National Commission on Innovation and Competitiveness Frontiers

Compete.
Council on Competitiveness

Competing in the Next Economy

Beyond Digital Manufacturing

Understanding the Imperative of Total Transformation

Presented by

LOCKHEED MARTIN

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Session Summary

Introduction

Council Executive Vice President Chad Evans welcomed participants to the second in a series of webinars, sponsored by Lockheed Martin. The focus is to explore in-depth the findings and recommendations of *Competing in the Next Economy*, the year-one report of the Council's flagship initiative, the National Commission on Innovation and Competitiveness Frontiers.

The series' inaugural webinar, on May 13, focused on sustainability. This second session focused on digital manufacturing and the imperative of total transformation across all aspects of the U.S. manufacturing enterprise, from small and large manufacturers to universities, national laboratories, and the public sector.

During her opening remarks, the Honorable Deborah L. Wince-Smith, President & CEO, Council on Competitiveness, recapped the series launch session on sustainability, which featured panelists from Lockheed Martin, Bank of America, the University of California San Diego, and Pacific Northwest National Laboratory. Key takeaways from this dialogue included: 1. Concurrence on the need for strong industry commitment to develop, implement, share and scale sustainability metrics; and 2. Agreement that universities and laboratories need to and can play significant roles in deploying technology to drive sustainability at scale, pushing innovations into the marketplace and helping to meet society's sustainability objectives.

Panelists

Ms. Yvonne Hodge
Senior Vice President and
Chief Information Officer
Enterprise Business and Digital
Transformation
Lockheed Martin

Dr. Jahmy J. Hindman
Chief Technology Officer
Deere & Company, and
Chairman, Technology Leadership
& Strategy Initiative

Dr. Thomas R. Kurfess
Chief Manufacturing Officer
Oak Ridge National Laboratory,
and Co-Chair, National
Commission Working Group 2

Dr. Theresa S. Mayer
Executive Vice President for
Research and Partnerships,
and Professor of Electrical and
Computer Engineering
Purdue University, and
Member, Technology Leadership
& Strategy Initiative

The Honorable Deborah L.
Wince-Smith
President & CEO
Council on Competitiveness, and
Co-Chair, National
Commission on Innovation and
Competitiveness Frontiers

Moderator

Mr. Chad Evans
Executive Vice President and
Secretary to the Board
Council on Competitiveness

Manufacturing and Prosperity

Ms. Wince-Smith emphasized the connection between leadership in manufacturing and American prosperity and competitiveness. She outlined the Council's historical role in defining the specific role manufacturing—and its related R&D enterprise—plays in shaping a nation's productivity and prosperity potential. She noted that the Council's own origins in the mid-1980s stem from a transformational and innovative response from the U.S. private sector to meet the then unprecedented competitiveness challenge posed by Japan's manufacturing surge, which was driven by a commitment to total quality management. In 2004, the Council's National Innovation Initiative report, *Innovate America*, presaged a major shift in America's manufacturing stance, coupled with an emerging shift from energy dependence to energy independence. U.S. manufacturers at the cutting-edge were demonstrating their enterprises were not "dirty, dumb, dangerous and disappearing," but were, in fact, "sustainable, smart, safe, and surging." Viewing manufacturing as key to the nation's long-term productivity and support of the middle class, the Council also teamed with both the George W. Bush and Barack H. Obama administrations to develop initiatives and partnerships to accelerate the adoption of advanced energy technologies to boost manufacturing productivity and unleash innovation. This included working with the White House and the U.S. Department of Commerce to create the National Digital Engineering Manufacturing Consortium (NDEMC), a Council-led public-private partnership—featuring Lockheed Martin, Deere & Company, GE, and others—to expose the supply chains of large OEMs to the power of advanced modelling and simulation capabilities. The NDEMC pilot PPP eventually led to the establishment of the MxD (Manufacturing times Digital) institute in Chicago, part of the Manufacturing USA institutes program.

Top row: *Mr. Chad Evans, Executive Vice President and Secretary to the Board, Council on Competitiveness; Ms. Yvonne Hodge, Senior Vice President and Chief Information Officer, Enterprise Business and Digital Transformation, Lockheed Martin; and Dr. Thomas R. Kurfess, Chief Manufacturing Officer, Oak Ridge National Laboratory, and Co-Chair, National Commission Working Group 2.* ***Bottom row:*** *Dr. Jahmy J. Hindman, Chief Technology Officer, Deere & Company, and Chairman, Technology Leadership & Strategy Initiative; the Honorable Deborah L. Wince-Smith, President & CEO, Council on Competitiveness, and Co-Chair, National Commission on Innovation and Competitiveness Frontiers; and Dr. Theresa S. Mayer, Executive Vice President for Research and Partnerships, and Professor of Electrical and Computer Engineering, Purdue University; and Member, Technology Leadership & Strategy Initiative.*

National Digital Engineering Manufacturing Consortium

NDEMC began in 2011 as a Council on Competitiveness conceived and executed partnership with the Whited House, the U.S. Department of Commerce, industry, other federal agencies, state governments and university computing centers to help SMEs (small and medium-sized enterprises) learn about and take advantage of modelling, simulation and advanced computing technologies beyond their current resource base or expertise. NDEMC projects with 20 SMEs increased sales collectively by more than $20 million per year, with half of those sales in exports. The SMEs created 160 new jobs in 2012 and developed three new products.

NDEMC Inc. was named a supporting partner in the winning proposal selected by the White House for a major manufacturing hub at UI LABS. The U.S. Department of Defense awarded UI LABS a $70 million grant to fund the Digital Lab in 2014, leveraging an additional $250 million in commitments from leading industry partners including Council members General Electric, John Deere, Procter & Gamble and Lockheed Martin—as well as other academic, government and community partners—to form a $320 million institute.

Ms. Wince-Smith also surveyed the current political landscape, noting in particular the emergence of strong bipartisan commitment to invest in bolstering America's manufacturing base and research enterprise, recognizing both manufacturing's role in sustainable growth and inclusive prosperity, and the rapidly intensifying global competitive landscape. For example, China's 2015 "Made in China" initiative continues to target leadership in digital manufacturing technology and is the platform for China's aggressive investments to position itself for global leadership in next-generation microelectronics, a platform capability for nearly every transformative digital technology. In response, the recently-passed "United States Innovation and Competition Act (USICA)," an evolution of the bipartisan "Endless Frontier Act" sponsored by Senators Chuck Schumer (D-NY) and Todd Young (R-IN), includes $52 billion in emergency spending for the development of domestic semiconductor manufacturing capabilities, as well as numerous cybersecurity provisions.

Trends, Challenges and Opportunities in Industry 4.0

In opening the session, Mr. Evans provided an overview of major trends, challenges and opportunities in manufacturing and digital technology.

- One of the most significant trends is that multiple advanced digital technologies are converging simultaneously on the manufacturing sector, radically transforming the way products are conceived, designed, made and delivered.
  - Sensors, intelligent controls, cyber-physical systems, the Internet of Things, modeling and simulation, 5G, big data, and cyber-physical systems are already being deployed across numerous industries.
  - Frontier technologies are emerging today that will drive even bigger change and make manufacturing even more intelligent, such as:
    - Augmented, extended and virtual reality;
    - Quantum computing; and
    - Artificial intelligence and machine learning.
- These technologies can deliver a mosaic of powerful capabilities, like:
  - Contemporaneous, adaptive quality management, and predictive maintenance;
  - Tracking and tracing products from inception to delivery, across supply chains;
  - Machines and systems that self-identify problems, make corrections without human intervention, and learn from each incident and every part produced;

- The ability to cost-effectively and virtually design hundreds or thousands of designs and features before a prototype is ever cast;
- The integration of data from machines, systems, production operations, and people for enhanced decision-making; and
- Collaboration within a company, and with customers and suppliers, while tapping the collective intelligence across the manufacturing ecosystem.

Taken together, he noted these capabilities have the potential to deliver enormous benefits across numerous manufacturing and business dimensions, including:

- Dramatic increases in manufacturing productivity and less production downtime;
- Improved energy efficiency, and reduced emissions and waste, increasing sustainability;
- Optimal use of the workforce, and enabling lower-skilled workers to perform higher-skilled jobs using intelligent aids;
- Cost savings from reduced work-in-process, defects, and rework, and increased value-added time in the fabrication process; and
- Reduced time-to-market, enabling a time-compression strategy in an Age of Innovation to outpace competitors by speeding-up the introduction of the next generation of technologies.

Mr. Evans argued that if the United States could capture these benefits at scale, the nation could leap-frog competitors in the global marketplace, drive economic growth, and increase prosperity—and also deliver national security. However, he outlined five challenges in scaling this manufacturing revolution in the United States.

- First, the vast majority of companies in the U.S. manufacturing sector are small. About 220,000 of them have fewer than 500 employees. Of those, more than 165,000 have fewer than 20 employees. Many are already struggling to integrate commodity digital technologies and may lack the ability to invest, or the technical and workforce skills needed to implement and operate an advanced manufacturing system.
- Second, new skills will be needed in the manufacturing sector.
- Third, a production paradigm shift will require significant organizational changes. For example, the introduction of new equipment could change everything from work processes to job design, skills and training needs, safety protocols, and facilities design.
- Fourth, the cyber-attack surface will grow dramatically, requiring significant enhancement of cyber security in production systems, factories and logistical systems, and across the supply chain.
- And fifth, scaling digitally-enabled manufacturing across the United States will require significant collaboration internally across functions in companies, and among a diverse set of external stakeholders: manufacturers, systems integrators, equipment designers and producers, software developers, the research community, standards developers, and educators and trainers.

Mr. Evans turned to the panel to discuss the biggest barriers companies and organizations face in making the array of organization, systems, and work and production process changes needed to leverage the power and promise of digitally-enabled manufacturing.

Barriers to Adopting Digital Manufacturing

Lockheed Martin Senior Vice President and Chief Information Officer for Enterprise Business and Digital Transformation, Ms. Yvonne Hodge, identified what she saw as the key barriers preventing greater adoption of digital technologies, as well as how Lockheed Martin addresses those barriers.

One major barrier for companies that want to adopt digital technology is the prevailing mindset that total change is not necessary. Ms. Hodge described how Lockheed Martin came to embrace total transformative change by focusing on its customers' missions,

the dynamic threats they face, and then integrating their evolving needs into the company's strategy and planning. She discussed building a "digital thread" that connects all of Lockheed Martin's suppliers and customers—as well as building customer requirements and sustainability into its supply chain.

Another major barrier that organizations must confront and challenge is the old understanding of infrastructure. Successfully adopting digital technology requires the ability to retrofit legacy infrastructure with new capabilities and protecting that infrastructure from cyberattacks, requiring unprecedented collaboration between the organization's information technology and cybersecurity teams. Companies must also work to ensure their suppliers are able to incorporate digital technologies and secure them, as even small suppliers can be responsible for developing critical components. Ms. Hodge added that Lockheed Martin's proactive, holistic work on digital transformation prior to the COVID-19 pandemic empowered the company to thrive when changing circumstances forced an accelerated adoption of new technologies and processes.

The Pandemic and Digital Opportunity

Oak Ridge National Laboratory's Chief Manufacturing Officer, Dr. Tom Kurfess, discussed the work the laboratory undertook early in the pandemic to produce personal protective equipment—quickly evolving and changing models of the demand, and leveraging advanced manufacturing technologies, from high performance computing to additive manufacturing. The lab's experiences became a case study, demonstrating how manufacturers might no longer need to stockpile extra physical products, which may be outdated by the next time they are needed. Rather, in leveraging advanced manufacturing technologies and capabilities, producers can, instead, stockpile items like components, molds to produce components, or even the digital designs for these components, which can be easily updated and enable rapid mass production in future emergencies.

Dr. Kurfess also argued that "innovating faster than the competition can copy"—whether in terms of the workforce, technology, or cybersecurity—is key to long-term resilience and competitiveness in the digital world.

Deere & Company Chief Technology Officer Jahmy Hindman jumped in, noting many organizations often blame legacy infrastructure for their reluctance or inability to adopt new technologies. He also emphasized for the panel the importance of "future-proofing" data structures with good architecture in order to adapt rapidly the next time there is a disruption on a similar scale to the COVID-19 pandemic. Dr. Theresa Mayer, Purdue's Executive Vice President for Research and Partnerships, aligned with Ms. Hodge's remarks, adding that much of digitization is culture change, and described how the COVID-19 pandemic accelerated Purdue's ability to think differently and adapt not just technologically, but also form new partnerships and networks with industry and laboratories as it worked to meet its needs and obligations.

The State of Play in Digital Manufacturing

Dr. Hindman provided an overview of the current implementation of digital technology in the manufacturing sector, which he characterized as a "spectrum." Large firms are beginning systematically to deploy and integrate advanced technologies, while smaller firms are just beginning to implement sensors and other elements of "smart manufacturing." He discussed the impact current supply constraints are having on the nation's manufacturing enterprise and highlighted the necessity to understand both one's own processes and the processes and needs of suppliers. For example, during the COVID-19 pandemic, a semiconductor shortage created unforeseen disruptions for many firms because they were not fully cognizant of the extent to which their Tier 1, 2, 3 and other suppliers relied on imported semiconductors for many of the products they supply to OEMs. Hindman argued that in light of this, firms are learning they must find ways to extend their networks and data collection efforts beyond their own organizations and into those of their supply chain to avoid or mitigate future disruptions.

Dr. Kurfess shared that the proliferation of sensory technology has created a wealth of data that can optimize production. However, the real challenge has been in bringing together in a useful way all of the relevant information. He contrasted the ability of large organizations, like Deere & Company and Lockheed Martin, to develop integrated systems harnessing digital technologies with the smaller firms that comprise the majority of the manufacturing sector. These smaller firms often lack the engineers and/or the funds needed to adopt digital technologies, especially in the face of their rapid obsolescence. He urged the development of a grassroots approach to integrate smaller enterprises into the digital world, for both data and cybersecurity. While this will require work from both directions to connect smaller firms to their larger partners, the innovation potential it could unleash would be significant.

Moving from Piloting to Scaling Technology

Panelists discussed ways to move from piloting new technologies to scaling them throughout firms' supply chains. Ms. Hodge described Lockheed Martin's efforts to keep its smaller suppliers from falling behind, including paying them in advance during the COVID-19 pandemic to keep them afloat through disruptions, and working with them to address cybersecurity challenges. She emphasized that small suppliers could introduce cyber vulnerabilities in a larger firm's supply chain, and discussed Lockheed Martin's Control Tower interface as a potential best practice model. The Control Tower provides critical information to suppliers to help them identify and resolve cybersecurity threats. Dr. Hindman added that businesses are quick to increase their digital footprint when they can see the value in doing so, and encouraged firms to highlight that concrete value when working with suppliers. He also stressed the importance of access to talent to enable the shift to digital infrastructure, and said it was a responsibility of larger organizations to encourage the cultivation of that talent in the workforce as a whole.

Developing existing and future education and training programs across the United States to meet the workforce needs of the future is a major theme in the Council's year-one National Commission on Innovation and Competitiveness Frontiers report, *Competing in the Next Economy*:

> "Realign federal, state and local workforce development programs and training to enable a highly skilled, digitally competent, innovation workforce—beginning at the junior and high school levels."

Workforce and Culture

Ms. Wince-Smith noted the COVID-19 pandemic has led to much greater communication and collaboration between firms and their suppliers. While firms previously took a hands-off approach to their supply chains, the need for resiliency and security have led to a "family" mindset in which companies provide greater communication with suppliers and provide support to help them remain resilient in the face of disruption. Dr. Kurfess stressed the importance of lifelong learning and continuing workforce development, as increasing technological and other disruptions require a continual reconfiguration of job skills and responsibilities. He characterized a robust workforce as one of the most important assets for a globally competitive economy, and noted the growing support in universities, community colleges, and professional societies for lifelong learning as means to maintain competitiveness and sustain the middle class.

Investing in Small and Medium-Sized Businesses

Dr. Mayer described Purdue University's work investing in SMEs across Indiana, which has one of the highest concentrations of small manufacturers in the country. The Purdue-based Indiana Manufacturing Extension Partnership provides funding for firms to make significant investments in upgrading their capital equipment and IT infrastructure, as well as education and training in the cultural shifts needed in a rapidly evolving marketplace. She noted many other nations are subsidizing these sorts of incentives and upgrades for small firms at a national level. Indiana is responding at the state level, committing to a biannual $20 million matching investment program for small companies working to upgrade their facilities and invest in workforce training. Dr. Mayer advocated for the deployment of federal and state resources to help ensure digital transformation extends throughout the entire supply chain, down to the smallest firms.

Opportunities and Priorities

Mr. Evans noted there was a unique degree of bipartisan enthusiasm for support for greater federal R&D investment, and asked panelists for their thoughts on the top priorities for technology and skills development in this context to scale manufacturing transformation. Dr. Mayer praised the degree of bipartisan support for R&D, and the growing number of public-private partnerships bringing together federal laboratories, industry, and universities on both technology and workforce issues. She discussed a recent meeting of the President's Council of Advisors on Science and Technology and the National Science Board, during which there was broad support for cultivating STEM talent. She also identified a range of other priorities, urging:

- Greater integration of social and behavioral aspects into research and talent development;
- Deployment of virtual, augmented or extended reality to open up new opportunities to retrain and upskill the workforce in real time;
- Increased investments and attention to sensory technology, interconnected factories, the Internet of Things, and data-driven training models to make decisions in real-time; and
- More use of test beds at laboratories, universities, and cross-sector institutes to help develop and scale technologies, and for laboratories and universities to work with industry partners to assess vulnerabilities in their technology, security and workforce.

Dr. Kurfess cited, as an example, Oak Ridge National Laboratory's Manufacturing Demonstration Facility and the work it engages in with industry partners to identify nascent technologies to scale up so that partners can deploy them. He also echoed Dr. Mayer's thoughts on the role of digital technology in workforce development, championing the potential of AI and real-time sensory feedback to boost worker productivity.

Mr. Evans asked panelists how they would define success in the transformation of the digitally-enabled manufacturing base, and how to measure that success. Ms. Hodge said that Lockheed Martin has developed several measures that have been designed and benchmarked across 1,400 different industries, but that the most important metric was the number of programs and platforms that were completely enabled through the "digital thread" approach Lockheed uses to connect all of its suppliers and customers on matters of technology, organizational culture and security. Dr. Kurfess added that Oak Ridge uses similar metrics with its partners, in particular to track how quickly it can deploy technology or learning capabilities and bring them to the shop floor.

Cybersecurity and Resiliency

Winding down the dialogue, Mr. Evans returned for a deeper dive into a theme that popped up over the course of the hour: The exponential growth in the cyber-attack surface.

- Ms. Wince-Smith predicted a surge in opportunities for cyberattacks, and a subsequent change in "cyber hygiene" comparable in magnitude to the changes in personal hygiene stemming from the COVID-19 pandemic.
- Dr. Mayer commented that the industrial Internet of Things will feature more than 60 billion connections in the United States, creating a massive security challenge for firms.
- Ms. Hodge emphasized the importance of sharing data across industries and with customers to prevent cyberattacks. She described the success Lockheed Martin has had with reacting to, mitigating, and even predicting attacks by analyzing what adversaries have done in the past. Using predictive algorithms, Lockheed Martin can not only stop attacks, but determine the identity and location of an attacker. The company shares all of the unclassified information it gathers with other firms, especially suppliers, who are increasingly targeted by hackers because of their lack of security compared to larger firms. She advocated the development of a national network for sharing similar information across all industries.
- Dr. Kurfess noted that one-third of all cyberattacks in the United States occur against manufacturing facilities, and praised the recent establishment of The Cybersecurity Manufacturing Innovation Institute (CyManII) in San Antonio as part of the Manufacturing USA program. He echoed other panelists in warning that small organizations without substantial resources will continue to be the Achilles' heel for cyberattacks, and said that cybersecurity was about staying one step ahead of the competition.
- Dr. Hindman urged firms to treat cybersecurity with the same gravity as they do workplace safety, and to value data as an asset.
- Ms. Wince-Smith warned that cyberattacks from competitors, especially China, were becoming increasingly surgical in their precision, and called for an all-hands approach to cybersecurity in similar fashion to the current national emphasis on microelectronics.
- Dr. Mayer noted that data standards and interoperability were a double-edged sword from a cybersecurity perspective, as they enabled faster transmission and analysis of data, but also removed obstacles for cyber criminals. She emphasized the importance of CyManII's work in striking a balance between interoperability and cybersecurity.

Reflecting on these comments, Mr. Evans suggested a potential action step emerging from this dialogue: a Council-led initiative/working group to explore elements of a potential public-private partnership to leverage the leadership of large companies, universities and national laboratories to empower SMEs to reduce their cyber-attack surface (a model similar to the Council's successful National Digital Engineering Manufacturing Consortium with the White House and U.S. Department of Commerce.)

Concluding Thoughts

Ms. Wince-Smith emphasized that digital manufacturing will be critical to America's economy, security, inclusiveness, and standard of living going forward. She highlighted the role the organizations represented by the panelists—Lockheed Martin, Deere & Company, Oak Ridge National Laboratory, and Purdue University—were already playing in integrating small and medium-sized businesses into the digital technology ecosystem, helping deploy digital manufacturing technology at scale, and helping small manufacturers make the cultural changes and capital investments needed to harness the full benefits of digital technology. She noted the importance of collaboration between different sectors, and thanked participants for their insights and conversation.

Mr. Evans summarized major takeaways from the discussion:

- The importance of thinking holistically and to optimize for digital adoption and deployment;
- The criticality of speed in innovation, and being open to partnership—including bringing in commercial partners to implement digital manufacturing;
- Fostering culture change and a mindset of lifelong learning and continuous adaptation; and
- Bolstering investment in fundamental infrastructure and cybersecurity.

And Mr. Evans announced the next webinar in the *Competing in the Next Economy* series, in partnership with Lockheed Martin, will focus on innovation frontiers and will take place in Fall 2021.

Panelist Bios

Ms. Yvonne Hodge
Senior Vice President and Chief Information Officer
Enterprise Business and Digital Transformation
Lockheed Martin

Yvonne O. Hodge is the senior vice president and chief information officer of Enterprise Business and Digital Transformation at Lockheed Martin, a global security and aerospace company employing 110,000 people worldwide. Ms. Hodge is responsible for developing strategies and implementing integrated, cross-functional solutions that transform operations through technology, culture, and processes to deliver business-based outcomes. She leads the corporation's Digital Transformation and Enterprise Information Technology teams, comprising more than 4,700 professionals worldwide.

Prior to this, Ms. Hodge served as the first vice president of Business Innovation Transformation and Enterprise Excellence for Lockheed Martin Space. She was charged with ensuring information was effectively governed and utilized as an asset, guiding data analytics and artificial intelligence capabilities, and driving data-related business direction.

Ms. Hodge has been the lead voice for data and analytics strategy with senior executives. She applies innovative capabilities to understand, track, and predict customers' needs, market trends, and competitive landscapes. She has brought leading-edge technologies and solutions to fruition to differentiate Lockheed Martin and meet dynamic corporate needs.

During her 18 years with Lockheed Martin, Ms. Hodge has also served as vice president of Business Innovation Transformation & Enterprise Excellence of Space; vice president of Information Technology for Space; vice president of Technical Operations for Enterprise Business Services; CIO & vice president for Electronic Systems; and vice president of Mission Success & Information Technology for Maritime Systems and Sensors. Prior to joining Lockheed Martin in 2002, Ms. Hodge served for many outstanding years at AT&T in various managerial and executive positions, including vice president of operations for business customers. She was a major factor in the network telecommunications disaster recovery efforts after the 9/11 tragedy and was formally recognized by New York City for her work. Ms. Hodge is considered an expert in Telecommunications, IT Business Resiliency, and Disaster Recovery contingency planning and network design.

Ms. Hodge holds a Bachelor of Science degree in mathematics, cum laude from Montclair State University, N.J. She also holds a number of awards, including the 2012 Black Engineer of the Year Award, with special recognition for career achievement. She is a champion for science, technology, engineering, and math (STEM) education and works with a number of leadership development and mentoring programs.

Ms. Hodge is also active volunteer in her community, a talented musician, and an avid sports fan. She travels often to support five of her godsons, who play in the NBA and NFL.

Dr. Jahmy J. Hindman

Chief Technology Officer
Deere & Company, and
Chairman, Technology Leadership & Strategy Initiative

Jahmy Hindman is Chief Technology Officer of Deere & Company, a position he has held since July 2020. In this role, Jahmy is responsible for building Deere's "tech stack," the company's intuitive end-to-end equipment solution made up of hardware and devices, embedded software, connectivity, data platforms, and applications. He will lead the company's Intelligent Solutions Group, the global network of technology/innovations centers, and the shared engineering function.

Working in both the Agricultural & Turf and Construction & Forestry divisions, Jahmy brings more than 20 years of advance technology, artificial intelligence, product engineering, and manufacturing experience to the role. Most recently, Jahmy led the engineering team for Deere's flagship product line.

His previous leadership assignments include Global Manager, Architectures, Systems and Modules; platform architect for the tractor product lines; Manager, Large Tractor Chassis; general manager and engineering manager at Deere's construction-equipment factory in Tianjin, China; product marketing manager and engineering supervisor for four-wheel-drive construction loaders. He joined John Deere 1996 as a test engineer working on backhoes and crawlers.

Jahmy holds a bachelor's degree in mechanical engineering from Iowa State University as well as master's and doctoral degrees in mechanical engineering from the University of Saskatchewan. His doctorate focused on the application of artificial neural networks in heavy equipment applications. Jahmy currently sits on the Industrial Advisory Council for Iowa State University's College of Engineering.

Dr. Thomas R. Kurfess

Chief Manufacturing Officer
Oak Ridge National Laboratory, and Co-Chair,
National Commission Working Group 2

Thomas R. Kurfess currently serves as the Chief Manufacturing Officer at Oak Ridge National Laboratory. He received his S.B., S.M. and Ph.D. degrees in mechanical engineering from M.I.T. in 1986, 1987 and 1989, respectively. He also received an S.M. degree from M.I.T. in electrical engineering and computer science in 1988. During 2012-2013, he served as the Assistant Director for Advanced Manufacturing at the Office of Science and Technology Policy in the Executive Office of the President of the United States of America, where he was responsible for coordinating Federal advanced manufacturing R&D. He was President of SME in 2018, and currently serves on the Board of Governors of the ASME. His research focuses on the design and development of advanced manufacturing systems targeting secure digital manufacturing, additive and subtractive processes, and large-scale production enterprises. He is a member of the National Academy of Engineering and is a Fellow of ASME, AAAS, and SME.

Dr. Theresa S. Mayer
Executive Vice President for Research and Partnerships, and
Professor of Electrical and Computer Engineering, Purdue University; and
Member, Technology Leadership & Strategy Initiative

Theresa S. Mayer is the executive vice president for research and partnerships at Purdue University, where she oversees the $690 million research enterprise of the university and supports holistic engagements with federal, industry, and global strategic partners.

Prior to this role, she was the vice president for research and innovation at Virginia Tech where she played an instrumental role in Virginia's successful bid for Amazon HQ2 as well as the formation of the statewide Commonwealth Cyber Initiative. While at Penn State University, she served as the associate dean for research and innovation in engineering and the site director of the NSF National Nanotechnology Infrastructure Network, which enabled cutting-edge materials and techniques to be shared among researchers in academia and industry.

She is widely recognized for her work in advanced manufacturing of nanoscale electronic, optical, and biomedical devices, which has been supported by the NSF, DOD, DOE, NIH, and industry. Mayer has over 350 technical publications, invited presentations and tutorials, and holds ten patents in these areas. She served on the U.S. President's Council of Advisors on Science and Technology and is a fellow of the Institute for Electrical and Electronics Engineers. Mayer received a B.S. in electrical engineering from Virginia Tech, and a M.S. and Ph.D. in electrical engineering from Purdue University.

The Honorable Deborah L. Wince-Smith
President & CEO
Council on Competitiveness

The Honorable Deborah L. Wince-Smith is the President & CEO of the Council on Competitiveness, a non-partisan leadership coalition of CEO's, University Presidents, Labor Union Leaders, and National Laboratory Directors, all committed to developing policy solutions and national initiatives to drive future productivity growth, prosperity for all Americans, and the global success of American business. She has more than 20 years of experience as a senior U.S. government official, as the first Senate-confirmed Assistant Secretary for Technology Policy in the U.S. Department of Commerce in the Administration of President George H.W. Bush, and as the Assistant Director for International Affairs in the White House Office of Science and Technology Policy in the Reagan Administration. She served as a Senate confirmed member of the Oversight Board of the Internal Revenue Service in the Administrations of President George W. Bush and President Barack H. Obama.

Ms. Wince-Smith is also the President and Founder of the Global Federation of Competitiveness Councils (GFCC). She previously served on the Smithsonian National Board, the Secretary of State's Committee on International Economic Policy, the U.S. Naval Academy Foundation and, the Board of Governors of Argonne National Laboratory. She served as Chairman of the World Economic Forum's Global Agenda Council on Competitiveness and as a Public Director of NASDAQ-OMX.

Ms. Wince-Smith currently serves on the Advisory Committee of the Export-Import Bank of the United States (EXIM) and UNICEF. She is also a Commissioner on the Commission on the Theft of American Intellectual Property, and as a member of the Council

of Japan's Science and Technology in Society (STS) Forum. As an expert in technology commercialization, Ms. Wince-Smith serves on the Board of Directors of Aerolase, Inc. and Q-Net Security, Inc., and she serves as the Vice Chair of the Board of the American College of Greece.

Ms. Wince-Smith graduated magna cum laude and Phi Beta Kappa from Vassar College and earned a Master's Degree in Classical Archaeology from King's College, Cambridge University. She has received Honorary Doctorates from Michigan State University, the University of Toledo, the Queens University Belfast, Worcester Polytechnic Institute, and the University of South Carolina.

Mr. Chad Evans

Executive Vice President and Secretary to the Board
Council on Competitiveness

As Council EVP overseeing all programs and initiatives, Chad develops and manages the Council's policy agenda and workstream, including: development of the Council's flagship "National Commission on Innovation & Competitiveness Frontiers;" creating both the "Building University-Industry-Lab Dialogue for Advanced Computing" effort and the "Exploring Innovation Frontiers Initiative" with the National Science Foundation; forming the "American Energy & Manufacturing Competitiveness Partnership" with the U.S. Department of Energy; and, helping to shape and launch the "National Engineering Forum."

In addition, Chad has built and shepherded over the past decade the Council's "Technology Leadership and Strategy Initiative," engaging Fortune 500 chief technology officers, university vice presidents of research, and national laboratory deputy directors to make the policy and business cases for America's innovation-enabling investments in talent, technology and infrastructure.

He has also helmed C-suite innovation summits, dialogues and immersions across Latin America, Europe, Asia and Oceania. Has focused, in particular in Brazil and Australia—having created 4 U.S.-Brazil Innovation Summits and 20+ innovation learning laboratories across both nations; and having launched the first-ever U.S.-Australia CTO Dialogue series.

Chad holds an M.S. from the Georgetown University School of Foreign Service, with an Honors concentration in International Business Diplomacy from Georgetown's Landegger Program. He has a B.A. in Political Science and International Affairs from Emory University.

He is Secretary to the Board of the Council on Competitiveness; Treasurer to the Board of the Global Federation of Competitiveness Councils; a member of the Texas A&M Engineering Experiment Station Advisory Board; an ARCS Foundation National Science and Engineering Advisory Council member; a U.S. German Marshall Fund Fellow; and a past member of the Lawrence Livermore National Laboratory Industry Advisory Council and the World Economic Forum Advisory Board on Russian Competitiveness.

About the Council on Competitiveness

For more than three decades, the Council on Competitiveness (Council) has championed a competitiveness agenda for the United States to attract investment and talent and spur the commercialization of new ideas.

While the players may have changed since its founding in 1986, the mission remains as vital as ever—to enhance U.S. productivity and raise the standard of living for all Americans.

The members of the Council—CEOs, university presidents, labor leaders and national laboratory directors—represent a powerful, nonpartisan voice that sets aside politics and seeks results. By providing real-world perspective to Washington policymakers, the Council's private sector network makes an impact on decision-making across a broad spectrum of issues—from the cutting edge of science and technology, to the democratization of innovation, to the shift from energy weakness to strength that supports the growing renaissance in U.S. manufacturing.

The Council's leadership group firmly believes that with the right policies, the strengths and potential of the U.S. economy far outweigh the current challenges the nation faces on the path to higher growth and greater opportunity for all Americans.

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