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Hearing on the Future of Manufacturing

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Mr. Chairman and Committee Members, thank you for the opportunity to testify on behalf of General Motors. I am Susan Smyth, Director of GM's Manufacturing Systems Research Laboratory. I lead GM's worldwide R&D efforts in support of advanced manufacturing processes and systems. While this past year has been one of unprecedented challenge and change at General Motors, in the wake of the bankruptcy, we are a smaller, leaner company that is even more focused on advanced technology.

I am pleased to be able to speak to you today about advanced manufacturing and the important role the National Institute of Standards and Technology (NIST) and other federal agencies play in support of this vital area of national interest. I also look forward to discussing some of the challenges associated with advanced manufacturing and suggesting areas where we can strengthen collaboration, especially in manufacturing R&D.

This is an important time in the history of the automobile industry. As we have seen recently, the world in which we live and do business in is changing. Automotive technology is rapidly advancing, presenting challenges and opportunities with high levels of risk to both the industry and the manufacturing base of entire nations.

Automotive manufacturing is one arena where we have significant opportunity to expand U.S. competitiveness and stimulate economic development and jobs growth. Chrysler, Ford, and General Motors together account for 110,000 U.S. manufacturing jobs and support three million additional jobs located in all 50 states. Our three companies annually invest $10 billion in U.S. plants and equipment. We also spend $12 billion on engineering and R&D, which is helping to drive a resurgence in American manufacturing.

This starts with the supplier community, which we know you care greatly about. We are currently updating the figures for 2009, but for 2008 the three domestic manufacturers purchased over $100 billion in U.S. auto parts, materials, and services. Every dollar spent in the manufacturing sector generates an additional $1.36 in economic activity. This represents a greater return than in any other sector.

The U.S., along with the rest of the world, is working to reinvent manufacturing to ensure competitiveness, improve efficiency, and increase energy and environmental stewardship. I would like to highlight a few projects that show the strength of private/public manufacturing partnerships.

NIST / MEL

NIST's Manufacturing Engineering Laboratory (MEL) promotes competitiveness in key manufacturing-related areas such as robotics, virtual, green, and nano technologies. In addition, the NIST lab drives standards that are key to adoption of efficient, safe, and

repeatable processes. As just one example of the power of partnering, NIST worked with GM, Ford, and Chrysler through the United States Council for Automotive Research (USCAR) to develop the standards for certification of wireless technologies such as the Ethernet, DeviceNet, and ControlNet.

These standards have increased OEM productivity and lowered cost because now we can buy off-the-shelf certified products and know they will work for the specified function. As companies strive to become leaner and compete in a global market, we cannot afford to waste our technical resources on non-core business. This NIST-USCAR collaboration has resulted in the growth of new jobs in a network of small local companies, which now certify that all these network devices conform to the new industry standards.

Many national labs, including NIST, have an influence on manufacturing technology. However, MEL stands alone as an organization having core technical skills, profound knowledge of the manufacturing domain, and a passion for manufacturing. Although MEL is a highly effective organization, well focused on customer needs, the structure in which it resides is not optimal. The percentage of resources dedicated to manufacturing remains a small part of the overall NIST budget.

We greatly appreciate working with NIST, but we believe the NIST charter should be revisited to allow a more equal footing between small and large business. The rationale for this request is that many of the challenges we are facing today are "systems-level" problems. Two examples are vehicle electrification – which is nothing less than the reinvention of the automobile – and the drive towards sustainable manufacturing. Technology solutions to enable us to meet these challenges need to be driven by a more nuanced mix of effort among small and large companies, to better leverage the speed of the small and the system-integration perspective of the large.

Another positive interaction between GM and MEL has been in the area of virtual manufacturing, which allows us to design and validate processes and tools in a computer prior to physically building a plant or product. In virtual manufacturing, we can mathematically model the form, fit, and function of manufacturing processes. It is a technology lever that we use to drive costs down and quality up, and we currently have active programs linking GM, USCAR, NIST, and several universities. One such research program, led by the University of Iowa, is linked with the Virtual Soldier, which will create a digital human to design safer and more ergonomically acceptable manufacturing processes.

DOE

The Department of Energy has been supporting crucial research and helping build manufacturing capability on batteries, motors, and other electric vehicle technologies through the FreedomCAR and Fuel Partnership. GM is grateful for the Stimulus grants we received to help us open our new battery manufacturing plant in Brownstown Township, Michigan and our electric drive production center in White Marsh, Maryland.

These two facilities are among the first advanced battery and electric motor manufacturing plants in the United States to be operated by a major auto company. They will provide us with valuable learnings and allow us to more rapidly move down the cost curve on these technologies – thus enabling us to get to higher production volumes, which is where these technologies start to have real-world impacts on petroleum consumption and greenhouse gas emissions.

Lightweight materials is another area where there has been great success with government-industry collaboration. Our collaboration with DOE through USCAR has led to introduction of more high-strength steels, aluminum and magnesium alloys, composites, and associated processes. These collaborative efforts have led to reduced material and energy requirements and lower material scrap rates in our plants.

To build on this progress, we support the creation of the Automotive Manufacturing Energy Reduction Partnership, which has been jointly mapped out by DOE and USCAR. Although yet to be funded, this partnership is intended to be a means to grow jobs by creating a more energy-efficient and, therefore, more competitive auto industry and supply base while simultaneously meeting the national objective of energy use reduction. We also feel that potential partnerships between the automotive and defense sectors in energy and materials research could produce synergistic results for both business sectors.

NASA

NASA has also been an important partner on manufacturing R&D. Recently, NASA and GM announced our advanced robotics partnership to accelerate development of the next generation of dexterous robots for use in both the automotive and aerospace industries.

Together, we were able to develop and build Robonaut2 – or R2 for short – a faster, more dexterous, and more technologically advanced robot. This new generation is able to use its hands to do work beyond the scope of existing humanoid robots, and it can safely do it side-by-side with people, which is the key to our robotic strategy of humans working in harmony and enabled not replaced by robots.

This partnership should interest the Committee for two reasons. First, the GM NASA partnership was a new business model for conducting high-end research with embedded personnel beyond the traditional sabbatical model. It is critical for both NASA and GM, as the joint learnings from the program help move robotics to the next level. For GM, we see the collaboration leading to development of assembly processes that integrate robotic technology with people. This has the potential to improve manufacturing processes, increase flexibility, and enhance the safety of the production environment. GM is also actively looking for ways to apply the robotics, controls, sensor, and vision technologies developed as part of this collaboration to leading-edge advanced vehicle safety systems.

Second, robotics is a central element of competitiveness in advanced manufacturing. The creation of the "roadmap for U.S. Robotics" was stimulated by the bipartisan Congressional Caucus on Robotics. It states that "Led by Japan, Korea, and the European Union, the rest of the world has recognized the irrefutable need to advance robotics technology and have made research investment commitments totally over a billion dollars, while the U.S. investment in robotics technology (outside unmanned systems for defense) remains practically non-existing."

This new segment in robotics is estimated to double the current $25-billion U.S.-based robotics industry (direct revenue, plus auxiliary automation equipment, castings, etc.) with many applications in the assembly area of manufacturing processes over the next 5-10 years.

The opportunity to create manufacturing jobs with this new type of robot can be extrapolated from the success of the medical robot industry. Since the inception of this

business at the beginning of the decade, the annual growth rate has exceeded 30 percent and is estimated to reach revenue levels of $2.8 billion by 2011.

As I have mentioned, other countries also see the value of robotics technology and have made it a national priority. What this means is that government and business are working together in a highly collaborative way to ensure that the technology moves from research to commercial implementation quickly. We are starting to see similar support in other areas of advanced manufacturing, such as radio frequency identification in Korea, lightweight materials and processes in China to name but two.

We need to adopt similar industrial priorities in other important areas of advanced manufacturing to ensure that the U.S. remains or becomes competitive and that jobs remain on shore. We can build on the successes that I have already outlined by:

- Providing more funding to the NIST Manufacturing Engineering Laboratory to grow its ability to manage important new projects and provide oversight for strengthened collaboration.
- Modifying the industrial technical program (ITP) charter of engagement with NIST to better engage large business on complex systems-level issues, and encourage technical transfer without significant royalty clauses, which impede commercialization and the creation of jobs in spinoff businesses.
- Creating a cross-agency forum to create and manage a national agenda for manufacturing technology. This forum could identify key technology goals and metrics and orchestrate collaboration to better leverage resources and eliminate redundant efforts.
- Nurturing the creation of product and manufacturing technologies related to the electrification of the vehicle. We need to develop a successful U.S. manufacturing base for this new breed of automobile. We also need to invent manufacturing systems capable of delivering automotive quality for new electric vehicle components at volume rates. As an example, we require technology for non-destructive evaluation during battery manufacturing processes and reversible joining processes that would enable remanufacturing, and repurposing of used automotive batteries for stationary power storage applications.

As we look to the future, we need to focus our collective attention on technologies that enhance our virtual and flexible manufacturing capabilities <u>at a project level</u>. Areas such as robotics, virtual manufacturing, and sustainability are key technology areas of focus for our business, and we would ask for additional development funding to:

- Develop the manufacturing aspects of batteries, fuel cells, electric motors, and power electronic components, including real-time quality processes.
- Support technology that creates flexible systems and facilities, which will enable more consumer custom-ordering using efficient manufacturing processes that can quickly respond to changing customer demand.
- Drive other cross-industry improvements such as those needed in the field of virtual manufacturing. Here, the development of standards would enable better communication between IT systems and help alleviate the unending challenge of system interoperability – expanding, for example, on some of the award-winning

work in ISO STEP Standards for the exchange of product model data that was carried out by the NIST MEL lab.

- In the virtual arena, we also need to create linkages between different virtual tools. This would enable a more efficient use of the software products that we have today, e.g., such as the development of automatic meshing capabilities.
- Finally, continuous support for technology is required to enable energy-efficient and environmentally neutral manufacturing processes.

Rethinking the Goal Line

Beyond funding, we may need to revise how we think about the meaning of success in automotive technology R&D. In addition to technical success, we also need to address how we take innovation to commercial scale and high rates of adoption.

Just as with any other advanced technology, there are three phases involved in adoption of advanced manufacturing technologies. These include innovation, demonstration, and commercial implementation. Moving through the three phases required to commercialize new technologies is a particularly difficult challenge in the auto industry because of the long time horizons and high capital cost. This is a challenge that urgently needs to be addressed because of the magnitude and importance of the dual societal objectives of energy reduction and jobs creation.

Historically, the U.S. has emphasized R&D discovery, but in order for innovation to be implemented (and have a meaningful impact on challenges such as petroleum consumption and greenhouse gas emissions), funding and collaboration must continue on to the next level, which is scale production. Many new ideas can be managed on small production lines, but the challenge of scaling to large and fast output rates cannot be overlooked. In order to be relevant to these great societal challenges, we need to ensure that government R&D programs are focused on ways to provide high-quality assembly, non-destructive evaluation, and high rates of repeatability at large volumes. Currently, the U.S. focus is on the first phase of innovation, which is essential but not sufficient because we must also give priority to demonstration and technical inventions required to enable high-volume, high-speed production.

Some countries have a different approach and focus support on development of the linkage to business. Germany, for example, has invested in a technology transfer infrastructure, i.e., the Fraunhofer Institutes, and also mandates that engineering academics spend a significant time in industry. China has a government-directed agenda and a strong focus on advanced manufacturing. Japan has a culture of OEMs and suppliers collaborating through government-funded initiatives. All of these countries have advanced manufacturing strategies, collaboration models, and a funding charter that extends beyond technical innovation.

Conclusion

In summary, General Motors asks the committee to focus on the following:

- First, collaborative prioritization of key technologies by industry and government. These priorities should include robotics and other flexible manufacturing enablers, virtual manufacturing, and green manufacturing, and manufacturing of key electric drive components, including batteries, fuel cells, motors, and power electronics.

- Second: Increased funding for the NIST Manufacturing Engineering Laboratory (MEL) to support these priorities.
- Third: The creation of a cross-agency forum with a charter to align with large-scale manufacturing R&D and with sufficient funding to compete with efforts in other countries.
- Fourth: Congressional consideration of DOE funding for the proposed Automotive Manufacturing Energy Reduction Partnership, which will be focused on enhancing the competitiveness and energy-efficiency of the U.S. auto industry and supply base.
- Fifth: Reframing the goals and priorities for advanced technology vehicle manufacturing at DOE, NIST, etc., from the point where technology metrics are met to the point where high-volume production is possible.

General Motors welcomes initiatives like these as well as government, public/private, and cross-industry partnerships to accelerate both technology development and early commercialization.

Thank you for the opportunity to testify today. I look forward to your questions.