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Committee on Technology

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P R O C E E D I N G S [9:00 a.m.]

MS. SKEMP: Good morning. My name is Susan Skemp and I am a fellow at the Office of Science and Technology Policy. I am also the OSTP representative to the Inter-Agency Working Group on Manufacturing R&D.

I will just give you a couple housekeeping items before Phil Bond comes up. The rest rooms are located at the end of this hall. If you want some refreshments, the cafeteria is downstairs. So, you go back towards the entrance and there are elevators to take you downstairs to the cafeteria.

For lunch today, it is everybody on their own, but we are suggesting that you go out the front entrance over to the Rayburn Building and they have a cafeteria over there. You will have to allow a little bit of time to come back through security to be able to come back through that system.

I have been told that there will be guards at both doors here. So, if you wish to leave anything, there will be somebody watching over it.

Again, this is a public forum. We do have a court recorder here. So, a transcript when it is available will be posted on the web site. Again, if you don't know that web site, it is on the back of your agendas, but it is www.ostp.gov/mfgiwg. We are using that as a communications

network and also Dale will talk about the next steps, but those who are not present here in person will also have an opportunity to provide comment.

This is not a classified meeting, just to remind everybody. If you will take those things called cell phones and, hopefully, mute them somehow, it would be appreciated. As I said, the recording will go on. So, the gentleman is down at the front.

We also have a sign individual up here, so, he will make some comments in a few seconds. If there is anything else, just please see myself or any of those who are wearing the Inter-Agency Working Group badges and you will see them throughout the audience.

Thank you.

Agenda Item: Welcome

DR. BOND: Thank you, Sue. Let me add my word of welcome to everybody. Welcome to the Department of Commerce and welcome to this public forum. My name is Phil Bond. I am privileged to serve here at the Department as the Under Secretary of Commerce for Technology and privileged, too, to serve as the chair of this particular Inter-Agency Working Group.

The reason I want to add a special underscore of welcome here is that we are the Department of Commerce. We do understand that anything that we do in the federal

enterprise that drives toward economic growth has to be partnered with the private sector. So, from the very beginnings of our inter-agency group we looked forward to the day when we could sit down and take input and opinions and guidance from the private sector, which is our mission today.

What we will do today is first to more or less brief you on the progress and thoughts that we have had as federal agencies on this Inter-Agency Working Group, give you rather in-depth briefings on where we are headed in our thinking, not for the purposes of telling you where we are going but for the purposes of asking you what you think and getting your input on that.

We are going to begin today with an overview, a very high elevation look both from the federal enterprise side, but then also getting the senior official here at the Department of Commerce, who is the liaison really to the U.S. manufacturing sector, to give an overview from both the public and private sector that will set the stage, if you will, for then a little bit of a briefing from myself on the Inter-Agency Working Group, where we are going. Then we will go into the detailed briefing of our initial findings.

After lunch, we will look forward then to taking your input, your thoughts and some time to react to what you have heard in the briefings and really give us your best

possible input.

So, we start this morning looking at manufacturing technology challenges from the federal perspective and we have perhaps the best qualified person in town to do that for us, Richard Russell, associate director of the Office of Science and Technology Policy and the deputy for technology to science adviser John Marburger.

Richard Russell has served in this capacity or I should say confirmed by the Senate for that capacity in August of 2002 and before that as many of you know, as I know many of you are familiar with Richard, served for a number of years on the House Science Committee, where he oversaw technology and environmental policy, including responsibilities for all federal civilian research and development and authorizing responsibilities for most of the civilian science agencies.

What you need to know in my view about Richard Russell before he comes to share an overview on the federal perspective is that it is his task from OSTP to look across all the federal agencies, the technology policy and R&D programs and then really be as I say all too often,perhaps, our quarterback on an inter-agency basis ont he different technology policies that we will pursue within the Bush Administration.

He is doing that in this regard as well in terms

of manufacturing. He is the co-chair of the NSCC Committee on Technology and really the quarterback for all of this policy. So, this morning, please join me in welcoming Richard Russell to give us an overview of the federal R&D perspective.

Richard.

[Applause.]

Agenda Item: Manufacturing Technology Challenges

DR. RUSSELL: Thank you all for coming here this morning and thanks so much, Phil, for the kind introduction. Phil neglected to mention that my co-chair on the technology committee is Phil Bond. So, if I am the quarterback, we decided this morning that he is actually much like Coach Gibbs in his first incarnation or maybe future carnations, but we will see as we go.

I would also like to thank Sue for putting this event together and we are very lucky to have her on loan to us for at least a year, although we may be able to persuade her to stay a little longer. She has been a tremendous asset to OSTP. So, we really appreciate that.

What I am going to do today fairly briefly is run you through what the Federal Government's priorities are with respect R&D, give you a little bit of background on what we are spending our money on, how much money we are spending and make a bit of the connection, which will be

made in a much more profound manner later in the day as to how that relates to both this workshop and also manufacturing R&D.

So, Sue, you want to put up the first -- okay. Great.

The President has three main goals and I don't think these come as a surprise to anyone because they have been his goals pretty much since 9/11 and that is, obviously, winning the war on terrorism, securing the homeland and strengthening the economy.

R&D plays a tremendous role in all three of these goals and so when we look at the R&D portfolio, we try to map it to the President's priorities and it is very easy to see that R&D is going to play a major impact on all three of them and, obviously manufacturing R&D is particularly relevant to the last but is also relevant to the first and second.

So, I think it is nice that the priorities of the administration map nicely to the R&D priorities overall. We are currently proposing to spend -- the President proposes to spend $132.3 billion on research and development and that is a big number. Just to give you some comparisons, that is a 45 percent increase from fiscal year 2001. The total R&D budget in fiscal year 2001 was $91.3 billion. That is a $733 million increase over last fiscal year.

So, we are talking about a lot of funds that are going R&D writ large across the entire Federal Government. To give you further context, if you look at R&D spending in constant dollars -- this is in 2000 constant dollars -- you will see that we really are at a high. There are often times discussion of the fact that the federal research budget is somehow lagging. It really isn't. We are spending now -- and these are actually outlays, so this is the actual amount of money in the pipeline that is out on the street -- we are spending more now in constant dollars than we ever have.

That is true not only for R&D writ large but it is true for non-defense R&D. Oftentimes you will hear a discussion of the fact that R&D on the defense side has been increasing and that most of the increases in R&D writ large are really just due to defense. That simply is not accurate.

When you look at non-defense R&D, one of the things that comes out much more clearly, though, is the Apollo Program, which you see is the big mountain at the front of the program. So, you see a little more of the variation over time, but, again, in constant dollars, we are at a peak and really it is a peak we have been building to since the start of this administration.

Another interesting way of looking at the R&D

budget is what fraction of the overall discretionary budget is taken up by R&D. I think this is a particularly important metric because when you think about it, the amount of resources that are available for R&D really are dictated by the total amount that the Federal Government is spending on discretionary programs. Within that context, we are currently at a 37 year high.

Again, you have to go back to the Apollo Program to find an era when the Federal Government was spending more of its discretionary budget on R&D than we are today. So, within that sizeable sum of money, what are some of the priorities that the President has outlined and the administration has outlined back to the agencies as to how we should be spending these funds.

Every year, the Office of Management and Budget and the Office of Science and Technology Policy, the directors of each, send out a memo to all the agencies outlining the priorities for the following fiscal year. Within that context, the priorities that we outlined this year, which are similar and have been similar year to year since the Bush Administration has started, are nanotechnology, networking and information technology, R&D for homeland security, R&D for the environment and the hydrogen economy has been a major part of that, biology of complex systems and physical sciences.

Within that, there clearly is a very strong mapping to the three themes that you all are here to talk about today and I think that that is where your input is going to be so important because three of the priorities that have been outlined for the overall R&D budget directly map to the three priorities that you have outlined or that are outlined and are going to be discussed in this workshop today, associated with manufacturing research and development.

Those are obviously manufacturing for the hydrogen economy, which clearly is a significant presidential priority; nanomanufacturing, another presidential priority and then intelligent and integrated manufacturing systems. This link may not appear quite as clear, but I think there is some real possibilities here in working with -- in networking and information technology research and development program. I will briefly break out each of these three programs, nano, hydrogen and NITRD in terms of where they are in the budget and what the programs do.

But I think there clearly is a connection there as well. So, I think that this workshop and the themes of the workshop are very nicely tied into the overall budget priorities, R&D budget priorities of the administration.

Starting with NITRD, the Networking and Information Technology R&D, NITRD has been a priority since

the beginning of the administration and this gives you some sense of where the program is compared to the previous four year period or in this case previous five year period, the cumulative total for five years is $10.4 billion. That contrasts with $6.7 billion in the prior five years.

If you look at it in constant dollars, you will also notice that there has been a significant increase in this program. NITRD is one of our critical cross cutting programs. Almost all the R&D agencies in the Federal Government participate in NITRD, obviously, major players, like DOD, DOE and NSF. And there are a couple specific areas that I think within NITRD that are particularly interesting to the manufacturing area.

One is high confidence software design and productivity. Another is high in computing and finally human computer interaction and information management. I think that these will map nicely to some of the areas within manufacturing R&D that should be looked at and prioritized.

Next is hydrogen and you are probably all aware the President in his State of the Union outlined a hydrogen fuel initiative and it shows up very starkly in the numbers. He outlined it for FY 2004 and you can see the rapid ramp up associated with it. The President very much feels that hydrogen is going to be a critical component to our energy and dependence to dealing with environmental issues, to

moving our economy forward in the future. It is clearly something that is going to require significant federal input. Transforming a sector from oil base to hydrogen base is obviously a massive undertaking and requires tremendous coordination between the Federal Government and the private sector and investments to match.

Next is nanotechnology and if you look at the nanotechnology chart, it is quite stark. We have increased nanotechnology R&D funding by 127 percent since 2001. It is now a billion dollar program and it really is, I think, making a tremendous difference. Phil, I know spends a lot of time going around the country talking about nanotechnology and talking about the tremendous economic benefit that we probably will see in the future. You are already starting to see a significant economic benefit from existing nanotechnology and clearly when we sort of get to the end stage of where we hope to go, where we can actually start constructing things on the molecular and atomic levels, it will have a tremendous impact on virtually everything we do and that is not only true for things like codings and pharmaceuticals. That is going to be true for virtually every segment of the industrial society.

One of the biggest issues with nanotechnology is clearly going to be in the manufacturing arena. It is great to be able to design things at the molecular and atomic

level, but, obviously, they are rather small and you are going to have to produce them in rather large numbers to have a significant impact. That is where manufacturing comes in and it is clearly a major part of the program and will be looking forward.

Finally, the President -- and this is based on a recommendation that came out of the Department of Commerce's manufacturing report -- the President issued an Executive Order in 2004 to specifically help tap into a significant fund, the SBIR, a Small Business Innovation Research and the STTR, Small Business Technology Transfer Program. This is a program that is roughly $2 billion. The way SBIR works -- and I know a lot of you are familiar with it, but for those of you who are not, it is a program that is funded out of the R&D budgets of each agency. So, each of the major R&D agencies have to give up a fraction of their money to fund SBIR.

Currently -- and this is an FY 2003 number because the numbers lag a little bit -- about 19 percent of the program or $332 million has been going to manufacturing related R&D activities. What the President did is he issued an Executive Order saying that the agencies should attempt to prioritize manufacturing R&D within the SBIR program. We have great hopes that this is going to make a big difference. It certainly seems that SBIR as it is currently

set up is an ideal mechanism to address many of the challenges facing manufacturing for an R&D context.

To give you some sense of where the SBIR money comes from and, again, this is not particularly surprising, it maps to the major R&D agencies or the major contributors to SBIR. So, you have HHS and DOD and DOE and NASA and NSF as significant players.

Finally, to sum up, a number of the research and development programs that we are prioritizing that are part of the $132 billion the President has proposed are really, I think, critically linked to manufacturing R&D. That is one of the reasons why we are looking forward so much to the results of this workshop, to figure out how we can use our existing R&D funding base to improve manufacturing R&D and better coordinate with the private sector.

I think there are some wonderful possibilities here and I thank you all for giving your day to this activity and I appreciate you taking the time to listen to me. Thank you so much.

[Applause.]

DR. BOND: Thank you, Richard, for that overview from a federal perspective, where we are going and the importance of manufacturing in the federal R&D enterprise, the importance in this administration that we assign to that.

Now we turn for the private sector perspective to the first ever assistant secretary of manufacturing, the Honorable Al Frink. That position was one of those recommendations in the Manufacturing in America Report and we are thrilled to have Al Frink in that post, thrilled because he embodies exactly the challenge that confronts so many manufacturers in America today.

He was the leader of not a Fortune 500 company, a relatively smaller company, but one that was successful and recognized globally in this global economy. So, he knows the challenges but also knows the opportunities for success that exist in today's global economic environment for manufacturers.

In his new role, he will be charged with advocating, coordinating and implementing policies that will help U.S. manufacturers to compete globally. So, it is imperative that our Inter-Agency Working Group be coordinating with him as we work together to try to implement some longer term R&D policies aimed at those same things, aimed at creating the conditions for economic growth for manufacturers, the conditions for investment in manufacturing.

The lowering of the cost of manufacturing, investing in innovation, these are all Al Frink's specified priorities in his job and, obviously, have clear links to

where we want to go in the R&D portfolio.

So, please, now join me in welcoming Assistant Secretary, my friend, Al Frink.

[Applause.]

Agenda Item: Industrial Base

DR. FRINK: I wondered if Phil's last name is a noun and an adjective. I think it is both.

Thank you very, very much. GTBH. That is a government acronym for good to be here. That is the language I have learned as I have come from the private sector. I have to learn the acronyms of government. But just to quickly put a little background and thorough face on where I came from and how I got to this position and what I expect to do. I will give you a bit of that overview.

I came from -- actually I was born south of the border, Mexico. Came to California at the age of 4 1/2, raised in California. Started a manufacturing company in 1974 with the help of an SBA loan. So, I am very passionate about SBA and what it has brought to companies like myself.

I think as I have stepped into this new position, one of the great honors was last year when our company, my old company, was given the SBA award for being the best of the best, hall of fame, joining the ranks of such companies as Intel, Hewlett Packard and many others. That gave me a sense of accomplishment and confidence that I would be able

to take this position with some experience and authority.

That also included 20 years of international travel experience. So, it has been five months and 24 days since I started. I was sworn in on September 9th. It seems like five years, but that is just how -- it seems like there has been so much activity since I began that it is hard to believe that it has only been that amount of time.

I have visited 70 manufacturing facilities. I have hosted 48 round tables. I have been to the crown jewel of the Department of Commerce, NIST. I hope to go back and get a chance to get further into the depths of what it does, especially as it applies to advanced technology that will help manufacturers as we leap into the next century and the manner in which American manufacturers will succeed against foreign competitors. That will be through innovation.

The position did come from round tables. The round tables were held at the President's directive. After some difficult meetings where questions and debates ensued about terrorists and what have you, it was decided that there was a need to put more of a direct face on a position in government and we would get that from the round tables. The round tables actually came about -- there were 24 of them held around the country and out of those round tables came my position.

The other thing that those round tables developed

was the book called Manufacturing in America and within that book we were tasked to accomplish many of the things Phil touched on. I will just give you a few of additional ones. The basic mandate is to lower the cost of manufacturing throughout the United States, keeping focus on competitiveness. I will talk a little bit about where that disadvantage is in a minute.

Open markets and level the playing fields, especially the international playing field. Investing in innovation, which is key to what we are here for today, maintaining a highly skilled work force and, as I said, appointing a new secretary, assistant secretary for manufacturing and services.

We also created a manufacturing council that is the first ever. That is made up of 15 members from various sectors of American manufacturing, from very small companies to very large and scattered throughout the country. These people will become the voice of manufacturing and bring their issues to the forefront and bring that advice to the Secretary. We will move up the branches to get results.

As a matter of fact, one of the first meetings we had produced subcommittees and one of those committees was focused on tort reform and the message that was given to the Secretary got to the President and he used it almost verbatim in his address at the economic conference held at

the Reagan Building.

So, the manufacturing council's efforts were quickly rewarded by the results that came from the President using that information, their recommendations, their overview of tort situation and what needs to be done to fix it.

The council met last month -- actually, I am sorry, it met just last week. It was our third meeting and that was the first domestic event Secretary Gutierrez was at. So, his actions and the fact that he is a manufacturer make it very clear that manufacturing is going to be one of the highest focused of his priorities as he moves forward.

We are also creating an inner agency working group. That is one of the most important, I think, that will help make this position very effective. Secretary Evans used to say -- when I first came on board, I listened to him talk and he would say that the government operates in silos and doesn't always communicate with itself. This Inter-Agency Working Group is one of the initiatives that came from the Manufacturing Report, was to take away that silo mentality from government and have agencies speak to each other to solve the problems that affects one another.

So, we will be matched in a group with education, labor, treasury and other departments so that manufacturing issues will have and speak with one voice. We have been

working on the 57 initiatives that came in that book, Manufacturing in America. That was the result of the round tables, 18 of which are now in place. So, we have conquered quite a few.

The most recent was just a little over a week ago, when the President signed the Tort Reform Bill on February 18th. So, with that, we are down to -- I think that is 38, 39 initiatives that we are tasked. That is my big -- that is my marching orders, to get as many of those initiatives put in place. Some of them are going to acquire some legislation that may be difficult, but at the end of the day, it is my job to get as many of those or all of those done in as quick a period of time as possible.

Regarding economic background, the manufacturing sector certainly relies on a strong economy and a strong global economy. Our economy has had some significant challenges. I think that the President inherited a very difficult situation. He stepped in and almost immediately there was a dot com crash. It was actually starting before he stepped on board. That resulted in a major market decline. We had 9-11. We had the loss of a lot of jobs. We had corporate scandals. We had SARS.

You couldn't have thrown more at our new President coming into place, but as the President says, he put in a lot of initiatives to help improve the climate for

manufacturing tax cuts that not only helped individuals, but helped subchapter S corporations, who are taxed at the same rate as individuals.

Now there is reason for optimism. The manufacturing sector is down, is rebounding from a long down turn and has expanded for 21 months. Everywhere I go I find business is up. It was interesting. Last week I was in Rockford, Illinois and I was walking around in this event where I was going to be speaking and there were many little booths set up of manufacturers in that region. There was a reporter following me around and everywhere we stopped, everybody to the person, I asked them how their business was going and they said it is remarkably up.

At the end of that whole event, I think the reporter was throwing the curves because reporters don't get a lot of press on good news. It was a very strong -- he made a very strong effort to try to say but, but, but, but. You know what, there isn't a lot of buts. The economy is coming back. It still has a long ways to go. There are sectors and pockets that are recovering, but in that room, one of the hardest hit during this recession, which was really a manufacturing recession, there was nothing but optimism. I have to say that I was extremely pleased and you know what, at the end of the day, the only reporting they had to put in their publications was manufacturing and

business is on the rebound. Anything else would have been a -- would not have reported what is currently taking place.

Home ownership is at an all-time high. I am from California. Real estate there just continues to move forward. I have spent a lot of time with economists. The belief is that they will continue to move in that direction. There is nothing in the forecast that suggests otherwise. Interest rates are still relatively low, even though they have been bumped. Prime has been bumped, but I am still seeing rates very similar to what they were two years ago as far as mortgage loans. So, that is the good news for home building and home consumption.

Unemployment rates, 5.2 percent. That is the lowest of the seventies, eighties and nineties. It is better than the average of all those three decades put together. And we have added 2.7 million jobs since last May. So, as I said, I see an optimistic direction in the way we are going at this stage.

There are other implementations coming from the manufacturing port that we have accomplished. We have established an Unfair Trade Practices Task Force. We have created a China Enforcement Office to focus on China trade law compliance. Internationally speaking, our marching order is to level the playing field on intellectual property. I know that intellectual property is a particular

concern to high tech industry, especially in China.

As such, manufacture -- the administration has placed an intellectual property rights attache in China to deal specifically with the intellectual property rights and abuses in that country. Mark Cohen, who is one of the brightest in the country at fighting intellectual property and he has got two top assistants working to help him fight on our behalf to overcome the difficulties of a country that has not yet learned the standards and regulations of the international community that is China.

So, we both have increased our enforcement staff there by 25 percent since 2001. We have over a hundred people in the country of China alone helping American manufacturers to level that playing field.

As I mentioned, we the Unfair Trade Practices Task Force. That brings a bit of an Elliot Ness mindset to trade enforcement by investigating and identifying the unfair trade practices before U.S. manufacturers and small businesses are harmed. Commerce has joined other departments also to initiate the STOP program. That Strategic Targeting Organized Piracy or the acronym STOP. It is the most comprehensive initiative every advanced to smash criminal networks, networks like traffics and fakes.

We will work to stop trade and pirated and counterfeited goods in America at the borders and we will

work to block bogus goods around the world and help small businesses that cure and enforce their rights in overseas markets. They have included to help a hotline that is 866-999-HALT. That provides a one stop shop for businesses to protect their intellectual property at home and abroad.

We have also, to help my job in my new sector, I have just appointed a new assistant Secretary for Industry Analysis. His position will officially start, I am told, about the middle of this month. So, in that capacity, I will have somebody, who will be leading the industry analysis that will develop information to help make the points that affect manufacturing more affected by being able to show what regulations are costing different sectors.

That will also be able to go right to the area of precincts that legislators may have, voting choices that can go one way or another. We are going to show them where their directed votes will affect the people they represent. So, it is going to be an incredibly effective office to help and assist manufacturing as we go forward.

Part of my travels, by the way, in my time that I have been in the -- short time I have been in this position was to go to China. I went on an eight day trade policy mission and I had a chance to see first hand how we interact with the Chinese and I brought forth a tremendous business man's perspective of intellectual property and brought not a

political way of communication or a diplomat, but more of a I speak the language of business.

I talked to the people -- the Chinese ministry in a manner that I am speaking with you today. I told them they are not getting the best of our best. They are not getting the -- if a company the size of General Motors cannot protect their intellectual property, how can a small company? You are not getting the best America has to offer. You are not getting the best from your own country because as you have small companies that may wish to try to enter into the market with innovative products, if you can't protect us or anybody else coming into your country, you are going to dissuade them.

So, intellectual property isn't just a matter of an area that they seem to be having difficulty putting their hands around, it is a detriment to their growth. I told them face on that you are now known as a country of imitation not innovation. And that is a shame. Every year I read the papers and I see how the people from China, as the USA Today often prints the top categories in academia and from arts to science and you can almost count on the Chinese being in the top five.

With all of that brain power to be recognized as a country of imitation and not innovation is -- I told them is a real detriment to your status as you move forward, plus

the fact that the IPR -- the intellectual property violations are not just affecting the companies. They are affecting the people. We had with us, one of the members on that trade mission, somebody from -- well, Jack Daniels, but they had documented 11 deaths from bogus versions of their product. It drove the point that it isn't just a matter of hurting businesses. It is hurting people and that is something that falls under the category of not just intellectual property or trade mark, it is trade dress, where people are miss -- buy something. They think they are buying from the original and getting a copy.

There are a lot of laws that are enforced with greater effort in protecting consumers than there are businesses. So, I took a course that was more that direction. It resonated very well. So, I will keep you posted on that kind of progress as I move forward. So, it is a different approach than what they have been experiencing. I am told they like the straight language.

So, as I have said, we have hired an assistant secretary for industry analysis and Secretary Evans, he just -- speaking of China, he just made a very -- his last visit to China was very loud and clear that violators who don't respect intellectual property will be thrown in jail or should be thrown in jail. So, he was raising the level of concern and enforcement that he believed was necessary to

get intellectual property in China in line with where it should be.

Cost competitiveness, why this position is so important, we have a 22 percent disadvantage over foreign competitors. That is the problem. Government, the very position I am in is the area that has caused that barrier cost, that the National Association of Manufacturers actually produced, all of the cost of taxes, litigation, energy, regulatory excess and, of course, the biggest one of all, health care, is added up to a 22 -- actually it is 22.3 percent detriment. We are on the short side of that against foreign competitors. We have to work to change that.

Part of the regulations is coming from the Office of OMB, Dr. Graham's office. He has tasked us with working on 189 regulations. All of these regulations came from the Federal Registry. There is about 550 of them; 189 were directed towards manufacturing. We are working on those regulations with the Office of OMB to determine which ones can be changed, revised so that regulations that were put in with the best of intent that are affecting manufacturers today are put in line with where they should be, reasonable and fair.

But you know, passing on higher costs to customers is rarely an option. So, this 22 percent disadvantage has got to be changed. Otherwise, we are not going to compete.

This has the biggest impact to small manufacturers. They are the ones who have the greatest burden on that and the small manufacturers employ half of all the people that manufacture. They are all responsible for 70 percent of all the new hires. So, small to medium size manufacturers -- my roots where I came from are where we need the help the most, I think that is where -- it was clear that was one of the reasons I was chosen to take this position.

Tax credits, the President gave and empowered with these -- to all of us has helped these companies spend the vital dollars on innovation instead of spending them in Washington. That has been a big help and I get that everywhere in my travels.

Health care costs represents the fastest growing and the most concerning cost of all manufacturers. Everybody is working on that. Administration supports the health care plans. This is where associations can -- small companies can form associations to get a group buying, go across the state lines and form a bigger buying power so that they can compete with companies that are much larger and that is going to be something the President is going to continue to work on to get in place so it can help smaller manufacturers compete.

Tort reform, it is -- by the way, I have backing up health care. When I was in Michigan, the cost of health

care is so significant that General Motors, Ford and Chrysler determined collectively that it is $1,400 per automobile and tort reform is costing about $800 per person in the United States. So, the Tort Reform Bill that was recently put in place is going to be at least a step forward towards reducing that cost.

Frivolous lawsuits have gotten out of hand. Our forefathers would be flipping in their coffins if they were to see how law has been moved in the manner it has and how tort reform has gotten so out of hand. So, we are going to work on getting those corrected and the President is well aware of that.

Education is one of the things that came to me as the biggest surprise in my travels when there were presidential elections going in place and the president was trying to maintain his position and the opposition was trying to take it away and jobs are being outsourced. Everywhere I went, it was jobs, jobs, jobs. Everyplace I went virtually had health on its signs, but the key was, the caveat to all of that is they can't find the qualified health.

The level of education that is needed for advanced manufacturing is probably one of the -- now becoming the number one concern in my travels. Health care, tort reform, everybody knows those big areas are being addressed. It is

the education now that has become the foremost concern. The numbers suggest that as we move forward between now and 2015, we are going to have 70 million people, baby boomers, that are going to retire from the manufacturing arena. We have 40 million in the pipeline. There is a shortfall of 30 that nobody knows where they are going to come from as of this point.

We need to do a better job of educating younger people on the opportunities of advanced manufacturing, the fact that no longer a dirty coverall, blue collar environment that I started in. I started out two years as a tool and dye maker. Today, you could work on the machines in a business suit.

We need to change that perception and get younger students to see the opportunities in education and I am going to be -- that is probably going to be one of my greatest focuses and if there is a legacy to my position, it will be the effort I put into advanced education for the future and it plays right into what we are here about today.

So, to help that, last year the government invested as far as innovation 123 billion. You heard some of those numbers already. In addition to that, as far as the educational concerns, No Child Left Behind, the President has proposed and establishing $125 million community college access grants fund to improve services to

community colleges. Most of the community colleges I visited, I visited five of them, their enrollments are down to 50 percent. They are not doing a good job of marketing the opportunities in that world.

So, to make work training more affordable, the President has also proposed loans to help workers pay for short term training, at least to industries and industry recognized certification.

Energy. Energy costs are huge. About one-third of the energy in the U.S. including -- one-third of the energy in the U.S., including 40 percent are natural gas and 30 percent of electricity is consumed by manufacturers. So, the President has an energy bill -- it has been in the congressional process. We are hoping to get that through. I think it was blocked a lot for political reasons. As we move forward, that bill will do a lot to help relieve some of the needs of energy.

Marketing and branding is one of the areas that I will get to, where I am pretty much on the close of what I have to say, but one of the areas I found that was most lacking in every area I travel to from my experience in California, was the lack of marketing and branding and how it can influence the success of companies.

The three areas that I found in my own personal experience in my company was the innovation we produced in

our products, the differentiation of how we positioned ourselves in the market and how we packaged and branded and built our image. If you can survive the 22 percent barrier costs of being in the United States and add to that the cost that you experience in the -- I refer to as the People's Republic of California. It is a huge cost to overcome and we were able to do that through the fact that we built a great marketing name for our company, a great branding.

It was innovation and it was differentiation. So, I think it plays right into where we are today in this meeting, the working group focused on research and development, which drives innovation and as such, I am very pleased to be a part of that.

In closing, I would like to say that the President knows -- you should know that the President is a business man. He is not an attorney. Most of the people that he has in his cabinet are not attorneys. They are all business people and I think that speaks well to the needs of business. I am proud to say that I am part of that effort and he is going to be ensuring that the United States is the best place in the world to manufacture.

There is no question that as I experience in my travels, I see the problems, but I am very much an optimist. I know that when we lift the burdens from our manufacturers, their creativity, their innovation, their

work ethics will continue to make our economy the marvel of the world. Everybody wants to be like the United States. We just need to make ourselves better.

So, thank you very much. I appreciate having the chance to speak with you and I will turn it over to Phil. Thank you very much.

[Applause.]

DR. BOND: Al, thank you very much for that overview. Richard, I know you need to get back over to the White House. Thank you for joining us today.

Please join me in thanking Richard again for being here. Thank you, Richard.

[Applause.]

I hope you will take away a couple of things from Al Frink's presentation. One that he is -- Al is moving around the country listening to the concerns of manufacturers, regardless of the size of the company, both near term and long term. You heard him talk about education and some of the other long term innovation, those long term needs. I also hope that you sense the collaboration and coordination that is going on between our offices with an eye towards the longer term R&D agenda, in particular.

So that you should know, today's important public forum is not the start and finish of seeking private sector input. Indeed, through Al's office and our coordination and

his travels to round tables around the country will continue non-stop to collect private sector input, which is so critical to formulating the best policies as we go forward.

Agenda Item: National Science and Technology Council, Committee on Technology, Inter-Agency Working Group on Manufacturing R&D

That is why we are, indeed, here today. So, now, let me proceed in just a very few minutes before we take a break at about 10 o'clock here, give you an overview of where we are on our Inter-Agency Working Group. After the break, we will come back and have much deeper detailed presentations on the three issue areas that we have selected from the federal side and now want your input on this afternoon.

The Inter-Agency Working Group is formulated under the NSTC. As has been mentioned, it was a specific action item in the Manufacturing in America report, which embodies the President's manufacturing initiative. It is formed within the NSTC to help address manufacturing R&D policy programs and budget guidance, that letter that Richard Russell referred to that gives guidance to the agencies.

And importantly, it promotes an exchange and leveraging of information among the agencies. Many of you know in the manufacturing community that an effort like this

presaged the establishment of the Inter-Agency Working Group. That was the GATE-M effort, the Government Agencies Technology Exchange in Manufacturing. So, we are going to incorporate, you will see in my slides here, and build upon the work that was started by GATE-M.

The next slide simply shows where we sit in the hierarchy of the NSTC, which Dr. Marburger serves as the executive director, then under the Committee on Technology, which Richard Russell and I co-chair, you see there, the Manufacturing Research and Development box, just to give you organizationally an understanding.

The NSTC, as many of you know, was established in 1993. It is actually chaired by the President and serves as the principal means for the President to try to coordinate the diverse parts of the Federal Science and Technology R&D Enterprise. That is no small goal with so many different missions and so much spent, $132 billion in R&D. We tried to through the NSTC to establish the national goals that were referenced by Richard Russell and prepare strategies that are coordinated and in particular in this enterprise, we want to coordinate what is done in manufacturing R&D.

The Committee on Technology is just one part of that. Let me move now to the agencies participating in this Inter-Agency Working Group on Manufacturing R&D. You see a rather exhaustive list there. Virtually all of the agencies

and importantly including in our working group OMB is there every step of the way understanding where we are going so that as budget proposals percolate up later, for instance, for the 2007 budget, that OMB is well briefed on what we are doing and, of course, OSTP is a full partner in this.

I am privileged to serve as chair. That is a bit of a misnomer. I need to acknowledge that the lion's share of the work is done by Sue Skemp, who was introduced earlier, from OSTP and also my vice-chair, but really a collaborator with Sue in doing the lion's share of the work and that is Dale Hall, who heads the Manufacturing Lab at NIST and is up here on the stage with us today. You will be hearing from Dale later.

What is the function of the Inter-Agency Working Group? It is to propose policy recommendations for manufacturing R&D to facilitate the inter-agency program planning to break down those silos that were referenced earlier, to make sure that people are comparing notes on what they are doing in the different priority areas, to review those priorities and the technical issues for some of the federally funded manufacturing R&D, promoting communications among the government, the private sector. We want to make sure that we understand and are driving toward the needs you identify, to report ultimately to the Committee on Technology and OSTP, to summarize our

activities and recommendations and in keeping with that manufacturing report, we are lashed up and reporting to the President's Manufacturing Council, which is -- which Al Frink serves as the executive director of in coordinating on a regular basis with Al Frink's office.

Under that charter, we may seek advice from the PCAST, the President's Council of Advisors on Science and Technology, an important listening post into the private sector. We also may interact and receive ad hoc advice from various private sector groups, consistent, of course, with law in this area under the Federal Advisory Committee Act and that is, indeed, what we are doing today and we will continue to enjoy interaction with the private sector through the President's Manufacturing Council.

So, what have we done to date? We have been meeting monthly since May of 2004. Our main focus, establishing technical priorities, defining challenges, identifying gaps. That is really one of our main roles. And then to propose solutions to those gaps. We have had a number of informational briefings for the members of the working group from the next generation manufacturing technology initiative, from the Partnership for 21st Century Skills.

You heard Al Frink's reference to education, which I know is of import to many of you in the private sector,

that you have got to have the skill set to enable manufacturers to drive ahead into the future. We, of course, had a briefing also from the NIST MEP program and from the Manufacturing Engineering Lab at NIST as well. We have regular cross agency communications in information and then, of course, we published the Federal Register notice that brought many of you here for this open meeting.

We went through a rigorous priority topic selection process. We started with more than three dozen topics that came out of the GATE-M work. We looked at those. We added to those. Many agencies had other priority items that they wanted consideration of in the Inter-Agency Working Group. We then asked everybody to go off and identify their top priorities and then reconvened to compare notes. Several priorities began to show up on each agency's list and we finally reached a consensus among the agencies and limited ourselves to three topics because if you have ten priorities, you have no priorities. We wanted to keep it to be a short list for this first year, in particular, the key factors in driving those national need and the need for inter-agency collaboration.

Three technical groups came out of this, the three priority areas, to form the basis for a coordinated multi-agency focus, intelligent and integrated manufacturing systems, manufacturing for the hydrogen economy. We all

know what a priority that has been for this administration, but, indeed, for the entire economy going forward. Then as has been mentioned already, nanomanufacturing and the longer term dramatic overhaul that that could represent in processes, leapfrogging to whole new ways to manufacture goods.

So, identifying those, we moved ahead with some technical priorities and goals there to lead development and promote implementation of advanced manufacturing technologies for the benefit of our economy and the manufacturing sector, to improve planning, coordination and collaboration of R&D among the agencies in these three critical areas.

Let me pause to say many of you know that there are national initiatives in these areas, as Richard Russell alluded to. Our task is to bring greater manufacturing focus to those areas, greater manufacturing focus, because the President has said this is a key national priority for economy, indeed, for our national security going ahead and having to have the capabilities domestically for many of these things. So, we are going to bring greater focus there to increase also the effectiveness and visibility of the overall federal manufacturing effort.

In terms of coordination, manufacturing R&D coordination, we have, of course, scoped those areas

provided by the Inter-Agency Working Group. They have developed draft white papers, draft white papers in each area to form the basis ultimately of an overarching document, as we have in other national initiative areas. We want to bring this together in a single report.

As we develop those white papers, the agencies self-selected for representation on the task teams. So, you see here on this slide a listing of those who have signed up to do duty on these different topic areas. Under "Intelligent and Integrated Manufacturing Systems," you see the list there. You see, of course, key players, like DOD represented on all three and then hydrogen economy manufacturing. You see the players and then now manufacturing as well.

In this public forum, what we want to do is get the private sector perspective on these three. You will hear next after the break detailed breakdowns of our draft white papers at this point for you to react to, for you to respond to, for you to give us your input on. Then we will go back to the drawing board, based on your private sector input and make sure that we are driving in a direction that meets both the federal enterprise priorities and the private sector priorities.

So, your input today is going to be absolutely critical to that because we understand that we need to be

relevant to the private sector needs and that we have to share common goals and then fund and bring greater focus to the priority manufacturing R&D efforts in those agreed upon areas.

So, what we will do now is proceed to just a 15 minute break. We are going to start promptly again at 10:15 and we will go into this deeper dive on those three areas; again, draft papers where we want to get your input at the end of the day.

Thank you for your attention. I note that uncharacteristically of many government operations, we are ahead of schedule. So, we will reconvene here in 17 minutes, at 10:15. Thank you.

[Applause.]

[Brief recess.]

Agenda Item: Public Forum/Expectations/R&D -- Focus Areas

DR. HALL: For those of you who are actually seated at this point and ready to proceed, let me say I am Dale Hall. I am director of the Manufacturing Engineering Laboratory at NIST and I am also the vice chair of the Inter-Agency Working Group on Manufacturing R&D. I would like to add my thanks to the thanks of our presenters this morning, to you for coming.

We are looking forward to sharing our thoughts

with you today on the three technical priority areas that we identified, as Phil discussed earlier. We believe that these areas are essential to the U.S. government, to the Federal Government and also to the U.S. economy.

Under Secretary Bond did describe the process that resulted in the identification of the three priority areas. So, I won't go into that in detail. Just to remind you of what they are, they are intelligent and integrated manufacturing systems, manufacturing for the hydrogen economy and nanomanufacturing.

The purpose of this next session is for us to present our perspective on the key needs and technical challenges in these areas and also to talk about what we think are the key federal roles in developing the needs in these areas of manufacturing technology.

Just to reinforce a little bit what Phil said about the basis of selection of the priority areas, there are -- manufacturing has many, many needs, including many technical needs. We focused on these particular areas for a reason. First, I think, we found as we came together that there was a strong commonality of interest among the Inter-Agency Working Group agencies and this reflected our perceptions of national need, partly driven by what we see as intense international competition in some of these areas.

The federal need, both from an inter-agency

perspective and in accord with the missions of the individual member agencies and I should say that learning about those individual agency missions was a real learning experience for many of us, who had little familiarity with what the drivers were for other agency interests.

Finally, the point of the Inter-Agency Working Group is to spur collaboration and coordination and we saw that in these areas we anticipated that there would be a benefit to technical communication, technical collaboration. This began with the government agencies technology exchange in manufacturing, which was an ad hoc group. The Inter-Agency Working Group in Manufacturing R&D is an officially chartered group. In addition to spurring communication within the member agencies, I think we also, as Phil pointed out, now represent a point of entry for many of you.

You now know that there is a chartered working group that is thinking about manufacturing technology issues. As Phil said, this is the beginning of what we expect will be a continuing conversation. So, we are looking forward to your input today, but we are also looking forward to continued involvement. We know that in many cases the technologies that you are looking at run in parallel with some of the things that we are going to talk about this morning.

I am going to hold comments and questions for the

session that begins immediately after lunch. We would like you to have a chance to hear about all three of the technology areas. We think about this in terms of an integrated package and there will be plenty of time to talk about your -- for your comments and questions this afternoon.

I am going to cover some ground rules for that conversation, but I am going to wait until the beginning of the afternoon session.

The members of the Inter-Agency Working Group, who are here today are identified with special badges that look like this. We are going to need calories just like the rest of you after a long morning and to prepare for the afternoon, but we are going to try to make ourselves available for as much of the lunch time as possible in this general area. So, after you have managed to get something to eat, if you would like to come and have informal conversations, one-on-ones, or whatever, we encourage you to do that. That is one of the reasons that we are here.

So, let's get started. The first presentation that you are going to hear is on intelligent and integrated manufacturing systems and it will be given by Al Wavering, who is the head of the team that developed the content and he is also chief of the Intelligence Systems Division at NIST.

Agenda Item: Intelligent and Integrated Manufacturing Systems

MR. WAVERING: Good morning. The other two areas, the nanomanufacturing and manufacturing for the hydrogen economy, are about R&D for manufacturing industries that we all expect to be important in the future. The intelligent and integrated manufacturing systems area is one that is about the future of today's manufacturing industries.

The revolution in computing, communications and distribution technology, as well as the emergence of new competitors in the global marketplace, have led to the threshold of new epic i manufacturing. The first epic, 1900 to 1960, was characterized by emphasis on increasing production rates.

Most production was manual and mechanical. There was little demand for product variations. With the introduction of computer technology in the form of numerical control, there is greater emphasis on cost reduction and product quality, improving the accuracy of parts and numerical control made this possible. It also made possible greater part variety and product variations.

Since 1990, we have seen the application of information technology throughout the enterprise in things like enterprise resource planning and manufacturing execution systems and manufacturing is now once again

undergoing fundamental structural change and that leads us to the next epic. That is what we have referred to here as the epic of intelligent and integrated manufacturing systems.

So, as Phil said, we are here today to get your help in identifying and prioritizing what are the federal R&D needs for U.S. manufacturers to succeed in this new epic. Just to define and characterize what we mean by this new epic. The Department of Commerce report Manufacturing in America identifies key characteristics that define the changes that manufacturing is undergoing. Three key bullets are listed here. One is the competition will be among supply chains rather than among individual manufacturers.

So, the key there is the supply chain aspect. Tied very closely to that is the fact that there has been a disaggregation of the functions in the product life cycle and along with that, there has been global competition that has arisen for all of those supply chain functions. So, you might have parts of it are designed in one place, manufactured in another, assembled somewhere else and then sold and serviced in yet another location.

So, again, now there is global competition for each of these different functions and as a result success will depend on the ability to integrate new technologies rapidly into products and processes. Individual companies

are going to need to be able to move in and out of these supply chains very easily and have innovative new products and processes to offer.

So, to start the process of identifying the federal R&D needs posed by these challenges, as was mentioned, the Inter-Agency Working Group on Manufacturing R&D formed a task group on intelligent and integrated manufacturing systems. We got together and discussed the agency priorities. We also reviewed just about every report that we could get our hands on that had to do with needs and trends in this area.

As a result of that, we came up with these five key need and challenge areas that you see listed here. We are going to talk about each of these in a little more detail, but briefly the first is predictive tools for integrated product and process design and optimization, intelligent systems for manufacturing, automated integration of manufacturing software, secure manufacturing systems integration. Then an interdisciplinary activity of sharing and integrating results and theories between manufacturing and other disciplines.

So, the first key research challenge area is that of predictive product or process design optimization. Here the goal is coming up with tools and technologies to be able to do things like predict downstream impact of design

decisions, reduce the lead times for companies to bring products to market and for mission agencies to be able to bring mission critical systems to the point where they can be used, as well as to have tools that will allow optimization of the supply chain as a whole.

Another aspect of product and process design tools is the third bullet here of improving innovation by broadening participation in manufacturing. The idea there is that if you can by using these tools abstract out the details of manufacturing process design, it may be possible to engage a broader cross section of the population in some of these different supply chain activities and harness the innovation that resides there.

For each of these challenge areas we are going to identify in a very high level sort of way what we see as research and development contributions that are needed and that are appropriate for the federal role. So, we are talking about infrastructural technologies and things where the benefits of investments are hard to capture by any individual companies working on their own.

So, in the area of predictive process and process design tools, some of the things that we see as an appropriate federal role would be generic algorithms and approaches, validated models and data that then companies who are actually developing these tools can use to validate

their products, that users can use to help apply those product and process design tools.

The next area is intelligent systems for manufacturing. The goal here is to take the rapid developments and continue to increase the computer power that is available and harness that for improved manufacturing processes. This is things like smart machining systems, being able to develop manufacturing shop floor equipment that knows more about what its capabilities are that can take higher level commands and directions and optimize their own performance based on those commands and their sensing capabilities and to be able to do things like reduce trial and error in product and process development so that you have something that is closer to being able to make the first and every part correct.

Here again the types of R&D contributions that we see as being needed include generic algorithms and approaches, but here it is more for processes at the equipment and shop floor level and, again, models and data at that equipment and shop floor level, at the process level for things like machining, forming, casting, various manufacturing operations.

The third area is automated manufacturing software integration. Being able to participate in global supply chains as a key capability is to just be able to share

information in a seamless, effortless sort of way. S, the focus of this is on reducing time, effort and cost needed to integrate manufacturing systems within supply chains. What you see here in the diagram is a trend from the lower portion where you have just common models of data and text-based standards, which are what we base our systems integration work on now to a situation where the computers and systems can integrate with each other automatically.

That would be the holy grail of this area would be to have self-integrating systems where the computer systems can talk to themselves and figure out what information they need to share, what it means and what to do with it, so they would know things like the difference between a purchase order and a machine tool program versus a schedule and know what to do with that information.

In order to do that, you need to be able to define what is the meaning of the different types of information that is shared, develop explicit formal semantics for that information and that then leads on a path towards self-describing, self-integrating systems. One of the big questions here is how far toward this theoretical ideal goal is it possible to get to. So, we think that research on theoretical and practical limits of self-integration is an important thing to work on, as well as what -- we know that we can do something to automate the process of systems

integration. So, we think that developing generic automation methods, tools and standards for manufacturing systems integration is an important thing.

The next area is secure manufacturing systems integration. Connectivity between these different parts of the manufacturing enterprise is a fact. It is something that is happening now. Companies are making information about their operations available and increasing the connectivity between different parts of the manufacturing enterprise. While that is important and necessary for optimizing supply chain operations, it also introduces new potential vulnerabilities and security issues and those are an important thing to address.

So, we need to maintain security while increasing this connectivity and the degree of integration. The things that are needed there we believe are things like performance metrics, standards, test methods, really looking at how can you apply computer security technologies that are developed outside the manufacturing environment to the specific requirements that you have in production in manufacturing.

Then finally the area of interdisciplinary sharing and integration because of the inherently interdisciplinary nature of manufacturing, we see a significant benefit to increasing the amount of sharing of information between the manufacturing domain and the other areas, things like

economics, mathematics, health systems engineering and this we see as a way to increase the benefits both to manufacturing, as well as to share information and techniques that have been developed within manufacturing to other domains, like health care. How can some of the lean production techniques, for example, be applied to improve the efficiency of the health care system.

Here really what is needed is to do a couple of things. One is to look at the different theories that have been developed in mathematics, in manufacturing and look at where are there are consistencies, where are there differences and test those differences and figure out what is right and what is the optimal thing to do. So, that has to do with resolving inconsistencies and then to put into practice that prove useful from mathematical optimization algorithms and a variety of other advancements.

Clearly, there are already a number of current federal efforts that are going on at a variety of different agencies. At the Department of Commerce at NIST, we have efforts in smart machining, interoperability, intelligence systems and also in the area of industrial control systems, security. Department of Defense has a number of initiatives going on, including next generation manufacturing technologies. The Doyle Center is another activity that is very closely related to IIMS.

Department of Energy and NASA are both very interested in integrated design and engineering and manufacturing tools, things like virtual verification testing, as well as data management, interoperability and, of course, the National Science Foundation provides funding for a number of engineering research centers that are closely related to IIMS as well.

The other thing I wanted to mention is that, again, the networking and information technology R&D program has a lot of parallel issues and a lot of synergy with the IIMS area in particular as Richard Russell was mentioning. So, we are in the process of developing strong collaborations and ties so that we can coordinate the work that we do within IIMS with the work of the NITRD and the various working groups that they have set up that have relevance to this.

We see huge potential impacts to R&D in the area of IIMS and I would categorize them into two main areas. The first is for the private sector, we are looking for enhanced manufacturing sector competitiveness, innovation, productivity. Profitability really is the bottom line. In the public sector, we are aiming at providing tools that will allow the domestic production and improved affordability, availability of components for mission critical systems for those agencies that have manufacturing

as an important part of achieving their mission, like the Department of Defense and NASA.

So, their missions are not focused on manufacturing per se. Yet, without effective efficient manufacturing, they can't do what they need to do. In both of these areas, we see a potential for billions of dollars of cost savings from improved information exchange, being able to better predict life cycle cost, being able to produce better products and new products that you can't -- that you wouldn't have been able to produce without advanced information technology. Greater responsiveness and optimized operations both in terms of cost but also to do things like reduce energy consumption, reduce environmental impacts as well.

Then just to put a few numbers on just one of these areas, that of information exchange, there have been a number of studies, economic studies done to try to quantify what are some of the costs that are involved in imperfect that result from the current state of imperfect information exchange. So, what is the potential of improvement that you could see if you could do this better. Those include an estimated $1 billion cost of the transportation sector just for engineering and business data alone; $5 billion estimated cost of discrete manufacturing supply chain, Something between 22 and 59 billion dollars is the estimated

cost of inadequate software testing infrastructure, not being able to more quickly and efficiently do software testing and then $15 billion cost to the capital equipment sector.

So, the next steps in this process really are to get your feedback on these areas and to use them to pursue coordinated government and academic R&D in the area of intelligent and integrated manufacturing systems, again, focusing on those things that are appropriate for the Federal Government to do, which include things like process models, scientific and engineering databases, test and measurement methods, technical bases for interfaces between processes and systems and providing mechanisms for making this interdisciplinary technical exchange happen.

So, just to conclude, the changing global competitive environment poses great challenges for the U.S. manufacturing sector, IIMS, R&D aims to provide the technical foundation needed for technological leadership and economic success. Again, we need your input to do a good job at this, to further develop and prioritize the IIMS research challenges and needs.

We look forward to hearing your comments and input this afternoon. With that, I thank you for your time and want to acknowledge also the other agency participants on the IIMS task team.

Thank you.

[Applause.]

DR. HALL: Thank you, Al.

Next we are going to hear from JoAnn Milliken, who is chief engineer in the Hydrogen Program at the Department of Energy. She is going to talk about manufacturing for the hydrogen economy.

Agenda Item: Manufacturing for the Hydrogen Economy

DR. MILLIKEN: Thank you, Dale.

This presentation is a summary of a proposed effort put together by representatives from several federal agencies, based on our knowledge and experience in hydrogen and fuel cell technologies. We look forward to your feedback today and specifically we would like comments on our approach, the proposed approach that we are taking and the R&D, the manufacturing R&D challenges and needs that we have identified.

This initiative, this effort, this manufacturing effort is closely connected to the President's Hydrogen Fuel Initiative. So, what I am going to talk about first is that initiative. I am going to spend about five minutes going over the driver, the challenges and the goals of the Hydrogen Fuel Initiative. Then I will talk about the manufacturing effort. Then I will get into very briefly the

current federal efforts in manufacturing and in hydrogen and fuel cell R&D and then I will talk about timelines, the benefits and next steps.

I would like to emphasize that the purpose of this forum is for comments on the proposed manufacturing effort and not to debate or provide comments on the Hydrogen Fuel Initiative itself.

As many of you know, the Hydrogen Fuel Initiative was announced by President Bush in his January 2003 State of the Union address. This initiative accelerated the research and development of vehicle and hydrogen infrastructure technologies so that they could be developed in parallel and address the so-called chicken and egg issue related to this area.

The initiative also enables industry to make a commercialization decision by 2015. The Federal Government will develop the technologies to enable this commercialization decision. Another thing that the initiative did was to bring the major energy companies into the partnership, the Freedom Car Partnership, with the Department of Energy and the U.S. auto companies. So, if successful, this initiative will lead to market entry of fuel cell vehicles and the refueling stations to support them in the 2020 time frame.

A little later I will talk about how the hydrogen

economy, the transition to the full hydrogen economy will take decades beyond that.

The driver for the Hydrogen Fuel Initiative is our increasing dependence on oil and this is largely due to the transportation sector. Transportation accounts for about two-thirds of the oil that we use. As you can see from the chart, that oil use is mostly by light duty vehicles. That is what the initiative targets.

We import today about 55 percent of our oil and that is projected to go up to about 68 percent in 2025. The Department of Energy is developing technologies for hybrid vehicles and these will address the problem in the near term by reducing the rate of growth of oil use. However, the number of vehicles is going to continue to increase and the number of vehicle miles traveled is going to continue to increase. So, hybrid vehicles will not solve the problem in the long term.

We really need a petroleum substitute to resolve our issue with long term oil dependence. Hydrogen offers significant benefits as a petroleum substitute. In terms of energy security, it can be made from a variety of diverse domestic resources. In terms of environmental quality, it can be used in fuel cells, producing zero criteria pollutants, emitting zero greenhouse gas emissions.

It can also be made in ways to significantly

reduce or eliminate pollutants and greenhouse gas emissions. It also offers benefits in terms of economic competitiveness because it is important to our national energy economy and to the global energy economy.

Although the focus of the initiative is on transportation. We are also developing fuel cells for stationary applications and for affordable power applications. The Department of Energy is the primary implementer of the hydrogen fuel initiative and we have put together a comprehensive and focused research and development program that is outlined here. The technical challenges in the areas of hydrogen production, delivery, storage and conversion in fuel cells are being addressed in a balanced portfolio that includes basic research, applied research and technical development and learning demonstrations so that we can demonstrate the technologies in a real world environment, measure progress and help to guide the R&D.

In addition, we are addressing the important issue of safety and development of codes and standards so that these technologies can be commercialized. We are also addressing education. Education is not funded in 2005. However, it will be critical to letting the public know about the benefits of hydrogen and the safe handling and use of hydrogen.

Systems analysis helps us to identify potential transition scenarios, infrastructure scenarios and examine tradeoffs and then a systems integration function is part of the program and will put everything together. So, the three technology areas that have been addressed in this manufacturing effort are hydrogen production, storage and fuel cells. These are the three major technical areas and cost, reducing cost is a primary R&D driver.

For hydrogen production, we need to reduce the cost of producing and delivering it to that competitive with conventional fuels. So, we need to be competitive with gasoline. Our current 2010 target is $1.50 per gallon of gasoline equivalent and that is about the same as a kilogram of hydrogen. Now, this target is currently being reevaluated to account for the fluctuations in the price of oil and projected changes in the price of oil and will likely go up in the next few months.

In the hydrogen storage area, in addition to cost, capacity of hydrogen storage systems is a big issue. We need to reduce the volume of hydrogen storage systems and increase the capacity to enable greater than 300 mile range. The average range in vehicle today is 370 miles and that will likely go up as hybrid vehicles are used more.

The 2015 cost target for hydrogen storage is $2 per kilowatt hour. That is equivalent to about $300 for the

complete system and that is where a 5 gilokram(?) system, which is the lower end of the amount of hydrogen that is going to be needed to power vehicles.

In the fuel cell area, we need to be competitive with the internal combustion engine. Our 2015 target is $30 per kilowatt, approximately equal to about $2,400 for a fuel cell engine at 80 kilowatts to power a typical core. High volume manufacturing processes will be critical to achieving these cost targets. So, that is the focus of this manufacturing effort. So, I am going to look a little more closely at each of these areas.

In the hydrogen production area, the current cost of hydrogen produced from natural gas is about $4 per kilogram. The transition to the hydrogen economy will use distributed reforming of natural gas initially. That is because that is the most mature technology and the most economic technology to produce hydrogen today. In the long term, central production facilities will be developed and a delivery infrastructure will be developed and hydrogen will be produced from a variety of resources, including fossil. We have a lot of coal in the U.S. and will employ carbon sequestration to generate hydrogen from coal.

In addition, we will be producing hydrogen from renewable and nuclear resources. Central production will take advantage of economies of scale. So, in the near term,

we will be generating hydrogen at refueling stations, using natural gas reformers, small scale reformers, and electrolyzers. The near term R&D needs are in the areas of thermal integration of the components, improved reforming and shift catalyst and scaling of components.

In this case, we are scaling down from the large systems used today. In the long term, to get to the dollar 50 or whatever our new target will be, we need to develop manufacturability, operational flexibility and remote operation. If we look at how much hydrogen is produced today, it is about 9 billion kilograms. That is about 9 million short -- well about 9 million tons of hydrogen. That is primarily for the refinery industry and the chemical industry. Ninety-five percent of that is by methane steam reforming and the rest is typically by electrolysis.

Capital costs contribute 20 to 50 percent to the cost of hydrogen today and that varies. The smaller facilities actually cost more because they have site specific requirements for the design of the reformer systems. These reformer systems include the water gas shift reactor and typically pressure swing absorption for clean up of hydrogen.

So, what we need in terms of manufacturing is standardized designs for both components and systems and design for manufacture methods. In the near term, we need

to manufacture systems for small scale reformer systems and electrolyzers. There is about 120,000 retail gasoline stations in the country today. We will probably need about 40,000 stations in the 2020 time frame.

Then in the long term we need manufacturing processes for renewable based systems. These will be small reforming reactors that use renewable liquids, such as ethanol, sugar derivatives and other alcohols.

In the area of hydrogen storage, there are a number of approaches that we are investigating today. The state of the art is compressed in liquid storage, compressed at 5,000 psi or 10,000 psi. These technologies will provide storage systems for some vehicles. However, they will not be suitable for mass market commercialization of hydrogen fuel cell vehicles.

What we really need are materials that enable lower pressures and technologies that don't have the energy penalty that, for example, liquid hydrogen does. This slide shows the status, the cost status, on the left and the capacity status on the right. If you look at the cost information on the left, liquid hydrogen looks pretty good. But about 35 or 40 percent of the energy of hydrogen is used to liquify the hydrogen and that is not reflected in this cost. This is the cost of the hydrogen storage system on board the vehicle, the tank and any ancillaries that go

with it.

So, on the right hand side are our targets; 2010 and 2015 targets are shown at the top, the bar charts at the top and you can see that no storage technology today meets those targets. The liquid and compressed data is approaching or actually meeting the 2010 targets. However, they are reaching the limits of their capability and will not achieve the long term targets. However, those technologies will be instrumental in the near term during the transition. And as I mentioned, they may be suitable for some vehicle. So, in the near term, we are going to need to reduce the cost of those technologies by developing high volume fabrication processes for tanks, both liquid and compressed.

In the long term, it is going to be very challenging because these technologies are still evolving, but we are going to need new manufacturing processes for materials based systems.

The next slide goes into a little more detail on this. Currently, there are limited supplies of compressed tanks and liquid tanks being made at pilot scale production levels and they are made in a labor intensive process, precise winding of -- these are typically carbon fiber composite tanks and precise winding of the fibers around the mandrill, as shown in the photo, is required to ensure

that the fibers are aligned properly and spaced properly.

The epoxy filler, the process of filling the epoxy and curing it is also time consuming. So, that adds to the cost of making compressed tanks. In addition, pressure regulators and sensors that are needed for the storage system add to the complexity and cost. There are developments within tank sensors that will help in this area, but a lot more needs to be done.

So, what we need are low cost fibers. We need to produce carbon fibers at lower cost and we need to optimize the winding technology and then we need to develop metrology techniques to control the winding, spacing of the fibers and filling of the epoxy.

In the long term, as I mentioned, we will need new manufacturing methods for materials based systems and that includes nanostructured materials. That is an important part. We really need a breakthrough in materials that is likely to come from nanostructures. So, there is a strong synergy between this task and a nanomanufacturing task, which you will hear about next.

In the area of fuel cells, we have made significant process over the past 10 to 15 years in reducing the cost from $3,000 per kilowatt in 1990 to about $200 per kilowatt today. That is based on high volume projection. We don't have high volume capability today, but studies

show, based on 500,000 units per year that the $200 per kilowatt can be met using today's processes. That reduction has been largely due to improvements in materials and components, reduced catalyst loading. Platinum is used in fuel cells and the amount of platinum used in the utilization of that platinum has improved.

And also membrane improvements have led to that cost reduction. What we are going to need to reduce the cost to $30 per kilowatt is standardized design, which doesn't exist today and improved fabrication methods for membrane electrode assemblies. I would also like to point out that this is a system cost not just a stack. It includes all the balance of plant that is associated with the fuel cell system.

The next slide goes into a little more detail here about how fuel cells are made. Membrane electrode assemblies are typically five layer structures that are hot pressed. Like storage tanks, the process is labor intensive, typically hand lay up of the MEAs into stacks as required to make sure that the electrodes are aligned properly, that the bipolar plates also have strict tolerances and basically what is being done is hand lay up of the MEAs and bipolar plates to assemble them into the stack.

Then adding the balance of plant to make up the

system, to integrate the full system is also time consuming. Repetitive measurements of the components are needed and the field connections to ensure the quality of the system and the performance.

So, what is needed in terms of manufacturing or standardized components and to facilitate mass production? We need to -- some of these processes that are being developed in the laboratory today and we need to transform those processes from small scale to large scale fabrication. We also need methods to accurately measure and control the processes. We need to be able to measure the distribution of the platinum, the uniformity of the distribution of the platinum and things of that nature.

A key point here is that we need to develop a supplier base, a supplier network. Cross work, acid fuel cells and molten carbonate fuel cells were developed in the past and their commercialization was limited by the lack of a supplier network. So, that is an important part of fuel cell manufacturing in the future.

There are several overarching manufacturing challenges for hydrogen technologies. I have mentioned some of them. We need to develop new, low cost, high volume fabrication methods. Currently, in the hydrogen program, there is only about two or three projects, R&D projects that are looking at this type of thing out of about 300 projects.

So, we really need to add to that portfolio. We need to adapt those processes that are being developed and any processes developed in the future from the laboratory to high volume. We need to develop a design for manufacturer methods while technologies are still evolving and that is extremely challenging.

We need to meet customer requirements. We need to consider those during the manufacturing process. The driving public is a very demanding customer, as is the refueling public. So, we think that we have a little more stringent customer requirements here. Then we need to address the diversity and size of the industries involved. The auto companies, the energy companies and their suppliers make up very large industries.

There are many current federal efforts in these areas. I mentioned the Department of Energy. The Department of Commerce supports fuel cell R&D through the ATP program and also is involved in a measurement standards and infrastructure technologies for high volume manufacture. The Department of Defense also has a very active fuel cell R&D program for a variety of military applications and are involved in manufacturing technologies for defense purposes.

DOT is instrumental in safety in the transportation and supply chain and will be so in that related to hydrogen products. The National Science

Foundation supports fundamental research in hydrogen fuel cells and manufacturing. The Department of agriculture is involved in biomass energy research; EPA in testing and evaluation of fuel cell vehicles and their impacts on the environment.

NASA has a lot of experience in handling hydrogen safely and they also carry out fuel cell R&D for space applications. The National Science Foundation is so important that they have got double billing here. The White House Office of Science and Technology Policy has established an inter-agency task force to coordinate all federal efforts in hydrogen and fuel cell R&D. The task force meets monthly and they have created a web site where you can get information about all these activities.

The time line for the hydrogen economy is shown here. There are four phases that have been identified, the first being the R&D phase that we are currently in. That is likely to be -- to graduate to a more technology development phase and be a fairly long term effort. Initial market penetration, if we are successful in the -- will start to begin in small quantities in the 2010 time frame, but the commercialization decision, which actually isn't shown here, but it is in 2015, will lead to what we think is the start of market entry in the 2020 time frame.

Then it will take two decades really for the

market to grow and the infrastructure to grow so that the complete hydrogen economy won't be here until around 2040. Now, the manufacturing R&D time line is connected there. I think that what you have seen here is -- as you have seen just touches the surface. We really need more input from the community and we need to do a road mapping exercise. So, that is what our next plan is.

Then beginning in 2006 or so, precompetitive R&D aimed at core technologies, high volume fabrication processes in the laboratory, developed in the laboratory, and then following that in about the 2012 time frame, industry led teams doing competitive research and development or developing the scalable manufacturing technologies.

The benefits of the manufacturing effort include accelerating the market entry and growth of the infrastructure, the market and the infrastructure for hydrogen and fuel cell technologies. It will help to jump start their implementation and it will also increase the chances of success toward the 2015 commercialization decision. In doing so, the manufacturing effort will accelerate the achievement of the societal benefits that come with implementing a hydrogen economy and then finally enhancing economic competitiveness on a global scale.

These technologies are being developed globally

and the international partnership for the hydrogen economy created by Secretary Abraham is going strong and has demonstrated the commitment of countries around the world. Over 15 countries and the European Union are involved in that.

So, the next steps, as I mentioned, we want to develop a road map and so we are planning a workshop in the July/August time frame here in Washington, D.C. We will be publishing that on the Inter-Agency Working Group web site, as well as on the hydrogen web site. We wanted to find the core manufacturing technology needs. As I mentioned we only, I think, touched the surface here. There is a lot of other component technologies that I didn't mention, like membranes for purification of hydrogen. And the road map -- the workshop will go a long way toward doing that.

Then we are promoting a coordinated broad based national effort in this area with the two elements that I mentioned earlier, precompetitive and competitive research and development.

So, in summary, high volume manufacturing processes are critical to achieving the cost targets. We can't get there without manufacturing. What we have proposed addresses the gaps we have identified. Perhaps there are others out there. We really need your input on this today and we are looking forward to that.

Then, finally, I would like to acknowledge the manufacturing, the Hydrogen Manufacturing Task Team. These are the organizations, the agencies that contributed to this particular task and we welcome other agencies involved in these efforts to participate in the future as well.

Thank you.

[Applause.]

DR. HALL: Thank you, JoAnn.

The final presentation this morning will be made by Warren DeVries, who is division director of Design, Manufacture and Industrial Innovation at the National Science Foundation.

Agenda Item: Nanomanufacturing

DR. DeVRIES: Thanks, Dale. It is great to see all of you that are interested in this important area of manufacturing research and development.

I am going to give another little view of the new epic in manufacturing as a lead in to the area that I want to talk about, nanomanufacturing, because I do think that, you know, the importance of manufacturing still remains paramount for the nation. It is, in fact, the source of wealth. I think all the nations would agree that it is a mark of an advanced nation and the other thing is it provides wealth for many things, for people, but also the excess wealth that is generated really helps create culture

because it provides the resources for art and other things that are important for culture.

So, having a strong manufacturing economy that is generating wealth is truly an important issue. So, if we look back a little back a little bit on just the previous century, now that means the 20th Century, and that is history of the role of manufacturing, if we look at the early part of the century, really some of the key things that we were looking at were capital, still important, resources, natural resources, and labor. Those key resources for manufacturing generated a lot of the wealth that made the United States a wonderful place, but actually another side of it is in terms of in addition to generating the wealth, that capacity that we built at that time, also was key in providing for the defense of the nation.

It really did win a couple of world wars. So that is another context that is important for us as we look at new opportunities created by nanomanufacturing. If we look at the time from say about the 1960s to about 1990, if we mark it that way, there actually also was a bit of a shift going on in terms of providing that infrastructure for manufacturing.

More of a science base for engineering and business, the importance of quality and productivity in enhancing the manufacturing enterprises was very important

and I remember very clearly -- I would guess a number of you would, too. We were really concerned about that and invested and moved forward there. That was the time when one of the mandatory trips was to Japan to look at issues of quality and productivity and how we could bring that here.

We did that successfully and also another important aspect was improving productivity and quality by looking at automation brought on by computer technology and information technology. Today that is an integral part of all businesses and it has also made manufacturing a truly global activity. So, another thing that we also have to remember, as I go toward discussion of nanomanufacturing, is that is where some of the basic discoveries in things like nanotubes, fullereins(?), the materials, the raw materials for nanomanufacturing were made, as well as we focus on manufacturing. Some of the tools that are used today, things like the scanning, tunneling microscope, atomic force microscope, how do we take those kinds of ideas and create the tools that will develop an industry?

Those are some of the important things that we have to deal with. Other important things, I want to go back a little bit because I also want to say now as we are in the 1990s to the present, some of the key resources have changed a little bit, where overall knowledge is an important competitive resource. Innovation is important.

But as I put on this slide in the middle, going from labor to people who are actually the holders of that knowledge and create that innovation, I think that is a very important role that we have to develop and you will see that I talk about that later on.

I really see -- and I would like to make the point that as we talk about nanomanufacturing, I see that our future opportunity that we would like to get your feedback on relates to how do we enhance the performance of industries today, but also look at the opportunity of creating new enterprises and new industries to generate that same kind of wealth that will keep us moving forward.

As I focus now on nanomanufacturing and just give some definitions of some terms that we used in terms of formulating this presentation, first of all, I want to focus on the idea of nanomanufacturing as the activities, systems, processes used to create things on the nanoscale and actually we have -- it has been agreed that when we talk about nanoscales, we are talking about things less than 100 nanometers in size scale that are going to deliver products or systems that exploit some of the unique properties that we can achieve on the nanoscale.

I am sure all of you remember your basic chemistry. Remember what the hydrogen atom is all about, the simplest one. Well, if you can put eight or ten of

those in a row, squeeze them altogether, that is what we mean by one nanometer. So, I want to impress on you the idea that the tools, the techniques and methods that we have to develop to enable nanomanufacturing are on a very, very different scale than a lot of times we have been thinking about. So, that is why it is an important area for us to look into.

Also, I want to say that when we talk about nanomanufacturing, some of the aspects that have always been important for manufacturing are still there. That is where we talk about this scale up, the three things, three things that we talk about; productivity, producibility and predictability. So, producibility is actually do we have the tools and systems and processes to do what we would like to do and can we make choices and select the best techniques and tools so that we can do it in an economical manner.

Predictability, we referred to both can we predict the performance of what we are producing, but also can we predict how long it is going to take to produce these things because when we talk about manufacturing, the idea of being able to deliver on time where needed is an important thing. So, we have to have that kind of knowledge also in what we do.

Then, the third thing is productivity. Can we do this and be competitive on a global basis? So, those are

things that actually everyone engaged in manufacturing has to think about and deal with. When we talk about nanomanufacturing, it becomes a particularly new area that we have to look into. I also want to just say as a kind of an aside, when we are doing this, when we use the words "scale up," we are talking about a couple of kinds of scale up, scale up from this very, very small nanoscale to a place where we can interact with the products that are going to be developed. So, that is a physical scaling, but the other, of course, is the same kind of scale up that JoAnn was talking about, so we get the number of -- the volume that we need to make this truly an enterprise.

Some of the other things that I want to just impress on your mind, scale up, but also up scaling and particularly up scaling integration of these three items that I indicated here. How do we scale up across these different scales of things from the basic structure, that very small -- the functional devices systems, as well as products and services? How do we make that kind of an upscaling.

Also, upscaling of materials in geometries and, third, how do we do this across different domains of where we provide energy and activation, mechanical, electro-mechanical, thermal and actually a great frontier area is going to be the biological and chemical. So, that is kind

of the background of all of the things that I am going to be discussing.

But about these different generations, if you look at this, this is actually the fact. Nanoproducts are here today enhancing the performance of materials, their toughness, their wear resistance, a number of different things actually are here with us today. We are also seeing a lot of investigation and it is an active area in nanostructures on these devices that deal with electronics, some chemical materials and looking at things actually on the basic element level. Those are things that we are looking at today even as we speak.

Other issues as we look farther ahead and actually -- you know, most of this list talks about the products and systems that will be developed, but we as we talk about manufacturing have to think about the capacity to provide these things. So, we have to also look at this agenda that is a little far reaching, looking at this third generation of the true three dimensional nanostructures, as well as when we bring together things truly at the nanoscale and molecular scale in building things up at that scale.

We have to start anticipating what kind of systems, processes are we going to have to put in place to be competitive there. I do have to spend -- put into context the work that we are discussing here today in the

context of an important investment that was made starting in the year 2000 and that was establishing the national nanotechnology initiative. It actually is also an inter-agency activity and you also should see the areas that they are focusing on in terms of program component areas.

I have just highlighted nanomanufacturing, but as I move along, you will see that on this list nanomanufacturing is the focus of this presentation here, but it also includes some of the other things because as soon as we talk about creating new industries that generate new wealth, you will find out that, you know, some of these issues, like societal dimensions, how will an enterprise fit in society become important.

But I really have to mention that to put it all in context. These are the three things on the next slide here that I am going to spend some time focusing on, are actually what we in the working group that has put together this presentation on nanomanufacturing focused on. That is issues of infrastructure, some of the design and manufacturing, tools and systems that we need, as well as how do we make sure that we are ready to move these enterprises and these industries forward.

I am going to start with focus on infrastructure and the development of standards because as soon as we start thinking about moving from basic discoveries of science,

trying to bring them through the innovation process and develop processes and industries. We have to worry about some of these things and pay attention. How can we make sure that the basic measurements, processes and systems are developed. That is part of the infrastructure issue, but more important, when we are going to be specifying components made on the nanoscale, what kind of a standard do we need to make those specifications.

Also, when we develop the tools to transform nanoscale materials into useful products and systems, how do we specify the performance of those kinds of tools and systems. So, we see that some important research and development contributions needed there are in terms of first developing this instrumentation for metrology and make it robust so that, in fact, it can be part of a manufacturing enterprise, as well as developing the standards for performance and specifications that are an important and integral aspect of all manufacturing activities.

Like the next talk about some of the what we see are some challenges and needs, some R&D needs in the area of design and manufacturing processes, the systems and instrumentation. I have got a list up here of several of the challenging areas for making these transformations, different types of processes, the issue of being able to develop tools that are able to have this ultra level of

precision, as well as being able to really do things on this scale up issue of processes that can reach that kind of level of sophistication.

We have identified some of these basic R&D contributions, these new processes and hybrid systems. An important aspect will be in the environment that nanomanufacturing is going to be carried on. Robust sensing, control and actuation systems, how do you see at the nanoscale? A lot of times we felt the ultimate was optical and light wave sensing in visualization. When we are at that scale we have to use new techniques and develop new methods. As we look further into the third and fourth generation of nanotechnology based products and systems, where we are starting to develop things at the scale of cells, how do we integrate those aspects into our manufacturing systems?

Other important thing is, again, remembering the size scale that we are dealing on. How do we directly interact with things that are so small? So, we feel that actually some of the tools, some of the tools that are going to be powered by information technology are going to be important for us to do that. That is where we talk about virtual design and manufacturing infrastructure or tools to do this.

Some of those things are available but we really

haven't fully utilized them on this scale of nanoscale manufacturing. So, we see some of the research and development contributions that are needed there are how do we connect and correlate this virtual environment, which we can -- which is still very new, but we can draw on that with the physical environment on this very small scale. That is an important aspect.

If we do that, how can we do it in real time? How, in fact, do we go about developing architectures for this kind of activity? Also, the other will be we believe that this virtual interaction with the products produced by nanomanufacturing is really going to be the only way that we can really truly interact with the products that we are building.

So, that will be an important issue particularly as we try to train and develop the work force to do that. They are going to need new knowledge, new skills to do that kind of activity.

Then I would like to also talk a little bit about some of the integration issues that we see are going to be important and critical. How do we again exploit all of these -- the functionality of things on a nanoscale as we move up in this upscaling to the device and system level. That is important and we are going to have to develop new ways to create products in that environment. The other is

how, in fact, do we provide choices in the design process?

So, as you look down on what we see are some of the research and development needs, some of this overall how do we, in fact, interconnect initially as soon as we have a conceptual design, design and how we are ultimately going to realize this design and produce it as a product that is going to have value in the marketplace.

The other is those of us who have engaged in design, we know that usually we design things based on a synthesis of elements that are available to us. We don't design every component. There are some basic building blocks. At this point, we haven't really defined what those building blocks will be so that we can put things together at the nanoscale in a modular way.

So, we see that as an area that we actually have to look into to move forward this exciting new area. Also, truly, if we look at this not only as a way to improve the productivity and generating capacity of existing industries and enterprises, but specifically if we think about trying to create totally new enterprises in a new nanomanufacturing industry, the issue of work force is going to be we see an important issue.

As you can see, it is the issue to support the industry. People engaged in this industry are going to have to continuously develop new skills. One of the other

questions is what will this if we develop a nanomanufacturing industry, what will it be like? Will it be highly distributed all around the nation? Will it be concentrated in certain areas?

What is going to be the area that they would concentrate on for a resource? And it might be people. It might not be some of the other traditional resources. So, those are some of the challenges or things as we look ahead, I think, that are important for us. So, we see some of the needs in research, development and on this slide you will see I have added education as an important aspect, the need for an important and strong science, technology and mathematics base. How do we instill this culture of lifelong learning that is going to be important in the future, in the 21st Century.

The other is really something that is very important, again, when we talk about creating an industry. What are the ethical, legal and societal implications of creating this new kind of industry. We see that that is actually extremely important.

Some others are going to be the environmental health and safety. How, in fact, do we accelerate our efforts to prepare society for a nanoscale manufacturing culture? So, some of the issues there will include in terms of this is what are some of the important things that we can

do that we can't do now in terms of nanotechnology products for cleaning the environment? There are some.

For example, the one that I have in the lower right hand corner is actually something developed at Argonne as a way to -- based on nanoparticles to actually help clean the environment in case of a spill or some other in this case I think one of the directed goals was if there was, in fact, a terrorist attack. The other is the recycle and reuse and remediation process. That also was included there. But probably one of the other things that is truly a very positive thing is in these -- building from the molecular level up or with these new processes is the avoidance of waste and the positive impact on the environment of being able to do that.

I am going to use these next two slides, first of all, to give you an idea of who is participated in helping us put together these ideas. The Department of Defense actually has activities going on and some of them are at the center level and building infrastructure. Some of them are very specific research foci. Similarly, with Department of Energy, since we specifically -- I just finished talking about the importance of work force for this 21st Century type of enterprise. The Department of Education has helped us and made contributions here.

NASA and their emphasis on sensors, structural

materials at the nanoscale; the National Institutes of Health, particularly when we look into the future, the idea of biomomemics as a new area or a new field that is going to merge with us at the nanoscale, is an important interest there.

Yes, also in terms of their laboratory and infrastructure, as well as their fundamental contributions to enabling this new nanomanufacturing industry, work on standards, measurement and metrology. NSF, our goal is also to help move this forward in terms of our centers and infrastructure, but also our research programs and educational programs that we hope are helping move this frontier along.

One of the things that also we have discussed and have included the full area of bio-based products and biotechnology, we actually do -- as soon as we start working on this very small scale, the kinds of things that we have an opportunity to have an impact in with nanomanufacturing broadened and also Food and Drug Administration as helping also in developing some of these standards that we are going to look at for the future.

Of course, I haven't got them on here, but the Office of Science and Technology Policy, as well as Office of Management and Budget have also helped us in developing and putting together these ideas.

What are some of the next steps? Well, I will just kind of iterate or list a few of the things that are actually ongoing in terms of infrastructure development and standards. I have alluded to that on the previous two slides. A number of the agencies are actually creating new centers, new centers that are actually focused on nanomanufacturing or metrology or that kind of processing.

Similarly, throughout here, one of the important infrastructure elements is actually going to be the cyber infrastructure or the information technology based infrastructure, again, because of how we are going to have to work on the nanoscale. A couple of examples in terms of the design and manufacturing processes and systems, a number of the agencies already have programs in place that might be called nanomanufacturing or nanomaterials.

We have the basis put together to do some of these things and also the whole area of bio-inspired and bio-derived products are coming together in this area on nanoscience and technology. That is an important enabler for nanomanufacturing. If we look at also the idea of work force and societal impact, one of the things that actually is going on and was alluded to or was identified in the presentation, the kick-off presentations this morning, was the important role particularly as we tried to develop commercial products and create a new industry of the small

business innovation research, small business technology transfer programs.

If you look at the portfolio of investment in nanotechnology by the SBIR, STTR programs, it is about -- I think it is about 70 million in physical year 2004 and we expect to see that going and growing. So, it is starting to help us develop this new opportunity area. I think probably some of the other aspects that is important that we have to work on more is the overall technology transfer because as government agencies, our role is an enabling role, but we have to make sure that that knowledge gets to the people that will actually execute and take advantage of these opportunities because it is this generating of wealth that is our goal.

Let me just -- as I prepare to conclude, just summarize what we see are some of these impacts and positive benefits of moving forward in nanomanufacturing. First, how do we make sure that the industries that are here today have better products, better productivity through these investments? That is the first thing because that is generating a wealth that we have today.

How do we also use the research and development to provide tools and systems that go beyond what we have to enhance existing products and industries, but actually try to create new industries that are knowledge-based and have

the work force there, ready to make this thrive and thrive in the United States.

The other is we do think that we have a strong position in nanoscience and engineering and this is only going to be fulfilled -- the promise of our investment there is only going to be fulfilled when we actually do have a nanomanufacturing industry because we see that it is going to be an important contributor to all of these other national priorities.

So, the first thing is we do see that, you know, the changing global competitiveness actually presents challenges for both industry and our agencies in trying to set priorities so that is one of the reasons why we are here and like to have your input. We think that nanomanufacturing can provide a strong technical base to move the manufacturing sector forward and also create a new industry. We actually do look forward to the interaction with you to get your input as we think about this and refine our thoughts on nanomanufacturing.

So, thank you very much.

[Applause.]

DR. HALL: Thank you, Warren.

I think from this morning's presentations it should be clear how much value there is in this group of federal agencies getting together to talk about our

individual agendas, our individual missions in these technologies and how we can work together.

We are going to get together this afternoon and we are looking forward to getting your comments. Under Secretary Bond and I and the three presenters from this morning's session will be here to answer your questions, to listen to your comments and your input. I would especially like to thank the three presenters this morning because when we originally asked them to take on the job, it involved getting the thoughts of the agencies together, those agencies that wished to participate in each area and getting something done in writing to serve as a guide.

They did not know at the time that their involvement would extend for many months and that it would also include being here to speak to you this morning and being part of the session this afternoon. They have, I think, done a wonderful job working with their counterparts in the agencies that have worked to develop these technical priority areas. So, as we adjourn and we will, by the way, get together at 1:15, as the program indicates, but as we close, I would like to give them one last round of thanks.

[Applause.]

So, we are adjourned. Sue may have a word or two to say about logistics. So, I will turn it over to her.

MS. SKEMP: Thanks, Dale.

I think earlier this morning I told you that we could go across the street to the Rayburn Building. Well, it seems that from what I understand, the President has been over there most of the morning and it may be a little bit difficult logistically to get in and out within an hour.

So, I am suggesting that we go downstairs in the cafeteria. Those with badges are free to go down, government employees. You have to go back around to the front and then there is an escalator or, excuse me, elevator and stairs there. For those of you who are not government employees, we will ask those government employees to help get you downstairs and there are also some people out front who can get you downstairs.

There is a cafeteria and there is plenty of room down there. The President didn't ask my advice. So, I apologize for the changes, but we know how to be flexible. Again, we will be back here at 1:15. Thank you.

[Whereupon, at 11:45 a.m., the meeting was recessed, to reconvene at 1:16 p.m., the same day, Thursday, March 3, 2005.]

A F T E R N O O N S E S S I O N [1:16 p.m.]

MS. SKEMP: Again, I get to do a few items ahead of time before Dale Hall comes up to moderate the next session.

I have been asked by a number of people about the presentations. They will be up on the web site. As I said, my goal is to have that active on Monday. So, all the presentations will be up there, including Al Frink's presentation, which was a speech. I am getting the indication that it will be somewhere on the order of seven to ten days we will have a transcript of the proceedings today.

In addition, there is a recording of individuals at the microphone. If you will note one thing, I wanted to make sure, we recognize the different agencies working in the Inter-Agency Working Group, but what I wanted to do was point out that the contacts for those agencies are listed on the agenda, on the handout you received when you registered today and those names will be up on the web site.

The other thing I was asked about was whether or not anybody could get a list of the attendees. Unless anybody has an issue, I will put those names up on the web site so that you have -- and I will put only at this point e-mail addresses, unless you want some other information. So, those will also be up on the web site.

If anybody has any questions, please see me.

Okay. Dale.

DR. HALL: Okay. Thank you, Sue.

Agenda Item: Public Comment

Welcome to the comment session. We have done a lot of talking this morning, telling you about what our plans are, but our plans need to be informed by the knowledge that you bring to the table. So, we are very interested in hearing what you have to say now. We welcome your comments. We welcome your suggestions. We welcome questions and we have a panel up here that we will be happy to address them.

I would like to say that I know we have a varied audience here and we are interested in hearing from all of you. We are particularly interested in hearing the industrial perspective. So, those of you who are representing the private sector, the people who are actually out there doing manufacturing, please, by all means, step up to a microphone if you have something to offer.

I want to mention that what we are looking for as the Federal Register said, the notice and the web site, we are looking for your input on the current status and the future technology needs within these three technical priority areas. We are focusing today, as I think it was clear from this morning, on technical issues, rather than

budget issues. That is where we would like the focus of the discussion to be.

We are interested in your comments, for example, on a number of subjects, which include the national and international context for these three areas, the importance to the U.S. economy and our national security, the position of the United States relative to other international leaders in these fields, what you see as the main technical needs. Please feel free to offer whatever justification you can for those opinions.

What you think the relative priorities should be for those needs and what your basis is for assigning them. You have heard the presentations this morning and we would like to know what resonates most strongly with the community. We have spent a lot of time thinking about appropriate roles for the member agencies of the Inter-Agency Working Group but -- and, of course, those are largely driven by mission priorities, as well as our perception of national need, but we also welcome your comment on that as well.

If you can tell us something useful about expected technical developments and also expected commercial developments in these areas, I think it would be very useful to us. Finally, anything you can say about the relationship to other efforts, national or international in scope, and

efforts that are both complementary and competitive. I know there are people in the audience today, who are working on building manufacturing technology initiatives of one sort or another and I know in some cases there appears to be complementarity. We would certainly like to hear from you and get your thoughts.

The necessary and desired outcomes and impacts in these areas we are, of course, interested in. So, let me just go through some ground rules quickly. We have microphones in each of the aisles. If you would like to make a comment, please step up to the microphone and we would like you to either leave a business card or fill out a personal information card so we have your contact information.

We are not sure how busy a session this is going to be but to start off, I think we would like to limit comments and questions to three minutes per. So, no long dissertations, but I think in three minutes it will be possible to make your statement.

Direct your questions to specific panelists as appropriate if there is a particular person that you think is best qualified to make a response. We are interested in focusing on strategic level direction and strategic level issues, rather than going into the technical details, unless, of course, it is necessary to do that to make a

point clear.

I want to say that there will be a complete -- I think Sue said this -- there will be a complete transcript of the meeting. It is going to be available on the web site and you will be able to find it there. What we are going to do to impose a little bit of order on this session is we are going to take comments first on intelligent and integrated manufacturing systems, second, on manufacturing for the hydrogen economy and third, on nanomanufacturing. I will do that -- we will make the switchover whenever I sense that we seem to have reached the end of a particular subject or in the case where it looks like interest remains robust, we may cut it off at 15 minutes to make sure that everyone has a chance to address the three areas and then with the remainder of the time we will go back and handle unfinished business in those areas.

We will also be here to answer questions about the work of the Inter-Agency Working Group, the strategic implications of this whole suite of technology areas taken together and so forth. Although I do not have a seat at the table there, the moderator retains the right to jump in and make comments as he sees fit, but we do have an outstanding group of panelists here and I anticipate that that will not be necessary very much.

So, with that, we will get started. Phil is there

anything that you wanted to say?

DR. BOND: Just to exercise the chairman's prerogative, if I could, on one item, to throw at you, Dale. Before we start in questions for the three, I would be particularly interested in hearing anybody who has a comment on whether you think there is some other major area that deserves higher billing than the three that the agencies have come to. So, kind of start on the very most fundamental question of all. I would like the record to include any thoughts that may be along those lines and then we can get deeper, indeed, to the three. But I don't want to foreclose the opportunity if somebody says that we missed the boat.

DR. HALL: Okay. The floor is open for comments on that subject. Maybe we didn't miss the boat.

MR. KETTOY: My name is Bob Kettoy(?) and I think my title is boy engineer. My question is for Dale.

We have approached the subject of manufacturing this morning particularly from a technical and a technology viewpoint and I think there is another dimension that is important. Some of the parts of that dimension came out in the speeches, intellectual property rights management, for instance; getting global viewpoints and global awareness of manufacturing technologies and allowing our SMEs particularly to participate in global manufacturing

technology development and process development and then sells the SMEs getting an awareness of what is happening in the world, what the state of the art is and developing a set of -- a market, a global market for them in addition to just a local market.

What I am talking about is sort of a management infrastructure that overlays the three areas and other areas that we talked about that has a global emphasis and there is an initiative that Dale's NIST support, his organization at NIST, called IMS, Intelligent Manufacturing Systems, which is an initiative that is joined by seven geopolitical regions, the European Union, the United States, Japan, Korea, Canada, Australia, Switzerland and Norway.

What this organization does is it provides a framework for joint advanced manufacturing R&D amongst participants from these various regions, but in an environment that allows for good management of and protection of intellectual property rights and it is a proven system that has been working for the last ten years, which provides for fair and equitable participation in these kinds of joint efforts, where you don't give a nickel and take back $10, but where there is equity and balance in the contributions and benefits and where there are some mechanisms set up for dissemination of information worldwide.

That almost takes my three minutes, but how does this fit in, Dale, to the activity that you have been involved in?

DR. HALL: That is a lot of material to try to respond to and I think some of you in the audience are certainly familiar with IMS; perhaps others aren't. Let me just say that IMS, as Bob said, is an international activity and it has just come to the successful resolution of a ten year long Phase 1 and is now in the initial stages of Phase 2. I think it was recognized by the international regions that participate that this was a useful activity and that we want to keep it going.

I won't comment in particular on such things as intellectual property because I think that is somewhat outside the scope of the Inter-Agency Working Group, but I will say as far as the technical agenda is concerned, I share your concern that we need to make opportunities available for the small business base in this country to participate. In fact, that is one of the things that IMS struggles with and that we all struggle with. How do we make sure that they get included, especially in the area of cutting edge technologies.

We had a conversation not too long ago with Australian representatives from IMS and they struggle with this, especially because -- this may be an overstatement on

the part of their representative, but what he said was we don't have any large companies. We are all small companies and making those opportunities available for the small business base is critical to them just as it is for us.

What that really gets to is technology dissemination and making sure that people are included in the conversations. We will do what we can to do that and I don't want to put Assistant Secretary Frink on the spot, but I know that he is very concerned about the small business base in this country. He alluded to that in his remarks this morning. I think that he is going to try to help carry that message.

Would anybody else like to add to that?

DR. BOND: I would add what I hope is a responsive thought. As we look at an R&D portfolio down the road for manufacturing, there will be elements of it that will be ripe for international collaboration, but that would be a separate discussion and decision, really driven mostly by OSTP and Dr. Marburger, rather than this particular working group.

DR. HALL: Any other questions of a similar nature? Yes.

MR. DANIELS: My name is Dennis Daniels. I am with ARC Advisory Group. This is not of a similar nature but in regard to manufacturing and some of the strategies

that are out there today, technology has moved ahead that we have a lot of capabilities today. One of the problems that I see in industry and I deal with most of the users and manufacturers today is that they are having problem with the people in the departmental guidelines and the departmental silos you might have within an industry. It seems to be holding us back a bit.

Does NIST or any of the agencies have any ideas of how to deal with this people and structural problem within these large companies in regard to technology?

DR. HALL: Let me make sure that I understand the question before we take it in hand. Are you saying that companies have trouble figuring out where to go within the Federal Government to have these conversations? Is that the essence of this?

MR. DANIELS: I think it is how much the Federal Government might want to take a lead, for example, on some of the technologies that are on the factory floor today, they are getting more IT oriented, which is basically been a business systems type of area within the companies. The IT people are now going down onto the factory floor for maintenance and support. Yet, the factor floor people don't want them down there because, you know, just with doing packers. You can't stop production to do packers. This is one of the areas that I didn't hear that any of the

organizations were going to be getting involved with whatsoever and I just wanted to know if the guidelines from the government would help companies in this regard, I believe.

DR. HALL: Okay. I am not sure who the best person is to take a whack at that. Al, do you --

MR. WAVERING: Yes. I guess for the purposes of this meeting and this group, the question would be what are the -- are there R&D issues associated with that as a problem? If you see that there are, then those would be things we would be interested in hearing about.

Aside from that, there are some things that are being looked at just within the security for industrial control systems, the kinds of issues -- this issue that you bring up is a major one, a significant one in that area, as you know. Within the groups that we are -- that NIST is working with and leading, we are trying to address that issue to some extent, but I am not sure that it relates directly to what this group is about.

MR. WASGOWIZ: Hello. My name is Fred Wasgowiz(?). I am director of standards at the Object Management Group. For those of you that don't know us. We are an international trade association that develops software specifications.

Following on this question and your remarks,

though, I think that it is part of the problem. When you talk about the systems, the advanced systems that you are looking at, software is such an integral part of it, whether you are at the factory level, you are at the cell level, the enterprise level, even imbedded control systems. You have software there, which is a key determining factor of how efficient you are and I have also heard words along the lines of interoperability integration today.

Certainly, to get enterprises working together, to get advanced equipment working, interoperating with one another, it is going to require addressing the problems within IT now that is preventing that from happening. I would think that that would be a key element of what you are looking at in regards to new and advanced processes and technology.

I guess I need some assurance that there is recognition that when you are looking at a piece of processing equipment, you are realizing that much of the control, much of the interoperability with the rest of the enterprise, the factory enterprise, is, in fact, IT and not some analogue line or something of that nature.

MR. WAVERING: Please be assured that we do recognize that. What I thought I was hearing from Dennis was more what can we do to address the more cultural issues within a company. That is, I think, where there is maybe a

bigger question of the role of this group as far as addressing some of those issues. But absolutely this is all about the kinds of things that you were talking about.

DR. HALL: Yes. We seemed to have moved into the area of intelligent and integrated manufacturing systems. So, let's continue in that vein.

MR. CAVANAUGH: Well, I sort of have -- I am sort of in the general comment question if that is all right.

I am Larry Cavanaugh. I work in the steel industry. I also chair a group that represents materials manufacturers, including steel, aluminum, glass, paper, chemicals and metal casting. I am here in that capacity today.

The conversations this morning, the presentations focusing on competitive advantage and lowering our cost of production are excellent. Certainly, the proper and exciting right focus. Within our group of material sectors, we think the biggest bang in that area is by banding together to bring about process change to develop new processes or to cooperate to take the steel industry today to the next generation steel industry or next generation aluminum or plastic or glass.

By leveraging our dollars and your dollars to invest in those game changing technologies that result in less process steps, less cost of production and the

competitive advantage we are looking for, those, you know, again, big picture. Does the program that you have envisioned and you have laid out include that.

DR. HALL: I will make a response and then certainly would like to throw it open to the panel.

I think in some sense it does. Clearly, we have laid out three technology areas that we intend to focus on for the moment and perhaps the one that aligns most clearly with what you are talking about is intelligent and integrated manufacturing systems because that whole technology is very highly infrastructural in nature and certainly when you talk about improving processes so that you can improve your economics, I think that is a part of it.

With that, I will defer to the panel.

MR. WAVERING: Well, I agree with Dale, I guess, that certainly the types of things that we are talking about within the IMS area would impact the future of those industries. What we wouldn't be focused on would be more materials issues, I would say, things that have to do with the fundamental manufacturing processes that you are using. I would not see us falling within the scope of intelligent and integrated manufacturing systems per se, but all of the application of IT, computer communication assessing, technologies, to support those processes would, product and

process design tools things like that.

MR. CAVANAUGH: Thank you. Again, I was making the comment based on Mr. Bond's introductory remarks. Is there a gap? Certainly, the structural components of integrating, you know, the business system with the production planning system with the production system. Those are all important technologies. The cost advantage gained from those technologies is pennies compared to the orders of magnitude bigger cost and competitiveness advantages by changing the process.

So, I am suggesting that that is an area that the inter-agency group look at for being able to leverage, you know, innovation, dollars, whatever, to change processes, the actual manufacturing processes.

DR. BOND: Let me respond in two ways. One, to point out that, of course, when you talk about nanomanufacturing, you are talking about a fundamental change of process, which will apply to many of the materials that you represent today, but also just to encourage you to submit for us and for the group's consideration a fuller discussion of exactly what you are talking about so that we might consider that as a subject area or it might be imbedded into the other things we are talking about. We appreciate that input.

MR. CAVANAUGH: That is great. We would be happy

to do that. Could you advise me of when would a submittal like that be timely? You know, deadline, when would you like to have that, any type of written comments or suggestions?

DR. BOND: We would really like to have that over the course of the next week or so and you can do that through the web site that will be set up to receive input like that. That would go for anyone else here in the audience. If the three minutes, for instance, is not enough to make a presentation or ask a question on something, rest assured that we are going to be in a receipt mode via the web site for much fuller input that you have for the working group.

MR. CAVANAUGH: Thanks.

DR. BOND: Thank you.

MR. MC CORMACK: Richard McCormack, Manufacturing and Technology News.

I was just wondering -- we have three distinct areas. Does the Inter-Agency Working Group foresee additional areas? Do they debate other areas? Also, is there concern among the government people here that you are developing R&D, you are funding R&D for industries that are not here anymore, that basically take the R&D and use it for production facilities, in production facilities that are not in the United States?

Are these growing concerns among the policy makers in the government?

DR. BOND: Sure. Let me start, Richard. First of all, we did look at more than three dozen different suggestions building on the GATE-M work. So, we did consider a lot of other subjects trying to whittle our way down to a manageable list of priorities. We will, I would foresee as chairman anyway, that we would continue to constantly reassess and ask that question year to year as we go forward. In terms of the global nature of manufacturing and so forth, we looked at what we thought was important to the manufacturing sector in the United States, which continues to grow in its output, although there is also growing manufacturing output all around the world and so forth.

There will be -- in globalized settings, there will be some benefits that globalized companies spread around the earth, but we believe these are important to a vital sector of our economy and it is the President's intent that we focus time and effort and R&D dollars on things that will help domestic manufacturing and we believe, at least from the federal agency perspective that these are three fundamental priorities that we could use more collaboration and deeper focus on.

DR. HALL: Yes, I will add to that, Richard.

If you look at the three areas, I see that they have maybe three distinct characters. Let me take nanomanufacturing first. I think this is an area where it is assuredly not true that manufacturing has moved offshore because we haven't really begun to see the real payoff of nanotechnology. I think this is an area where the United States is supremely qualified to compete.

This is about having good ideas. It is about being first to market. It is about innovation and our concern is that we are everyday hearing discoveries in the area of nanoscience and nanotechnology, but if we are going to realize products, if we are going to see commercial success, we will need the ability to manufacture those products. Warren talked today about the attributes that are necessary to make that happen.

So, I think there the game is wide open and we have an excellent chance to do very well. In the area of manufacturing for the hydrogen economy, this is really about a conscious choice that the United States has made about its energy future. As JoAnn said this morning, we aren't here to debate whether that is the right choice or not, but within the context of that choice, again, I think that this is not an area that has moved off shore and I really don't see that that will be a big element of this.

Now, in the third area, intelligent and integrated

manufacturing systems, the game plan is very broad. There is a lot of scope in that topic and it ranges all the way from integration of the entire enterprise, for example, how does a company compete in a manufacturing enterprise that is widely distributed, global in nature. Al talked about the real competition being among supply chains, rather than among individual entities and it extends from that global reach all the way down to the factory floor. How do we build intelligence into what is going on within a localized manufacturing environment.

There, I think the issue is that manufacturing is distributed. It is global in nature. There are forces that are very powerful that are driving it that way, that extend far beyond the technical sphere, which is what we are concerned with. Our job is to think about how we can position the United States so that our companies can compete in that environment.

MR. KETTOY: Bob Kettoy, again. This is for IIMS. Several of us noticed in one of your slides, one of the latter slides, that you were describing the activity of your group as providing some degree of coordination or probably networking of those laboratories that were inputting to this subject and you mentioned the government labs and academia, academic labs.

Noticeably missing from this networking or

coordination was industry. Is the normal modus operandi one of normal coordination among academia and government labs with an occasional workshop, such as this that gets limited input from industry or was there an error on the slide?

MR. WAVERING: I think the slide was intended to show something different from how you interpreted it. Certainly, the mode of operation that we follow and that we anticipate continuing to deal within this activity is to work very closely within industry for many of the federal agencies and many of the programs that I showed on that slide, industry is a critical partner in a lot of those efforts.

What the slide was intended to show was simply those federal R&D programs that are related to this area that are already going on. So, it was -- that is all it was intended to convey, not that industry is not an important part of this overall exercise. Universities were not listed individually either. So, it was just to identify some of the relevant federal activities. That is all.

DR. DeVRIES: I would just follow-up with Al on that because as an inter-agency working group, I think that was probably what we were trying to convey and, you know, the different agencies probably have a different closeness to industry, but it is important for all of us in setting our research agenda to get that interaction.

MR. NEAL: I am Richard Neal with IMTI and I would applaud the excellent selection and excellent presentations that we have heard, but I would make one observation to Mr. Russell's presentation this morning. He easily found major initiatives for nanotechnology for the hydrogen economy, but we had to work really hard to fit manufacturing into a position.

With that very important message, I would like to offer that this body and perhaps the IWG could advocate for raising manufacturing to that level of importance, perhaps the grand challenge, perhaps the presidential initiative and very soon. And to my brother, I would offer that in the intelligent integrated manufacturing systems, I felt like it was excellent coverage on the information technology side, but I would like to see more emphasis on that critical process technology side that needs to come along side the information technology piece.

DR. HALL: Thank you, Richard.

Is there a response from the panel?

MR. WAVERING: No, just to thank you for your comments and, again, if there is additiional supporting information or more detail that you can provide, we would be happy to see that and get it.

PARTICIPANT: I would like to make just an additional comment, not really a question, but the

consideration of the panel seems to be the industries that you are covering right now are only a portion of what industry is in the United States and I would like to see the possibility of expanding some of the reach that you are looking at into some of the food and beverage industries, which is very critical, has a lot of technology advancements going on and a lot of momentum and a lot of money being spent in that industry also, but in regard to homeland security, as far as traceability and those types of things, technology has a lot to do with traceability in the food and beverage industry.

So, just a comment that I would like to see a bit more advancement of vertical industries than what you have shown us today.

MR. WAVERING: Well, yes. I appreciate the comment and I think that is the intent of this meeting is to try to get to some of the other sectors that we haven't fully covered possibly in the past. So, again, where there -- what we are interested in here is for those industries to provide to us some input on what are the R&D issues and where are those issues different from the issues that are seen in other sectors, automotive manufacturing or aerospace or something like that.

So, I think there are two sides to this. One is where there are things, technologies that are being

developed and results that are being made that just aren't making their way to those industries, but they could be applied if that outreach could be made. That is one issue and the other is do they have their own set of particular problems that are not being addressed in the more broad and generic work that is being done.

PARTICIPANT: One of the areas that I think that needs to be addressed is your collaboration with other agencies. FDA is one of the big agencies that should be addressed with this packaging in the food and beverage industry and pharmaceutical industry also. They are the ones that really control a lot of the industry and coordination between the manufacturing part of it and the manufacturability of a product and the FDA would be, I think, advantageous. The two government agencies could work together.

DR. HALL: Yes. Let me just address this in sort of a general way. I think as Under Secretary Bond said, we have selected three priority areas, but that doesn't mean that these are the only areas that we are going to be involved with over the passage of time. The initial objective of our group was to get off the dime to actually do something and to get past discussing our organizational arrangements and so forth endlessly.

So, we focus very quickly on a set of

technologies. We picked three. We believe that they are extremely important to the future of the country, but it is not the list of technologies that are exclusively so. Many of those that didn't quite get into the top three are very important. We are very happy to take under advisement your suggestion.

I would point out that another agency that has a big potential role here is the Department of Agriculture and our representative from the Department of Agriculture is here today.

The other thing I will say, again, in a general nature is this is really the first time that there has been a formally chartered group in the Federal Government to talk about how we can better work together in the area of manufacturing technology. It is more likely that subjects like this will percolate up as a result of these cross fertilizations. Some of the subjects, for example, that might be interesting to DHS or the Department of Agriculture would not be on NIST's radar, for example, otherwise. But this forum gives us an opportunity to share issues, to share problems and to think about how we can work together to solve them.

So, thank you for your comment.

DR. BOND: Dale, let me add just two quick sentences. One that we will promise to reach out to FDA for

-- as an example to join our efforts in this Inter-Agency Working Group, but I also want to point out what a benefit it was to have Al Frink here today because I think some of the issues that you imply or identify in that last comment are nearer term than a federal R&D program. Some will get to the R&D reach and near term ones are ones that Assistant Secretary Frink, through the President's Manufacturing Council and through his own inter-agency efforts will be able to address. So, thank you for that point.

MR. WARNDORF: Hi. I am Paul Warndorf(?). I am with AMT, the Association for Manufacturing Technology. We represent the material removal and forming industries, equipment builders and accessories in the United States. I commend the fact of the government starting to work together to join forces on working on issues.

The thing I would like to bring forward that you might want to consider is often you are doing a lot of good work and it is hard to find out just what has occurred and dissemination of information, I know, is a difficult thing to do, but in your future activities, if there is some way or some means that industries like ours, which are very small companies, maybe $10 million is their sales for the year, have difficulty in trying to find out just what is going on and what they can take advantage of. I would just like you to consider how that can be improved.

MS. SKEMP: [Comment off microphone.]

DR. HALL: I would add to that, Paul, since you do know something about how your members can usefully receive information, you know, where they look and so forth and what is useful to them, we would welcome suggestions from you or from anyone here today on how we could accomplish that.

MR. BIRNACK: My name is Steve Birnack(?). I am with General Motors Corporation.

I would like to take a few seconds at the onset to address what I am going to call the exogenous factors, the exogenous factors to the manufacturing enterprise, that Phil Bond, Rich Russell and Al Frink addressed. I want to totally concur that three of those four issues, the free and fair trade, the tort or litigation reform and certainly health care are major issues and factors for that 22 percent cost in competitiveness -- non-competitiveness that all of us mutually incur as a result of that. And any influence certainly would be encouraged and appreciated toward our mutual interests going forward.

In regard to -- I have got a couple observations and comments regarding more specifically the intelligent and integrated manufacturing systems, but I am going to bring in a couple of things that occurred within the nanomanufacturing as well.

If you take a look at the epics that you put

together, Al, the first epic was 1900 and 1960 or 60 years, if my math is right and the next one was 60 to 90, which was 30 years, which is half of that and then we go from 1990 to 2005 and that is half again. So, if the trend continues, we are talking about 7 1/2 years that -- and we are going to be looking at another epic. So, obviously, the sense of urgency to get this done and implemented needs to occur.

Focus certainly is on flexibility and intelligence I heard you say in the machining industry and the forming industry, et cetera, but also even more so in general assembly, which is very, very labor intensive. We would be looking for flexibility and intelligence in our handling systems. We are looking at flexibility in intelligence in our material handling systems, in our conveyance systems, excuse me, and also in our tooling and not only just flexible and intelligent tooling, but tooling that is energy efficient.

For example, a lot of the air tooling that we have today is very, very inefficient and could be replaced with electronics. Part of that and what we shouldn't forget about is the human in this whole process and especially in general assembly, once again, very labor intensive, but the need for a digital human model that might be globally accepted would be very, very important and instrumental in the development of our processes within our manufacturing

operations.

Many times we don't recognize the obstructions. We don't recognize up front as we are designing or manufacturing processes and our products, some of the ergonomic issues that occur until they are very late, especially if you are dealing with compliant parts, like hoses, robot dress in the body shop, et cetera. So, the human is very important from that aspect, but also from the aspect -- and this is where I am going to go toward what Warren talked about, the training aspect or the work force aspect. As we develop these new technologies, there is a continuing need to make sure that those students that are coming out of our trade schools or colleges are more prepared to step right in, almost land running, if you will.

Many times our companies have to spend a year, two years to train these very well book smart individuals, but not necessarily manufacturing smart. So, those were some of the issues -- talk about the need for assimilation and modeling, doing as much of that up front as possible before we incur real bucks and in a vast manner also that deals with process modeling as well.

Thank you.

MR. WAVERING: I don't know that there is anything specific to respond to, but I certainly appreciate your comments and input and we will take that into consideration

as we put together our papers.

Thank you.

DR. BOND: Let me add a thought, too, in terms of your comments about the need for people to hit the ground running and so forth. You heard one mention the importance of education for a nanomanufacturing future, but really -- and I am sure Al has heard this on the road everywhere he goes as well, as he mentioned in his remarks this morning. So, all of that to say that it is two sides of the same coin, to talk about the need for an educated technology savvy work force going forward and increasingly technology reliant economy, including manufacturing. That is what is behind the 21st Century Jobs Initiative, the President trying to engage the community colleges in quicker skilling for new things.

We also have an inter-agency group under the Committee on Technology looking at advanced technologies for education and training, K to gray. So, we have some programs and procedures in place to try to get at exactly that issue because human capital is critical to getting the most out of your financial capital.

Thank you.

DR. DeVRIES: I would actually like to also comment that the different epics that you were talking about and the idea that these epics, they are shortening. That is

probably one thing I did forget to mention when I talked and I think all of us are aware of that, that, you know, somebody was talking about the anniversary of Moore's Law, which we always think of as pertaining to electronics, is getting ready to be commemorated, but that is true for everything that we are doing and in all engineered and manufactured products. That time factor is important. That is why also having people who not only hit the ground running, but are ready to keep learning all of the time is going to be a critical element for us to be competitive throughout this century.

DR. MILLIKEN: I would like to add also that education is not exclusive to the other two task areas. It is also important for the hydrogen economy in terms of manufacturing but also in terms of training maintenance technicians. So, the hydrogen program addresses education as well.

DR. HALL: We have had a number of comments and questions on sort of general topics and also on intelligent and integrated manufacturing systems. So, I am going to throw the floor open at this point. You can continue to address those issues but also questions in the other two areas would be welcome as well.

Somebody has to ask Warren a question or he will feel left out.

MR. PUFFERT: My name is Ray Puffert(?). I am with the Flexible Manufacturing Center at Renssalaer Polytechnic Institute. RPI has been very active in the fuel cell in this trade for many years. We have several organizations really focused on fuel cells. We have a center for polymer science, develops high temperature pem(?) membranes. My organization, the Flexible Manufacturing Center, that looks at manufacturing of high temperature pem MEAs. We have a newly formed fuel cell center and we have a center for future energy systems.

So, we really have a lot of organizations. In regards to specifically the FMC's activities, which has been focused on manufacturing of high temperature pem MEAs, we have been doing that for several years. One of the outcomes has been a fully automated manufacturing line for MEAs. In the course of doing our R&D work, I have come in contact with many pem fuel cell companies and I would like to make a couple of observations.

First of all, that industry is really characterized by a large number of product development companies that are small entrepreneurial companies, ranging from two men in a garage, literally, to small companies that are joint ventures, between larger companies to divisions of large companies that operate as an entrepreneurial activity.

I am afraid that the industry in general has not

really learned the lessons that other industries have happened because of the nature of the industry. We have all heard the horror stories of engineering and marketing, throwing a product over the wall to manufacturing and then dump it in their lap and say now you figure out how to do it. I am afraid we are repeating some of those mistakes because we have the two guys in the garage, who may have a great idea for a product, but they wait so long before they start addressing manufactureability issues that I think it is going to drag out the time for implementation.

Just simple things like their focus on product development and they hand build a system in the lab and they have hand built tolerances of 10 microns for dimensional tolerances or alignment tolerances, which are very incompatible with high volume low cost manufacturing. If they had only had the involvement in the manufacturing community earlier, they could have avoided some of these problems. I am not sure what the solution is.

It may be that agencies might want to consider a special grants program, for example, that is focused specifically on partnering small entrepreneurial system development companies with manufacturing organizations, be they in universities or in industry to do very early stage DFA, DFM studies, manufacturing feasibility studies and so forth so that we can somehow encourage these entrepreneurial

organizations to start thinking sooner and earlier about this very critical thing that may spell the success or the failure of the whole industry.

DR. MILLIKEN: Thank you for your comments. They are well taken. I would like to point out a number of things. The teaming approach is one that the Department of Energy encourages strongly in the hydrogen and fuel cell area so that every step along the way or every component is addressed. I think that this effort here is going to go a long way to addressing some of the issues that you raised regarding lack of DFMA approaches and things of that nature.

As far as establishing special grants, we can certainly include manufacturing R&D as part of our program solicitations and we intend to start in the near term with the Small Business Innovative Program, which also encourages teaming as well.

DR. HALL: Let me add also, Ray, that I think you have really identified a key problem. In the area of fuel cells, which is what you talked about rather than the broader scope of manufacturing for the hydrogen economy, but I think you put your finger on something very important. As a former electro-chemist myself, I think that you have really analyzed the situation very well, that it is not clear how we are going to go from making dozens of units a day to thousands of units a day or tens of thousands of

units a day. There is a great deal of work to be done in this area.

Anything more that you care to contribute, I think, would be, you know, in terms of specifics would be very useful to us.

DR. FRINK: Dale, can I make mention before this next question comes -- this is Al Frink over here -- in listening to Ray, I was intrigued by the question and his involvement in the manufacturing process at the academic level. I would like to ask that you invite me out to visit your facility and your -- where you are in the process of educating so that I can integrate some of that into my knowledge pattern as I move forward. I think that there is a lot of areas that we have been talking about that I am walking away with a direction on, one of which is the Manufacturing Council should be finding ways to collaborate with this inter-agency group and also the new one that will be formed under Secretary Gutierrez. As we interact in that group, we will try to find ways to integrate, collaborate with this R&D group, which I think is -- at the end of the day, we are all together on this and we need to make sure that we work out of the silo element that I referred to earlier and develop a single voice.

DR. HALL: Thank you, Al. And I want to point out, you probably noticed that Al sneaked up onto the end of

the table there a little while ago and brought his name card with him. He was not on the program. We were not expecting to put Al to the test up here as part of the panel, but we are very delighted that you have stuck around and that you are willing to --

DR. FRINK: I wasn't sure if you wanted another Albert at the table here.

DR. HALL: We are delighted to have you, Al.

For those of you who have been at the microphone before, would you please state your name again, not because we don't know who you are but because we are taking a transcript and it will be easier to figure out who said what.

MR. DANIELS: This is Dennis Daniels again with ARC Advisory Group.

I want to compliment NIST on some of the work that they have involved themselves with, such as the standards groups and working with open systems architecture to promote it. Some of them being the S95 Committee, which is on cyber security, S95, which is interoperability and also AP238, which is the step in CEA(?) machining.

One of the areas that you work on quite extensively and do a lot of good work on has a hard time or has a lead time to get implemented in industry. Do you have any ideas of how you could better work together as an inter-

agency group to commercialize some of the good work that you have been doing or work within the government agencies to have them require some of the things that you have developed?

MR. WAVERING: Well, I think this gets back to Paul's point about a lot of times there is good work that gets done and how can we be more effective in making that known more broadly and getting it deployed in the marketplace more quickly. Certainly, as with Paul, that is something that we would like to talk with you about and anyone else who has good ideas on how we can be more effective at doing that.

As far as the requirements issue, I don't know that -- there is nothing that I am aware of in terms of the context of this working group that is contemplating mechanisms like that for deployment, but I don't know if Phil or -- either you or Dale --

DR. HALL: It looks like Al would like to make a response.

DR. FRINK: That is right in my power. I have been amazed in the short time I have been here in the government how this is one great big no gloat zone. There is so much good that comes out of all the sectors of government. Dr. Graham's office in working on the regulations has conveyed to me that they have cut down 60

percent of the regulatory cost before they even get into place and I thought what an incredible degree of accomplishment that is and I said why aren't you trumpeting it. He said we are not marketers, but we would love for somebody to do that.

It is amazing that maybe five years ago, the entire Department of Commerce was being touted as not necessary. It wasn't performing a significant enough contribution to maintain its existence. That is a pretty sad testimony to marketing 101. We need to do a better job of creating a mechanism for keeping track of our accomplishments and to that end, I am going to be doing that. I want to work in a web site that will start to charter or keep track of accomplishments and manufacturing services and I want it to branch over into all areas, an incredible division within Commerce of NIST gets cutback in funding. I think that is a good example of missing the marketing opportunity to trumpet its successes and its contribution.

It is an area that I have seen has a great deal of need in the Department of Commerce. Manufacturing itself has not received all the attention it deserves. It is 15 percent of our GDP and it doesn't have anywhere near the support as agriculture, which is 2 percent, and agriculture is an incredible facet of our government, but it gets a lot

more horsepower and I know why because I visited California and I saw how they speak. They speak in one voice and part of my job is going to be to unite the voice of manufacturing all over the sectors that support it and to do that with information technology, e-brochures, e-newsletters and et cetera. So, I am putting together actually a committee on the marketing of the Department of Commerce and all of its services within my branch so that I can accomplish some of what you are talking about.

DR. BOND: I will just add that one of the great benefits of inter-agency work like this is that people get greater visibility into what is going on at the different labs and different outposts of the Federal Government and having a prejudice but exalted opinion of what NIST does, I have no doubt that people are going to come to a greater appreciation of the value that they provide and could help in other agencies meeting their missions. Indeed, I think that is happening on an increasing basis.

It is too slow, but we are making real progress on this point that Al has just alluded to, that people are sharing information, people are getting more visibility in the work, sharing the knowledge that they have gained, getting more bang for the federal buck as a result and ending up with people like Al Frink out on the road, able to talk about what is going on in the Department of Commerce,

in another bureau of the Department of Commerce or another agency of the Federal Government altogether. So, the silos are beginning to come down and certainly, I think in this case that will be a benefit to them.

PARTICIPANT: [Comment off microphone.]

DR. FRINK: Our news releases that we intend to put through the e-mail process, we will assign an individual who will be responsible for making sure all the releases we put out are sent to the trade publications and business sections of every paper so that when we have successes, we can scatter that success to all areas of media.

MR. NEAL: Yes. My name is Richard Neal and I do have a question for Warren, but I think it is relevant not just to nanotechnology but how do manufacturing topics in -- how do topics in manufacturing become identified in the technology area generally. You talked about the National Nanotechnology Initiative and we all see that as a real role model for how to create national programs, but if you hear briefings, a lot of that is about biotechnology. There are so many aspects of it.

How do you see the IWG and your role in working with the National Nanotechnology Initiative -- do you see the manufacturing topics being identified out of that program or do you see a responsibility for this group or for other people bringing those manufacturing topics to the

table?

DR. DeVRIES: Well, clearly, one of the reasons that we want to have these forums is to find out and get input on that. Our working group is actually -- we see it very complimentary to the NNI and I think one of the things that we have is the people that are active here from the different agencies actually have a passion for the manufacturing research and development activities. So, we really think that we can help move the whole national agenda forward on that and really do want to do that.

But I think the other very important thing about having this working group that is -- the title of the working group is Manufacturing Research and Development. This is actually I think a very positive accomplishment that we have had in a pretty short amount of time. It is less than a year and that we have a chance at least in the inter-agency and also working with industry and the public to make sure everyone knows of the importance of basic discoveries that we invest in in research, the development that goes on to bring those things forward and the other is -- I will just reiterate, the importance is wealth generating, not only for people to have jobs and employment and generate wealth, but that excess wealth is good for society in many ways.

DR. HALL: I would also add, Richard, that one of

the things we don't want to do is break down silos and create others. We have had a lot of contact with NNI, for example, and Warren showed you the list of grand challenges this morning and nanomanufacturing was on that list. We applaud that. In fact, we would like to reinforce the notion that nanomanufacturing is a critical element of success in nanotechnology.

Back in the days of GATE-M, which was the forerunner of this inter-agency working group, as Phil said this morning, we actually asked for time on the NNI agenda and did talk to them about nanomanufacturing. So, the link was made very early on.

PARTICIPANT: With regard to hydrogen, I know that there are a number of states that have very aggressive hydrogen programs and I was wondering whether the working group was conceiving of some way to interface with these state programs, given that the state programs simply want to encourage manufacturing within the states. Maybe this could also apply to the other sectors. Though I am not too -- I am familiar with hydrogen.

DR. MILLIKEN: Yes. As a matter of fact, we are interfacing with the states. We have interacted with the -- we interact with the State of California to a large extent through the California Fuel Cell Partnership and their California Highway Initiative. We have worked with the

State of Ohio and New York and as a matter of fact, we just participated with the State of New Mexico in their upcoming initiative.

So, we are engaged with them. We are continuing to be engaged with them and we are identifying areas where we can work more closely with them. We also have a program, the State Energy Projects Program, to actually provide funding through the states to businesses within the states that are collaborating with the state governments to develop and demonstrate technologies.

So, it is a very active area in the hydrogen program.

MR. LUSADER: My name is Rex Lusader(?) with Millennium Cell, a small development stage company that is trying to develop energy solutions for portable power. We have spoken a lot today about the initiatives associated with the DOE mission and the national mission of reducing the dependence on foreign oil. That is a good effort that we should continue, but I would make an observation that we have come to the conclusion from our small company's perspective that there is another initiative that is just as important and that is portable power.

We would classify portable power as those applications that require energy that is typically less than 1 kilowatt, where we are looking at transportation systems

that are as large as 50 or 75 kilowatts. We are talking about systems that are less than a kilowatt.

Individual soldier power for military applications, remote power for sensors and disaster relief is another good application. Medical applications are another. It creates an opportunity to reduce dependence on foreign batteries. A lot of our batteries today that are used in consumer electronic devices come from off shore. So, if we can take hydrogen storage systems, marry them with small fuel cells, to produce energy, we have an opportunity to create an additional industry here in the United States that doesn't exist today.

So, I would encourage the panel to look at another facet here of power and energy that steps away from reducing dependence on foreign oil, but plays just as an important role in wealth creation and technology creation and the ability to bring forward technologies that benefit, in the military today, our soldiers everyday, when they go into battle.

DR. MILLIKEN: Thanks, Rex.

We also believe that the portable power, that portable power fuel cells are important, not necessarily for the reasons that you mentioned, but they will probably be an earlier market for fuel cells than transportation or stationary. They are basically pem fuel cells. So, the

manufacturing capability that developed for them will help develop manufacturing capability for larger fuel cell systems.

You know, the panel may want to consider having another topic in that area. However, in terms of the Department of Energy mission and the hydrogen program focus, portable power devices do not have substantial energy savings and do not address our dependence on oil.

However, we will continue to support that at a relatively low level compared to the rest of the program, but we will continue to support their development. As a matter of fact, there is a workshop coming up. We are working with the U.S. Fuel Cell Council and participating in the upcoming workshop in that area.

DR. HALL: Let me add to that that one of the things that we have learned in the Inter-Agency Working Group as a result of exchanging information is the critical nature of the battery problem in defense, the multiplicity of batteries, the difficulties of maintaining inventory and so forth. So, that is another reason to take your comments under advisement. So, thank you.

MR. MC CORMACK: Hello. Richard McCormack, again.

We have four years coming here with the Bush Administration. Are there any projections as to what the budgets will look like in these areas over the coming four

years? Also just whether or not there is going to be more attention paid to manufacturing R&D in general over the next four years?

DR. BOND: I think you can take the fact that the group has been established that is one of the specific goals or actions outlined in the Manufacturing in America report to mean that, yes, there is going to be more attention to this and you also had the Executive Order on the SBIRs, focusing more on manufacturing. So, yes, there is relatively more attention than perhaps four years ago.

Our purpose is to advise on where we think there are priorities, where we can collaborate better and to advise the science advisor in particular about what we see on the inter-agency basis. This is not a budget group, but I think that as Richard Russell pointed out in his presentation this morning, I think we stand in pretty positive position in terms of the amount of R&D funding that the Bush Administration has come up with in some very trying budget times.

I am very confident that we will continue to devote record amounts to R&D. What we are going to try to do is make sure that we bring a sharper focus and more collaboration to that R&D that is targeted on the vital manufacturing sector.

MR. DANIELS: This is Dennis Daniels again.

I would like to -- on the last point of the hydrogen cells for power, I would like to encourage you to consider more emphasis on portable hydrogen cells because that has a lot to do with manufacturing in the near future, mainly with wireless technologies. One of the constraints of wireless technologies right now is the end devices at the manufacturing level can't be powered and they have to be wired. So, you know, if we could get a way to possibly power those devices in the manufacturing level, it would mean a great deal to manufacturing in all different segments.

So, there is a compelling reason to have hydrogen cell portable type of area.

DR. MILLIKEN: Thank you. We will certainly take a look at that area as well.

MR. SHRENK: This is for Warren. My name is Ken Shrenk(?). I am with SEMI, also known as Semiconductor Equipment and Materials International. I really enjoyed your presentation and I agree with you that standards are absolutely very important for nanomanufacturing.

About a month and a half ago, ASTM officially formed a community on nanomanufacturing or actually nanotechnology overall. Do you know of any other standards developing organizations that are currently forming committees on nanotechnology to address standards in that

area.

DR. DeVRIES: I knew this was going to happen. I honestly don't know. I am wondering if Dale or someone --

DR. HALL: Celia can help you.

DR. DeVRIES: Thanks.

DR. HALL: You said ASTM. I think you might have meant ANSI?

PARTICIPANT: No. ASTM is -- he meant ASTM

DR. HALL: But ANSI also has a committee formed now --

PARTICIPANT: I am Celia -- with the Office of Science and Technology Policy and, in fact, I just came back yesterday from an ANSI nanotechnology standards panel meeting at which ASTM, I believe, was represented, as well as IEEE, which does have activities in this area and there is an unusual, I think, consortium of -- led by ASTM, along with ASME, IEEE and NSF International to develop terminology and nomenclature for nanotechnology and nanomaterials.

This is in response to some activity that has begun at the ISO level, as well. So, there is a lot of different things going on.

A couple of other standards development organizations are, I think, also thinking about it but perhaps not up and running right now. But ANSI is very much sort of involved at the high level.

DR. HALL: Okay. I do not see anybody stepping to the mikes. If there are no further comments, what we will do -- is there anybody that does wish to ask a question or make a comment? If not, what we are going to do is we will take a short break. We will take a 15 minute break. When we come back, we are going to talk about the next steps.

We have had a public forum. You have all come and heard what we had to say. You have given us the benefit of your input. So, what happens now? I will talk about that and then Phil Bond will give a short wrap up session in which he will probably cover some of the significant things that we are going to carry from this meeting today.

So, let's -- yes?

DR. MILLIKEN: Are we going to have an opportunity to make some closing comments when we come back?

DR. HALL: Yes.

Let's say -- it is 2:37 now by the clock on the podium. Let's say that we will get back together at ten minutes to 3:00.

[Brief recess.]

DR. HALL: Okay. Well, as we move into the final session, let me say that I did let the break run a little longer than scheduled because one of the signs of a good meeting is the amount of networking that goes on in and around the formal program. I know I have done a lot of it

and it has been obvious from watching the rest of you that a number of good connections have been made or renewed today.

We are very happy that we have had the opportunity to be a catalyst for some of these meetings. Just as we have managed to catalyze interactions among the member agencies of the IWG, we also hope that some of the connections being made here will continue as well.

My function is to talk about the next steps but before I do that, I have been asked for just a minute of time by one of the panelists in particular. JoAnn Milliken would like to add a few thoughts and I will throw it open to others, who may or may not wish to. It is entirely up to them.

So, JoAnn, we will begin with you.

DR. MILLIKEN: Thank you.

I just wanted to address a couple of common themes that have been mentioned earlier. One, on communication, I wanted to point out that the Department of Energy and the Hydrogen Program has gone to great lengths to communicate better with the community. We have a comprehensive web site. As a matter of fact, OSTP, the inter-agency task force, also has a web site that describes all work in hydrogen and fuel cells in the Federal Government.

I think -- has that gone live yet, Amy?

PARTICIPANT: [Comment off microphone.]

DR. MILLIKEN: It will go live any day.

The DOE Hydrogen Program has one as well. We also have a program review, an annual program review that describes all the work going on in the program. It is in the D.C. area. This year it is May 23rd through 26th in Crystal City. All of that is advertised on our web site. If there are ways that we can communicate better, please let us know.

As well, we will link to the IWG web site. Then finally I really didn't address university participation very well regarding an earlier question. We have also gone to great lengths to increase university participation in our program. We have recognized the need for breakthroughs, particularly in the area of hydrogen storage.

One of the mechanisms we are using now is centers, where we team universities, national labs and industry and, you know, maybe that approach might work here as well. So, we will look to the university community for fundamental work in the area of manufacturing.

Thank you.

DR. HALL: Anyone else on the panel wish to make a remark? Okay. We are going to hear from Under Secretary Bond in a few minutes, but first let me talk about the next steps.

Agenda Item: Next Steps

As I said at the end of the last session, so we have put together some technical positions in three priority areas and we have told you about our plans and we have asked you for your input so that we can factor those into what we are going to do. So, where do we go from here?

The first step, in fact, is that we will begin by evaluating the public comments from this meeting and also from the web site and, of course, we continue to accumulate other sources of information and expertise as we go along. The web site will be open for comment by Monday, close of business. That is the best estimate. And comment will be allowed for a period of a couple of weeks. The cutoff date will be indicated on the web site. So, you will have some idea of what the deadline is there.

We are expecting that we are going to get divergent comments. We have had some divergent commentary today and I can't guarantee that everything that was said today or that comes in on the web site is going to wind up in the report that we will produce as an IWG position, but what I can assure you is that everything that was said and everything that is submitted will be considered very carefully in developing our final positions.

The immediate task at hand with this information is to produce white papers in each of the technical priority areas and those white papers will be combined with other

material and that will form the basis for a report by the National Science and Technology Council. The focus of that report is going to be on technical challenges and opportunities that fall within the mission scope of the Inter-Agency Working Group and its member agencies.

Because it is possible that we will wish to continue drilling deeper in some of these areas and exploring some of the ideas that have been brought out today, we may arrange follow on workshops as appropriate and specific technical areas. As you know, we were focusing on the high level today, looking at things from the strategic sense, but follow on workshops would allow us to go into more detail.

It is possible that these workshops could lead to the formation of communities of common interest. If we see that there are enough people, enough organizations who wish to continue to have some lifetime as a community of common interest, perhaps we could catalyze that. And the workshops will address such things as opportunities for collaboration between the members of the Inter-Agency Working Group and other stakeholders in these various communities, as well as the more detailed assessments of technical challenges, opportunities and priorities.

At roughly running concurrently from this time forward, we are going to be developing a taxonomy that

describes the existing federal efforts in the three priority technology areas. Obviously, from getting to know each other, from meeting, from developing positions as members of these three teams, a great deal of information has been exchanged, but we haven't done a formal taxonomy so that we can capture the full extent of the work that is being done.

Of course, that is a crucial part of being able to identify what the gaps are. The focus so far has been in what are the technical challenges and opportunities. Once we also have some idea of the existing effort in hand, I think the gaps will emerge more clearly.

The purpose of this whole exercise is to work toward inclusion of the key findings of the Inter-Agency Working Group in Office of Management and Budget and Office of Science and Technology Policy guidance for the fiscal year 2007 budget. This is really the first cycle where we will have an opportunity to inject some ideas into thinking for program planning and so forth. The report and the taxonomy we intend will be an aid to the Inter-Agency Working Group member agencies in their program planning. If we are successful, we can expect to see some things reflected in the program plans for 2007 that come directly out of the work that we have been doing.

In particular, we want to define individual agency priorities within their mission scopes that fall within

these technical areas and also to plan and implement agency programs that respond to what we believe are critical technology needs and that we have identified as critical technology needs with your help.

So, in summary, the report and the taxonomy will be used first in inter-agency discussions about programs and we hope that we will be successful in identifying and actually implementing research collaborations among the member agencies as a result.

So, that just sketches out what the process is going to be in these areas over the next several months. With that, I will turn the floor over to Under Secretary Bond, our chair, who will give us a wrap up.

Agenda Item: Wrap-up

DR. BOND: Thank you, Dale.

What I would like to do is just take a few minutes here at the end of the day will be happily wrapping up ahead of schedule, but take a few minutes to share some of the things that I think we have heard today that we will be taking away from this and we will, of course, be looking forward to more input, sharper distinctions and messages from you on some of the topics raised today. But I just wanted to share some of these and review out loud with you, if I could.

First of all, in general, I think one big theme

that we heard today was the critical importance of ongoing communication between industry and government and between the agencies certainly as well as the whole silo issue, but just really critical that we continue to look for ways to communicate. The private sector needs to know where we are going and where the priorities for longer term R&D funding are. We need to know what your needs are, the problems you are identifying so that they may direct us as well in our R&D efforts. So, communication is certainly one critical thing, a recurring theme.

Secondly, a couple of folks brought focus to the whole notion of keeping our eye on the ball for intellectual property is an issue as we invest public dollars for this R&D and move out in the global market of intense competition, the importance of keeping our eye on the ball for -- of intellectual property and in particular I would add SMEs intellectual property.

Third, I think we heard another general message of don't forget some of the imbedded or perhaps even smaller segments of manufacturing as we often tend to talk about things that are vital to national security or homeland security, but don't forget about some of the other industries out there doing vital manufacturing. Food and beverage were mentioned and, of course, I want to reiterate that we will reach out to FDA to include them in our work.

We already have Agriculture and so forth, but we will continue in that effort.

Some specifics on the different topic areas, I think, in the IIMS area, again, here, a form of communication but specifically in this area, continuous interaction as industry uncovers the hurdles that they are running into to make sure that that is what we keep on the front of our R&D radar scope, if you will.

So, continuous interaction there for those. Then dissemination of information and work that is going on here that will, of course, lead ultimately to real tech transfer as we share some of that but -- and making sure that SMEs are not left out of the information loop as we go forward on some of that, translating it. A point that I know is near and dear to Al Frink's heart, making sure that we translate that, too, for SMEs, not leaving it at the technical level of communication but putting it in language that the SME can understand as they are hustling to make ends meet in their smaller enterprises.

We heard from a number of folks about the focus on the human capital as being critical, that we have to have a work force for these increasingly technology centric forms of manufacturing that we are envisioning. That is certainly something that resonates I think with all of the working group members.

In the fuel cell area, I think, voice was given to the notion that this is an industry that is very entrepreneurial and product focused, not necessarily thinking about the procedural manufacturing issues. So, it is incumbent on us to ask the right questions and keep our eyes on that. I think along those same lines would be this mention of portable power and how that might provide some insight and move along the larger manufacturing enterprise.

In the nanospace, I think we heard some encouragement for us to use this inter-agency group to really sharpen the focus within that larger initiative on the manufacturing, on the nanomanufacturing piece and, indeed, we are dedicated to that. As one pointed out, we are bringing the other people who are focused on the manufacturing element and so we will continue in a partnership way with the NNI to drive a deeper understanding of manufacturing challenges as we move to that new paradigm.

In that same space, too, we heard a lot of talk about standards for nano, certainly, where we need metrology and instrumentation standards to unlock the potential, but also that would track right back to the other two initiatives as well, where it is clear that we really need the metrology instrumentation and standards for whole new elements of a manufacturing sector.

So, we will keep our eyes on all of those things

and others that you will I am sure submit and bring to our attention in coming days.

I also want to observe that I think we did receive some confirmation on the agreement of these three areas as being key long term areas, appropriate focal points for R&D in the government space, as long as we make sure to do our job then to communicate and think about tech transfer and think about intellectual property as we are moving down that road and making sure we keep the SMEs in the loop.

So, those are just some of the things that I think we heard today and we look forward to hearing more from each of you as we go forward to make sure that we keep our eye on the ball where U.S. industry is concerned. We have our missions that we need to make sure that we are fulfilling, that the President has made it abundantly clear to us that part of our mission is a vibrant manufacturing sector in the United States. So, we are going to make sure that we look at our missions, as well as what the private sector is saying to make sure that we have that kind of vibrant manufacturing sector for both economic security, as well as national security ultimately as well.

So, let me wrap up things here with a final word of thanks. A special thanks to our task team leaders, who just did a phenomenal job. I want to thank Al Frink for being here today, too, and letting you see the connection

that we have and that we will continue to deploy on behalf of manufacturing near term and long term.

I want to thank the task teams themselves, who stand behind each of the task team leaders, who presented here today, for their great work, perhaps being roped in for a bigger job than they ever imagined at the outset, but I think important work. Indeed, as I mentioned before, the President has said this is a vital national priority, a vital national priority. That is why Don Evans was tasked more than a year ago to come up with the Manufacturing in America game plan. That is why Al Frink today is working on 57 different initiatives to make them reality and that is why one of those was this one, to have an inter-agency group to look together in a collaborative way at what the future needs of our manufacturing sector are going to be to make sure we are researching those, developing those, so our entrepreneurs can take them with protected intellectual property, create jobs and wealth, as Warren says, that fuels the American culture.

So, let me close with an observation. This isn't the end. It is not the end of anything, except the blissfully early end of today's workshop, but it rather is the beginning, the beginning of a real partnership. We want to make sure that the lines of communication are wide open and oft used so that you are telling us your needs and we

are telling you what we see that we need to do to accomplish our mission.

So, the beginning of a partnership. We are going to take your input seriously. We are going to consider it seriously and we are going to move together in a serious fashion to make sure that manufacturing in America continues to lead the world and be on the cutting edge, highest value add, brand equity that Al Frink talked about, that meets both our economic security needs and our national security needs, both today and in the future.

So, again, thank you for your time. Thank you for your input. We look forward to the partnership.

[Applause.]

DR. HALL: So, we are adjourned. Again, thanks everybody, for coming, and as Phil said, this is the beginning of a partnership. We look forward to working with you.

[Whereupon, at 3:15 p.m., the meeting was concluded.]