gravitometers, breakthroughs that we make being able to look at voids and either acoustical or physical sensing and monitoring. We don't have all the tools, so we're working again in partnership with universities, international partners, so that we can do a better job. We don't have the solutions that we have today, but with the advancements in new types of sensing technologies, data fusion, because there's probably no one single sensor but many different approaches, bringing that information together would allow us to be able to discover the use of these tunnels that again, if you can bring -- of course, a lot of it is to bring drugs into countries, but you could also bring bad

people or weapons of mass destruction. So it's very important for us to be able to have technologies to be able to control and enhance our border securities for any area, any nation. So this is a third program we have underway, and again it's international in scope and it reaches across other government agencies as well as with academia. So this is I think an exciting area, again fertile for discovery, and it's again looking at ways that we can help protect and enhance the nation. The last one that I'm going to discuss will be the one on the -- we talked about the resiliency of infrastructure, and we also have heard over the last two days the concern we have with the terrorist's choice weapon of improvised explosive devices. A lot of people are harmed by the breakage of the glass and the shards that are created in an explosive detonation as that shock wave hits a window, breaks in fragments into very small pieces of glass that are moving at high velocity, and they literally can cut you in two. So a lot of people are harmed by that. So if we could come up with a composite window that gave us the optical properties that you all desire and maybe even good thermal properties so that they're, as we would say, a low E window, "E" being E massivity, but providing good energy parameters for new construction, but also would not be

fragmented upon detonation. So we again have a program underway using advancements in materials science, international in participation, and at the same time taking a look at how these new materials that are being developed, how those would be then placed in. So we have a testing program underway that looks -- I think we're going to see some exciting breakthroughs, but again it's how can we make the infrastructure more resilient, how can we protect people. So this is something that we're trying to accelerate in our demonstration program.

These are four examples of many that we have underway. Again, I think the work that CREATE is doing allows us to quantify in a better way let's work on the ones that seem to be the most serious in terms of how it will affect society and how more people could be harmed and we have solutions. Let's pick some demonstration programs where we think we've got a good, solid science footing. We also see that there are discoveries occurring that may be able to be addressed and shown to be very helpful in that, and then move forward with these projects. And, again, it's something that integrates across all of our directorate where we have innovation. We have our six divisions that become involved, and likewise we bring in university programs.

As you know, our Centers of Excellence, as I said yesterday, encompass about 240, 250 academic institutions, with reaching out internationally as we just heard with CREATE -- this is true for all of our centers -- and we are looking at emphasizing the importance of international collaboration. So I just wanted to give you at least a cross-sectional view of four areas that we're working on. And as we see other opportunities, we're going to continue to have additional demonstration programs which brings the international community together in a way that improves and safeguards all of our nations. So I guess with that I'll stop and probably be able to have a little bit of time for some questions. Thank you.

PROF. BENGT SUNDELIUS: Thank you very much, and we have an unusual opportunity here. We have two very seasoned scientists of independent minds, so we can pick their brains for a few moments. While you think about some questions you want to raise, we had a question from our global audience this morning. I thought it was a good question and I bring it up now. There have been many subjects discussed over the last two days, and everything is important, but what should really be prioritized? What's the most urgent? We all have our favorite topics, but research requires sometimes long

term investments and will not yield results for a number of years. So if you put the question on urgency, if you had the 10 million dollars now or more, urgent, what are the most urgent priorities? Shall we start with the social scientist?

DR. DETLOF VON WINTERFELDT: All right, let's start with the decision analyst and risk analyst. That's me also. The way I would address the question is not by picking particular technologies but by answering to develop or to suggest that those technologies are to be looked at where one can make a difference. Maybe not now, but at least have a chance at success, and if they're successful they make a difference. So I would ask two questions. What's the chance of this technology being successful and what difference does it make?

PROF. BENGT SUNDELIUS: Impact, impact.

DR. STARNES WALKER: Let me describe another program we have underway that relates to both the critical infrastructure but also takes a look at improving energy efficiency and giving us a way where we think in addressing this it might be important from several different factors. And that is what we are calling our resilient electric grid, and that's where we're taking the advances in superconducting technology, materials science, that allow us to go to higher and higher

temperatures of superconductors to provide a means to move power efficiently, but also to be able to put it installed in a parallel path where we have in an urban area where you have a very complex underground environment, as you would know with an existing city, where if power should fail, and it would affect hospitals and a number of critical sectors that are important for emergency response, to have some redundancy in the system. Well, here, as we make the advances in superconducting technology, it's possible we've seen now for us to be able to take what I would say would be a cross-sectional size of cabling to bring power from one midstation to another, something on the order of the size of the screens behind us, and replace it with one cable running through phases, something on the dimension of around six inches in diameter, and what impact that would have. So this is an example of a program that addresses many different areas of infrastructure that are important, and at the same time it can be on the cutting edge of science. And then maybe some day, as our materials scientists and physicists make further breakthroughs, if we ever have a room temperature superconductor, then that changes almost the whole world. That will be far reaching and maybe some day we'll have that. But here's a good first

step which takes a look at something we know is important in emergency response. As we saw the attacks at 9/11 with the World Trade Center, disruption of power affects emergency services. Here's a good example of bringing that together. So I think that's something that again decision-making and, as we've just heard, making maybe some choices in terms of working on the most important things, but dovetailing that into something we could do today.

PROF. BENGT SUNDELIUS: Thank you. Another good question popped up. You have it in front of you. What's the biggest obstacle to increased cooperation of science and techology research among the U.S. and international partners? What is the major obstacle to increased cooperation? Seasoned, experienced...

DR. DETLOF VON WINTERFELDT: Well, I struggled with this question when I started my directorship at IIASA because I was interested in trying to bring some of the research that we had started in CREATE or that the DHS had started with the Centers of Excellence in general, like behavioral work, into IIASA. And there is one aspect, not just in terms of international relations in this work, but also even starting just in the United States as a matter of universities working on security issues, and that is that you very quickly get into sensitive and

potentially into the neighborhood of classified information. And that will I think create some issues both at the university and as well as in international collaborations: What is classified, what is not classified, what can be exchanged, what is sensitive? How do you deal with sensitivity? I think all of this can be overcome, and I'm very pleased that there hasn't been a major scandal yet in this particular topic area. I have not heard of any stories that said somebody revealed sensitive or close to classified information at this research, but I think it's an issue that you have to pay attention to.

DR. STARNES WALKER: I agree with my distinguished colleague that it's also possible as we look at the opportunities to break it down into basic research, applied research, and if you break the problem down, then you can have researchers in the international community working on certain areas coupled with other work going on that's, say, behind a firewall where you end up with the product, but it still is an involvement. If you break the problem down, you always can put it in a framework that allows I think enhancing international collaboration and cooperation. The one thing that I think it really comes down to is people having a personal commitment to -- it goes down to the individual

and if you would like -- science and discovery knows no bounds, no geographic bounds, so it's really important to bring, as I said yesterday, an international community together as a catalyst. I think you will find more creativity coming from people working at different -- at the same problem from different perspectives. So it comes down to the personal commitment of the leader saying this is important to do this. And if we continue to have leadership as we do today, I think that's going to continue to grow because the world is flat, the web has enabled technology and understanding to be done within nanoseconds as you move information and electron packets from one part of the world to the other. So I think this is just going to continue, and I really don't see there's going to be major roadblocks to international collaboration.

PROF. BENGT SUNDELIUS: A third and final question that we have from the web. We have viewers in Australia, South Africa and Latin America. This panel was about success stories in international collaboration, and the question is then raised we need better ways to measure and describe success. How do you know that you have success stories? What criteria do we use for success in conducting research and leveraging for security solutions? Please.

DR. STARNES WALKER: I think there's always a struggle in proposing metrics that will really allow you to measure what is important, but I've always looked at what goes on within a laboratory and how successful it is to be able to put it into practice. The other is the importance of having tactical and operational values within those metrics so that there's a feedback between what a demonstration program is doing back to the basic research that's going on within a laboratory. So metrics have to really be carefully defined to measure the movement of information and understanding and discovery from the laboratory into the field, and then from the field back to the laboratory. And I think that there are many different successes that can be shown that if you keep those benchmarks in front of you.

DR. DETLOF VON WINTERFELDT: I would like to respond perhaps a bit like an economist might, and that is that at least in terms of what CREATE set out to do, I said that in ten years of CREATE's existence I would like to be able to say at least two things: One, that we have saved the country a lot of money from investments that weren't so great, and I'll just give you one example. I thought our analysis indicated that putting surface-to-air missile defenses on airplanes was probably too expensive for the return you get. Or, two,

that we show that certain risk reductions can be achieved and implemented at a rather reasonable cost. So those are two flip sides of the coin.

PROF. BENGT SUNDELIUS: Thank you very much. Two highly accomplished scientists that care about the results and impact on the real world, save lives, save property. Thank you very much.