AI IN MANUFACTURING: SECURING AMERICAN LEADERSHIP IN MANUFACTURING AND THE NEXT GENERATION OF TECHNOLOGIES

HEARING

BEFORE THE

SUBCOMMITTEE ON COMMERCE, MANUFACTURING, AND TRADE

OF THE

COMMITTEE ON ENERGY AND COMMERCE

HOUSE OF REPRESENTATIVES

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C O N T E N T S

WITNESSES

SUBMITTED MATERIAL

AI IN MANUFACTURING: SECURING AMERICAN LEADERSHIP IN MANUFACTURING AND THE NEXT GENERATION OF TECHNOLOGIES

WEDNESDAY, FEBRUARY 12, 2025

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON COMMERCE, MANUFACTURING, AND TRADE,
COMMITTEE ON ENERGY AND COMMERCE,
Washington, DC.

The subcommittee met, pursuant to call, at 11:07 a.m., in the John D. Dingell Room 2123, Rayburn House Office Building, Hon. Gus M. Bilirakis (chairman of the subcommittee) presiding.

Members present: Representatives Bilirakis, Fulcher, Harshbarger, Cammack, Obernolte, James, Bentz, Houchin, Fry, Lee, Kean, Evans, Goldman, Guthrie (ex officio), Schakowsky (subcommittee ranking member), Castor, Soto, Trahan, Clarke, Dingell, Veasey, Kelly, Schrier, and Pallone (ex officio).

Also present: Representative Joyce.

Staff present: Ansley Boylan, Director of Operations; Jessica Donlon, General Counsel; Sydney Greene, Director, Finance and Logistics; Natalie Hellman, Professional Staff Member, Commerce, Manufacturing, and Trade; Megan Jackson, Staff Director; Daniel Kelly, Press Secretary; Sophie Khanahmadi, Deputy Staff Director; Alex Khlopin, Clerk, Commerce, Manufacturing, and Trade; Giulia Leganski, Chief Counsel, Commerce, Manufacturing, and Trade; Joel Miller, Chief Counsel; Brannon Rains, Professional Staff Member, Commerce, Manufacturing, and Trade; Evangelos Razis, Professional Staff Member; Chris Sarley, Member Services/Stakeholder Director; Kaley Stidham, Press Assistant; Matt VanHyfte, Communications Director; Hannah Anton, Minority Policy Analyst; Rasheedah Blackwood, Minority Intern; Keegan Cardman, Minority Staff Assistant; Tiffany Guarascio, Minority Staff Director; Perry Hamilton, Minority Member Services & Outreach Manager; Lisa Hone, Minority Chief Counsel, Commerce, Manufacturing, and Trade; Mackenzie Kuhl, Minority Digital Manager; Phoebe Rouge, Minority FTC Detailee; and Andrew Souvall, Minority Director of Communications Outreach and Member Services.

Mr. BILIRAKIS. The committee will come to order. Good morning, everyone.

The chairman recognizes himself for 5 minutes.

OPENING STATEMENT OF HON. GUS M. BILIRAKIS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF FLORIDA

First of all, I want to say "Happy birthday" to one of our greatest Presidents, if not the greatest President we ever had: Abraham Lincoln. Today is the 12th, right? Absolutely.

And then also I want to make sure I remember this. One of my staffers who has been with me about 10 years, including the internship, he has made me a better Member, and he has worked really hard on healthcare but also this committee, this particular committee. He is assigned to be my staffer for this committee.

And I tell you what, he has made me a better Member, and I want to congratulate him for all his work. His name is Jim—excuse me—Chris Jones, and he will be going over to the other side, but you know what—not the Senate—but he deserves a lot of credit. I think we have done a lot in this committee. And I tell you what, we have terrific staff.

But thank you very much, Chris, for all your hard work. Congratulations and God bless you.

[Applause.]

All right. So good morning, everyone, and welcome to the first Commerce, Manufacturing, and Trade Subcommittee hearing of the 119th Congress.

I would like to express my sincere congratulations to my good friend, the chair, Mr. Guthrie, on his appointment to the powerful Energy and Commerce Committee, the oldest standing legislative committee in the House—I don't care what Ways and Means says—and the best darn committee in Congress, by far.

I also want to thank the chair for putting his faith in me to lead this important subcommittee, which has broad jurisdiction over a great many important matters. This will be a busy Congress, and I am excited to lay the groundwork to accomplish a robust legislative agenda.

I would be remiss if I didn't identify and welcome to this wonderful panel the new members of the Energy and Commerce Committee: Mr. Bentz from Oregon; Ms. Houchin from Indiana—we will be working closely together; Mr. Fry from South Carolina; Ms. Lee from the great State of Florida is a great friend of mine, and go Gators; and Mr. Kean from New Jersey, Mr. Evans from Colorado, and Mr. Goldman from Texas. Welcome. Welcome.

I also want to thank my very good friend Russ Fulcher from the great State of Idaho. He will be serving as my vice chair. He is going to do an outstanding job. So it is either Gus or Russ. That is what he says.

And, finally, it is good to be sitting next to my good friend Ms. Schakowsky from Illinois. I am greatly looking forward to working with you again and all the Members on this particular subcommittee.

Now on to the business at hand. I am excited to kick this Congress off with an educational hearing examining the state of American manufacturing and how it can be revolutionized with the use of artificial intelligence.

We know generative AI is currently dominating the headlines for its specific use case of AI, such as how DeepSeek is capturing war-

ranted attention with their collection of Americans' personal data and subsequently sharing it with the Chinese Communist Party.

But I think we must remember that generative AI—and, of course, you know, has some positive aspects, there is no question. But generative AI is only a specific use case of this technology, and AI's applications are much broader than what has claimed the spotlight recently.

We have seen how AI applied to vehicles is paving the way for the next generation of vehicles that will drive themselves. I tell you what, it is very, very exciting, particularly with someone with disabilities such as myself.

These autonomous vehicles promise to greatly improve auto safety, which is the most important thing, and provide vast mobility benefits to every American, including those with disabilities.

We have also seen how the technology holds the power to completely revolutionize American manufacturing and bolster our supply chain. By integrating AI and machine learning into supply chain systems, we can better predict constraints and find potential weak points, which can be used to prevent shocks that disrupt entire industries.

Our committee has led on supply chain mapping and monitoring legislation before and empowering companies to deploy emerging technologies like AI to better understand our supply chains. It could help us protect against the next pandemic or the next major labor shortage, and that is huge.

We need to send that legislation—and I know Representative Bucshon, Dr. Bucshon, had it last session, but he is no longer on the committee, unfortunately, but he will be helping us. But, anyway, we ought to send it to the President's desk as soon as possible so we can begin work on making America resilient.

Industries can also utilize the power of AI in our manufacturing ecosystems to find where redundancies exist and reduce waste in the developmental pipeline. To bring this country back to the forefront of what made it great, we need to reduce unnecessary waste and optimize our building capabilities.

We know the American people are the most innovative in the world. Our job here in Congress will be to provide a pathway for these innovators to succeed. This is exciting stuff, folks. America's global leadership in the 21st century will be contingent on our ability to promote emerging technologies and establishing a pathway to unleash them throughout American manufacturing.

We have a great panel of witnesses today to share examples of how AI is actively being used in manufacturing and supply chains. I want to thank them for being here today, particularly with this bad weather. Thanks for coming in. I think the chairman did a great job in giving us an extra hour to get here, so we appreciate that very much. I didn't run Greek time today because I had that extra hour.

So, in any case, I yield back.

[The prepared statement of Mr. Bilirakis follows:]

Opening Statement for Chairman Gus Bilirakis
Subcommittee on Commerce, Manufacturing, and Trade
Committee on Energy and Commerce
Hearing on: AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies
February 12, 2025

Good morning everyone and welcome to the first Commerce, Manufacturing, and Trade Subcommittee hearing of the 119th Congress. I'd like to express my sincere congratulations to my good friend, the Chair, Mr. Guthrie, on his appointment to the powerful Energy and Commerce Committee – the oldest standing legislative committee in the House, and the best Committee in Congress.

I also want to thank the Chair for putting his faith in me to lead this important subcommittee, which has broad jurisdiction over a great many important matters. This will be a busy Congress, and I'm excited to lay the groundwork to accomplish a robust legislative agenda.

I would be remiss if I didn't identify and welcome to this wonderful panel the new members of the Energy and Commerce Committee:

Mr. Bentz from Oregon; Ms. Houchin from Indiana; Mr. Fry from South Carolina; Ms. Lee from Florida – and I'll add a Go Gators to you my friend; Mr. Kean from New Jersey; Mr. Evans from Colorado; and Mr. Goldman from Texas.

I also want to thank my friend Russ Fulcher from the great State of Idaho for serving as the Vice Chair of this Subcommittee.

And finally, it is good to be sitting next to my friend, Ms. Schakowsky from Illinois. I'm greatly looking forward to working with you again, and all of the Members of this Subcommittee.

Now onto the business at hand. I'm excited to kick this Congress off with an educational hearing examining the state of American

manufacturing, and how it can be revolutionized with the use of artificial intelligence.

We know generative AI is currently dominating the headlines for its specific use case of AI, such as how DeepSeek is capturing warranted attention with their collection of American's personal data and subsequently sharing it with the Chinese Communist Party.

But I think we must remember that generative AI is only a specific use case of this technology, and AI's applications are much broader than what has claimed the spotlight recently. We have seen how AI applied to vehicles is paving the way for the next generation of vehicles that will drive themselves. These autonomous vehicles promise to greatly improve auto safety and provide vast mobility benefits to every American – including those with disabilities.

We have also seen how the technology holds the power to completely revolutionize American manufacturing and bolster our supply chains.

By integrating AI and machine learning into supply chain systems, we can better predict constraints and find potential weak points which can be used to prevent shocks that disrupt entire industries.

Our committee has led on supply chain mapping and monitoring legislation before, and empowering companies to deploy emerging technologies like AI to better understand our supply chains could help us protect against the next pandemic or the next major labor shortage. We need to send that legislation to the President's desk to begin the important work of making America more resilient.

Industries can also utilize the power of AI in our manufacturing ecosystems to find where redundancies exist and reduce waste in the developmental pipeline. To bring this country back to the forefront of what made it great, we need to reduce unnecessary waste and optimize our building capabilities. We know the American people are the most

innovative in the world. Our job here in Congress will be to provide a pathway for these innovators to succeed.

America's global leadership in the 21st century will be contingent on our ability to promote emerging technologies and establishing a pathway to unleash them throughout American manufacturing. We have a great panel of witnesses today to share examples of how AI is actively being used in manufacturing and supply chains. I want to thank them for being here today amidst the bad weather to give us much needed testimony on such an important topic. I yield back.

Mr. BILIRAKIS. And before I yield back, though, I want to recognize my good friend, the ranking member, Ms. Schakowsky, for 5 minutes for her opening statement. You are recognized.

OPENING STATEMENT OF HON. JAN SCHAKOWSKY, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Ms. SCHAKOWSKY. Thank you so much, Mr. Chairman. And I just want to really welcome you back. I am wearing my Valentine's Day——

Mr. BILIRAKIS. I appreciate that.

Ms. SCHAKOWSKY [continuing]. For you. And I just wanted to say that we have been working on this committee for 12 years. We have really been partners here. And I want to say just at the beginning we have a lot of wonderful things that we have done for consumers.

We have made life better for many children by protecting them. And, you know, we almost made it to the TICKET Act. So there are still things that are left undone that we want to do, and I know that we want to work on them together.

So we are focusing today on the—we are focusing on AI, and we are focusing on manufacturing, and this is all very important. Let me just say that we saw, under President Biden, that, after many years of outsourcing, we saw a focus on providing wonderful things in the United States and a lot more building of things and doing of things here. But, you know, we have a long way to go to make sure that all the manufacturing is brought to the United States of America.

And I wanted to talk a little bit about AI. You know, we have not done in this subcommittee a lot of work on holding tech accountable. And we made it partway to protect privacy. We have talked a lot about caring for children and protecting their privacy, but actually, when it comes to the dramatic improvements or increases you would say for tech companies, we really haven't done enough to count on them.

What is really important, I believe, is that the tech companies right now have had a free rein from the beginning, and we have done so little to really make sure that consumers are considered all the time on what these tech companies are able to do.

And I think we still are at the place that people feel that their most private information, their children's information, is not reined in. And I think it is time for us to take a look at what Big Tech is doing and if there are things that we might want to change and take them under control.

So AI, I think what we have to make sure is that AI, which will certainly increase the volume of work that we do, that we are able to bring about in manufacturing, but what I am concerned about is that ordinary workers are also going to be considered when we talk about AI, and that they are not going to be—because there is going to be a lot more manufacturing that is done with AI, but what is going to happen to everyday Americans? So I think that has to be part of the consideration.

I also just want to say that I am concerned about the Consumer Financial Protection Bureau. And I know that I am out of time, but I am very disappointed that that agency which protected con-

sumers—did a great job, $20 billion returned to consumers because of what they do. So we need to do more of consumer protection, and I hope we will.

And with that, I yield back. Thank you.

[The prepared statement of Ms. Schakowsky follows:]

Committee on Energy and Commerce

Opening Statement as Prepared for Delivery
of
Subcommittee on Commerce, Manufacturing, and Trade Ranking Member Janice Schakowsky

Hearing on "AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies"

February 12, 2025

President Trump and Elon Musk are creating chaos and uncertainty. That chaos is hurting American workers. We've spent billions of taxpayer dollars to bring manufacturing back to America. Democrats' investments created good-paying jobs making chips and building cars.

But these jobs, and the families they support, are under threat from President Trump. Republicans have turned their back on American workers. It has already led to layoffs. This is the opposite of what our manufacturing industry needs. One thing that could benefit American manufacturing is artificial intelligence (AI).

But the benefits of new technologies must flow to workers. We must ensure AI democratizes success. Not that it upholds an economy rigged for the wealthy. So much of this subcommittee's work is about consumer protection. That's why I want to express my outrage that the Trump Administration is trying to close the Consumer Financial Protection Bureau.

The CFPB was created after the Great Recession to protect consumers from banks picking their pockets. It has returned over $20 billion to Americans cheated by greedy corporations. By closing its doors, President Trump is empowering scammers and fraudsters at the expense of hardworking Americans.

Mr. BILIRAKIS. I thank the gentlelady.

And now I will recognize the chairman of the full committee, my good friend from the State of Kentucky, the great State of Kentucky, Mr. Guthrie. You are recognized for 5 minutes for an opening statement, sir.

OPENING STATEMENT OF HON. BRETT GUTHRIE, A REPRESENTATIVE IN CONGRESS FROM THE COMMONWEALTH OF KENTUCKY

Mr. GUTHRIE. Thank you, Mr. Chair. And as my friend the ranking member from Evanston, Illinois, may have on her car "Land of Lincoln," February 12th in 1809, he was born in Hodgenville, Kentucky, in the great Commonwealth of Kentucky, so lived there until he was a young boy. So you can come visit. National Park has a great service there. So thanks.

It is important to be here today. And I just want to say that my path to the middle class as a family, my family's path is right through the factory floor. My dad worked for a big automotive foundry and worked his way into management from the union floor to management.

And then, when I was in high school, they announced they were getting out of the foundry business and closed the foundry. So I saw the disruption that happens when that happens. I saw my dad being—he moved up into management, kind of became the leader of saving the plant. So we were kind of at our kitchen table where people gathered to try to—how are we going to try to keep the plant open? And I saw grown men that had coached me in Little League crying because they don't know how they are going to feed their families.

So things are disruptive. And what we have to remember is that—I will never forget this lesson—when people in authority make decisions, it does affect real people. And what my friend the ranking member talked about, and we have to factor that in. I like to say what we do in the people's House affects people in their homes. So we have to be mindful.

But, having said that, we know that we have to be more productive and continue to be more productive, and AI gives us the opportunity to be more productive. We have to outpace our competitors, and particularly in Asia and China, and AI gives us a great opportunity to do so.

And we have to remember that we have to improve the fundamental skills of the people that work in manufacturing so they can take advantage of AI to become more productive. As AI gets more involved in the manufacturing process, people who know how to program it, people who know how to fix it and repair it and do all of the things make far more money than people who just operate.

And that is what we need to focus on, and I think it will lift everybody—a more productive society is more beneficial for everyone, so we need to look and focus in on that. And I do believe by utilizing AI, the U.S. can return to its rich history of global leadership in manufacturing.

So I appreciate this hearing. This is a subcommittee that is dear to me since I worked in—my dad, after the plant closed, started his own business, and I worked with my brothers. And some of the

men who had coached me in Little League moved to Kentucky to work together and build a successful foundry.

So this is near and dear to my heart, because I know that it is the pathway for a lot of families to the middle of the middle class.

[The prepared statement of Mr. Guthrie follows:]

Statement of Chairman Brett Guthrie
CMT Subcommittee Hearing Titled "AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies"
February 12, 2025

I'll echo the Chairman, it's great to have so many new Members in the room, and thank you to our witnesses for being here.

Manufacturing is the backbone of the American economy, driving job creation, supporting countless working-class families, and providing the foundation for towns and communities to thrive.

I've been around manufacturing my whole life — when I was young, the factory that my father worked in was shut down. I watched men cry around our kitchen table with my dad, as they figured out how to provide for their families.

This taught me a truth I will never forget — people in positions of authority make decisions that affect employees, families, and communities.

The closure of this plant led my parents to open an auto manufacturing company in Bowling Green, Kentucky. I worked alongside my father, my brothers, and some of the men who were left unemployed by the closure of that local factory where I had grown up. At a young age, this showed me just how important these jobs are to American families and how much our nation relies on the manufacturing industry.

And while the U.S. has long been a global leader in manufacturing, recently, that leadership has been neglected. Adversaries, like China, are challenging our competitiveness and threatening our supply chains. We

must act decisively to safeguard our industrial strengths before these risks become reality.

Manufacturers are increasingly harnessing the use of Artificial Intelligence, or AI, to enhance innovation in manufacturing and increase productivity, optimize process management, and improve safety. The use cases and benefits are numerous, and the potential gains are exponential.

Deploying AI on the floors of manufacturing facilities can bring a competitive edge back to American manufacturing.

By reducing the amount of time spent on repetitive, monotonous, and routine tasks, workers can focus on the parts of their jobs that require a greater degree of problem solving and judgment, which require fundamentally human skills. Rather than displacing employees, AI empowers workers to focus on skilled tasks requiring critical thinking and analysis.

While transitions in the workforce are never easy, changing technologies have historically created new jobs that never existed today. These periods have always illustrated America's greatest competitive advantage: our skilled and resilient workforce.

Beyond the factory floor, AI can mitigate risks and help to secure American supply chains. The importance of supply chain security in the face of competitive threats from China cannot be understated. Through dynamic, real-time responses to disruptions, AI can help us mitigate risks and stabilize potential threats in times of uncertainty. A strong manufacturing base and secure supply chains will help to protect all sectors of our economy.

To harness AI's full potential, we will cultivate an environment that fosters innovation, ensuring manufacturers can continue to develop and deploy AI solutions across their operations.

By utilizing AI, the United States can return to its rich history of dominant manufacturing and reestablish our global leadership. In Congress, we must work with industry leaders and workers to spark this next, great American manufacturing revolution.

Thank you, Mr. Chairman, and I yield the balance of my time to the subcommittee Vice Chairman, the gentleman from Idaho, Mr. Fulcher.

Mr. GUTHRIE. And I will yield the remainder of my time to the vice chair, Mr. Fulcher from Idaho.

OPENING STATEMENT OF HON. RUSS FULCHER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF IDAHO

Mr. FULCHER. Thank you, Mr. Chairman. And thank you to you and to the subcommittee chair for the honor to serve here. It is truly an honor, and I am thankful for that.

We were talking about President Lincoln, and most people don't realize there is also a connection to Idaho with President Lincoln. It was Abraham Lincoln who established the Idaho Territory in 1863, and that was the precursor to our statehood in 1890. So there is an honored connection there.

Mr. Chairman, manufacturing is the core of our economy. It contributes to more applications, is more sophisticated, and operates in a highly competitive environment with countries like China. China's manufacturing value-add and contribution to global GDP continues to outpace the United States', and China produces more goods than the U.S. in 9 of the top 11 manufacturing industries. But the U.S. could outcompete and outperform China or any other country if we fully utilized our technologies, resources, and personnel.

For example, in my home State of Idaho, global food manufacturers locate there because of our agricultural resources. And we have other manufacturers fulfilling contracts on major weapon systems, like the F–35 aircraft. We have major semiconductor producers developing chips for the next generation of mobile logic and industrial computing needs.

But, in all these cases, innovation and production, identification of defects, ordering parts for machines before they fail, helping workers improve safety and productivity are all crucial. Speaking for myself and I think for most of my other colleagues here, we need to learn how AI can help improve the production process, empowering the line worker to catch defects, innovate processes, and improve safety.

We need to know how AI can help predict machine failures better to prevent production interruptions. We need to understand how to provide for data sharing for these needs while ensuring privacy among our end users.

And, finally, we need to find ways for the Federal Government to properly optimize its position to enable manufacturers to recruit, train, and reskill new and existing people. That is our challenge, but it needs to be in the appropriate fashion.

Thank you, and I yield back.

[The prepared statement of Mr. Fulcher follows:]

Opening Statement:

Thank you Mr. Chairman. I appreciate Chair Bilirakis and Ranking Member Schakowsky for holding this important hearing on the role of AI in the manufacturing space. Manufacturing is at the core of our economy. It contributes to more applications, is more sophisticated, and operates in a highly competitive environment with countries like China. China's manufacturing value add and contribution to global GDP continues to outpace the United States. And China produces more goods than the U.S. in 9 of the top 11 manufacturing industries. But the U.S. can outcompete China (or any other country) if we fully utilize our technologies, resources, and talented people.

In Idaho, global food manufacturers locate in our state because of our agricultural resources. We have small manufacturers, fulfilling contracts on major weapons systems like the F-35. And we have major semiconductor producers, developing chips for the next generation of mobile, logic, and industrial computing needs.

In all these cases, innovation in production, identifying defects, ordering parts for machines before they fail, and helping workers improve safety and productivity are all crucial.

I want to learn how AI can help improve the production process, empowering the line worker to catch defects, innovate processes, and improve safety. I want to know how AI can help predict machine failures better to prevent production interruptions.

I want to understand how we take care to provide for data sharing for these needs, while ensuring privacy among end users.

Finally, I want to find ways the federal government can help manufacturers recruit, train, and reskill new and existing people by streamlining or eliminating barriers to opportunity. Thank you and I yield back.

Mr. BILIRAKIS. I thank the vice chairman. I look forward to working with you, sir.

Next, we have the ranking member of the full committee, Mr. Pallone, a good friend of mine from the great State of New Jersey.

You are recognized for 5 minutes for your opening statement, sir.

OPENING STATEMENT OF HON. FRANK PALLONE, JR., A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW JERSEY

Mr. PALLONE. Thank you, Mr. Chairman.

I want to thank the witnesses for taking the time to testify this morning.

But, to the Republican majority, I want to express extreme frustration that we are not addressing the fact that the Trump administration has given billionaire Elon Musk and his young, anonymous henchmen unfettered access to government systems containing vast amounts of incredibly sensitive personal data about all Americans.

Musk and his team have access to all the data of the Department of Health and Human Services and the Centers for Medicare and Medicaid Services, and that means that they can access and may be able to delete, modify, and transfer for their own purposes detailed healthcare information about tens of millions of Americans, including virtually all of our Nation's seniors.

And they also have access to Treasury Department data that includes Social Security numbers, tax returns, payment information, all tied to names, addresses, phone numbers, and email addresses.

And, for decades, we have had strong privacy and data protection laws in place that govern access to these government records to protect Americans' privacy and the security of their personal information. But, with the full support of President Trump and House Republicans, Musk and his minions have ignored those protections, and civil servants attempting to protect Americans' data from Musk's unauthorized access have been fired.

If a foreign adversary or a domestic hacking group got access to any one of these government systems containing Americans' sensitive personal information, we would consider it a major data breach, a privacy disaster, and a consequential national security incident.

And State's attorneys general, public interest organizations, and the courts are doing their part to put a stop to the Trump administration's decision to hand over Americans' most sensitive data to the richest man in the world and his cronies.

But Congress and this subcommittee in particular should be using all of the tools at our disposal to protect Americans' privacy. Unfortunately, instead of expressing outrage or holding hearings and demanding accountability for Musk stealing Americans' personal information, my Republican colleagues have chosen silence. And so I urge my Republican colleagues to raise their voices to protect Americans' personal health and financial data and all of the other sensitive personal data that is now in the hands of Elon Musk and his henchmen.

Now, turning to today's hearing, Mr. Chairman, a strong and technologically advanced manufacturing base creates a healthy

economy that uplifts hardworking middle-class Americans, lowers the cost of American-made goods, and bolsters our national security and promotes global leadership.

And yet, in just the first few weeks of the Trump administration, Republicans have turned their back on American families by attempting to illegally steal resources being put to work to grow and modernize the manufacturing sector. The CHIPS and Science Act made a transformative $52 billion investment to develop the advanced infrastructure and workforce needed to build critical semiconductors here in America. And this will reduce the cost of American-made semiconductors and end our dangerous dependence on foreign manufacturers.

The Inflation Reduction Act recharged our domestic energy sector by providing $369 billion to lower energy bills for American families and grow our economy so we can lead the global clean energy transition.

And Republicans say they want to foster innovation and beat China, support American workers, and lower costs. Yet they are choosing to look the other way as President Trump steals money from the American people, businesses, and communities. American companies are being put at a disadvantage by President Trump's constant chaos. It is simply not realistic to expect American manufacturers, especially small- and medium-size companies, to confidently make investments in their future when they are at risk of having to confront a senseless trade war or having Federal funding they rely on illegally stripped away.

This is not a recipe for success. In my opinion, if Republicans are actually interested in securing American leadership in manufacturing and the next generation of technologies, they should work with us to defend the programs that are bolstering American manufacturing and the dedicated civil servants who work tirelessly to implement them.

So it is time for Republicans to stand up to the senseless Trump chaos that threatens American workers and small businesses and our economy.

And, with that, Mr. Chairman, I yield back. Thank you.

[The prepared statement of Mr. Pallone follows:]

Committee on Energy and Commerce

Opening Statement as Prepared for Delivery
of
Full Committee Ranking Member Frank Pallone, Jr.

Hearing on "AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies"

February 12, 2025

I want to thank the witnesses for taking the time to testify on this wintry morning, but to the Republican Majority, I express extreme frustration that we are NOT addressing the fact that the Trump Administration has given corrupt billionaire Elon Musk, and his young anonymous henchmen unfettered access to government systems containing vast amounts of incredibly sensitive personal data about all Americans.

Musk and his team have access to all the data at the Department of Health and Human Services and the Centers for Medicare and Medicaid Services. That means they can access, and may be able to delete, modify, and transfer for their own corrupt purposes detailed health care information about tens of millions of Americans, including virtually all of our nation's seniors.

They also have access to Treasury Department data that includes Social Security numbers, tax returns, payment information, all tied to names, addresses, phone numbers, and email addresses.

For decades we have had strong privacy and data protection laws in place that govern access to these government records to protect Americans' privacy and the security of their personal information. With the full support of President Trump and House Republicans, Musk and his minions have ignored those protections, and civil servants attempting to protect Americans' data from Musk's unauthorized access have been fired.

If a foreign adversary or a domestic hacking group got access to any one of these government systems containing Americans' sensitive personal information, we would consider it a major data breach, a privacy disaster, and a consequential national security incident.

State Attorneys General, public interest organizations, and the courts are doing their part to put a stop to the Trump Administration's decision to hand over Americans' most sensitive data to the richest man in the world and his cronies.

But Congress and this Subcommittee, in particular, should be using all of the tools at our disposal to protect Americans' privacy. Unfortunately, instead of expressing outrage, holding hearings, and demanding accountability for Musk stealing Americans' personal information, my Republican colleagues have chosen silence.

I urge my Republican colleagues to raise their voices to protect Americans' personal health and financial data, and all of the other sensitive personal data that is now in the hands of Elon Musk and his henchmen.

Now turning to today's hearing, a strong and technologically advanced manufacturing base creates a healthy economy that uplifts hardworking, middle-class Americans, lowers the cost of American-made goods, bolsters our national security, and promotes global leadership.

And yet, in just the first few weeks of the Trump Administration, Republicans have turned their back on American families by attempting to illegally steal resources being put to work to grow and modernize the manufacturing sector.

The CHIPS and Science Act made a transformative $52 billion investment to develop the advanced infrastructure and workforce needed to build critical semiconductors here in America. This will reduce the cost of American-made semiconductors and end our dangerous dependence on foreign manufacturers.

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Republicans say they want to foster innovation, beat China, support American workers, and lower costs. Yet, they are choosing to look the other way as President Trump steals money from the American people, businesses, and communities.

American companies are being put at a disadvantage by President Trump's constant chaos. It is simply not realistic to expect American manufacturers, especially small and medium sized companies, to confidently make investments in their future when they are at risk of having to confront a senseless trade war or having federal funding they rely on illegally stripped away.

This is not a recipe for success. If Republicans are actually interested to securing American leadership in manufacturing and the next generation of technologies, they should work with us to defend the programs that are bolstering American manufacturing and the dedicated civil servants who work tirelessly to implement them. It is time for Republicans to stand up to the senseless Trump chaos that threatens American workers, small businesses, and our economy.

Thank you and I yield back.

Mr. BILIRAKIS. Well, I guess I thank the gentleman. Thank you very much. But the honeymoon is over.

But I will say this. I think. respectfully, because he is a great guy and a good friend: I think the President is doing exactly what he said he was going to do, and so far, so good. So, anyway, let's get on to it.

Our witnesses today are Mr. Jason Oxman, president and CEO of Information Technology Industry Council; and we have Dr. Elisabeth B. Reynolds, Professor of Practice at MIT; and then we have Mr. Jeff Kinder, executive vice president, Product Development and Manufacturing Solutions, Autodesk; Ms. Barbara Humpton, the president and CEO of Siemens Corporation.

I want to welcome all of you, and thank you very much for your patience this morning. And this is going to be a great hearing. We are going to learn so much.

So I want to recognize Mr. Oxman. You are recognized, sir, for 5 minutes, please.

STATEMENTS OF JASON OXMAN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, INFORMATION TECHNOLOGY INDUSTRY COUNCIL; ELISABETH B. REYNOLDS, PH.D., PROFESSOR OF THE PRACTICE, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; JEFF KINDER, EXECUTIVE VICE PRESIDENT, PRODUCT DEVELOPMENT AND MANUFACTURING SOLUTIONS, AUTODESK; AND BARBARA HUMPTON, PRESIDENT AND CHIEF EXECUTIVE OFFICER, SIEMENS CORPORATION

STATEMENT OF JASON OXMAN

Mr. OXMAN. Thank you, Chairman Bilirakis and Ranking Member Schakowsky. It is an honor to be here with you at the first hearing of the 119th of this subcommittee.

I am Jason Oxman, president and CEO of the Information Technology Industry Council, or ITI. Thank you for inviting me to testify today in a period of remarkable and dynamic change in the U.S. economy and in global competition for artificial intelligence.

Technology is key to our Nation's continued growth. And manufacturing is the economic lifeblood of the communities that this subcommittee's members represent, and manufacturing increasingly is powered by artificial intelligence. AI, as with all technology, requires digital innovation, but it also requires hardware, networks, infrastructure, energy. In other words, AI requires manufacturing innovation.

As the trade association of the technology industry, ITI represents the entire AI ecosystem, including Siemens here today and other global innovators that are investing in AI to drive manufacturing and to solve industry's biggest challenges. Indeed, ITI, as a trade association, in its 109-year history has represented the largest manufacturers in the world.

Now, today ITI member companies manufacture and build the digital infrastructure that powers the AI economy, including AI models and software, memory, semiconductors, networking equipment and servers, cooling systems, infrastructure, power, data centers, and much more.

Now, for the manufacturing sector, AI means increased efficiency, productivity, safety, and innovation. For example, AI in manufacturing today includes predictive maintenance, where AI can analyze in real time, using sensor data, the manufacturing equipment that may need predictive maintenance and also analyze predictive equipment failure; supply chain management, where AI can optimize operations by analyzing data from multiple sources, including demand forecasts, inventory levels, and logistical constraints; and digital twinning, an AI-powered digital representation of physical assets or a process that can allow virtual planning in advance of actual manufacturing.

Now, these innovations and investments, among others, will greatly benefit the manufacturing sector and the U.S. in maintaining its competitive edge. We appreciate that this committee is focused on harnessing U.S. opportunities for investment in AI to the benefit of the U.S. economy and job creation, and we also appreciate that the new Trump administration is focused on advancing U.S. AI leadership internationally, as the Vice President just returns from the Paris AI Summit.

Now, reaching these clear goals will require close collaboration between the private sector and government. And I would like to offer the committee five specific recommendations on areas where we can ensure a bright future for AI manufacturing in the U.S.: First, create an enabling environment for innovation to allow manufacturers to realize the full benefits of AI through competitive tax measures, such as the advanced manufacturing investment credit and restoring the immediate deduction of R&D expenses; second, accelerate the adoption of AI in manufacturing by developing a skilled AI workforce that can leverage these new capabilities and create new jobs; third, maintain a data policy environment that enables private sector innovation by increasing access to Federal datasets, by unlocking the data necessary to create new AI solutions for manufacturers; fourth, continue public and private partnerships that spur private-sector investment in AI and manufacturing, such as supply chain security through the Promoting Resilient Supply Chains Act, a bipartisan bill that originated in this subcommittee; and, fifth, remove barriers to U.S. manufacturers' ability to compete in global markets by advancing digital trade agreements and by revisiting hastily drafted policies from the prior administration, like the AI Diffusion Rule.

We see increasing global competition for AI development and deployment. For America to win, we must get these policies right. We are keen to work with you to unleash the power of AI to expand domestic manufacturing, to ensure that the United States builds on its competitive lead in AI, and enable AI to transform all sectors of the economy and generate economic growth and job opportunities that benefit manufacturers, workers, and consumers.

Thank you again for the opportunity to be here today, and I look forward to your questions.

[The prepared statement of Mr. Oxman follows:]

ITI Promoting Innovation Worldwide

Written Testimony of

Jason Oxman
President and Chief Executive Officer
Information Technology Industry Council (ITI)

Before the

Committee on Energy and Commerce
Subcommittee on Commerce, Manufacturing and Trade

United States House of Representatives

AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies

February 12, 2025

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Chairman Bilirakis, Ranking Member Schakowsky, and members of the Subcommittee, thank you for the opportunity to testify before you today. My name is Jason Oxman, and I am the President and CEO of the Information Technology Industry Council (ITI). ITI represents 80 of the world's leading information and communications technology (ICT) companies. Our members span the tech industry and are making the physical components that power AI systems, developing AI models that serve as the brains of AI systems, and developing and deploying the AI software applications that bring the benefits of AI to the manufacturing sector. ITI members manufacture the building blocks that power the digital infrastructure undergirding the AI economy, including semiconductors, networking equipment, cooling systems, and electrical solutions. Our members are also investing billions of dollars in expanding domestic capacity for advanced semiconductor manufacturing and critical AI infrastructure like data centers.

The tech sector continues to empower the American manufacturing renaissance, and my testimony will outline our industry's investment and innovation and how we hope to work together with the Committee to further strengthen U.S. leadership in AI and manufacturing. Reaching those shared goals will require close collaboration with the innovators in the private sector that ITI represents. I would like to offer the committee several recommendations about how we can work together to secure a bright future for American manufacturing and technology development.

- Create an enabling environment for innovation to allow for sectors like manufacturing to realize the full benefits of AI, especially competitive tax measures that encourage U.S. investment in semiconductor manufacturing, such as the Advanced Manufacturing Investment Credit and restoring the immediate deduction of R&D expenses.
- Accelerate the adoption of AI in manufacturing operations, including by developing a skilled AI workforce that can leverage these new capabilities and create new jobs.
- Maintain a stable data policy environment to enable private sector competition and innovation, including by increasing access to federal data sets, unlocking data necessary to create new AI solutions for manufacturers and American businesses in all sectors.
- Continue public-private partnerships that spur private sector investment in AI and manufacturing, such as the SMART USA (Semiconductor Manufacturing and Advanced Research with Twins USA) Institute for Digital Twins at NIST.[1]

[1] See U.S. Dept. Of Commerce Jan. 3, 2025 announcement that awards $285 million to the Semiconductor Research Corporation Manufacturing Consortium Corporation to operate a CHIPS Manufacturing USA institute located in Durham, North Carolina.
https://www.nist.gov/chips/research-development-programs/chips-manufacturing-usa-institute

- Remove barriers to U.S. manufacturers' ability to compete in global markets, including revisiting hastily drafted policies like the Bureau of Industry and Security's Interim Final Rule on "Framework for Artificial Intelligence Diffusion."

Congress and the Administration should work together with the private sector to encourage future innovation and investment in the United States and harness American manufacturing prowess, protect consumers and businesses, mitigate foreseeable risks, create U.S. jobs, and do not complicate or duplicate existing standards, laws, and sector-specific policies and frameworks.

I. Impact of AI on U.S. Manufacturing

Today, the United States is leading AI development, deployment, and innovation. The United States employs the best and the brightest AI researchers and technical experts working to advance American leadership in AI innovation. Other nations have recognized the United States as the center for AI excellence and are working harder than ever to develop the next major technological advancements in AI and to deploy AI in new use cases in their countries. In fact, an Accenture survey of 1,500 executives across all sectors found that 84 percent believed AI is critical to meeting their growth objectives and 73 percent said they risk going out of business if they cannot scale AI.[2]

Below is a sample of the AI use cases that will empower innovation in the manufacturing sector:

- **Predictive Maintenance:** AI can analyze real-time sensor data from manufacturing equipment to predict maintenance needs accurately. By identifying potential equipment failures in advance, manufacturers can schedule maintenance proactively, minimizing unplanned downtime and reducing costs.
- **Supply Chain Management:** AI can optimize supply chain operations by analyzing data from multiple sources, including demand forecasts, inventory levels, and logistical constraints. AI algorithms can optimize inventory management, improve demand forecasting accuracy, and enable efficient routing and scheduling of shipments.
- **Cobots:** Cutting-edge AI solutions are deployed to work alongside human workers by augmenting factory-focused tasks and enhancing productivity and safety while handling physically demanding tasks.
- **Digital Twin:** A digital representation of a physical asset or process that evolves over the lifecycle, from a product or machine to production, plants or even the entire supply

[2] https://www.accenture.com/us-en/insights/artificial-intelligence/ai-investments

chain. By combining the real and the digital worlds, the Digital Twin helps to define and optimize the product and production system before investing in physical assets, thus reducing the need for physical prototypes.

- **AI Packaging Manufacturing System:** Semiconductor companies have built fab-deployed automation that incorporates equipment automation, carrier and container standardization, automated material handling system, real-time dispatching systems, and product resume and yield analysis. Moreover, these advanced manufacturing systems employ the use of intelligent mobile devices, Internet of Things, and mobile robots with intelligent automated material handling systems to aid with complex manufacturing architectures.

As evidenced by the above examples, AI has the potential to significantly improve applications in the manufacturing context and play a transformative role for society more broadly. At the same time, ITI recognizes there are key questions that are emerging in the AI policy conversation, including questions related to workforce development and skills training, resource constraints that may disrupt global supply chains and manufacturing operations, energy demands, and permitting reforms that directly impact manufacturing facilities. We know there is increasing interest on the part of lawmakers and policymakers to identify solutions that address the foregoing questions.

II. ITI's Response to the Administration's Executive Order (EO) 14179, Removing Barriers to American Leadership in Artificial Intelligence

The Trump Administration's recent executive order will enable the administration to develop an AI Action Plan that is driven by market trends and aligns with a pro-innovation agenda.[3] As Congress and the administration consider policies that help incentivize increased investment and innovation in AI, it is worth reminding policymakers that the first Trump Administration was active in AI policymaking and progressed important work that propelled U.S. AI leadership onto the global stage. Key actions include signing two AI Executive Orders, one in 2019 on Maintaining America's Leadership in AI (EO 13859)[4] and one in 2020 on Promoting the Use of

[3] See Executive Order 14179, *Removing Barriers to American Leadership in Artificial Intelligence* (Jan. 23, 2025). Found here: https://www.whitehouse.gov/presidential-actions/2025/01/removing-barriers-to-american-leadership-in-artificial-intelligence/

[4] Executive Order 13859, *Maintaining America's Leadership in AI* (Feb. 11, 2019). Found here: https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/

Trustworthy AI in the Federal Government (EO 13960).[5] EO 13859 significantly focused on driving research and development, as well as the critical role of leading the development of technical standards to maintain U.S. competitiveness.

The first Trump Administration also prioritized international engagement on AI policy. For example, the first Trump Administration was a leading voice in efforts taking place in the Organization for Economic Co-operation and Development (OECD) to establish a set of AI principles (formally adopted in 2019 and adhered to by 47 countries).[6] The 2019 NIST Plan for Federal Engagement in Developing Technical Standards and Related Tools specifically highlighted the importance of ongoing engagement in international standards dialogues in order to shape the development of international technical standards, which are critical to advancing U.S. AI technology.[7]

ITI is encouraged by the Office of Science and Technology Policy's (OSTP) recent request for information (RFI) pursuant to EO 14179, which will define priority AI policy actions related to hardware and chips, data centers, energy consumption and efficiency, workforce, innovation and competition, and export controls, among other areas. ITI looks forward to contributing its perspective to the OSTP RFI, and we call on the Trump Administration to revisit the beneficial policies enacted during the first administration and build on those achievements to elevate the United States into the next stage of AI leadership.

III. Supporting Innovation and Investment for a Strong U.S. Manufacturing Sector

The United States must advance a robust strategy that supports multiple components of innovation and investment, which will ensure that manufacturers and companies from all sectors are able to reap the benefits of AI.

AI's transformational impact is being felt across all sectors, including manufacturing. AI has increased U.S. economic growth, facilitated economic opportunities for businesses of all sizes, and enabled the U.S. to deepen cooperation with allies and remain competitive with other nations. In seeking to advance a pro-innovation AI policy agenda, which will in turn benefit the adoption of AI technology in the manufacturing sector, it is important that Congress work with

[5] See EO 13960, *Promoting the Use of Trustworthy AI in the Federal Government* (Dec. 3, 2020). Found here: https://www.federalregister.gov/documents/2020/12/08/2020-27065/promoting-the-use-of-trustworthy-artificial-intelligence-in-the-federal-government

[6] https://www.oecd.org/en/topics/sub-issues/ai-principles.html

[7] https://www.nist.gov/artificial-intelligence/plan-federal-engagement-developing-ai-technical-standards-and-related-tools

stakeholders to develop policies that support innovation and workforce development, advance helpful applications of AI, and progress the research and development needed to maintain American leadership in AI.

Technology companies, including ITI members Microsoft, NVIDIA, OpenAI, Oracle, and SoftBank Group, recently pledged to invest $500 billion over the next four years to build new AI infrastructures needed to power future-generation AI technologies here in the United States.[8] Stargate is not just a tech project—it's a massive manufacturing and construction effort in the United States. It will entail building large-scale data center campuses, power generation facilities, and deploying high-end hardware across the country. OpenAI collaborated with outside experts to analyze the potential job creation and GDP growth associated with building a single 5-gigawatt data center in various U.S. states. The analysis found that each data center would create or support approximately 40,000 jobs and contribute between $17 billion and $20 billion to a state's GDP.[9] The Stargate Project's investments will directly benefit the manufacturing sector, produce thousands of American jobs, and generate the economic output needed for the U.S. to maintain its competitive edge.

Congress and the administration should provide the necessary resources and support to complement the private sector's contributions.

a. Enact policies that support increased access to data, AI infrastructure, and compute.

Data is foundational to AI innovation as one major component of AI systems. By leveraging large and diverse datasets and increased computing power and ingenuity, AI developers and other stakeholders will be able to innovate and find solutions to meet the needs of individuals and society in unprecedented ways. More available data means more inputs with which to train algorithms, resulting in higher quality AI offerings. U.S. businesses of all kinds, including manufacturers, currently lack the certainty of a single U.S. national data privacy standard, which would help encourage pro-innovation uses of data like AI applications in manufacturing and help the U.S. reassert a global leadership position. It is also important for the government to promote the adoption of existing international standards regarding data governance and data quality, as well as focus on the development of new standards for data quality. In addition to making government data available in machine-readable formats, governments may also be able to curate widely available data as labeled, diverse, representative, quality data for the purposes of training corresponding AI.

[8] https://openai.com/index/announcing-the-stargate-project/
[9] https://cdn.openai.com/global-affairs/openai-infra-economics-10.09.24.pdf

A U.S. approach that prioritizes innovation should therefore **seek to support existing international data standards and promote the development of new standards for data quality, as well as make government data available in machine-readable formats and curate widely available data.**

We also support efforts to establish opportunities and resources for companies of all sizes to partner with federal research centers focused on AI R&D, including the National AI Research Resource (NAIRR).[10] Specifically, ITI supports the CREATE AI Act,[11] bipartisan, bicameral legislation that is supported by members of this Subcommittee, as well as the U.S. House Task Force on Artificial Intelligence.[12] The NAIRR is a shared national research infrastructure that provides AI researchers, small business owners, and students with greater access to the compute resources, data, and tools needed to develop safe and trustworthy AI. If authorized, the NAIRR could provide AI testbeds, open-source models, and high-powered computational tools to small-and-medium-sized enterprises, including manufacturing businesses, that hope to leverage AI to improve cross-business functions. The continued success of American manufacturers and U.S. AI leadership also depends on meeting the increased demand for electricity to operate the manufacturing facilities being reshored in the United States and rapidly expanding AI infrastructure such as data centers, while enabling all Americans to benefit from a more resilient power grid. U.S. policymakers at all levels of government need to act quickly to strengthen the electrical grid, remove regulatory barriers to siting and permitting, and promote an all-of-the-above energy strategy that encourages and enables innovations in the generation and distribution of power.

b. Foster public trust in AI technology.

Fostering public trust remains critical to supporting innovation. In particular, efforts to develop metrics, benchmarks, and evaluation techniques for AI systems, which are intended to help foster public trust, rely upon innovation. Innovation in measurement tools for AI will make risk management more concrete and objective and improve accountability and transparency. The

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[10] As authorized under P.L. 116-283 (FY21 NDAA), specifically sections related to *the National AI Initiative Act of 2020,* the National Artificial Intelligence Research Resource Task Force published a report on Jan. 2023 entitled, Strengthening and Democratizing the U.S. Artificial Intelligence Innovation Ecosystem: *An Implementation Plan for a National Artificial Intelligence Research Resource,* which details the mission and resource needs for a codified NAIRR. Report can be found here:
https://www.ai.gov/wp-content/uploads/2023/01/NAIRR-TF-Final-Report-2023.pdf

[11] From the 118th Congress, H.R. 5077, *The CREATE AI Act*:
https://www.congress.gov/bill/118th-congress/house-bill/5077

[12] https://www.speaker.gov/wp-content/uploads/2024/12/AI-Task-Force-Report-FINAL.pdf

National Institute of Standards and Technology (NIST) will play an increasingly important role in convening stakeholders to develop these metrics, guidelines, and best practices, and we encourage the government to continue supporting NIST's work on AI.

Promoting trust in AI systems requires AI model developers, deployers, and policymakers to collaborate. Transparency is a key means by which to achieve that trust. Manufacturers play an essential role in promoting trust and accountability of AI systems as well. To support those efforts, ITI developed Policy Principles for Enabling Transparency of AI systems, which offer recommendations to policymakers on how best to approach transparency as a policy tool, including considering the objective of and intended audience for transparency requirements, targeting transparency requirements to level of risk, and considering the role that disclosure plays. Additionally, ITI members are actively taking steps to build and deploy safe and transparent AI systems.

While transparency can take different forms, our member companies are working to ensure that users understand when they are interacting with an AI system and, broadly, how that system works. For example, several of our member companies provide information about an AI system via model or system cards. In the manufacturing context, this type of transparency measure allows manufacturers looking to integrate an AI model or an AI system to better understand the intended uses and potential limitations of the model, what type of data it was trained on, and evaluation metrics.[13] This can help a production manager determine a specific AI model's potential application and whether that specific AI model or system is applicable to a manufacturer's envisioned use case.

c. Support a skilled workforce.

ITI supports legislative efforts to advance education and workforce development programs and to strengthen the nation's workforce in ways that ensure all people can participate in an AI-enabled future. These policies could include modernizing candidate recruitment, hiring, and training, and should establish and advance industry-informed skilling and re-skilling programs to prepare individuals for the future of work, including an AI-enabled future. To support these initiatives, we encourage government and businesses to continue to focus on policies designed to advance and incentivize professional and technical apprenticeships, education and training programs in STEM fields, and access to external and online reskilling programs.

[13] Importantly, there is not one standard model card, but there are common elements across model and system cards introduced by different member companies.

ITI member companies already invest countless resources to help develop and advance the workforce needed to fuel American innovation. For the workforce pipeline to improve, the U.S. government must play an influential part in growing and supporting a skilled American workforce that is prepared for the future of work. Last Congress, ITI endorsed the bipartisan LIFT AI Act, which would instruct the National Science Foundation to award grant funds to higher education institutions or nonprofit organizations that support research activities to improve educational curricula and evaluation methods for K-12 AI literacy.[14] ITI is encouraged by efforts that would address several aspects of the workforce pipeline by providing opportunities for AI skilling and expanding AI education to boost America's competitiveness and innovation.

That said, AI is not just a function of STEM or advanced technical training; one way to ensure access to an AI workforce is to invest broadly across all relevant disciplines and teach flexible skills and problem solving from early childhood education. At the university level, AI and/or data science programs should incorporate the social sciences, humanities, and history to integrate humanistic approaches into the curriculum beyond a single, separate "AI ethics" unit.

d. Adopt pro-innovation tax policies and foster partnerships to promote R&D activities.

The tech sector spends over $200 billion annually on domestic research and development (R&D), and for every $1 billion of that investment, 17,000 jobs are supported in the United States. U.S. tax policy should encourage companies to make investments in domestic cutting-edge R&D by allowing companies to deduct their research and development costs in the year they occur. Reforms in the Tax Cuts and Jobs Act (TCJA) bolstered U.S. innovation and competition with other countries and encouraged companies to locate their R&D investments, facilities, and jobs in communities across the United States.

To make the U.S. the top destination for R&D investments, ITI reiterates the importance of restoring the ability to deduct R&D expenses during the current year. ITI has also been a leading advocate for the Advanced Manufacturing Investment Credit (section 48D), which provides an investment tax credit of 25 percent for qualified investments in the operation of a facility to manufacture semiconductors or semiconductor manufacturing equipment.[15] Section 48D will bring the U.S. an estimated $24 billion in investments for semiconductor manufacturing and equipment. Extending the placed in construction date for eligibility will promote section 48D's effectiveness by providing the certainty necessary to undertake large multi-year investment

[14] From the 118th Congress, H.R. 9211, The LIFT AI Act: https://www.congress.gov/bill/118th-congress/house-bill/9211
[15] https://www.irs.gov/pub/irs-drop/a-24-40.pdf

decisions to keep the U.S. at the forefront of semiconductor manufacturing. ITI provides more detail on these recommendations in its October 2024 letter to members of the Ways & Means Republican Tax Teams.[16]

U.S. Manufacturing Centers of Excellence (MCoE) offer a collaborative partnership for industry, government, and academia to optimize R&D activities and standards development geared towards enhancing manufacturing processes. In an effort to evolve traditional manufacturing operations into the next era of advanced manufacturing, MCoE are increasingly looking to partner with innovative technology providers that develop fit-for-purpose solutions. Similarly, the National Institute for Standards and Technology (NIST) has built a national network of manufacturing partnerships, known as the Manufacturing Extension Partnership, to support public-private partnerships that deliver comprehensive, proven solutions by helping small and medium-sized manufacturers grow, make operational improvements, and reduce risk.[17] ITI encourages the government to continue to support these types of helpful partnership activities.

Technology companies and U.S. manufacturers must seize the opportunity to work with Congress and advocate for pro-growth policies that incentivize both sectors to build manufacturing facilities across the country, promote public private partnerships, spur cutting-edge innovations that benefit manufacturers, and create more jobs for American workers.

All of the above recommendations will help to create a holistic, innovative framework that can help to enable the development of AI tools and adoption of AI in the manufacturing sector.

At the same time, supporting such a framework requires assessing the evolving geopolitical landscape, including evaluating and targeting policy activities intended to protect U.S. economic and national security interests.

IV. AI and U.S. Global and Economic Security Interests

In the next decade, U.S. policymakers will wrestle with geopolitical challenges with implications for American technological innovation and, as a result, economic security. The technology sector represents around 10 percent of the U.S. Gross Domestic Product (GDP), directly employing nine million Americans, and accounts for roughly 32 percent of the market capitalization of the S&P 500. As the numbers demonstrate, the strength of the innovation

[16] https://www.itic.org/documents/tax/ITITAXTEAMSFINALLETTER_signature.pdf
[17] https://www.nist.gov/mep

economy bolsters the broader U.S. economy, but it also drives the U.S.'s leading edge responsible for developing the technology tools and capabilities that underpin U.S. national security, such as semiconductors, AI, and advanced manufacturing. Both the technology sector and U.S. economic security depend on smart and stable government policy that supports American innovation, ingenuity, and global competitiveness.

a. Global technology competition.

While the United States has an enviable starting point in the global competition for AI development and deployment, continued success in U.S. innovation and leading in the race for emerging technologies is not guaranteed. As recent news around DeepSeek demonstrates, foreign competitors are working hard to achieve AI breakthroughs and deploy AI in new use cases. There are still many scientific, technical, and business questions surrounding DeepSeek's R1 model and its development. However, it is a clear reminder that companies around the world, including in China, are innovative and racing to catch up with American AI companies, many of whom are ITI member companies.

American companies leverage global markets for developing and selling their products. For U.S. high-tech innovation to truly thrive in the years to come, policymakers must create and sustain an environment, both at home and in the global marketplace, in which innovative companies can compete and expand. As such, it is important to ensure that export controls, and other review authorities, are tailored to realize economic security objectives by ensuring robust stakeholder engagement during their development and implementation, providing sufficient transition periods, and are scoped to address clearly identified national security objectives. Overly broad controls on technology products will undermine and limit the ability of companies to participate in the global marketplace, which will then disrupt the virtuous cycle of private-sector R&D investments made possible by revenues from sales of U.S. products to a diverse customer base in overseas markets.

b. The Biden Administration's "AI Diffusion Rule" is one example of an overly broad control on critical technologies without sufficient consideration of the unintended consequences on American innovation and global competitiveness.

In the final days of President Biden's administration, ITI raised concerns[18] over the late-term issuance of the Interim Final Rule titled "Framework for Artificial Intelligence Diffusion," which would establish a unilateral global licensing regime for advanced computing chips for training AI

[18] https://www.itic.org/documents/trade/AIDiffusionExportControlLettertoCongress-FINAL.pdf; https://www.itic.org/documents/AIDiffusionLettertoRaimondo010725.pdf

models and was promulgated without sufficient stakeholder consultation.[19] A rule of this nature – if not crafted correctly – may cede areas of AI and AI-enabling infrastructure to U.S. competitors. Other countries – including China – are eager to fill gaps in market demand created when there are barriers prohibiting U.S. companies' ability to compete on a level-playing field abroad. Should the U.S. lose its advantage in the global AI ecosystem, it will be difficult, if not impossible, to regain in the future.

ITI urged the Biden administration to follow the appropriate regulatory review process for the AI Diffusion IFR to protect against destabilizing global export controls and endangering U.S. leadership in the AI ecosystem. If implemented hastily, a rule of this nature could fragment global supply chains potentially encouraging multinational companies and customers to limit their reliance on U.S. technology, fundamentally undermining the objective of keeping the U.S. the global leader in AI. Therefore, ITI calls on the Trump Administration to delay the IFR's compliance dates and open a deliberative process to review and revise the IFR, to ensure reforms promote U.S. economic and national security.

c. The U.S. government should work closely with industry to strengthen the information, communications and technology (ICT) supply chain.

America's most innovative technologies, including AI systems and components, develop from a stable, robust, diverse, and interconnected global landscape of markets, innovators, and suppliers. Successful policies will revitalize and strengthen supply chains and allow businesses operating in the United States to leverage the global landscape to enhance the competitiveness of their products, services, and the American workforce. ITI supports supply chain policies that promote diversity, stability, and resilience, where the private and public sectors partner to understand and mitigate strategic supply chain vulnerabilities and identify areas that will have concrete national security benefits and limited adverse economic consequences. We believe it is imperative for Congress to advance the bipartisan *Promoting Resilient Supply Chains Act,* legislation under this Committee's jurisdiction which would help anticipate and address future supply chain disruptions before they happen, identify opportunities to grow manufacturing capacity and jobs here at home and reduce costs for American consumers.[20]

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[19] *Federal Register, (*Jan. 15, 2025). 15 CFR Parts 732, 734, 740, 742, 744, 748, 750, 762, 772, and 774, [Docket No. 250107–0007], RIN 0694–AJ90: https://www.govinfo.gov/content/pkg/FR-2025-01-15/pdf/2025-00636.pdf

[20] https://www.commerce.senate.gov/2024/5/cantwell-blackburn-introduce-bill-to-prevent-supply-chain-disruptions-before-they-happen-protect-american-producers-pocketbooks

Conclusion

Congress has an important role to play in maintaining U.S. leadership in the development and deployment of the technology making sure that the benefits of AI are realized not just by the manufacturing sector and but also society more broadly. We share the Committee's goal of equipping Members of Congress with the tools and expertise needed to advance meaningful legislation that encourages future AI innovation and investment in the United States while mitigating real risks to consumers and businesses alike. We look forward to partnering with you in that important work and appreciate the opportunity to testify before you today.

Mr. BILIRAKIS. Thank you very much.

Now I will recognize Dr. Reynolds. You are recognized for 5 minutes, and we appreciate you being here.

STATEMENT OF ELISABETH B. REYNOLDS, PH.D.

Dr. REYNOLDS. Good morning and thank you, Chairman Bilirakis, Ranking Member Schakowsky, Chairman Guthrie, Ranking Member Pallone, and members of the subcommittee. It is an honor to be here with you this morning and speak about a topic that is of the utmost importance to the country's national and economic security.

My name is Elisabeth Reynolds. I am a professor of practice at MIT and former special assistant to the president for manufacturing and economic development in the National Economic Council in 2021 and 2022.

I am also originally from Manchester, New Hampshire, home of the Amoskeag Mills, the largest textile mills in the world at one point and now the center of global research on regenerative medicine.

Rebuilding the U.S. industrial base using AI and advanced manufacturing technologies is an urgent priority. We are in the midst of the next industrial revolution, one where the U.S. has the opportunity to catch up and rebuild its manufacturing capacity and capabilities.

The U.S. has made significant gains in the past few years in rebuilding these capabilities as a result of largely bipartisan government investments in areas critical to the country's industrial base: semiconductors, critical minerals, defense, and energy infrastructure.

Recent legislation has led to several positive developments: A tripling of manufacturing construction spending since 2021; $450 billion of private-sector investments in semiconductor production across over 40 facilities; over $80 billion of private sector investment in clean energy-related production across over 200 manufacturing facilities, including over $5 billion invested in each of Georgia, Michigan, Tennessee, North Carolina, and Ohio.

These energy investments in particular are essential to ensuring energy security, particularly when the rise of AI and data centers will only increase energy demand. The leverage of these public dollars is significant. Roughly between four to seven private dollars invested for every Federal dollar spent.

All of these steps underscore there is an important role for the Government to play in catalyzing economic growth, prosperity, and innovation. My written testimony has a complete list of my recommendations, but I am going to focus on several areas right now.

First, we need to focus on increasing adoption of new technology by small and medium-size enterprises, SMEs, to increase productivity and wages. U.S. manufacturers are behind in technology adoption. Many SMEs, the backbone of our industrial base, are hesitant to change existing manufacturing processes, despite the return on investment associated with digital technologies that can increase both productivity and wages.

Several steps could be taken to encourage adoption of AI and advanced manufacturing, including providing Federal matching funds

to State-led programs that offer incentives, like programs in Indiana, Massachusetts, and Michigan; incenting large manufacturers that have contracts with the Federal Government to support AI adoption and digitalization in their suppliers; and modernizing the manufacturing extension partnership to work with SMEs to focus on promoting lean principals while also supporting digitalization.

Two, we need to increase investment in manufacturing workforce training and education. It is estimated the U.S. could face a shortage of nearly 2 million manufacturing workers by 2033. We must both upskill current workers with digital skills as well as attract a new generation into the sector. AI can play a positive role in this process by augmenting the skills of frontline manufacturing workers and democratizing the technology so workers are part of continuous improvement. The process can lead to improving manufacturing wages, which today, on average, are less than the average all-industry hourly wages for nonsupervisory workers. Several steps also can be taken here, including creating robust preapprenticeship and apprenticeship programs, identifying the most successful training programs in the country, encouraging 4-year institutions of higher education to partner with community colleges to advance digital skills, and increasing the number of women working in manufacturing, who currently represent about 30 percent of the manufacturing workforce.

Three, we need to accelerate innovation and scale up. The U.S. is the envy of the world and is renowned as the startup Nation, but we must now become the scaleup Nation. Because of their often large capital requirements and longer time horizons, manufacturing startups have challenges attracting growth capital from investors, who prefer asset-light investments. We must develop financing models that are helping with the missing middle capital gaps. This could include Federal procurement, such as advanced market commitments, providing tax incentives for startups that are building their first manufacturing facility, exploring the role of the Federal Industrial Finance Corporation that could operate like the Development Finance Corporation, and expanding the role of Manufacturing USA Institutes.

Fourth, we must invest in the research and development and deployment of advanced manufacturing technologies. Historically, U.S. Federal R&D institutions have underinvested in advanced manufacturing processes. Additional RD&D funding is required in emerging advanced manufacturing technologies to help the U.S. stay ahead in such areas as biomanufacturing, quantum, energy, defense, critical minerals, robotics and additive manufacturing.

Through investments in scientific and engineering breakthroughs, the U.S. can leapfrog current standard manufacturing processes and lead the world in advanced manufacturing.

In conclusion, I will thank the committee for the opportunity to speak, and I hope that my remarks have underscored the importance of U.S. advanced manufacturing agenda to the country and the urgency with which we must address these issues. Thank you.

[The prepared statement of Dr. Reynolds follows:]

House Energy and Commerce Committee subcommittee meeting on:

AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies

Elisabeth B. Reynolds, PhD

Professor of the Practice, MIT

February 12, 2025

Rebuilding the US industrial base using advanced manufacturing is an urgent priority for several reasons: supply chain resilience, geopolitical tensions, quality jobs, and advances in manufacturing technologies. The U.S. has made significant strides in the past few years to rebuild these capabilities with largely bipartisan support for investments in areas critical to the country's industrial base: semiconductors, critical minerals, defense and energy infrastructure. While the U.S. has made some important steps to expand manufacturing capabilities in critical areas to the country, there are some foundational challenges that must be addressed to succeed at rebuilding the U.S. industrial base. These fall into five primary areas:

1) ***Expand small and medium-sized enterprise (SME) technology adoption to increase productivity and wages***
2) ***Increase investment in manufacturing workforce training and education while building off existing successful programs***
3) ***Accelerate manufacturing innovation and scale-up***
4) ***Invest in the Research, Development and Deployment (R,D&D) of Advanced Manufacturing***
5) ***Limit the use of tariffs on products not critical to U.S. national security***

House Energy and Commerce Committee subcommittee meeting on:

AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies

Elisabeth B. Reynolds, PhD

Professor of the Practice, MIT

February 12, 2025

Introduction

Good morning and thank you, Chairman Bilirakis, Ranking Member Schakowsky, Chairman Guthrie, Ranking Member Pallone, and Members of the Subcommittee. It is an honor to be with you this morning and speak about a topic that is of the utmost importance to the country's national and economic security.

Advanced manufacturing refers to a suite of manufacturing technologies as well as to production systems that are converging to create both new manufactured products and processes that can have a significant impact on U.S. innovation, growth and global competitiveness. These technologies involve digitalizing the production process through automation, AI, robotics, and additive manufacturing among other technologies to improve quality, yields, safety and overall productivity while also augmenting the capabilities and productivity of manufacturing workers.

Rebuilding the US industrial base using advanced manufacturing is an urgent priority for several reasons:

First, when I came to Washington in 2021 to work at the National Economic Council, the country was facing unprecedented supply chain disruptions and shortages due to the global pandemic. Our lack of resilience in critical supply chains for products and inputs as well as the lack of

transparency and connectivity across supply chains was apparent – whether it was low commodity Protective Personal Equipment (PPE) for our first responders, or high value-added semiconductors for our auto and medical device industries.

The emphasis on supply chain efficiency over resilience had left the country at a disadvantage, dependent on individual companies or countries for key inputs. Today, companies and countries have started to reconfigure their supply chains to address resilience which, in part, involves building domestic manufacturing capabilities.

Second, geopolitical tensions and increasing global competition have underscored the need for the U.S. to develop key technologies critical to national security and economic prosperity. Frontier technologies in areas such as biomanufacturing, quantum, critical materials production, defense and energy rely on advanced manufacturing capabilities. A strong defense industrial base as well as technological leadership in these key technologies depends upon the U.S.'s ability to innovate not just in design but also in production.

As MIT research[i] over the decades has underscored, manufacturing capabilities are deeply entwined with innovation capacity in both product and process innovation. It is through advances in manufacturing, including the use of AI, that we can increase the speed of production and time to market of new technologies, reduce costs, increase energy efficiency and provide quality jobs for workers.

Third, the loss of manufacturing jobs and the hollowing out of communities across the U.S. over several decades has had a devastating effect on people and places across the country.[ii] Manufacturing jobs represent a small share of US employment (under 10 percent[iii], although with a large multiplier effect), and new ones will be created at a slower rate, partly because of AI and automation. But these jobs are tied to technologies and industries that underpin the

country's national security and economic prosperity. Such work can provide solid career paths and be high quality in terms of wages and benefits, which is more important for the US than increasing the *quantity* of jobs[iv].

Finally, it is worth noting the significant technological advances being made in the industrial sector today. Industrial systems undergird the country – from transportation to energy to manufacturing – and with advances in process and product innovation, we can now manufacture differently than before, leading to completely novel production systems, whether making bioindustrial products or creating critical minerals like titanium and nickel or in novel 3D printing processes. Our challenge as a country is to scale and adopt these new technologies to give us a differentiated advantage in advanced manufacturing.

US Progress to Date

The U.S. has made significant strides in the past few years to rebuild these capabilities with largely bipartisan support for investments in areas critical to the country's industrial base: semiconductors, critical minerals, defense and energy infrastructure. The passage of the Bipartisan Infrastructure Law, the CHIPS and Science Act as well as the Inflation Reduction Act has led to several positive developments:

- Manufacturing construction spending has tripled since 2021[v]
- $450 billion of private sector investment in semiconductor production across over 40 facilities will reduce US reliance on any one company or region for advanced semiconductor production.[vi]

- Approximately $80 billion of private sector has been invested to date on clean energy-related production across over 200 manufacturing facilities, primarily in battery production, a crucial area for US global leadership in the future [vii].
    - These investments, facilitated by tax incentives, will be essential to ensuring energy security for the country at a time when the rise of AI will only increase energy demand. Energy demand in the state of Virginia, for example, is expected, to double in just a decade.
    - Investments are going to a range of states: for example, over $5 billion is being invested in each of the following states: Georgia, Michigan, Tennessee, North Carolina and Ohio
- The leverage of these public dollars is significant: roughly $4-7 private dollars invested for every federal dollar spent.

In addition to these strategic investments, significant investments have been made in the defense industrial base in key areas such as microelectronics, bioindustrials and critical minerals, as well as new sources of funds for startups and suppliers in the aerospace and defense supply chain.[viii]

Recommendations

While the U.S. has made some important steps to expand manufacturing capabilities in critical areas to the country, there are some foundational challenges that must be addressed to succeed at rebuilding the U.S. industrial base. These fall into five primary areas:

1) ***Expand small and medium-sized enterprise (SME) technology adoption to increase productivity and wages***

Despite the return on investment associated with digital technology adoption by SMEs, many are reluctant to invest because they are risk-adverse and hesitant to change existing manufacturing processes. There are 250,000 small and medium-size manufacturers in the country. If we wanted as a country to ensure that just 20% of them were at the frontier of digitalization and ready for 21st manufacturing, that would be 50,000 manufacturers. Currently, we do not have a way to reach these companies at scale. Financial incentives are required to help those SMEs that are interested in growing to make the leap into digital manufacturing. Several steps could be taken:

- Provide federal matching funds to state-led programs that offer incentives to SMEs with a growth mindset willing to invest in new productivity-enhancing technologies that include hardware, software and integration services. There are several successful programs at the state level such as the Indiana Manufacturing Readiness Grant, the Massachusetts Manufacturing Accelerate Program and the Michigan Industry 4.0 Technology Implementation Grants.

- Large manufacturers that have contracts with, or grants from the federal government should be incented to support digitalization among their suppliers. Provide carrots to OEMs that can show that all tiers in their supply chain are digitally enabled and that they are supporting their SMEs in digital transformation.

- Create a national, AI-based open-source platform of advanced digitalization tools to encourage manufacturers to adopt digital technologies in their operations. Leverage the Manufacturing USA network, specifically the soon-to-be announced AI and Manufacturing Innovation Institute[ix] to elevate AI adoption among SMEs as a national priority.

- Modernize the Manufacturing Extension Program's work with SMEs so they are focused on "augmented lean"[x], promoting lean principles while also supporting digitalization. MEPs need to reinterpret their role to include helping SMEs navigate a complex and dynamic technology market in which digital technology is now a prerequisite for competitive manufacturing performance. This may require creating a new set of metrics by which MEPs are measured.

2) *Increase investment in manufacturing workforce training and education while building off existing successful programs*

Revitalizing and expanding the manufacturing workforce is critical to the U.S. economic and competitiveness agenda going forward. It is estimated the US could face a shortage of nearly two million manufacturing workers[xi] by 2033. The best way to avert a shortfall is to upskill current workers, which would make them more productive and extend their careers, as well as attract a new generation into the sector through use of advanced technologies. This can be achieved alongside digitalization, because companies that adopt new and advanced technologies also invest in skills upgrading[xii] of their workforce.

AI can play a positive role in this process by augmenting the skills of frontline manufacturing workers by reducing routine activities and democratizing the technology so workers are part of "continuous improvement". This process can lead to improving manufacturing wages, which today, on average, are less than the average all-industry hourly wage for non supervisory workers.[xiii]

Several steps can be taken to upskill and expand the US manufacturing workforce:

- Create robust pre-apprenticeships and apprenticeship programs for manufacturing education that can be adapted from the Swiss and German models. Connect apprenticeship programs across industry and community colleges[xiv] and learn from existing state-wide programs.[xv]
- Identify the most successful manufacturing training programs in the country and look to scale them. The Department of Defense as well as a number of Manufacturing USA institutes[xvi] and community colleges have strong manufacturing training programs that could be scaled.
    - Bring advanced manufacturing into undergraduate engineering curricula.[xvii]
    - Combine online education with learning-by-doing to scale advanced manufacturing workforce education.
- Encourage four-year institutions of higher education to partner with community colleges, industry and state and local government to develop workforce programs, including for a new manufacturing position and career path between technician and engineer.[xviii]
- Diversify the workforce including targeting an increase in the number of women working in manufacturing. Currently, women represent approximately 30 percent of the US manufacturing workforce but that number could be increased with greater flexibility and increased pay.

3) Accelerate manufacturing innovation and scale-up

The U.S. is the envy of the world and is renowned as the “startup nation.” But it now has to become the “scale up nation.” Decades of capital markets focused on “asset light” investments have made it difficult for manufacturing startups to find growth capital to meet their large capital needs over longer time horizons than pure software investments.

New financing models, tools and instruments are needed to address the “missing middle” capital gaps needed by startups to scale advanced manufacturing technologies from pilot to demonstration-at-scale[xix]. Challenges exist across multiple industries including semiconductors, biomanufacturing, clean energy and advanced manufacturing technologies. Several steps could be taken:

- Use federal procurement to support commercialization of novel technologies. Early-stage technologies struggle to secure customers because prices for their first few units may be too high, or customers may not be willing to commit until they have actually seen the products work. Many technology innovations and breakthroughs have come through the use of government procurement tools, particularly from the DOD. Such tools, like advanced market commitments that guarantee purchase of a product or “offtake” have also been used beyond defense, such as vaccine production. The federal government could increase its impact in priority areas by using procurement tools to accelerate innovation, technology adoption and scale up in areas such as biomanufacturing, defense including drone production and shipbuilding, and energy security including geothermal and nuclear energy.

- Explore new scale-up financing tools that could help scale production that requires a longer time horizon and increased capital expenditures for pilot and demonstration-at-scale production. Currently, U.S. capital markets, specifically venture capital, are not well aligned with the long-term investments required to bring manufacturing/engineering -based startups to scale given the amount of equity an investor must take early on to reach desirable returns. The federal government could:

    - Provide tax incentives for startups that are building their first manufacturing facility in the U.S.
    - Engage the private sector in exploring new financing models such as a "First-of-a-Kind" (FOAK) fund and "tech insurance" in which credit insurance is developed for customers and lenders to cover performance risk on projects where others are unlikely to appropriately price technology risk.
    - Explore the role for a federal Industrial Finance Corporation[xx] that could operate like the Development Finance Corporation (DFC) to help companies with financing of FOAK and early stage scale up.
- Expand the role of Manufacturing USA Institutes to allow for engagement at the pilot production stage of manufacturing scale up. The Institutes' initial mandate was to focus on Manufacturing Readiness Levels (MRLs) 4-7, between lab to pilot production. The Institutes should be leaning into pilot production and low-rate initial production (LRIP) to extend their MRL work to 8/9 to help de-risk technologies further to attract private sector investment.

4) Invest in the Research, Development and Deployment (R,D&D) of Advanced Manufacturing

Historically, U.S. federal R&D institutions have underinvested in advanced manufacturing processes. Additional R, D and D funding is required in emerging advanced manufacturing technologies to help the U.S. stay ahead in such areas as biomanufacturing, quantum, semiconductors, energy and critical minerals. Through investments in science and engineering breakthroughs, the US can dramatically increase yields, reduce costs and strengthen supply chain resilience while “leapfrogging” current standard manufacturing processes.

5) Limit the use of tariffs on products not critical to U.S. national security or fair trade

Tariffs can be used effectively if used in limited and targeted ways to protect national security as well as address unfair trade practices. However, used broadly, and particularly against trading partners and allies with whom U.S. manufacturers rely heavily, will have long-term negative effects on US manufacturers and consumers.

The current uncertainty introduced by the Trump administration by the imposition and pausing of tariffs on US allies and largest trading partners Mexico and Canada, are creating costly disruptions to manufacturers in the US. Tariffs may help domestic manufacturers by protecting them from foreign competition, but they hurt them and other industries by driving up the cost of imported components. The auto industry, for example, is particularly at risk with such policies. No cars currently manufactured in the U.S. are built without imports from Mexico and Canada. Without incentives to increase competitiveness, tariffs can also lead to uncompetitive companies unwilling to invest in innovation. Ultimately, tariffs also drive up consumer prices.

Conclusion

Thank you for the opportunity to speak with the Committee today. I hope my remarks have underscored the importance of the U.S. manufacturing agenda to the country and the urgency with which we must address the opportunities and challenges for the U.S. industrial base.

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[i] Berger, Suzanne (2015) *Making in America: From Innovation to Market*, MIT Press.
[ii] Autor, D., Dorn, D. et al (2025). "Places Versus People: The Ins and Outs of Labor Market Adjustments to Globalization,"NBER, Working Paper, 33424. https://www.nber.org/papers/w33424
[iii] Bureau of Labor Statistics, https://data.bls.gov/timeseries/CES3000000001
[iv] Autor, D., Mindell, D. and Reynolds, E. (2022). *The Work of the Future: Building Better Jobs in the Age of Intelligent Machines*, MIT Press.
[v] See FRED Total Construction Spending in Manufacturing, https://fred.stlouisfed.org/series/TLMFGCONS
[vi] The Economist, "America's Bet on Semiconductors Starts to Pay Off," January 9, 2025. https://www.economist.com/united-states/2025/01/09/americas-bet-on-industrial-policy-starts-to-pay-off-for-semiconductors
[vii] Rhodium/MIT CEEPR, Clean Energy Investment Monitor, Q3 2024 update; https://www.cleaninvestmentmonitor.org/reports/clean-investment-monitor-q3-2024-update
[viii] See multiple announcements related to the DIB including the Microelectronics Commons: https://www.cto.mil/ct/microelectronics/commons/; the Bioindustrial Manufacturing Program: https://www.defense.gov/News/Releases/Release/Article/3662704/dod-launches-distributed-bioindustrial-manufacturing-program-to-bolster-domesti/; DPAP awards for Critical Minerals Production: https://www.acq.osd.mil/news/office-news/asda/2024/Summary-of-DPAP-Awards-Funded-via-Inflation-Reduction-Act.html , and new investment vehicles such as the DOD Office of Strategic Capital as well as the new SBIC created with DOD, "ASTRO America's AM Forward Initiative Gets Final Approval for Private Equity Fund, https://astroa.org/press-release-astro-america-lauds-governments-approval-of-new-private-equity-fund/
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[xi] Deloitte, "US Manufacturing Could Need as Many as 3.8 million New Employees by 2033," April 3, 2024; https://www2.deloitte.com/us/en/pages/about-deloitte/articles/press-releases/us-manufacturing-could-need-new-employees-by-2033.html
[xii] Armstrong, B. and Shah, J. "A Smarter Strategy for Using Robots," Harvard Business Review, March/April, 2023; https://hbr.org/2023/03/a-smarter-strategy-for-using-robots
[xiii] Krugman, Paul, "No, Trump Can Make Manufacturing Great Again," January 25, 2025, Substack; https://paulkrugman.substack.com/p/no-trump-cant-make-manufacturing
[xiv] American Association of Community Colleges, Virtual Apprenticeship Network Home. https://www.aacc.nche.edu/programs/workforce-economic-development/expanding-community-college-apprenticeships/intro-virtual-apprenticeship-network/
[xv] See Bonvillian, W. and Sarma, S, (2021). *Workforce Education: A New Roadmap*, MIT Press. For good examples of apprenticeship programs, see Indiana Modern Apprenticeship Program as well Apprenticeship Carolina of the South Carolina Technical College System.
[xvi] Bonvillian, W. (2022). The Playbook for Workforce Education at Manufacturing Innovation Institutes, ResearchGate; https://www.researchgate.net/publication/366893743_The_Playbook_-_for_Workforce_Education_at_Manufacturing_Innovation_Institutes

[xvii] See the National Academies report (2022). “Infusing Advanced Manufacturing into Undergraduate Engineering Education,” https://nap.nationalacademies.org/catalog/26773/infusing-advanced-manufacturing-into-undergraduate-engineering-education

[xviii] Liu,J and Bonvillian, W (2024). “The Technologist,” in *Issues in Science and Technology*, Winter, 2024. https://issues.org/technologist-advanced-manufacturing-workforce-liu-bonvillian/

[xix] For an overview of the challenge as it relates to the clean energy industry, see SG2 Ventures, “The Missing Middle: Capital Imbalances in the Energy Transition,” September, 2023. Earlier research at MIT highlighted the challenge across a number of technology areas: Reynolds, E., H. Samel and J. Lawrence (2014). “Learning by Building: Complementary Assets and the Migration of Capabilities in U.S. Innovative Firms,” in *Production in the Innovation Economy*, Eds Richard Locke and Rachel Wellhausen, Cambridge, MA: MIT Press, pp 81-107.

[xx] See Senator Coons et.al, Industrial Finance Corporation Act of 2021; https://www.coons.senate.gov/imo/media/doc/SUMMARY%20IFCUS%20117%20v.2.pdf

Mr. BILIRAKIS. Thank you, Doctor. Appreciate it very much.

Now, Mr. Kinder, you are recognized for 5 minutes for your opening statement.

STATEMENT OF JEFF KINDER

Mr. KINDER. Thank you, Chairman Bilirakis, Ranking Member Schakowsky, for holding a hearing on this important, timely topic and inviting me to testify today.

My name is Jeff Kinder, and I oversee design and manufacturing at Autodesk. Autodesk is an American company that designs and makes software, spanning product design and manufacturing, architecture engineering and construction, and media and entertainment.

I am also proud to have grown up in Indiana, the State where President Lincoln, by the way, spent his formative teenage years. I grew up in a family of factory workers. I studied engineering in college on an ROTC scholarship and then became an officer in the U.S. Navy.

Following my service, I went on to lead digital transformations for several technology companies. This is a dynamic time in the manufacturing industry. We face supply chain disruptions, skilled labor shortages, inflation, and a changing geopolitical and economic landscape, yet the demand for products isn't slowing down.

Autodesk believes the U.S. is poised for growth in manufacturing. Reshoring initiatives and a reimagining of supply chains have led to a surge in new factory starts. But the manufacturing industry has a capacity challenge to meet this growth opportunity.

To increase our capacity, to innovate, and to compete on a global scale, we need new technologies such as AI. Manufacturers are ready, and it is in our national interest to help. And while cutting-edge technologies have historically advantaged larger manufacturers, we are democratizing access by offering manufacturers of all sizes the same advanced capabilities at a fraction of the cost. We believe empowering small and medium-size manufacturers with technology like AI is key to unleashing a renaissance in American manufacturing.

Autodesk began investing in AI research more than 10 years ago. We are the world's leading publisher of peer-reviewed original research on AI models trained for computer-aided design, and we are focused on developing pragmatic AI capabilities that help product designers and manufacturers do their work more productively.

We have three primary areas of focus with AI: First, augmenting creative exploration. Take, for example, our work with Stewart-Haas racing team. Using AI-enabled design, Stewart-Haas were able to reduce the weight in the brake pedal of Cole Custer's number 41 Mustang, resulting in a reduction of the pedal that was 32 percent lighter and 50 percent stiffer, reducing weight without sacrificing safety.

Our second area of focus is reducing repetitive and tedious tasks. Manufacturers design products in 3D, but they still need to translate those to 2D for documentation. Skilled engineers spend as much as 40 percent of their time doing this manually. Now, with the click of a button, Autodesk AI creates those 2D drawings auto-

matically, freeing up time for more creative and more productive work.

Our third area of focus is accelerating time to production. Computer numerical control, or CNC machines, are automated manufacturing machines that perform precise and complex operations. Programming code for these machines can take hours or even days.

By using AI to generate machining strategies, we save manufacturers hundreds of production hours a year. Autodesk is also dedicated to equipping educators, students, and workers with the tools and curricula they need to learn the manufacturing skills of the future.

We provide free access to most of Autodesk's portfolio of professional software. We also partner with institutions like the University of Florida, where we are establishing the world's first-ever industrialized construction program, bringing manufacturing methods to construction.

My testimony offers recommendations for the committee to consider on how to foster AI in manufacturing. This includes bringing together tech companies and manufacturers to develop national strategies that elevate the importance of AI in manufacturing, providing tax credits and access to low-cost capital to small and medium-size manufacturers, and digital skills training for the manufacturing workforce.

We have a tremendous opportunity to realize our collective mission to revitalize American manufacturing. Embracing AI will increase innovation and productivity, strengthen the competitiveness of American manufacturing, and fuel long-term economic growth and prosperity. Autodesk is eager to help you realize this vision.

Thank you, and I look forward to answering your questions.

[The prepared statement of Mr. Kinder follows:]

U.S. House Energy & Commerce Committee
Subcommittee on Commerce, Manufacturing, and Trade
Hearing on AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies
February 12, 2025

Testimony of Jeff Kinder, Executive Vice President, Product Development and Manufacturing Solutions, Autodesk, Inc.

Thank you, Chairman Bilirakis and Ranking Member Schakowsky, for holding a hearing on this important, timely topic and inviting me to testify today.

My name is Jeff Kinder, Executive Vice President of Design and Manufacturing at Autodesk, where I oversee our manufacturing business. I grew up in Indiana, hailing from a family of firemen, policemen, and factory workers. After studying engineering in college on an ROTC scholarship, I had the honor to start my career in the U.S. Navy as a Navigator, as well as Gunnery and Missiles Officer, on the guided missile cruiser, USS Texas.

After deciding to pursue an MBA, my career led me into business strategy and operations, product development, and most relevant for today, digital transformation. Transformations have been hitting industries since the mass adoption of the internet. And over the course of my career, I've had the privilege of guiding companies in a variety of industries – hospitality, e-commerce, and banking, to name a few – through digital transformations.

All these transformations have something in common: they seek to leverage the latest technologies to solve customer pain points and create competitive advantage. What's currently happening in the manufacturing industry is no exception.

INTRODUCTION TO AUTODESK

At Autodesk, we have a long history of providing innovative software solutions that enable our customers to design and make a better world for all. From the buildings we live and work in, to the

cars we drive, to the movies we watch in theaters, chances are you engage with the outputs of our software every day.

Autodesk technology serves three primary industries – Design & Manufacturing; Architecture, Engineering, Construction, & Operations; and Media & Entertainment. We are an American company headquartered and founded in the United States in the 1980s. We've been a part of many technological transformations – from PC to web to mobile to cloud, and now artificial intelligence (AI).

Autodesk uses the power of the cloud, AI, and other innovative technologies to give our customers increasingly powerful software tools that enable them to save time and money, reduce waste, enable better decision making, and train their workforces. In effect, these tools promote innovation and make our customers more competitive.

Autodesk has served the manufacturing industry, starting with computer aided design (CAD) software products like AutoCAD mechanical and electrical, for more than three decades. Manufacturing is competitive – both in the US and globally. We know firms large and small are continually looking for the latest technology to give them an edge over the competition. Autodesk helps provide them that edge.

OVERVIEW OF THE MANUFACTURING INDUSTRY – CHALLENGES, OPPORTUNITIES

As the Members of this Committee know, it is a highly dynamic time in the manufacturing industry. The pandemic exposed weaknesses across the manufacturing ecosystem. Manufacturers had to realign and reimagine their supply chains in real time, while simultaneously learning how to harden themselves against future shocks. Significant disruptions caused shortages of raw materials and finished products, including essential goods.

The post-pandemic years have been filled with other challenges that tested the resiliency of manufacturers. Inflation increased costs for an industry that operates on tight margins. The

evolving geopolitical environment has exposed additional risks. A confluence of factors, like demographic shifts and an aging workforce, alongside the rise of new technologies, have created a significant shortage in labor and skills. And yet, demand for products continues to expand, due to the growing global population and increased interest in high-quality, customized products. In short, the U.S. manufacturing industry has a capacity problem – not enough resources, labor, and time to meet demand.

Mix all these factors together and it's clear, while the opportunity is tangible, there are challenges to realizing the dream of expanding and making American manufacturing the most prolific in the world. The good news is we have a solution available to us: digital transformation. To remain competitive, the manufacturing industry has accelerated its digital transformation[1], which offers many benefits, including:

- **Increased efficiency and productivity:** McKinsey reports that digital transformation can reduce machine downtime by 30 to 50 percent and increase labor productivity anywhere from 15 to 30 percent[2].
- **Reduced costs without sacrificing quality:** PwC reports that companies anticipate a nearly 4 percent cost savings over a five-year period due to digital technologies, alongside improved product quality[3].
- **Provide competitive advantage:** Digital tools streamline the product design and development process, automate non-value-additive tasks, and provide critical insights into operations – leading to faster time to market and improved competitiveness.

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[1] https://www2.deloitte.com/us/en/insights/industry/manufacturing/manufacturing-industry-outlook.html
[2] https://www.mckinsey.com/capabilities/operations/our-insights/capturing-the-true-value-of-industry-four-point-zero
[3] https://www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf

Manufacturers know digital tools and technology are necessary to remain competitive but *executing* a transformation can be challenging – it is complex, time-intensive, and requires new skills as well as investment.

While new software may be affordable and more powerful, switching costs are high. Small and medium-sized (SME) manufacturers have many barriers to new technology adoption. They may have old, outdated machinery. Skilled labor is scarce. Their margins are incredibly narrow. Often, they are unaware of how digital technologies can improve their processes and productivity. Even when they are aware of new technologies, they don't always have the resources to invest. Historically, cutting-edge manufacturing technologies have advantaged larger, often global companies that can afford expensive teams of engineers and customized systems to gain economies of scale.

At Autodesk, we are democratizing cutting-edge technology by offering manufacturers the same advanced capabilities at a fraction of the cost. We believe empowering SME manufacturers with technology is the key to unleashing a new renaissance of American manufacturing. A healthy and robust ecosystem of SME manufacturers not only supports good-paying jobs; it also supports supply chain resiliency and flexibility – which ultimately contributes to U.S. economic and national security.

Sustaining the strength of American manufacturing requires a relentless focus on innovation and productivity to remain competitive in our current macroeconomic environment. Empowering manufacturing workers with increasingly powerful technology, such as AI, is the way to do this. Manufacturers are ready. They are eager to stay ahead of global competition and willing to adopt digital capabilities – including AI – that make them more productive. It is in our national interest to help them get there.

AI IN MANUFACTURING

Embracing digital transformation in manufacturing is key to increasing competitiveness. Our customers see AI as an important next step, with the potential to dramatically accelerate the industry's ability to manage product complexity, supply chain chaos, and labor shortages while increasing innovation and output.

Autodesk started investing in AI research over 10 years ago because we knew that's where the industry was heading. Autodesk has a Research team, including an AI Lab, which is the world's leading publisher of peer-reviewed original research on generative AI models trained for creating digital representation of physical products – also known as computer aided design (CAD). Our team of research scientists is dedicated to advancing artificial intelligence research, with the ultimate goal of giving our customers tools to help them design, simulate, build, and manufacture with more innovation and efficiency.

Autodesk is focused on developing concrete AI capabilities that help product designers and manufacturers do their work more effectively and efficiently. Specifically, we aim to reduce the repetitive tasks that traditionally require tedious manual work or significant overhead, address key pain points in the manufacturing process, minimize error, and free up more time for creative work and innovation. More importantly, our AI facilitates improved decision making at all points in the product development and manufacturing process. As supply chains get more complex and production cycles get shorter, our AI augments the decision making of human experts by factoring in the many variables from available material, labor, manufacturing technologies, and supply chain options, to name a few. This translates to improved global competitiveness for manufacturers.

Here are examples of how Autodesk AI is driving practical benefits for the manufacturing industry:

- **Enhancing the creative design process.** We incorporate AI capabilities into our manufacturing design tools that help product designers quickly generate a wide range of design alternatives based on defined parameters, such as materials, manufacturing methods, performance requirements, and cost. This approach can result in innovative designs, efficient use of materials, and significant time savings. Designers and engineers input design goals and parameters, and the software can generate a number of design alternatives that meet these criteria. The product designer then works with these design options to refine them and determine which are best for the needs of a particular project. For example, in auto racing, every second counts and safety is a priority. The North Carolina-based Stewart-Haas racing team used AI-enabled design[4] to reduce weight in the brake pedal on Cole Custer's #41 Mustang. The resulting pedal was 32% lighter and 50% stiffer than the previous part, helping to lightweight the vehicle and make it faster without reducing safety. Cole Custer was the 2023 NASCAR Xfinity Series champion.
- **Reducing time spent on tedious low-value tasks.** Manufacturers design products in 3D but need to translate their work into 2D manufacturing documentation for production. Traditionally, skilled engineers spend as much as 40% of their time doing this documentation work manually. It's a tedious process. Automating this leads to a massive improvement in efficiency. With Autodesk AI, they can now hit a button and create those 2D drawings with radical time savings for customers, freeing up time for more productive, creative work. The adoption numbers show this tool has been incredibly useful to manufacturers – we have generated more than 9 million dimensions in product designs since introducing this feature less than a year ago. That translates to a new dimension being automatically generated every 2 seconds.

[4] https://www.youtube.com/watch?v=9iibf3l-7Ho

Another example of this is the process of adding constraints to product designs. These constraints provide parameters to ensure the design intent remains intact. For example, when designing a table, it's necessary to specify that the legs of that table need to remain at the corners, even if the width or length of the table is changed as part of the design process. Autodesk has developed AI technology to automatically apply these constraints as a designer works, dramatically increasing their productivity over the traditional manual process. This is analogous to autocomplete, spell-checking, and grammar-checking in a text-based application. This is another use of AI in manufacturing that provides major productivity gains, enabling designers and engineers to increase their focus on developing new and innovative concepts.

- **Accelerating time to production.** Computer numerical control (CNC) machines are automated manufacturing machines that perform precise and complex operations such as cutting, milling, and drilling. CNC programmers can spend hours or even days manually creating instructions or code – known as tool paths – that are used to control these machines. To solve this, Autodesk uses AI to generate machining strategies in one click, saving hundreds of production hours a year. Our AI capabilities "learn" from a manufacturer's processes as well as from specific models, materials, and machines.

DIGITALLY CONNECTED FACTORY SYSTEMS

Factories are also undergoing technological transformation. Too often the focus is on 3D printers and robots, but there's another, unappreciated source of innovation: using digital tools to connect factory systems, data, and machines to improve factory operations. Autodesk has seen firsthand the ways our customers, particularly SME manufacturers, have improved their factory operations and empowered their people to grow the business.

The ultimate vision of a digital factory connects everything and everyone – shop floor, building, infrastructure, suppliers, vendors, workers, and stakeholders – creating an integrated data flow. From that foundation, factory managers can generate actionable insights that maximize productivity across the entire operation while eliminating pain points.

This kind of data is critical to build, train, and use practical AI models.

Digital factories enable manufacturers to visualize their processes and identify bottlenecks by modeling and simulating for a variety of scenarios. Allowing them to adjust the process before production ever begins. This results in improved product development agility and increased capacity for innovation.

For example, a specialized American footwear brand operates a facility in the Midwest to handle shoe repairs and customized order manufacturing. The company uses software – almost like an operating system for your computer – to manage the factory holistically from raw material ordering to inventory management, maintenance, and managing assets to production. Before, tracking quality control information would require taking all the pieces of paper off the production floor, entering them into a spreadsheet, doing the calculations, and adding up the totals. Imagine: the team can now easily visualize and seamlessly communicate production status, machine outages, quality, productivity, and more. The result: rework on products decreased 54% and productivity is up 29%.

Using digital tools and AI to improve factory operations helps empower manufacturers and their workers to be more productive. When considering how to strengthen American manufacturing and expand factories nationwide, especially for small and mid-sized businesses, it's crucial to explore how AI and digitally connected factory systems can boost productivity and competitiveness.

Of course, the most important component of any successful manufacturing business is its employees, which is why Autodesk invests in people through education and training tools.

EDUCATION AND SKILLS TRAINING

At the beginning of 2024, the U.S. Chamber of Commerce identified that durable goods manufacturing was facing 622,000 unfilled jobs[5]. Over the next three to five years this will be compounded as many manufacturers will face an employee turnover rate of more than 10 percent, simply due to retirement.

To support our customers' skills and talent needs, we provide free access to a large sampling of Autodesk's portfolio of professional software to students, teachers, and educational institutions. Our software is used in over 19,000 schools nationwide, including community college systems, vocational schools, high schools, and universities. We offer certifications for students and mid-career professionals to upskill in computer aided design (CAD), computer aided manufacturing (CAM), simulation, along with AI-enabled design and AI-based processes. We are also helping millions of Americans – mostly youth – build STEM confidence through project-based learning with Tinkercad, our free web app for 3D design, electronics, and coding.

We are dedicated to equipping students, workers, and educators with the tools and curriculum they need to learn, teach, and master the manufacturing skills of the future. For example, we are working with the University of Florida to establish the world's first ever industrialized construction program. Industrialized construction applies manufacturing processes to construction, helping make it more efficient and affordable[6]. Bringing the efficiencies of manufacturing to the construction process can lead to major time and cost savings for building housing and other major

[5] https://www.uschamber.com/workforce/understanding-americas-labor-shortage-the-most-impacted-industries

[6] https://dcp.ufl.edu/news/autodesk-gifts-dcp-hwcoe-1-5-million-for-industrialized-construction-engineering/

building projects. UF students will learn how to reduce housing development costs by 50% while doubling the speed of traditional construction methods.

We have also partnered with Limbitless Solutions, a non-profit organization based at the University of Central Florida, where research staff, affiliated faculty, and more than 50 students are working with Autodesk tools to transform what bionic prosthetics for children will look like in the future[7]. In this case, it's custom, 3D printed bionic arms with built-in electronics. Advanced prosthetic solutions for children with limb differences are often difficult to find and expensive to purchase. But Limbitless Solutions is transforming the possibilities with its goal to create "3D hope."

The ingenuity behind these programs and projects is truly inspiring.

With the acceleration of AI, educators and employers are eager to prepare workers to engage with AI features and tools. There's a popular saying, "AI won't take your job, but someone who can effectively work with it will." We agree. We surveyed our industries and recently published a report on skills in the age of AI[8]. The ability to work with AI was ranked as a top skill by 71% of the respondents in design and manufacturing.

These respondents realize that global competitors are also racing to effectively work with AI and introducing AI into their design and make processes. We believe AI will become an imperative to compete in global manufacturing.

While new technologies can create disruption, they also offer exciting opportunities to attract new talent into the manufacturing workforce. Manufacturing has a reputation for being an industry rooted in traditional, analog processes. The integration of digital technology, AI, and advanced machinery is changing that – offering exciting opportunities to draw talent back to this field. Digital skills lead to more satisfying jobs, more secure careers, and better pay – as much as a 65%

[7] https://www.autodesk.com/products/fusion-360/blog/limbitless-solutions/
[8] https://www.autodesk.com/design-make/research/spotlight-on-skills-in-the-age-of-ai

increase in pay over non-digital employees. With proper training, current and future workers alike stand to benefit from these advancements.

POLICY RECOMMENDATIONS

We commend the Committee for looking at this critical issue for the future of American manufacturing. AI presents a tremendous opportunity to improve productivity and global competitiveness. Autodesk offers the following recommendations for the Committee to consider as it continues its work.

- **Promote the benefits of AI for manufacturing and global competitiveness.** Partner with technology companies and manufacturers to develop national strategies that elevate the benefits and importance of AI for the future of American manufacturing. This effort should also identify and propose ways to mitigate obstacles to adoption of AI in manufacturing.
- **Accelerate digital transformation for small and medium manufacturers.** Targeted tax credits and access to low-cost capital for modernizing software and machinery are essential to enhancing the sector's resilience and the industry's global competitiveness, particularly for SME manufacturers. These would help drive needed investments in digital transformation from manufacturers, which is foundational to AI adoption.
- **Encourage the development and adoption of interoperability standards.** AI relies on data to train models. Industry standards that improve interoperability of hardware and software tools used in manufacturing will promote better data flow and sector efficiency. This will enable manufacturers to upgrade or integrate their technologies more easily and cost effectively.
- **Include factory design, construction, and operations in manufacturing initiatives.** Leveraging digital tools to design, build, and operate factories is a key opportunity for manufacturers to realize savings and efficiencies that support business growth. Any

initiatives supporting U.S. manufacturing should also prioritize ways to support the development of the most advanced and digitally connected, AI-enabled factories.

- **Continue to support the Manufacturing USA Institutes and Manufacturing Extension Partnerships (MEPs).** Continued support for these programs is crucial to innovation, regional manufacturing ecosystems, and SMEs. These resources can also drive specialized initiatives focused on accelerating SME digital transformation and AI adoption.
- **Target limited workforce resources to dedicated training for key sectors like manufacturing with a focus on digital and STEM skills.** This targeted approach will ensure economic competitiveness and help new and displaced workers upskill in the use of AI-enabled tools.
- **Support industry-led apprenticeships and programs that connect business and educators to identify skills gaps and develop tailored curriculums to train students and mid-career workers.** Strengthening the school-to-career pipeline is essential for building a resilient, digitally skilled workforce.

CONCLUSION

We have a tremendous opportunity to realize our collective mission to revitalize American manufacturing. This revitalization will be achieved through innovation and emerging technologies, like AI, in addition to the ingenuity of American manufacturers. We have the tools to drive technological advancement, create high-quality manufacturing jobs, and secure ongoing U.S. leadership in the global economy.

Embracing AI in manufacturing will not only strengthen the resilience and competitiveness of American manufacturing but also fuel long-term economic growth and prosperity. Autodesk stands ready as a committed partner, offering insights, technology, and expertise to help turn this vision into reality.

Mr. BILIRAKIS. Thank you so very much.

Now I will recognize Ms. Humpton. You are recognized for 5 minutes for your statement.

STATEMENT OF BARBARA HUMPTON

Ms. HUMPTON. Chairmen Guthrie and Bilirakis, Ranking Members Pallone and Schakowsky, and to all of the members of the committee, thank you for the invitation to be here.

I serve as president and CEO of Siemens USA. Siemens is a leading technology company pioneering a new industrial tech sector. We were founded during Abraham Lincoln's lifetime, I will note, and have been building our American business for more than 160 years.

Today, the U.S. is our largest market. We have more than 45,000 people and 12,000 suppliers nationwide. In recent years, we have invested more than $650 million, expanding our own U.S. manufacturing plants.

Since 2007, Siemens has invested $10 billion in U.S. software companies to strengthen our digital capabilities, and we recently acquired Michigan-based Altair Engineering, adding another $10 billion of investment in U.S. software. We did this to make American industry more state of the art and competitive. We did this to help regrow domestic manufacturing, which brings us to today.

Siemens is a world leader in industrial AI. This is different than consumer AI. Industrial AI uses controlled data from the manufacturing environment to help manufacturers create business value. Think better products, more efficient operations, a more prepared workforce. Think about a safer automotive industry.

Using industrial AI, Siemens built a predictive maintenance model for a major automotive OEM. Instead of manually analyzing data from 10,000 machines, the company uses AI to help workers detect machine failures up to 6 months in advance. Or what about a more innovative aerospace industry? Consider startup JetZero. With our AI-enabled software, JetZero is using real-time data and virtual simulations to design the next generation of ultraefficient commercial aircraft. And when their first factory opens, Siemens Industrial AI will optimize their operations, electrifying and automating the manufacturing process.

This is just the beginning. Industrial AI is transforming construction for commercial and residential buildings. It is addressing national energy challenges by managing electricity use and data centers. It is improving energy efficiency in semiconductor factories to help expand American chip production.

Now, of course, technological leaps like this raise questions for workers. Will technology replace people? No. Industrial AI expands what is humanly possible. It will create more opportunities for workers at all stages of their career. This is even more true with the introduction of generative AI.

GenAI is making technologies more intuitive, letting workers speak to machines using natural language instead of code. Siemens has led the industry in this area, deploying the first GenAI-powered assistant. We call it an industrial copilot. What it does is improve worker productivity by managing repetitive tasks. It helps people start manufacturing careers without specialized skills.

We are going to need this to help fill more of America's 500,000 open positions in manufacturing. We continue to encourage government to guide AI development in a way that balances innovation and safety.

Like this committee, at Siemens we recognize the advantage that industrial AI leadership will bring to American manufacturing. Industrial AI will enable all companies, from startups to small and medium enterprises to industrial giants, to thrive in this new era of American manufacturing.

I will finish with a quick example of how industrial AI is supercharging the growth of U.S. manufacturing. In 3 weeks, Siemens will celebrate the opening of a new manufacturing facility in Fort Worth, Texas.

To build the factory, we used industrial AI to develop a digital twin of the factory's product as well as its production lines. To staff the facility, we created 480 new jobs, with another 320 to come next year. To train workers, we recruited former high school teachers to develop a program for people with no manufacturing experience.

And, when that facility starts operations, it will produce the electrical components that power American data centers, the very foundation of AI. Fort Worth shows what industrial AI can do for U.S. manufacturing. With these technologies, we can boost economic growth, create jobs, empower innovation, and secure the next generation of American industrial leadership.

Thank you, and I look forward to your questions.

[The prepared statement of Ms. Humpton follows:]

Written Testimony of Siemens USA CEO Barbara Humpton

House Committee on Energy and Commerce
Subcommittee on Commerce, Manufacturing, and Trade

"AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies"

February 12, 2025

Introduction

Chairmen Guthrie and Bilirakis, Ranking Members Pallone and Schakowsky, and all the members of this subcommittee – thank you for this invitation and the chance to speak about this pivotal moment in U.S. manufacturing.

I serve as the President and CEO of Siemens USA.

Siemens is a leading technology company focused on pioneering a new industrial tech sector. We were founded in 1847 and have been building our American business for more than 160 years.

We're proud that the U.S. is our largest market. We have more than 45,000 people and 12,000 suppliers nationwide. In recent years, we've invested more than $650 million in new manufacturing facilities and factory expansions. We've invested $10 billion in the U.S. market since 2007, with an additional $10 billion announced in a planned acquisition of a Michigan-based software company – all to build out our digital technology portfolio. With customers in all 50 states and Puerto Rico, we are creating more productive factories, more resilient buildings, and more efficient power systems.

Industrial AI

As a global leader in industrial technology, we are at the forefront of industrial artificial intelligence, or Industrial AI. We have been working on Industrial AI since the 1970s, when our R&D teams first began incorporating AI into our products. Industrial AI differs significantly from AI used in commercial or consumer settings. It must meet the rigorous requirements and standards of the most demanding industrial environments. With the ability to process large amounts of machine data and recognize complex patterns, Industrial AI helps companies accelerate their digital transformation at scale.

At Siemens, we believe making AI industrial grade requires partnership. We team up with partners from various industries, the public sector and academia to advance AI and make it industry ready. With decades of experience in the discrete and process industries, our domain expertise, and our own factories, we have long been working to improve the capabilities of AI for product and production design, production operations,

and services. Siemens is committed to making Industrial AI accessible, enabling companies of all sizes to drive digital transformation effectively.

Furthermore, we've been steadily investing in Industrial AI in the U.S. for over two decades, building the AI capabilities to support digital innovation and regrowth in domestic manufacturing. We've done this because we see tremendous potential to make American industry more state-of-the-art and competitive. Industrial AI provides opportunities for reliable, secure, trustworthy applications that help manufacturers create business value from their data. Because of Industrial AI, businesses across the country are advancing towards better products, more efficient operations, and a more prepared workforce.

Industrial AI Use Cases

Siemens is using Industrial AI to advance automation and digitalization across industries, spanning power, automotive, aerospace, pharmaceutical, food and beverage, chemical, oil & gas, and more. We're proud to partner with customers across all sectors of the economy to propel them towards their digital transformation.

For example, we are leveraging Industrial AI to build a safer automotive industry. Siemens recently built a predictive maintenance model using Industrial AI for a major automotive OEM. Now, instead of manually analyzing data from 10,000 machines, the company uses AI to help workers anticipate potential machine failures six months in advance and take preventative action.

We're also driving innovation in the aerospace industry, as Industrial AI is enabling Siemens customers to bridge the real and digital worlds like never before. At CES 2025, Siemens announced our partnership with JetZero, a pioneering aviation startup working to build the future of air travel, to collaborate on the development and production of JetZero's revolutionary blended wing aircraft. With our AI-enabled software, JetZero is using real-time data and virtual simulations to safely design the next generation of ultra-efficient commercial aircraft. And when their first factory opens, Siemens' Industrial AI will optimize it, electrifying and automating the manufacturing process.

This is just the beginning of the stories we can share demonstrating Industrial AI's profound impact. Industrial AI is optimizing construction for commercial and residential buildings. It's addressing national energy challenges by managing electricity use in data centers. It's improving energy efficiency in semiconductor factories to help expand American chip production.

With a digital-first approach built on massive volumes of data, Industrial AI is positioned to play an ever-increasing role in product design, testing, and manufacturing to leverage the tremendous amount of information to the fullest extent. Thus, advancing the capabilities of Industrial AI is critical to securing domestic manufacturing, driving

American economic growth, competing in the global economy, and advancing U.S. technological leadership.

AI and the Manufacturing Workforce

Major technology developments raise questions for workers. What does AI mean for jobs? Will technology replace people?

For Siemens, the answer is no. We believe the opposite is true. Industrial AI expands what is humanly possible, creating more opportunities for workers at all stages of their careers. We believe digital transformation is elevating the roles of our workers.

This is even more true with the introduction of generative AI.

Generative AI is making technologies more intuitive, letting workers 'speak' to machines using natural language instead of code. Siemens has led the industry in this area, deploying the first Gen AI-powered assistant, or 'copilot', for industrial operations.

For experienced workers, industrial copilots help them with more repetitive tasks. That means they can spend more time innovating and making decisions. For new hires, industrial copilots introduce the possibility to help people start manufacturing jobs without specialized skills. This can crucially bring new people into the workforce, helping fill more of America's 500,000 open positions in manufacturing.

Furthermore, in order to close these gaps in the manufacturing workforce, we also believe in investing in the workforce development programs we need today and in the future. Institutions from high school STEM classrooms to university laboratories are developing curriculum to tackle real-world challenges through programs that teach both technical and career skills. This collective action is exactly what it takes to develop the strength of digital talent necessary not just for Siemens, but for our whole country.

Siemens is engaged in collaborative efforts across the country to address critical labor shortages and rapidly shifting skill demands driven by exciting advancements in technology. As an example, Siemens recently kicked off a microcredentialing program with the University of Colorado Boulder and Pennsylvania State University to credential students and recognize career readiness, thereby creating a stronger pipeline of engineering talent demanded by industry. The credentials are intended to supplement a formal degree by validating industry knowledge and skills.

Recommendations to Policymakers

With this in mind, we continue to encourage government efforts to guide AI development in a way that balances innovation and safety. We believe that all technologies should be applied securely and with purpose.

Like this committee, we recognize the advantage that Industrial AI leadership will bring to U.S. manufacturing. This technology is not only here to expand what is humanly possible; it is advancing our ability to bolster American manufacturing and build a skilled workforce.

In order to harness the full potential of Industrial AI, it is vital policymakers understand the unique role of industrial applications and separate Industrial AI from consumer-focused applications. We encourage Congress and policymakers to recognize the distinction between Industrial AI in business-to-business contexts, as opposed to the consumer-facing applications where much of the attention is directed and the center of many policy issues currently under debate.

Furthermore, as state legislatures across the country consider individual measures to regulate AI, targeted definitions matter now more than ever. Overly broad definitions of which role an AI actor plays would negatively impact our ability to develop and provide access to next-generation technologies, especially harming small- and medium-sized manufacturers. This would be detrimental to the future of economic growth and innovation in the U.S.

Additionally, it is essential for policymakers to be very specific about risk. We support safe development and secure deployment of AI technologies to mitigate risks to end users. However, many industrial AI applications are not in the operational environment, instead being utilized earlier on in the value chain at the design and test stages, where finished products can be optimized before being built.

In terms of trustworthiness of data, the core distinction of Industrial AI is that it is trained on highly monitored data from sensors and machines, providing a more reliable foundation for training AI models in this domain when compared to generally publicly available data used for many consumer-facing AI uses. Furthermore, in our industrial settings, we implement robust data quality checks and validation processes to ensure the accuracy and consistency of industrial data, critical for trustworthy AI.

We also encourage policymakers to align public sector priorities with private industry efforts to maximize these efforts. We believe the relationship between the public sector and the private sector is critical, and we can learn a lot from each other. All levels of government benefit from expanding understanding of fast-moving technology, finding creative ways to encourage broader adoption, and creating the necessary ecosystems to develop technology further.

One example of these successful ecosystems is Manufacturing USA. The network of Manufacturing USA Institutes has been effective in improving the competitiveness of U.S. manufacturing by accelerating technology commercialization and developing the manufacturing workforce. Siemens is a proud partner in several institutes supporting:

- Cybersecurity in manufacturing at MxD in Chicago
- Advanced materials, process and systems engineering at LIFT in Detroit
- The new digital twin for semiconductor manufacturing institute in North Carolina, SMART USA
- Teams applying for the newest institute focused on AI in manufacturing

Lastly, policymakers must advance Industrial AI by prioritizing strong rules for digital trade, especially to include strong protections for source code and algorithms. We encourage policymakers to build upon the success of previous U.S.-led efforts to protect intellectual property, prevent forced data localization, and oppose the use of customs duties on electronic transfers. These priorities have built the foundation of an ecosystem where American-driven technology can compete, grow and innovate in the global economy. By remaining committed to strong digital trade protections, policymakers can propel Industrial AI applications to enable all companies – startups, small and medium enterprises, industrial giants – to thrive in this new era for American manufacturing.

Conclusion

Industrial AI is poised to revolutionize the way we're managing the factory floor, making manufacturing processes more responsive, more agile, and reprogrammable in real time. As production becomes more connected and more autonomous, Industrial AI will make human-machine collaboration more innovative, enabling manufacturing operators and engineers to detect and analyze the most useful data points that no human could ever fully interpret alone. This will bolster crucial decisions that advance product customization and production resiliency.

By combining cutting-edge digital tools with improved machinery and infrastructure, we can propel domestic manufacturing and economic growth forward, helping American businesses of all sizes to maximize their potential.

I'll finish with an example of how Industrial AI is supercharging the growth of U.S. manufacturing. In three weeks, Siemens will celebrate the opening of a new manufacturing facility in Fort Worth, Texas.

To build the facility, we used Industrial AI, developing a digital representation, or digital twin, of the facility's product and production lines. To staff the facility, we created 480 new jobs, with another 320 to come next year. To train workers, we recruited former high school teachers to develop a training protocol for people with no manufacturing experience. And when the facility begins operations, it will produce the electrical components that power American data centers – the foundation of AI.

Fort Worth is a microcosm of what Industrial AI can do for domestic manufacturing. With these technologies, we can boost economic growth, create jobs, empower innovation, and secure the next generation of American industry.

To all the members of this committee, know that Siemens stands ready to work with you. Together, we will advance American manufacturing and build a skilled workforce.

Mr. BILIRAKIS. Thank you very much. Very informative. I thank all of you for your testimony.

And now I will recognize myself for 5 minutes for questioning.

So we will start with Ms. Humpton. AI has already enveloped itself into the manufacturing ecosystem, and it is creating more efficient systems to build here in America. We need to do more to encourage this type of growth here at home.

As I mentioned in my opening statement, AI and its applications are incredibly broad and can't let generative AI control how the world sees AI in its entirety. So I am glad you gave that example, though. That is good.

What is important to view AI in manufacturing in a different lens than generative AI?

Ms. HUMPTON. Mr. Chairman, thank you for the question. And industrial AI is really quite different from consumer AI. Let's think first about the data that is used. In generative AI in the consumer applications, we have seen the use of large swaths of data from many, many sources.

In a manufacturing environment, what we are typically doing is gathering data from multiple sensors in a very controlled environment, in fact, so controlled that many manufacturers don't want that data shared with anyone. This is a competitive advantage they have, being able to own and manage their own data.

That is why they trust a company like ours. They trust Siemens to build the AI tools that will operate in a secure environment using what we have learned over decades with machine learning, with deep network, neural networks, to be able to take advantage of that data and draw conclusions that would literally be impossible for any one of us to do if we were standing on that floor.

I mentioned the automotive manufacturer. Imagine the question of, how do we ensure the quality of doors as they are coming off a production line? Well, it is really difficult to do with the human eye, but with a sensor, with a sensor and machine learning, we are able to define perfect, what does perfect look like, and then compare every door that is produced to that standard, identifying defects earlier and taking action to correct the manufacturing process.

The difference with industrial AI is the data it operates on, the environment in which it is used, and the tools that are applied. Trust will be the foundation of our future work in this area.

Mr. BILIRAKIS. Thank you very much. Excellent.

Mr. Oxman, the National Association of Manufacturers found that, after deploying AI in their manufacturing operations, 72 percent reported reduced costs, improved operational efficiency, 51 percent reported improved operational visibility and responsiveness, and 41 percent reported improved process optimization and control. These statistics show just how beneficial AI can be in the manufacturing sector.

Can you provide examples of use cases that may be attributed to these statistics, please?

Mr. OXMAN. Thanks, Mr. Chairman. It is not surprising to hear those statistics that you cited about the importance of AI to manufacturers. Just to give one example from across the ITI membership: Ericsson, one of our member companies that is the reason

that we have the robust mobile networks that we have in the United States.

Ericsson has a 5G smart factory in Texas. And what they have done with that smart factory, to your point about the importance of AI-enabled manufacturing, is they use advanced analytics for machine learning. And they do predictive maintenance, as Ms. Humpton was talking about. They deploy autonomous robots to help with the manufacturing process, particularly areas that would be too dangerous for human beings. They do process automation. They do demand prediction.

So a huge number of what I will call intelligent automation tools that are made possible by AI. They don't replace humans, but they take areas where human error could be dangerous or could be inefficient, and they make humans better in their deployment.

And the stats are remarkable: 120 percent improvement in output per employee and a 65 percent reduction in manual material handling at that Ericsson USA 5G smart factory in Texas.

Mr. BILIRAKIS. Thank you very much.

Mr. Kinder, whenever we talk about the greater adoption of sophisticated technologies, I think it is equally critical to talk about protecting these systems. Can you walk us through how Autodesk addresses this question of cybersecurity for AI manufacturing?

Mr. KINDER. Sure. Thank you for your question, Chairman.

Cybersecurity is paramount. And, as a company, we prioritize this, and we work continually to evolve our processes to mitigate any vulnerabilities. Our approach is—and our chief trust officer is fond of saying this: Build secure, run secure, and stay secure. And that is integral to engendering customer trust.

And what we mean is, "build secure" is using secure methods in software development right from the beginning, "run secure" is implementing security controls across the platform, like identity and access management, encryption, and "stay secure" is continually assessing the products for vulnerabilities and any compromises.

Mr. BILIRAKIS. Thank you very much.

And I will yield back the rest of my time. I don't have any left. But, in any case, we will have the ranking member. You are recognized for your questioning, 5 minutes of questioning, please.

Ms. SCHAKOWSKY. Thank you, Mr. Chairman.

I have two questions for you, Dr. Reynolds. One is, yesterday I met with a manufacturing company, but they also are engaged in getting young people more engaged in manufacturing. So I asked them, so how many of those students that are signing up and want to do this, how many are women? And they said, "Well, I know there is at least 13 percent or something." It was a low number.

And you had mentioned trying to engage more women in manufacturing. I am just wondering if just the name "manufacturing" sounds like a guy. And how can we get more—certainly, there is a lot of room for women. What are you doing to make that happen?

Dr. REYNOLDS. Thank you very much for that question. And it is very important, particularly given the shortage of workers we have just been talking about, half a million currently and close to 2 million within 10 years. We need to bring everybody into the manufacturing workforce, including women, who represent about

30 percent of the workforce today, which is underrepresented, given that they are 46 percent of the total workforce in the country.

So I think there are a number of things that we could be doing. The first point is to say that the kind of manufacturing we are talking about now with AI and automation and all of the developments we are talking about really should change the view of manufacturing in this country.

Historically, we think of it as dirty, dull, physically laborious. That is completely gone now in the 21st century. And I think that will be helpful in terms of attracting the next generation into manufacturing, particularly also new technology. This next generation is much more interested in working with advanced technologies than working with older industrial systems.

Right now, we know that women who are working in manufacturing earn, on average, 16 percent more than the median income for women nationally. So this is attractive from a wage point of view.

It may be less attractive from a flexibility point of view, and that is one area that I think we could hopefully see manufacturers work toward attracting more women into the field is whether, given childcare responsibilities, et cetera, can we see more flexibility in the workweek? But we really need to get the next generation in, particularly starting in high school.

Ms. SCHAKOWSKY. I hope so. I wanted to also mention I am concerned about manufacturing jobs and when wondering how AI is going to fit into this, is there some reason to worry for everyday workers that their jobs will begin to disappear because of AI, a different way to get the technology out?

Dr. REYNOLDS. So I think it is always important to look at the impact of technology on work and on workers, because we know that technology has had an effect on increasing inequality in this country and hollowing out a lot of our middle-class jobs, because it replaces workers.

The important way to address that is, when we use technology to enhance and augment workers, how do we make the technology a tool for workers so that they themselves can benefit from its use? That has often been tracked by the level of education that jobs have and the level of routine operations that we have in jobs.

The important opportunity with AI is that, while it may reduce waste and get rid of some of the automated work that is quite tedious, it does have a chance to really augment the skills of our workers and particularly lower-skilled, lower-educated workers, who can use AI, as described earlier, as a copilot, where it is actually helping guide workers who don't necessarily have the skills.

And this is the opportunity for digitalizing our workforce. And I think we have to look and work very hard to make sure that AI is the tool and provides the opportunity right now for bringing workers who have actually perhaps less education, less skills, into career paths and into promising, well-paying jobs.

Ms. SCHAKOWSKY. Thank you for that, because I think it is really important that we consider that not only really highly educated people but the many people who are right now involved in technology that there is going to be a place for them and not just for

the most educated and, it turns out, the wealthiest either. So thank you.

And I yield back.

Mr. BILIRAKIS. I thank the gentlelady.

I now recognize the vice chair of the full committee, Vice Chairman Fulcher. Thank you. You are recognized for 5 minutes.

Mr. FULCHER. Thank you, Mr. Chairman.

Ms. Humpton, most of my private-sector life was in the semiconductor industry with Micron Technology, and at the time—I am dating myself here—but Siemens AG was a competitor in the memory component, D–RAM, business, and so—I know that is not your focus. I am not even sure that they are in that anymore, because it was years ago.

But you were talking about your involvement with generative AI—and I have been out of this for a while—and you mentioned about the potential to—the use of these copilots in speaking to machines and whatnot.

Where is this going to go? I mean, are we talking about when you are speaking to machines? Is this mirroring human interaction? Just talk a little bit more about this. Where is this going?

Ms. HUMPTON. Thank you so much, Vice Chairman, and I want to first comment, we did sell the semiconductor business. It became Infineon.

But today we have a fantastic EDA component so we are using exactly these technologies to help semiconductor manufacturers work their design and plan out their factories. So it is an exciting time for the semiconductor industry.

But the question you ask really ties to the conversation we have just had about workforce. Where is this going? What I am excited about is that, for the first time, we have a technology that actually comes to the people instead of forcing them to go to school, learn more, et cetera.

And I am going to tell you just my personal experience with this. I went to a recent tech show, and my team was there showing what they are doing with industrial AI.

And they said, for instance, the programming of robots for a factory floor, they said this would typically be done by an individual who would get on a bicycle and ride along the floor because you had to go to each machine, you had to know the programming language.

Instead, I stood in front of a laptop and texted in, "Please sort the following items by size." The computer generated the code, and the machinery was then commanded to do the sorting.

The team looked at me and said, "By the way, do you enjoy writing comments for the code that you have to write?" It is just one of—it is drudgery. And I said, "Oh, I hate that."

They said, "Well, press this button," and 5 seconds later, I had all of the commentary that was required to go with that code.

I am telling you, this is going to be such a cool era because, yes, we can bring young people in. If you can play a video game, you will be able to——

Mr. FULCHER. So is verbal interaction next?

Ms. HUMPTON. Verbal interaction is already here. Verbal interaction is already here. I encourage anyone who would like to visit

us at the Hanover Fair that is coming up next month, we will be demonstrating much of this technology right here, right now.

So I think we have the opportunity to see it and be able to envision the future today.

Mr. FULCHER. Thank you for that.

Mr. Oxman, I didn't know about the word "reskilling" until I was going through some of this testimony, and I would like to flesh out your thoughts on the reskilling component here.

We have got a lot of middle-aged workers, we have got older workers that change is always a challenge, and trying to recruit young people at the same time.

Talk about recommendations for reskilling, and understand that you are talking to a congressional panel here, so in the sense of—talk about recommendations for reskilling, and what might be the proper role of the Federal Government in that effort?

Mr. OXMAN. It is a great question, and I do think that the role of the Federal Government is to partner with industry to make sure that we are working on STEM education and reskilling wherever it can benefit the workforce.

Mr. FULCHER. Keeping in mind, we don't want to be where we are going to hinder, but——

Mr. OXMAN. Absolutely.

Mr. FULCHER [continuing]. Let industry be industry, but—go ahead, I am sorry.

Mr. OXMAN. No, that is absolutely right. You know, for example, in Boise, where ITI member company Applied Materials is very active, they are working in partnership with local community colleges on reskilling, to train the workforce that is necessary.

Meta is currently investing in an $800 million data center in your district, or adjacent to your district, and needs the workers for that data center.

So the kind of public-private partnership I am talking about is the Government making sure that local educational institutions have the resources they need and the training programs they need, and making sure that workers have the opportunities they need to get the skills necessary to get the jobs of tomorrow.

As Ms. Humpton mentioned, 500,000 open jobs in the technology industry. We need to find those workers with the skills that they have and fill those positions.

Mr. FULCHER. Great. Thank you for that.

Mr. Chairman, I do have a question for Mr. Kinder on interoperability standards, but I know I am out of time, so——

Mr. BILIRAKIS. Go ahead.

Mr. FULCHER. So, Mr. Kinder, briefly, please, it sounds like, when you are talking interoperability standards, it sounds like you are talking about the sharing of data, having the ability to adapt new technologies to improve productivity in the overall manufacturing process.

Do I read you correctly on that? Is that your intent with interoperability standards?

Mr. KINDER. Thank you for the question, Vice Chairman. Yes, it is. The interoperability of data, as you heard in all of our testimony, data is critical for training AI models. With interoperability

across different software applications, we will have more data, and it will be smarter on how the whole system operates.

Mr. FULCHER. Great. Thank you very much.

Thank you, Mr. Chairman. I yield back.

Mr. BILIRAKIS. The gentleman yields back.

Now I recognize the gentlelady from the great State of Florida, from the great city of Tampa.

Ms. CASTOR. Thank you.

Mr. BILIRAKIS. Representative Castor has been—we have worked on several issues together on this subcommittee. I have enjoyed working with you. Thank you.

Ms. CASTOR. Yeah, Chairman Bilirakis. It has been a pleasure working with you. Congratulations on leading the subcommittee again.

Thank you for recognizing Chris, your aide. I am sorry to see him go. He was instrumental in helping us get out of the committee the Kids Online Safety Act and the Kids Online Privacy Protection Act.

Unfortunately, they didn't get across the finish line.

Mr. BILIRAKIS. We are going to do it this year.

Ms. CASTOR. That is good to hear your commitment on that.

Mr. BILIRAKIS. We are going to get it done this year. Top priority.

Ms. CASTOR. There were a number of things out of the committee that did not, that were stripped out at the last minute, and I hope that we can get back to working on those expeditiously.

But I know we are gathered here today to talk about AI and advanced manufacturing, and it seems like it is vital that we continue to build on the success of the past few years. And Dr. Reynolds highlights a lot of the progress in her testimony.

She says, "The U.S. has made significant strides in the past few years to rebuild these capabilities with largely bipartisan support" in "semiconductors, critical minerals, defense, and energy infrastructure" and that the Bipartisan Infrastructure Law, the CHIPS and Science Act, the Inflation Reduction Act has led to manufacturing construction spending having been tripled since 2021, $450 billion of private-sector investment in semiconductor production, over 40 facilities, approximately $80 billion of private-sector investment in clean energy across 200 manufacturing facilities, particularly batteries, a crucial area for U.S. leadership in the future, and investments going to all sorts of States.

I wish there were more in Florida, but a lot are going into the battery belt in the Midwest, and so that is so important to see because of the drain in jobs and offshoring of jobs over the past decades.

But this hearing does seem like a big disconnect today because of, right at the outset of the new Trump administration, they threw a wrench into so much of the progress that we have been making.

They illegally shut down loans and grants that, you know—I focus a lot on on the Department of Energy—the Executive orders and the default on grants and loans have thrown a lot of the manufacturing sector into chaos.

Just yesterday I had a critical mineral developer in my office. They do not—they cannot get answers from the Department of Energy because of the halt in payments. We have had a Federal court say, "You must continue to disburse these moneys."

So we are seeing layoffs, business capital pulling back already. So, Dr. Reynolds, are you hearing these same stories here just over the past few weeks?

Dr. REYNOLDS. Thank you for that question and for raising what is a very concerning situation right now in the country. As you said, we have had significant investment, looking at over $1 trillion over the next decade across physical infrastructure, across our digital infrastructure, if you will, and with our energy infrastructure.

But these latest steps by the current administration are very concerning, I think first and foremost, because what we have are contractual obligations, with the backing of the Federal Government in many of these cases, for funds that are expected to flow in many important projects.

Right now, there are approximately over 400 clean-energy projects that have been announced. They have not yet broken ground, but those plans are in motion, and those companies have been banking on a lot of that funding that is supposed to be coming.

A lot of this is really about what we see today, but I think we have to also think about what is potentially lost if these investments do not flow as they have been intended, and also passed by Congress.

Right now, what some estimates are, certainly recently by Johns Hopkins, is that if the IRA pulls back on a lot of these investments, what we are going to see is foreign companies—foreign countries, including China, stepping in, and that U.S. companies, and the U.S. as a whole, are at risk of losing approximately $50 billion in annual lost exports, et cetera. So the stakes are enormous.

We have already got tremendous momentum, and as you said, a number—many States across the country who are benefiting from these investments, communities benefiting as well as the workers.

So I hope that we are going to see some common ground and an understanding that really we need to maintain some order and continue those investments as we passed them in the past.

Ms. CASTOR. Thank you. I agree. I think China is cheering this on. Any wrench that is thrown into building up our advanced manufacturing and AI and progress is to the detriment of our people.

Thank you. I yield back.

Mr. BILIRAKIS. The gentlelady yields back.

Now I will recognize my favorite pharmacist on the committee—I know Buddy is going to kill me for this.

Mrs. HARSHBARGER. You are just——

Mr. BILIRAKIS. Anyway, I am telling the truth.

Mrs. HARSHBARGER. Thanks, Gus.

Mr. BILIRAKIS. I recognize you for 5 minutes.

Mrs. HARSHBARGER. Thank you, Mr. Chairman, and thank you to the witnesses for being here. I don't have an Abraham Lincoln story, but Davy Crockett is from my district, FYI.

Mr. BILIRAKIS. And so is——

Mrs. HARSHBARGER. Stop it, stop it.

Well, let's just get back to the crux of this. Ms. Humpton, your company has a digital industry design and testing facility in my district that employs 202 Tennesseans, and my question to you is,

When you train your employees to use AI, do you offer that training for advanced engineering staff or to all the employees?

Ms. HUMPTON. Thank you so much, and I am going to tell you, we actually have 219 in Johnson City.

Mrs. HARSHBARGER. Johnson City. Well, dang, I didn't—let me correct the record.

Ms. HUMPTON. Yes. This business is growing and thriving, and we have made the AI training within the Siemens Corporation available to all. We actually have a learning platform that uses AI so that an individual learner can come in, give a little bit of information about where they are with their knowledge base, and have recommendations made.

Now, we are going to take this one step further because what we recognize is that everyone needs to be able to learn these skills. So we are working now on a project to make this training available on a platform publicly so that anyone who wants to get engaged would be able to understand the technologies we are implementing at Siemens and be able to get on that learning ladder themselves.

Mrs. HARSHBARGER. Well, that is fantastic. You talked about predictive maintenance, and I thought that was very interesting, where you could—it helps manufacturers identify machines that might break down 6 months ahead of time.

So can you give us a couple other examples for the committee, where it shows this predictive maintenance and what role AI plays with that?

Ms. HUMPTON. Yes, I am happy to describe this. This is really interesting. I mean, how do you know when something is going to break down? It is a little bit like the door example I gave before, that to the human eye, you may not notice a change in vibrations, a change in the noise that is being made by a machine.

I think we all know that in any business, there are those savants, the experts who actually can smell it in the air when something is wrong. But we can't all be as smart as that individual.

What we are able to do with our predictive maintenance tools is use sensors of all kinds—sound, sight, smell, et cetera—to give us those indicators of when something isn't performing as expected. That alerts people in the loop to figure out, is this something that we need to take action on now.

Mrs. HARSHBARGER. You always need a human component—smell.

Ms. HUMPTON. We absolutely do.

Mrs. HARSHBARGER. Unless you come up with something on AI. OK. Thank you, ma'am.

Mr. Oxman, you spoke a little bit about the President's recent Executive order and that it will develop an AI action plan that will chart the course for the new industry.

So my question to you is, What details do you think the administration should consider which would benefit innovation and growth in American manufacturing?

Mr. OXMAN. We absolutely—thank you, Congresswoman, for that question. We absolutely do appreciate President Trump's Executive order on AI, and particularly because he is focused on input from industry, to make sure that the regulatory roadmap is appropriate

for continued AI leadership in the United States. So we are looking forward to providing that input.

The Vice President, as I mentioned, was in Paris yesterday at the AI summit, and he noted that the regulatory environment is really going to control who wins. And so, in this Executive order, our hope is the President advances a public-private partnership that focuses on industry, voluntary standards, and not taking an overly regulatory approach as some other jurisdictions like Europe have done, that has hindered their leadership on AI.

So I think we have a real opportunity here, and we are grateful to the President.

Mrs. HARSHBARGER. Well, continue to give him input.

Mr. Kinder, you know, I am a compounding pharmacist—Gus didn't tell you that—but that is what I am, and I understand how critical it is to strengthen the resilience of our domestic healthcare supply chains and stop the dependence on foreign adversaries.

Can you share with me how AI technology is used in healthcare manufacturing, sir?

Mr. KINDER. Sure, thank you for your question, Congresswoman. Pharmaceutical companies use Autodesk software to build their factories, to produce medicines, and to produce the packaging that the medicines they come in.

Our tools help ensure that the entire supply chain stays connected and optimized. I can give you an example. One of our partners saved over $350 million annually by using a fully integrated digital twin model of their factories, and, you know, these twins help with renovations, with space and resource allocation, and energy consumption.

Mrs. HARSHBARGER. OK. I just have one other question and 5 seconds. NASCAR——

Mr. BILIRAKIS. Go ahead.

Mrs. HARSHBARGER. OK. Well, it is just a fun one. NASCAR, how in the heck did you get that lightweight brake past the specs? Because I have Bristol Motor Speedway in my district, and you got to go through a lot to make sure they meet the specs.

So how did you get that through tech, is my question. Did you do that before, or did you even do that? Do they even know about this brake?

Mr. KINDER. I don't think it is a secret. But it did pass——

Mrs. HARSHBARGER. OK. Just checking, because he won the championship.

Mr. KINDER [continuing]. It did pass the weight test for the car.

Mrs. HARSHBARGER. OK. I am just checking. You know, we have got to keep it above board now. OK? Thank you, sir.

I yield back, Mr. Chairman.

Mr. BILIRAKIS. All right. Very good.

I recognize my good friend Darren Soto from the great State of Florida. You are recognized for 5 minutes for your questioning.

Mr. SOTO. Thank you, Mr. Chairman, and congratulations on your new granddaughter. We are so happy to see that amazing addition.

You know, it wasn't that long ago we saw a chips shortage because of the pandemic, and it raised the prices of vehicles, of appli-

ances, of computers, and many Americans found out chips are in everything nowadays.

And so we came together to pass the CHIPS Act, all the Democrats and some of the Republicans. We appreciate their support on that. And it has been a big help for Florida's Ninth Congressional District.

We are home to the biggest CHIPS Act project in the State at NeoCity, near St. Cloud in Kissimmee, and we just welcomed our next fabricator, ELSPES, which is going to be working on capacitors that work directly on lowering energy for AI technology.

We also saw the Inflation Reduction Act be a huge help for central Florida—Green Garden Village, where we are going to be making solar panels as well as EV charging stations;

We are going to see the largest solar plant in North America in south Osceola County, thanks to Florida Power & Light; the largest, fast-charging station, thanks to Tesla going to Yeehaw Junction in the south part of my district; and the first used electric vehicle dealership, also by Tesla.

We have seen, because of the CHIPS Act and because of the IRA, factory construction has surged and manufacturing capacity is expanding, both in Florida and across the Nation.

Many of you may be surprised to know that Florida has the second-most electric vehicles of any State in the Nation, even though we are the third-most populous State, so just after California. Just another interesting example from the Sunshine State.

And so we are concerned that President Trump, with his freeze order, could stop some of these projects from going through, whether it is the CHIPS Act, whether it is projects under the Inflation Reduction Act.

And then what is this going to do? It is going to raise costs, it is going to raise pollution, and it is going to limit our competitiveness at a time when China and so many other countries are trying to advance these issues.

We just filed a letter today taking on President Trump's attempt to take back the national EV charging station infrastructure we see across the Nation.

This is going to affect rural areas. This is going to affect a lot of urban areas. We need to make sure our Big Three remain competitive, knowing that EVs and hybrids are a big part of this future transition that we see.

And then I am concerned about the reconciliation package that will attempt to gut these programs for more oil. You know, we are already at record production right now. And so we need a balanced approach.

And all this is at the backdrop of an inflation report where we saw inflation is now at a 6-month high, tariffs, deportations, division, chaos, the four horsemen of Trumpflation that could get worse.

It doesn't have to be this way. We could work together, and this committee has a long history of doing that. We need a balanced approach where we continue with electric vehicle progress, continue to work on the CHIPS Act, keep oil production steady, to keep gas prices affordable, and have a transition over time.

Ms. Humpton, thank you so much for being here. We appreciate Siemens' great investment in Orlando in partnership with University of Central Florida, focusing on energy systems, sustainable energy solutions.

How critical is it for us to continue to be competitive in clean energy and to have workforce development programs to meet this demand?

Ms. HUMPTON. Thank you, Congressman. It is vitally important that we attend to the mega trends that have driven us for such a long time. And in fact, what is so exciting about where we are in this moment is that it is, in fact, the private sector who has stepped up to the plate.

Many statistics have been shared this morning about the level of investment, first being made by the Federal Government as a down payment, but pouring—the private sector funds that have been pouring in.

Our customers are demanding the kinds of technologies that we as a Nation have been focused on these last few years.

What is exciting is that industrial AI can contribute to our progress overall. You see, the same technologies that help us address the goals that we have had for sustainability, et cetera, also make us more efficient. They make our businesses more productive.

We really can have it all in this moment by deploying technology to make American manufacturing cleaner, smarter, and more cost-effective, competitive on the world stage.

Mr. SOTO. And we appreciate Siemens' contributions to this factory renaissance, this manufacturing renaissance, that has been pushed onward because of the IRA, CHIPS Act, and many other private-sector companies coming together.

Thanks, and I yield back.

Mr. BILIRAKIS. The gentleman yields back.

Now I will recognize the gentleman from California, Mr. Obernolte, for his 5 minutes of questioning.

Mr. OBERNOLTE. Well, thank you, Mr. Chairman. Congresswoman Harshbarger recommended that I continue her line of questioning about NASCAR brake pedals, but instead I am going to focus on something else she was asking about.

Mr. Oxman, you and she were talking about regulation and the executive branch and the President's Executive orders. Could I follow on to that discussion with a question about what we, in Congress, should be doing to establish a regulatory environment that, as you say, encourages innovation and the use of AI in the manufacturing space?

Mr. OXMAN. Well, thank you, Congressman Obernolte. As the AI scientist on the panel, you have been very focused in the last couple of years on legislative solutions that we have been proud to support, ranging from the Center for AI Advancement and Reliability, to the CREATE AI Act.

And of course, we are starting over in the 119th, but the work that you have been focused on, encouraging public and private partnerships, I think, is the shortest answer to your question. That is where we really need to be focused.

We need to be focused on how the Government can partner with research institutions, not only on the reskilling issues that we have

been talking about, but organizations like the NAIRR, the National AI Research Resource, that you have been very vocal and supportive, and we have as well.

That is the kind of public-private partnership I think we need to be focused on, not focusing on the regulations so much as how can government and the private sector partner together to make these investments a reality. That is where I think the focus really should be.

Mr. OBERNOLTE. Right. Well, obviously I completely agree with you about NAIRR and Create AI and the AI Advancement and Reliability Institute. You know, I think that those would be really vital public-private partnerships in that sense.

I am hopeful that you read our AI Task Force report, and I am wondering, what do you think we got right and wrong in our approach to regulating the use of AI in manufacturing?

Mr. OXMAN. Yes, and congratulations to you and Mr. Lieu, your cochair in that effort, on a remarkable task force initiative. It was a—I did read the report. It was very long, very comprehensive.

The things you got right in there, I think, were a focus on what the Vice President talked about in Paris, which was those jurisdictions that have taken a regulation-first approach, like Europe, are now behind in the race to dominate globally.

I also really appreciated the focus on the competition that we face internationally and how other countries are looking to lead the way, and if we are not making the right kind of focused investments and not ensuring that the regulatory environment is appropriate to investment, we are going to fall behind.

We have got a lead now, but that lead is by no means guaranteed to lead to future success.

I also appreciated your focus on training, workforce development in the report and ways in which investment in those kind of initiatives can also lead to further U.S. leadership in AI.

And finally, I think the focus of the report on encouraging Congress to hold hearings to better inform itself, like this hearing today, about what is necessary for congressional solutions, if any, to the challenges that we face in AI, particularly in manufacturing. I think that is important as well.

Mr. OBERNOLTE. Is there anything that you think we should have focused more on?

Mr. OXMAN. I think if I had to pick one area that more focus could have been on, it would be on how we can solve energy issues. I think you certainly touched on it in the report, but I think we have seen just in recent months since the report came out that energy issues have become more prominent, particularly for data center construction.

And I think we have an opportunity to look at this not only from the energy pathway side, but also the regulatory side, about permitting and the way in which energy is authorized for use for data centers for AI.

I think that is going to be an issue for U.S. leadership going forward, and I think that is going to be an important issue for Congress to focus on as well.

Mr. OBERNOLTE. Yes, I agree with you.

Ms. Humpton, I was very interested in the distinctions that you highlighted between industrial AI and consumer AI, and I really hadn't done a lot of thinking about this, but it certainly seems to me that the regulatory approach to those two technologies should be probably pretty different, given the differences and how tightly curated the trading data is for industrial AI and the more limited operating environment. It is much more controlled.

So what can you think—what would you say would be the differences in our regulatory approach to those two technologies? How is industrial AI different?

Ms. HUMPTON. Thank you, Congressman. As I mentioned earlier, we really do need to look at those key distinctions. It is going to be very tempting for the public to take one big paintbrush and sweep all of this into the category of AI.

If we can be very clear on those definitions, we can actually think through the key questions of trust and risk. What do we need to secure in order to maintain and build trust? Where do we see the risk areas?

We all know that consumer AI, we are running dramatic risks across our entire society. But with industrial AI, we have a very unique, controlled environment. I would be delighted for my team to further engage with you and your staff as——

Mr. OBERNOLTE. Great.

Ms. HUMPTON [continuing]. As you work forward.

Mr. OBERNOLTE. I would welcome that. Well, thanks to our witnesses. It has been a fascinating hearing.

I yield back.

Mr. BILIRAKIS. The gentleman yields back.

Now I will recognize Representative Clarke from the State of New York for your 5 minutes of questioning.

Ms. CLARKE. Thank you very much, Mr. Chairman, and I thank our ranking member. Good afternoon, everyone, and thank you to our witnesses for being here to testify. I know it may not have been easy to navigate through DC in this weather and political uncertainty.

I believe, as many of my colleagues on this committee do, that it is in our best interest to support the adoption of emerging technologies, like AI, in the manufacturing sector and that we should make the critical hardware that power AI tools, like chips, at home, right here in the United States.

That is why, unlike many of my colleagues on the other side of the aisle, I was proud to support President Biden and Democrats in passing the CHIPS and Science Act, a $53 billion investment in bringing semiconductor supply chains back to the United States.

All over the country, we have seen the benefits and successes of the CHIPS Act, not only supporting manufacturing and innovating at home, but also with the creation of over 115,000 jobs as of last summer.

My home State of New York has been a leader in the semiconductor manufacturing industry, and the benefits are showing. Thanks to CHIPS and Science Act, 34,000 New Yorkers are employed by semiconductor and supply chain companies.

The importance of supporting the domestic manufacturing of AI tools is undeniable and essential to our workforce and economy,

and that is why I remain committed to supporting the implementation and disbursement of CHIPS funding that uplifts the industry, national security, and our workforce.

While I am disappointed, I am not surprised to see the chaos of the current administration giving way to an unstable business environment that undermines the progress that we have seen in the American semiconductor manufacturing.

Illegal freezes, tariff threats undermine the work Democrats have done to modernize critical domestic manufacturing sectors.

Dr. Reynolds, can you speak to the steps Congress can take to support stability in the industry and further the progress we have already made?

Dr. REYNOLDS. Thank you, Congresswoman, for that question, and for also underscoring the importance of the CHIPS Act and its impact already on the U.S. economy and U.S. competitiveness.

I will mention as well that we now see that TSMC in Arizona is manufacturing four nanometer chips, frontier chips, out of Arizona for the first time in American history.

And this is a very exciting time for building the semiconductor industry in the country and ensuring that we have global competitiveness going forward and are not at the mercy of foreign adversaries and other countries.

In terms of how we take this work forward, I think first and foremost, as we have discussed, is we want to see the obligations that have been made already followed through and supported over time.

So while perhaps these obligations have not been expended yet, we know that we have important taxpayer interests involved in the payment of these CHIPS Act grants, the importance of the tax incentives.

We want to make sure that all of these important parts of the legislation passed in the last few years continue forward under the intention of Congress.

I think also that we are seeing, as you said, an enormous amount of momentum already at the State level. Whether that is in the CHIPS Act, around a number of places around the country, whether that is in the clean energy space, whether that is in other areas of manufacturing, it is very important for the Federal Government to be a partner in ensuring that those investments continue and that those partnerships help us in building out those investments and those clusters of excellence.

I think the importance of the U.S. strategy under this legislation was not just about a few projects here and there, but creating critical mass, and with that critical mass we develop globally competitive industries.

And our goal, of course, is to not only develop the expertise and provide the quality jobs but to export and to become a world leader in many of these areas, and we are on that path.

And through the creation of these new factories and facilities, using new technology that we have just discussed, we are now in a position to really be leaders in areas that we have not been and where we have been lagging in the past—so semiconductors, EVs, batteries, all of these areas where now the U.S. is really in a competitive position.

We may have lost in many ways on the generation—on the first generation of technology. You know, invented the technology here, it went elsewhere.

But now we are in a different position. Now we are in a place where the U.S. can actually compete and lead. And so that requires that we maintain these investments, that we support them on the ground, and that we build through a new generation for U.S. manufacturing.

Ms. CLARKE. Very well. Thank you so much for your response, and I thank all of our witnessesfor bringing the expertise to the table.

With that, I yield back.

Mr. BILIRAKIS. The gentlewoman yields back.

Now I will recognize Mr. James from the great State of Michigan. You are recognized for 5 minutes of questioning, sir.

Mr. JAMES. Thank you, Mr. Chairman. I would be remiss if I didn't recognize you for your leadership and also bestowing on me the very high honor of leading supply chain and manufacturing policy for the subcommittee in the 119th Congress.

So I look forward to working to make this committee proud and make America strong and great again.

I would also like to give Chairman Cruz a shout. I was pleased to hear the Senate Commerce Committee approved the Promoting Resilient Supply Chains Act, and I look forward to leading this bill in the House.

And I recognize the grand opportunity that we have in front of us to pass real, substantive policy to benefit the American people as it pertains to AI and manufacturing.

If we don't lead in AI, the Chinese Communist Party will have all the brainpower because they have stolen our IP. And they will have all the manpower because they are using slave labor to end western civilization without firing a shot.

It is simply not enough to close our eyes and hope for the best. We are in global competition with communist regimes that are hellbent on building their economy on the backs of ours.

AI in manufacturing here means not relying on goods made with slave labor, on brainpower stolen from Americans.

It means predictive modeling to reduce costs and risk in supply chains.

It means minimizing supply chain disruptions before they occur.

It means making people more productive, allowing them to upskill and businesses to upscale into the future.

This Congress I am also going to be launching bicameral and bipartisan Reindustrialize Caucus. This new caucus will serve as a natural convening body for Congress to engage with the broader ecosystems of sectors vital to national security, economic resilience, and global competitiveness, taking feedback from industry leaders and experts such as yourself.

We will increase manufacturing in a smart way. We will industrialize, and we recognize that folks are not afraid of the future, but we demand to be a part of it.

So in that vein, I am very concerned about our supply basis—our supply basis and the ability to keep up. Forty-seven percent of manufacturers view data fragmentation as a major obstacle to ef-

fectively implementing AI, while small and midsized manufacturers, which make up 98.6 of U.S. manufacturing firms, often lack the capital to invest in AI.

Can you speak, Ms. Humpton, on some of the suppliers who you rely on, the important nature for them to help you accomplish your mission, and also what the R&D tax credit would do for you and your suppliers' survival?

Ms. HUMPTON. Thank you, Congressman James, for the question, and I am going to share with everyone that Siemens USA has been localizing its supply chain for quite some time.

You may know us as the manufacturers of America's high-speed rail when Brightline West proceeds, and what we have built is a very robust supply chain that activates across 40 States whenever we build a train, as an example.

But we also believe that there is a trend going on here that we want to share with everyone: "glocalization," the idea that we can take advantage of global innovation but actually build and perform locally, closer to the point of demand.

And this is going to be a key concept for strengthening us here in the United States. The idea of incentivizing research and development is key because it is here that we are able to bring these concepts together. Now, one——

Mr. JAMES. So R&D tax credits are vital?

Ms. HUMPTON. Excuse me?

Mr. JAMES. The R&D tax credits are vital?

Ms. HUMPTON. We are looking forward to having tax credits that actually make the U.S. a net exporter to the rest of the world in innovation.

Mr. JAMES. Perfect. I would like to piggyback on another one. You operate the largest digital twin in the world for the Navy. Can you tell me a little bit more about that and how AI will help address the bottlenecks in the defense industrial base, in about 30 seconds, please?

Ms. HUMPTON. In 30 seconds, what I can tell you, the world's largest digital twin is the digital twin of the Navy's shipyards.

How do we get a bigger Navy? We do it by making sure that ships spend less time in repair, maintenance, and overhaul.

How do we do that? We have to redesign the process in the shipyards. The digital twin that Siemens has been supporting the Navy with, at first look, there were notions about what do we need to do to fix the problem.

By using a digital twin, the team was able to discover that what they thought were the bottlenecks were not. We would have spent billions of dollars solving a problem that didn't solve the bottleneck problem. The digital twin——

Mr. JAMES. Perfect. Sounds like a great technology to bring to Michigan to help us build ships.

Mr. Oxman, we hear the demand for more computing power and data center processing to service AI is going to increase. Can you give us a heads up on permitting reform, all-of-the-above energy production, and maybe cite a couple of the unworkable environmental regulations that might hinder the energy required for this AI revolution?

Mr. OXMAN. Thanks, Congressman James, we definitely need an all-of-the-above energy solution for data centers. Data centers power the AI revolution that is taking place in the U.S., and you are absolutely right to highlight hindrances to the rollout of energy to supply those data centers.

An all-of-the-above energy solution will support the construction of data centers and make sure that there is not too much of a burden on the existing grid.

The biggest obstacle by far is the one you highlighted—the local, the State, the county permitting requirements that hold up the deployment of energy. And we are looking forward to working with you on making sure that those challenges can be addressed so we can move forward with the energy solutions that data centers need.

Mr. JAMES. Thank you.

Mr. Chairman—and I don't have a Lincoln story as well—but my youngest son turns 6 today, so I am going to go FaceTime with him.

Mr. BILIRAKIS. Oh, happy birthday.

Mr. JAMES. Thank you so much for your leadership. I yield.

Mr. BILIRAKIS. Great. Thank you.

All right. Now we will recognize Representative Dingell for her 5 minutes.

Mrs. DINGELL. Thank you, Mr. Chairman, and I look forward to working with you, Ranking Member Schakowsky, and all the members of this subcommittee on this issue because it really is one of the most important issues facing us in this country—how do we ensure that America stays at the forefront of innovation and technology?

And I want to thank the witnesses, many of whom I have worked with, some who have workers in my district, and I want to increase those workers and keep them building.

Over the last several years, we have made real progress advancing policies that strengthen our manufacturing sector, foster innovation, and create jobs.

I am deeply concerned about where things are headed, though, in this Congress. It is only February, and we have already seen too many actions that have been done by this new administration, and maybe Mr. Musk, seem an attempt upon dismantling our Federal Government and ceding American leadership to our adversaries.

This is more than troubling, and I hope my colleagues will help us keep the United States at the forefront of manufacturing innovation on the global stage before it is too late.

Last Congress, this committee worked in a bipartisan manner on supply chains. We passed the Promoting Resilient Supply Chains Act in the House, which included several provisions I helped colead, and we reached bipartisan, bicameral agreement on a supply chain provision to be included in the end-of-the-year continuing resolution, which has been removed when Mr. Musk tweeted his opposition to that very carefully negotiated bill.

Strengthening our supply chains is critical for our industrial base, for our economic security, and our national security. The Federal Government must have the tools to prevent vulnerabilities from escalating into full-blown crises.

I am also concerned about efforts to roll back investments from the Inflation Reduction Act, especially the 45X tax credit, which has been vital in driving domestic manufacturing and innovation, and where I come from, particularly in the auto industry.

Everyone—everyone—has told me that these incentives are critical for our global competitiveness. One of the backbones of American manufacturing is the auto sector.

We have seen the devastating consequences of uncertainty and divestment on manufacturers and suppliers. We have got to bring our supply chains home—and not just steel and aluminum and autos as we are talking about, but pharmaceuticals and many others.

We should not be producing 80 to 90 percent of our medicines overseas. That is a national security issue.

For decades, poorly negotiated trade deals, the outsourcing of jobs have hollowed out our industrial base, and at the same time the rise of automation has cost many workers their livelihoods.

Yes, innovation is critical, and we have got to lead, but we have to be honest about the impact on workers and ensure that progress does not come at the expense of the middle class. We cannot leave labor behind.

As we look to the future of advanced manufacturing, labor must have a seat at the table and have access to the training and tools necessary to develop the skills they need to help the companies they work for compete in the world of advanced manufacturing.

And we, as the Federal Government, have a duty to protect American manufacturing and its workers. As we have seen, doing so is instrumental to our national security and economic vitality.

Mr. Kinder, can you speak to the importance of passing bipartisan Federal supply chain legislation in this Congress? And fast, because I went too long.

Mr. KINDER. Thank you, Congresswoman Dingell, and thank you for representing so many of our employees in your district.

We are—I don't know what you are specifically referring to on supply chain legislation. Like I say, the supply chain—and particularly small and medium-sized manufacturers who populate that supply chain—are the backbone of the manufacturing industry. They create jobs in every district.

Those manufacturers struggle to make investments in digital transformation and in AI. And to the extent that, you know, this subcommittee and to the extent that Congress can come together to help strengthen that segment of the supply chain, that is going to be positive for the manufacturing sector.

Mrs. DINGELL. Thank you.

Dr. Reynolds, tell us how important labor is in the advanced manufacturing conversation.

Dr. REYNOLDS. Thank you, Congresswoman. Well, of course, labor is essential. We are unable to make any of these products. A lot of people like to talk about the lights-out factory, but what we say at MIT is a lights-out factory really can't innovate. We need our workers to be able to do that.

Currently manufacturing jobs represent just under about 10 percent of all jobs in the economy, but they come with a very large multiplier effect, very important for the economy.

And they are also tied to technologies and industries of the future, and they underpin the economic growth and prosperity for the country. Whether that is in transportation, in energy, or in manufacturing, we see our industrial systems really throughout the economy relying on our workers.

And we know that manufacturing can provide career paths and quality jobs. Our challenge in this country has not been about creating new jobs and the quantity of jobs. It has been about the quality of jobs.

And so I think that the fact that we are thinking about and talking about how can AI augment workers and support workers is really the first step to making sure this technology helps workers through increasing productivity, which can also lead to increasing wages.

As it stands right now, our small and medium-sized firms are struggling to adopt this technology, to find workers, to pay their workers, and we can find a path forward that invests both in technology and in workers for the country.

Mrs. DINGELL. I obviously yield back. I would like to submit some questions for the record, Mr. Chairman.

Mr. BILIRAKIS. Next, we will recognize Mr. Fry from the great State of South Carolina. Thank you again, and welcome to the committee.

Mr. FRY. Thank you, Mr. Chairman, and thank you for your leadership on this issue.

Good afternoon to our witnesses. I really appreciate the professional discussion in which you are informing us. I think that partnership is absolutely needed as we launch into this brave new world called AI.

Back home in my district in Florence, South Carolina, GE HealthCare manufactures some of the best MRI machines and systems in the world. These systems are used to provide high-quality patient care in the U.S. and around the world, and they leverage AI to enhance imaging speed and quality, helping doctors make faster and more accurate diagnoses.

But AI's impact extends far beyond just healthcare. It is improving forecasting, planning, and process optimization at GE HealthCare's manufacturing facilities, ensuring efficiency from the production line to the supply chain.

And it is not just changing manufacturing. It is really redefining our economic future, as you have testified to. It offers unprecedented opportunities to strengthen American industry, enhance our global competitiveness, and secure our technological future.

But to fully realize these benefits I think we must ensure that policies support rather than stifle AI innovation. And as we discussed today, I look forward to hearing from our witnesses on how we can do that.

Ms. Humpton, thank you for being here today. Siemens has operated not only across the U.S., but really in a global market and across the globe.

Do you find—with all the States and all the different countries and all the different approaches in which they are treating AI, do you find that regulatory uncertainty or fragmented legal require-

ments, do you find that to be cumbersome for U.S. manufacturers to adopt AI?

Ms. HUMPTON. Thank you for the question, and I think my team, who has joined me here today, would tell you they are burning a lot of calories trying to track everything that is happening at the Federal, the State, the local level, and with regulation, you know, obviously regulation being formed all around the world.

This is why we are thrilled that the Congress has invited industry to the table. We really believe that, as responsible businesses, if we raise our voice in this environment, we can help the Congress understand what we know.

But the thing that we really appreciate from the Congress is a better understanding of the risks we face as a Nation. So this sharing of information is vitally important right now.

Mr. FRY. Absolutely. Thank you so much.

Mr. Oxman, you have discussed how AI could strengthen our supply chain resilience and improve operational efficiency for our manufacturers.

But the regulations like the Bureau of Industry and Security's AI diffusion rule have raised concerns about unintended consequences on U.S. innovation and global competitiveness.

How should Congress and the administration approach AI-related regulations to protect our national security without hindering that very vital private-sector innovation?

Mr. OXMAN. Thanks, Congressman Fry. I am glad you mentioned that AI diffusion rule, because that is something we were very disappointed to see happen in the waning days of the Biden administration.

The good news is, there is an opportunity, there is an open rulemaking, and the Trump administration can make that rule better.

These are complicated issues. Protecting national security is obviously vital as we look at opportunities to continue global leadership by the U.S. in AI.

So our hope is that the industry collaboration that we will see in the coming weeks and months will lead to a better rule than was adopted the first time around, and that is particularly important because, as you noted, these supply chain issues are also supply chain security issues.

So we need to make sure that American manufacturers have access to everything they need to build and grow the economy here, but we also need to make sure that vital American national security interests are protected overseas.

And we are looking forward to working with the administration on striking that balance and working with Congress to make sure that there's proper analysis here as well to make sure that balance is struck.

Mr. FRY. Thank you for that.

Mr. Kinder, you talked about this with my colleague, Mrs. Dingell. What do you think the biggest challenges are for SMEs right now as it relates to AI?

Mr. KINDER. Thank you for the question.

Small and medium-sized enterprises, you know, they face global competition, and they need to invest to stay competitive.

They need to be able to invest in digital transformation, they need to be able to invest in AI, and, you know, switching costs are high. So they have systems that are in place now that they are using. Those switching costs are high.

The thing that can help them most is support from Congress, either whether it is access to capital, whether there could be some incentives or tax credits. It would help them to make that investment, be willing to make that investment, to leapfrog and be competitive.

Mr. FRY. All right. Thank you.

Mr. KINDER. As long as they are competitive, the even larger manufacturers they work with will benefit.

Mr. FRY. Great, thank you, and just to wrap up, what is Autodesk doing? I think one of the concerns that I hear from my constituents is bias that might be in AI.

What is Autodesk doing to ensure that AI is safe and not biased?

Mr. KINDER. Yes. I mean, similar to, I think, what Siemens is doing on industrial AI, we train on very specific datasets that are around the manufacturing process. We don't run into some of the probably—the concerns around bias of large, public datasets where you don't know where that may be coming from.

Mr. FRY. Thank you for that.

Mr. Chairman, I yield back.

Mr. BILIRAKIS. I thank the gentleman and now recognize Mr. Veasey from the great State of Texas. You are recognized for 5 minutes for questioning.

Mr. VEASEY. Mr. Chairman, thank you.

You know, one of the great things that have happened in the Dallas-Fort Worth area is that we have really emerged as leaders in this area, to lead manufacturing facilities and operations in this new cutting-edge technology that we are seeing.

And I think it is really part of a generational shift when it comes to the future of domestic manufacturing, and it is amazing to see it right in your own backyard.

And I think that long-term that we are going to see continued investments in the DFW area that are going to make the United States keep its competitive edge in innovation against global competitors, and obviously artificial intelligence is going to be a really big part of that.

However, we also have to acknowledge that there are some risks involved with AI that we need to continue to be talking about, that we are not mentioning enough.

And if we think that social media is out of control, I can tell you that AI will even be more dangerous if we don't make sure that we are taking these protective measures to make sure that middle-class, hardworking Americans don't become left behind.

And, unfortunately, one of the things I am worried about is President Trump's recent Executive order, titled, "Removing Barriers to American Leadership in Artificial Intelligence," because I think that has undermined some essential AI protections that are accelerating the unchecked spread of AI across the country.

And so I wanted to ask Dr. Reynolds, what measures do you think Congress should take to mitigate the increased risk of cyber

attacks and other threats to our national security as manufacturing increasingly adopts to AI without sufficient regulation?

Dr. REYNOLDS. Thank you very much for the question, Congressman. Certainly the concerns about cybersecurity have been around for several years and have been escalating, and particularly in our manufacturing base, which has been most directly attacked.

So I think that the issue has been elevated, and I think there is bipartisan concern about how we address this.

How actually we go about doing that is another question, and I think you have heard a range of comments here this afternoon about exactly what the role of government should be.

My hope is that we find a path forward that is going to accelerate our investigation and our research in this area but also find a pathway forward in which cybersecurity is front and center, but also the issues you raise—whether it is privacy, protection of minors, security of information for the consumer, et cetera—those are critical issues.

And I think at this point in time, we have had a lot of discussion and debate, but we need to find a collaborative and bipartisan path forward which is going to protect not just the consumer and the worker but also our manufacturing base.

Mr. VEASEY. Yes. No, absolutely. And also, I want to talk about energy use—AI and energy use. That has gotten a lot of attention, and it should.

Last year I visited Siemens. They have a new facility in my district in Fort Worth, and I understand that Siemens' digital twin offerings can provide real-time insights into the energy usage of various components in the data center.

But I am worried that if we don't reform our permitting process to allow energy of all forms to be generated and put onto the grid, that there are going to be risks to constituents in the manufacturing sector.

I wanted to ask particularly, Ms. Humpton, do you think that that is something that we should be concerned about?

Ms. HUMPTON. Congressman Veasey, we were thrilled to host you at Fort Worth, and I have been bragging today about this as a real illustration of the power of AI in not only building but in staffing, training our staff, and bringing people from outside the manufacturing world into manufacturing in Fort Worth.

The power that is going to be required for AI is absolutely essential, and actually technologists like us, but in particular Siemens has been working in the field of electricity management for almost our entire existence.

And what we have right now is a brilliant opportunity to use AI as we solve this problem. We do need to use new techniques like microgrids, the ability for people to generate power onsite, perhaps sell it back to the grid when they are not using it, the ability to control those microgrids for maximum up time.

The AI that is available now in the energy sector is very exciting, and we have been working with—very closely with the Department of Energy and with several administrations to make sure that we are making these things visible and available.

So I do believe that we need to consider both the AI itself as well as the power provision.

Mr. VEASEY. Thank you very much.

Thank you, Mr. Chairman.

Mr. BILIRAKIS. All right. Thank you, Mr. Veasey. I appreciate he yields back, and now we will recognize Ms. Lee from the great State of Florida, Tampa Bay area. And she is doing a great job representing my former constituents. So I will recognize you for 5 minutes of questioning.

Ms. LEE. Thank you, Mr. Chairman. It is, indeed, big shoes to fill in Pasco County.

Ms. Humpton, thank you very much for being here today and for providing your testimony. Your perspective on artificial intelligence empowering employees really resonates, I think, with many of us on this committee. There is a fear that AI will replace the American employee, but I agree with you that we need to look at AI as an assistant to the American manufacturer rather than its replacement.

Can you provide some examples of how Siemens is using AI in manufacturing and supply chains to help its workers do their jobs more effectively and productively?

Ms. HUMPTON. Thank you, Congresswoman Lee. And, yes, this is really fun, because there are a couple of fantastic stories here.

Imagine a couple of engineers thinking that they want to design a light motor to be used in aviation, electric aviation. What you have to do is take weight out of the motor. How are you going to do that?

What these engineers did is they collaborated. They were debating back and forth. They were going to have votes on the team of who had the better design for one element.

And one member of the team said, "Well, why don't we ask our generative design assistant?" And it turned out that assistant drew a picture that was unlike what either of the expert engineers had come up with, and in fact its performance was better than what could have been designed using paper and pencil.

Now, let me tell you another funny story. We work with battery manufacturers all the time, and I met with one startup about 18 months ago. And the president of the company was telling me about his new U.S.-based factory that he was getting ready to build.

I asked him if he had used a digital twin to plan that facility. And he said, "No, I have done something even better. I am actually building a scale model. We are going to have just one-line, small-scale production."

I saw that same CEO several months later. And he said, "Barb, I should have gone the digital route. When I built it, I forgot to put in any overflow area, and so anytime one part of the line stopped, we had a mess on our hands."

These are just examples of the kinds of things that come up where the use of AI can actually elevate the results that we get. And that is not to mention the things that are happening every day.

We have operations that require intensive stocking and restocking, and, frankly, that is drudgery. But the ability now to use artificial intelligence to help us plan that work, plan the movement

of goods through our factories, we are making our own factories safer, more productive and, frankly, just plain more fun to work in.

Ms. LEE. Thank you, Ms. Humpton.

Now, Mr. Kinder, I want to first congratulate you on the grant that Autodesk received from my alma mater, the University of Florida, to advance the field of industrialized construction engineering.

As I understand it, this work will dramatically reduce construction cost while doubling the speed of construction, and I look forward to seeing what this partnership can accomplish.

Could you tell us about how Autodesk's software makes manufacturers more resilient and ready to adapt to supply chain disruptions, inflation, and other things?

Mr. KINDER. Thank you for your question, Congresswoman Lee.

We are incredibly excited about the project with the University of Florida. Industrialized construction is something that we have supported for a long time. It is basically bringing manufacturing practices and the efficiencies of that into the construction process, which does save time and money.

When you talk about industrialized construction, we are talking about building some things off site and then bringing them and assembling them on site. We talk about taking software, including AI, and bringing manufacturing software, the HVAC system in the building, you know, into the architectural software and combining those. Historically, those have been very disconnected.

So all of this drives efficiency. And, when you add AI on top of that and digital twins, it becomes a much more efficient process.

Ms. LEE. And in addition to the added efficiencies that you describe, how can the use of artificial intelligence in this way also foster innovation?

Mr. KINDER. We have a capacity challenge in the U.S. in terms of a shortage of skilled labor and manufacturing jobs that are unfilled.

AI, by taking some of the drudgery, as described or some of the more mundane or tedious, low-value-added tasks, by automating those, you augment the worker. So you are augmenting the worker, freeing up some of their time so they can focus on much more creative and more productive tasks.

Ms. LEE. Thank you.

And, Mr. Chairman, I yield back.

Mr. BILIRAKIS. I thank the gentlewoman.

I now recognize Representative Trahan for her 5 minutes of questioning.

OK. Well, Ms. Kelly will go first. Thank you. You are recognized.

Ms. KELLY. Thank you, Rep. Trahan. And thank you to the chair and ranking member for holding this very important hearing to discuss the importance of AI's role in the future of American manufacturing.

Last Congress, I joined former Rep and now U.S. Senator Lisa Blunt Rochester and Reps Dingell and Wild in coleading multiple bills to make up the supply chain act, which garnered the support of over 160 stakeholders.

These vital bills would have established a new office within the Department of Commerce charged with monitoring supply chains,

identifying supply chain gaps and vulnerabilities, as well as addressing supply chain risks. Unfortunately, many of these critical provisions were pulled from the bipartisan continuing resolution that failed to receive a vote.

Dr. Reynolds, based on your experience with the supply chain shock during the pandemic, do you agree that it is important that the Federal Government take a leading role in mapping and monitoring supply chain vulnerabilities?

Dr. REYNOLDS. Well, thank you, Congresswoman. It is an important question and one that I lived and breathed for my couple of years in the White House. I still have PTSD, I think, from the experience.

But what we learned from that experience at the beginning of the COVID crisis was that, in fact, maybe the U.S. Government did not have sufficient information—we knew that—about supply chains2, but what was more disturbing is that the private sector didn't have the information either.

When the semiconductor crisis hit and we brought in a lot of the semiconductor companies or leaders in auto and medical devices, they themselves were not clear what their supply chain looked like and what the semiconductor industry, you know, in supply was facing.

So it really underscored the role of government here, that there is an important role for the Federal Government to play, to try and collect the data, obviously, in a way that is respecting privacy, to disseminate the data, and be able to look around the corner at what the next vulnerability will be.

And so, while we have really made, I think, significant progress on that, we have to realize there is a long way to go. And I applaud the work that you have done and the creation of more capabilities at the Federal Government level to do this.

If we think about the recent crisis we had after Hurricane Helene hit and all of a sudden the one facility that produced IV fluids in this country was wiped out, was that something we could have predicted ahead of time? Would we have known that that was a challenge? And, in fact, I think AI, generative AI will be helpful for us to understand our supply chains and our vulnerabilities.

So I think it's an incredibly important area. I think we now look at the U.S. economy in a way that we never did before, through the lens of supply chains, and I applaud that work.

Ms. KELLY. Thank you. Illinois has a history of manufacturing, as one of the largest manufacturing centers in the Midwest. Chicago and other parts of my district became a hub for trade and commerce due to its access to strategic waterways and railroads.

I believe that Illinois' history, coupled with existing infrastructure to accommodate large industrial sites of manufacturing facilities, will ensure the State has a major role in the U.S.' effort to increase domestic manufacturing. But to accomplish this goal, we must ensure that small and medium-size manufacturers can compete.

And, Dr. Reynolds, in your written testimony, you mention that there are 250,000 small and medium-size manufacturers in the U.S. and that we need financial incentives to help them make the leap into digital manufacturing.

What are your best arguments for why, in this budget-constrained environment, we should invest more Federal funds in small and medium-size manufacturers?

Dr. REYNOLDS. Yes. We have been talking about the role of the SME as the backbone of manufacturing for this country. And I bring that statistic forward, the 250,000 small and medium-size firms in the country. If we just wanted 20 percent of those to be digitally advanced and leading the country, that is 50,000 small and medium-size firms. And right now we have no way of reaching those firms through any direct mechanisms.

So what we have to really think is creatively, how do we try and support those firms at scale? And I think the argument here is that we know that our small and medium-size firms are less productive than our larger firms.

And the positive spillover effects that happen if we can get them to become more productive are important not just for national security, which would be the first argument you made. We have a shrinking supply chain base, and our defense industrial base is really suffering from that.

To the extent that the DoD highlighted in its national industrial strategy report last year, supply chain resilience among our SMEs is critical for them. But we need that not just for defense and national security purposes but also for the supply chain resilience.

As we are looking at ways in which we are trying to invest in resilience, not just efficiency, we really have to see how our small and medium-size firms play into that and how we can support them in being more resilient.

Ms. KELLY. Thank you. And I am out of time. I yield back.

Mr. BILIRAKIS. I thank the gentlewoman.

Now I will recognize Representative Kean for his 5 minutes. Welcome to the committee.

Mr. KEAN. Thank you, Mr. Chairman.

And thank you to our witnesses for being here today.

In an era of innovation driven by emerging technologies such as AI, it is essential that the Federal Government support equally innovative policy solutions to maximize the benefits of this technological growth but also allow businesses to innovate to stay competitive.

A successful program in New Jersey has been the Manufacturing Extension Partnership. This public-private partnership with centers in all 50 States was dedicated to helping small and medium-size manufacturers grow and to compete.

Ms. Humpton, as a large manufacturer provides critical technologies and tools to a company, what policy tools should Congress consider prioritizing the needs of smaller and medium-size manufacturers who need access to AI-enabled technologies to optimize their operations and to drive their long-term success?

Ms. HUMPTON. Congressman Kean, thank you. And we are so proud that our research headquarters are located in Princeton, as well as many of our headquarters functions are in the Iselin area.

The role today of public-private partnership is key. How do we reach those small and medium enterprises at scale? We know that we have a lot of people, you know, working on that problem.

I believe the work of the manufacturing institutes has been critical to progress. And so we alone participate in six or seven of the manufacturing institutes, with the goal of bringing technologies into an environment where others, including small and medium enterprises, can actually experiment and adopt.

One of the things that business can do is to actually look at the way technology is provided. We have done an analysis and have determined that we need new licensing structures, for instance, for small and medium enterprises so that they can afford the entry level, you know, to get into the same toolsets that large enterprises are using.

I do believe that a critical piece, then, to cap all of this and tie the workers back in is the network of community colleges across the United States can be an excellent partner in scale.

Mr. KEAN. They are crucially partners in that regard. I agree with you on that.

Mr. Oxman, as you know, there have been ample conversations regarding preparing the AI workforce. What do you recommend that we as Congress do to position ourselves to better remain competitive amidst the growing technological landscape?

Mr. OXMAN. Thank you, Congressman Kean. And I also want to thank you for your sponsorship to the LIFT AI Act, which is focused entirely on this very important issue. The technology industry is laser focused on finding top talent and filling hundreds of thousands of open roles and making sure that American workers are trained for those opportunities.

And what we look forward to working with you on in the new Congress is opportunities to partner industry and government together. The LIFT AI Act, what was great about that is it was focused on the National Science Foundation funding research opportunities, grant opportunities, educational opportunities for STEM education.

And we would like to work with you on that as well again, because that is the important key to making sure we have an educated, AI-enabled workforce.

Mr. KEAN. And thank you for that partnership, and look forward to continuing to work with you.

Last month, several of your member companies announced a multibillion-dollar investment in a Stargate project over the next 4 years to build AI infrastructure, which will power future-generation AI technologies here in the United States. This is an exciting development for job growth, future innovation, and shows another example of U.S. leadership in AI development.

Can you discuss how this project will catalyze U.S. economic and AI growth, and what are the direct impacts on U.S. manufacturing?

Mr. OXMAN. This is such an exciting announcement. It happened on just the second day of the Trump administration. The President had leaders from three ITI member companies—OpenAI, Oracle, and Softbank—at the White House to announce it.

It is a multihundred-billion-dollar investment in building these incredible data center campuses. The first one that has been announced has been in Texas, but there are announcements pending in multiple States around the country.

This is going to cement AI leadership in the United States, and it is going to create just in the first announced campus 40,000 jobs. That is what OpenAI predicts will happen. And it is going to be a partnership across the entire AI ecosystem that will eventually create hundreds of thousands of jobs.

And, as I mentioned, they are targeting $500 billion worth of investment in the United States. So this is a great opportunity, another great example of how AI and manufacturing together can really partner and grow the U.S. economy and create incredible jobs.

Mr. KEAN. Thank you. And I yield back my time.

Mr. BILIRAKIS. I thank the gentleman.

Now I will recognize the ranking member of the full committee, Mr. Pallone, for his 5 minutes of questioning.

Mr. PALLONE. Thank you, Mr. Chairman. I am deeply concerned that the chaotic and destructive environment being created by President Trump and congressional Republicans is costly for consumers and for businesses, including manufacturers.

American manufacturers are working hard to modernize their facilities by adopting AI and other new technologies and training their workforce to meet the demands of advanced manufacturing. And many of them rely on Federal financial support, tax incentives, and other Federal programs to make this transition possible.

But, instead of continuing to promote our vital manufacturing sector, President Trump and his billionaire friends are sowing seeds of destruction, illegally halting Federal funding across the Government, and thrusting our Nation into nonsensical trade wars with our allies.

So, Dr. Reynolds, I have three questions. I will try to get them in the 4 minutes.

How have the programs, investments, and tax credits created by the Inflation Reduction Act, CHIPS and Science Act, and the Bipartisan Infrastructure Law enabled American manufacturers to compete in the global economy, if you will?

Dr. REYNOLDS. Thank you, Congressman.

And I agree with you that, for all of the great investments and the progress we are making in our advanced manufacturing, we also have experienced in the last few weeks a lot of uncertainty. And uncertainty is bad for business, it is bad for planning, it is bad for U.S. manufacturing.

But these investments that have come through the different parts of legislation have really sown enormous amounts of investment and opportunity going forward. Particularly the use of tax incentives, I think, has encouraged private-sector investment and leveraged numbers that we have discussed already that have been very important.

Those investments are just getting underway. We have at least a decade ahead of us of watching them come to fruition and bring jobs and investment in communities across the country.

And I think it is in industries that not only are important for the country in terms of national security and supply chain resilience but also in terms of export opportunities, places where the U.S. can lead globally and where we haven't historically.

Our companies have been put between a rock and a hard place over time, over decades. On one side, we have actors, such as China, who are engaged in sort of nonmarket activities that have made it very hard for our manufacturers to compete. On the other hand, we have investors who are looking for short-term returns from our manufacturers without a long-term view.

We now have an opportunity through this legislation in which we have invested in the long-term capabilities of manufacturing in the U.S. And this is an inflection point, a moment for the U.S. in which we can lean in and lead globally in these areas.

Mr. PALLONE. Well, I am going to compress my last two questions into one. You mentioned tariffs, and this is, of course, one of my concerns, that the President and Republicans are raising costs for American families who are already struggling by throwing the United States into trade wars with these tariffs for our closest allies: Canada, Mexico, European Union.

So can you discuss the importance of preserving trade relationships with our close allies for access to intermediate goods and external markets for finished products, if you will?

Dr. REYNOLDS. Well, of course, there are appropriate places for tariffs, when it comes to national security, when it comes to unfair trade practices.

But, when it comes to our largest trading partners and allies, it is really not the right place for the use of these tariffs. I think it raises a number of issues. First, of course, it creates this enormous amount of uncertainty. We have seen our manufacturers have to, you know, have whiplash over whether they were going to see major tariff impositions on Mexico and Canada, and then to have that paused. It is costly to the economy, it is costly to our manufacturers.

Second, as you said, it raises the price of intermediate goods, and it is not just for some industries. It is for all of our manufacturing industries. And so that kind of cost not only makes them less competitive, it also puts at risk our manufacturing jobs.

Third, I think it is important for us to recognize that we have had trade agreements that we have all come around with our allies, Mexico and Canada, and that, if you break those trade agreements, you are losing the trust and you are losing credibility long term. I think it also makes it harder for us to sell our end products, our finished goods in those markets.

And it is important to understand as well that we have built a manufacturing ecosystem that not just ends at our borders, it is a North American innovation ecosystem, and it is one that the auto industry in particular benefits from.

Just as a reminder: Mexico supplies about 42 percent of our intermediate goods in our auto industry, and Canada supplies around 13 percent. So it is very hard to imagine that you are putting tariffs on some of these partners who actually are part and parcel of our auto industry.

Mr. PALLONE. Thank you. Thank you, Mr. Chairman.

Mr. BILIRAKIS. Appreciate it very much. The gentleman yields back.

Now I will recognize Representative Evans from the great State of Colorado. Welcome to the committee. And, also, I enjoyed our

conversation on this very subject yesterday. So I recognize you for 5 minutes for questioning.

Mr. EVANS. Thank you so much for that, Mr. Chairman. I enjoyed the conversation as well.

Thank you to the ranking member. And thank you, of course, to all of our witnesses for coming on this snowy day to have this conversation.

Mr. Oxman, I will start with you first. We have talked a lot about competition with China and the CCP. In my district, I have a company that uses AI both in the manufacture and the deployment of technology that is used to stabilize suspended loads. So, right now, it is predominantly used for helicopter rescue hoists, military search and rescue, things like that.

But this technology can also be applied to critical infrastructure around, for instance, cranes, port cranes, cranes for construction. And so I think most of us are probably familiar with some of the risks of the U.S. relying on Chinese cranes for that critical infrastructure.

And so my question to you is, what role does AI play, both in being able to protect and harden some of our critical infrastructure from malicious attacks abroad, and how can we best protect and promote that intellectual property rights and keep that from being compromised by some of our foreign competitors?

Mr. OXMAN. Thank you, Congressman Evans, for the question. This is actually the topic that I think the Trump administration is spending some of the most time on, with the very early release of the AI Executive order and the recent announcement from the Office of Science and Technology Policy opening a request for input, for inquiry from industry into AI rulemaking.

We are very pleased to see this early attention to this issue because, as you noted, there are critical national security implications of making American AI technology available internationally. But we have to balance that with the need to address international markets and give American companies the opportunity to sell around the world to the 95 percent of the people who live on the planet who don't live in the United States.

So you are right that these are critically important issues. And that balance of national security and economic interest is one that is very important and very challenging, because we do want to make sure that these use cases of AI that we have talked about today are available here and also available to our allies.

As you noted, AI can be a critical tool in cybersecurity defenses, for example, augmenting human capability and making sure that we are hardening our networks and our infrastructure against potential adversaries.

So I think all of these issues are critically important. It is heartening to see the Trump administration paying such close attention and soliciting industry input, and we look forward to working with you on these important issues as well.

Mr. EVANS. Thank you.

Moving on to Mr. Kinder, in your testimony you talked a lot about the use of AI in manufacturing. And we oftentimes hear when we are having this conversation that oil and gas levels in the U.S. are at record level productions. But I know from conversations

with my local electric utility that we are going to need—at least in my area, we are going to need three times as much electricity as currently produced right now to meet some of the growing demands for digital and for AI purposes.

And so my question to you is specifically with regard to energy availability, what can Congress do to help ensure that the United States and not our foreign adversaries remains the global leader both in AI and also in the manufacturing that AI supports?

Mr. KINDER. Thank you for your question, Congressman Evans. With respect to energy, AI will use a tremendous amount of energy.

I think what Congress can do is to both strengthen the grid, establish policies to help us to strengthen the grid, and also help us to find all sources of energy production—renewable, nonrenewable—to be able to power.

Now, I would also add that we are in a stage right now where I believe chips will get more efficient. I believe the training of models will become more efficient, and the energy use will become more efficient in AI. We are still in early days in terms of training a lot of these models.

Mr. EVANS. Thank you.

And then last question to Ms. Humpton. You brought up one of my favorite topics, which is microgrids and using AI to be able to implement. We were just talking about that all-of-the-above energy policy.

So can you just talk a little bit more about how AI can be used when you have rooftop solar panels that are feeding electricity into the grid. Then the cloud cover rolls over, the temperature drops. Now the heaters kick on, and in the space of just a few minutes, now you have electrons flowing the other way to now powerhouses that used to be powering the grid, but now it is going the other way.

Can you talk about the complexity of managing the grid and AI?

Ms. HUMPTON. Thank you, Congressman. This is my favorite topic. I actually think this is the most exciting segment of the U.S. economy right now, is the grid edge, right, where the old-fashioned grid and its transmission and distribution meets all those users. Well, now all those users of electricity can also produce electricity, everything from our cars to our homes to our carports.

So the idea of using the power of software, with large utilities now using software to manage the flow across their distribution networks to even now the smallest users.

My mom put rooftop solar on her house. She sells back to the utility when she has extra and she buys when she needs to, and she has the lowest electricity bills she has ever had.

These are simple concepts, but they are complex when they come together into basically what the National Academy of Engineers called the greatest invention of the last century: the grid. It is a very complex organism.

So I think the work of Congress to ensure that we support the administration in finding ways to trim back regulation that prevents us from being able to make changes, the attention to technologies and the ability to educate policymakers—and, by the way, Siemens stands ready to work side by side with you. This is exciting times.

Mr. EVANS. Thank you so much. I yield back.

Mr. BILIRAKIS. The gentleman yields back.

Now I will recognize Representative Trahan for her 5 minutes of questioning, and I appreciate her patience.

Mrs. TRAHAN. Thank you, Chair Bilirakis.

Good afternoon, everyone. Although I am not sure that we are always going to reach agreement in this committee on a whole host of issues, I think everyone in the room absolutely agrees that America needs to lead the world on advanced manufacturing and artificial intelligence, especially with the constant geopolitical threats to our supply chain.

Stability and reliability in public-private partnerships is vital to ensure that American businesses can plan for the long term and trust that the Government will be there to build out programs to foster these types of partnerships, the CHIPS and Science Act, the Infrastructure Law, the Inflation Reduction Act.

You know, in my district in Massachusetts, I have seen the powerful impact that those strong public-private partnerships can have on stimulating the local economy and onshoring high-paying jobs. And, when done together with groundbreaking research institutions, like UMass Lowell, those programs are one of the best ways legislators can work to increase American competitiveness.

Dr. Reynolds, how does direct investment in public-private partnerships accelerate the onshoring of manufacturing? I know you have answered this question, but I wanted to set the stage.

Dr. REYNOLDS. Sure. Thank you very much. It is a great question, and appreciate that, particularly coming from the State of Massachusetts, which is really a leader in these kinds of partnerships.

What we have seen, of course, is that some of our best innovation is coming out of the university partnership that occurs between universities and investors and basically the larger ecosystem in a place like Massachusetts.

And those innovations are leading to some of the most advanced new technologies as well as startups. And our hope in developing that kind of investment and building up that pipeline is that in fact we grow these companies, we grow these technologies, and they become global leaders for the country and for export.

So we have a lot of great examples of how we do this. I think the investments that we have seen to date in university research, in early stage research, is critically important for driving some of the later developments. We saw it, of course, with the COVID vaccine.

Mrs. TRAHAN. Absolutely. I don't know if you could just follow up. How are those manufacturers affected when sudden changes, like a blanket Federal funding freeze, are announced? I mean, I am hoping that you can just describe the impact that that kind of unpredictability has on the investments in these partnerships or deter even private-sector engagement in those ongoing efforts.

Dr. REYNOLDS. Well, I think that we have talked to date about the importance of certainty and predictability in the business context and what it means for firms as they decide what to invest in and when to make those investments that they can see ahead. And

it certainly has been an uncertain few weeks here in the United States.

I think that is also the case when it comes to collaborators and partners like universities. Budgets are laid out years in advance. The importance of building up labs and building up the knowledge base and capabilities in a lab does not happen overnight. It happens over years. It is also very expensive to build that kind of capability.

And so having some predictability on budgets is something, of course, everybody in this room can appreciate how that helps us deliver the important outputs we are looking for.

Mrs. TRAHAN. Thank you, Dr. Reynolds. I can tell you that manufacturers in my district and across Massachusetts are deeply distressed when they hear the President threaten to take those funds away. In some cases, it will be catastrophic. And even the threats weaken America as a place to do business.

Mr. Kinder, you mentioned in your testimony that the U.S. manufacturing sector has 622,000 unfilled jobs. And you highlighted the critical role of STEM education from K through 12, technical training, apprenticeship programs in addressing this gap.

This administration is threatening to cut those very educational programs, even going so far as dismantling the Department of Education. The development of our technical and manufacturing workforce would be decimated.

How would you, how would Autodesk have to adjust as an employer to meet that demand in workforce if that was to happen?

Mr. KINDER. Thank you for your question. We work with the education community at length. We have over 19,000 institutions from kindergarten all the way through graduate schools, vocational schools, to provide free software to be able to train that next generation.

We think that is absolutely critical, and we will be training them in tools that include AI going forward, helping to upskill that workforce.

Mrs. TRAHAN. Well, thank you. I know I have run out of time. I will submit my other questions for the record.

Thank you, Mr. Chair.

Mr. BILIRAKIS. Thank you very much.

Now I will recognize Mr. Goldman for his 5 minutes of questioning.

Mr. GOLDMAN. Thank you, Mr. Chairman, very much.

Mr. Oxman, Lockheed Martin and other defense manufacturers in my district use AI into their assembly lines and supply chain logistics to improve efficiency, enhance quality control, and more. Why is it important both to our economic and national security that this industry have access to cutting-edge technology in manufacturing?

Mr. OXMAN. Thank you, Congressman Goldman. And your district is, in fact, a hotbed of innovation. ITI member company Medtronic is also doing a lot of investment in AI-powered medical devices in your district as well.

So the short answer to your question is, This is key to the manufacturing renaissance that is taking place in the United States. And what we are particularly excited about is how, as you hear

from all the witnesses today, this is an ecosystem in the technology sector that is powering this.

So you have got software companies, hardware companies. Data center operators is another area that is just exploding in Texas in particular. Semiconductor manufacturers also exploding in Texas right now, the investment of literally tens of billions of dollars in semiconductor manufacturing facilities in Texas.

So all of this is taking place at a time that we are focused on the right solutions to power that kind of investment in innovation. And power is quite literally one of those areas that we need to focus on as well, making sure the energy grid can support it, that we are investing in an all-of-the-above energy strategy to make it happen.

So we are very excited about working together to make sure that the policy environment is right. But, as you can tell, in Texas and across the country, this investment is taking place today.

Mr. GOLDMAN. Thank you so much.

And, Ms. Humpton, I know you know something about not necessarily my district, Mr. Veasey's district, but welcome to Fort Worth. Siemens is opening a new facility there, exactly the type of activity we need to enhance our technological leadership and support onshoring domestic manufacturing.

I understand that Siemens is innovating not only with industrial AI but is also experienced in how to drive efficiency and maximize operations at data centers.

Can you please elaborate on Siemens' expertise in this arena and how you view data centers as critical to domestic manufacturing?

Ms. HUMPTON. Thank you so much, Congressman. And by the way, you would be delighted to know that our technology is also used by some of those other manufacturers.

So here is the interesting thing about this technology: It is in and around the manufacturing life cycle. And so it is fascinating to think about where does a company like Siemens play in the data center marketplace. Not only are we helping the semiconductor manufacturers design their chips so that we can achieve that, you know, enhanced energy efficiency, cooling, et cetera, and enhanced performance, we are also helping those who are constructing the data centers to build their data centers and provide the critical power to them.

So my colleagues at Siemens Energy are off generating power, and they put it on high-voltage transmission lines, medium- and low-voltage switchgear. I mean, don't get me started, because it is great stuff.

But we are using those AI tools and in fact manufacturing them close to you at Fort Worth, all of those components that go into the data center. And then we ourselves are users of the AI that gets managed inside those data centers.

This is truly—I heard a phrase recently that may apply right now: "Partnership is the new leadership." That is the era we are in now, and I am excited about what we can do together.

Mr. GOLDMAN. We are glad to be your partner. Can you also describe the likelihood of autonomous manufacturing facilities in the short term? What are the pros and cons and which regulations

should we consider removing or adding to facilitate U.S. innovation versus those we should create as guardrails to protect workers?

Ms. HUMPTON. Well, as we have talked about today, we actually have a shortage of workers in manufacturing. So what we know for sure is that we need to make every individual who is in a manufacturing environment as productive as they can possibly be. Technology can help us do that. That is wonderful.

We have had a little bit of conversation about lights-out facilities, and I don't know about many of them. Sure, there are many things that can be done on a lights-out basis. If we think about, you know, let's say the pharmaceutical production line, and when we get to the point of individualized medicine, the ability for an autonomous line to actually control and monitor the progress of materials that are flowing through the manufacturing line.

We know that will come. But, in most cases, what we are really doing is making things that need to be assembled within a larger supply chain. There is a lot of logistics, yhere is a lot of tracking. People are needed in the creativity that puts all of those pieces together. And I think we are going to see that for quite some time.

Mr. GOLDMAN. You timed that perfectly. Thank you very much.

Thank you, all the panelists.

Mr. Chairman, I yield.

Mr. BILIRAKIS. I appreciate it very much. The gentleman yields back.

Now we are at—I believe we have Ms. Schrier.

Dr. Schrier, you are recognized for 5 minutes for your questioning.

Ms. SCHRIER. Thank you, Mr. Chairman. Thank you to our witnesses. We have heard from each of you that we need significantly more workers with targeted technical expertise, including in AI-assisted manufacturing, in order for America's advanced manufacturing industry to stay competitive in a global market.

However, what I am hearing from the business community is that President Trump's erratic, emotional behavior has brought uncertainty and chaos to American businesses that are looking to invest in the future and plan and train up labor.

My Republican colleagues have spoken at length about the need to protect America's competitive advantage within the increasingly competitive field of advanced manufacturing. And I agree with them. We have got to keep our competitive edge in every industry where it makes sense for us to be leading in manufacturing.

But, at the same time, the Trump administration's recent governmentwide Federal funding freeze and efforts to dismantle the Department of Education, a career and technical information source, tariffs on our strategic allies—I have heard just radio silence from my Republican colleagues about this. And this is ultimately going to undermine the United States' competitive and educational workforce and technological competitiveness.

Ms. Humpton, you are the CEO of Siemens USA, a subsidiary of the much larger Siemens International, based in Germany. And in fact your ultrasound headquarters is just down the street from my house in my congressional district, and I have visited many times and have been so impressed by the way that you have used AI to

diagnose fatty liver disease with a simple ultrasound. And so thank you for using that and saving lives.

On Monday night, President Trump issued an Executive order imposing 25 percent tariffs—excuse me—on steel and aluminum imports. Germany is one of the largest exporters of steel to the United States.

And you talked about sourcing materials here, but the issue is complicated because, if there is scarcity here, prices go up, and there are retaliatory tariffs. You are going to have difficulty exporting—you are going to have difficulty exporting——

Ms. HUMPTON. I wonder if I understand the question. Let me say this, that I don't think you will get any business to say, "Yes, we want more cost in our supply chain." Nobody would say that.

But what we do recognize is that we have an administration that is very supportive of manufacturing overall in the United States.

We are going to stay laser focused on our customers' needs, make sure we are responsive to them and make sure we do everything we can, even as policies and regulations change, to make the most of American manufacturing and the opportunity ahead of us.

Ms. SCHRIER. Thank you. I am going to yield back because of my cough. I apologize.

Mr. BILIRAKIS. Thank you. It happens. It happens. It happened to me the other day, so we understand. Thank you.

The gentlelady yields back. Now I will recognize my good friend, who represents the University of Florida. I know what she is going to talk about, what she is going to highlight, I am sure. I will recognize her for her questioning, her 5 minutes of questioning.

Mrs. CAMMACK. Thank you, Mr. Chairman.

And, of course, go Gators, as always.

Actually, my questions were asked earlier by my good friend also from the Sunshine State, Representative Laurel Lee. And so now that we are towards the tail end of the committee hearing, a lot has been discussed.

Certainly, I wanted to talk about digital twins, the investments the University of Florida is making, but I wanted to open up the floor to each of our witnesses, because I know there is always something that gets left out of these hearings.

So I am going to start with you, Ms. Humpton, if you can maybe speak to some of the things that you wanted to cover or didn't get asked in this hearing yet today.

Ms. HUMPTON. This has been a phenomenal conversation. And I am looking down at my notes of things that I wanted to make sure we covered, and I am coming up empty.

Thank you for making sure that we have a comprehensive dialogue. I think the thing that I hope we all leave with today is that industrial AI is different from consumer AI. Thank you.

Mrs. CAMMACK. Absolutely. And thank you for all the work that you do on digital twins. It is absolutely revolutionary, and I am very excited for the possibilities of digital twins in multiple different industries and sectors. So thank you.

Mr. Kinder, I know Representative Laurel Lee, she mentioned the University of Florida and the College of Engineering. Anything that you wanted to add as part of your response to her question or expand on that?

I should clarify a little bit: more specifically, the importance of R&D and the investments that we have to make at the university level in order to continue pushing this type of technology.

Mr. KINDER. Yes. Thank you for the question, Congresswoman. We are very excited about the Florida partnership. I think it is going to launch this fall, I believe is the plan for the degree program.

We think bringing manufacturing techniques to the building sector will revolutionize how we build, especially housing, of which there is a critical shortage in the U.S. Our software, the training we provide teaches students how to reduce those costs by 50 percent. And this is where Autodesk brings together both manufacturing and architecture, engineering, and construction.

We partnered with a modular construction company in Oakland, California, to design more than 300 AI-enabled affordable housing units at about half the cost and half the time and half of the waste in the process. So we are very proud of that and look forward to, you know, working with and partnering with universities to further that type of research.

Mrs. CAMMACK. And, along with that, in Congress we are doing everything we can to make sure that the regulatory environment doesn't trip everybody up as we are innovating. And you guys are doing so much more with half the cost and half the time. We need to do it with half the regulation. So this is my shameless plug for the REINS Act right now. But thank you for that.

Dr. Reynolds, I saw you flipping through your notes to make sure that there was nothing that you hadn't missed. Was there anything that you wanted to cover that we haven't touched on today?

Dr. REYNOLDS. You know, I might just reinforce a few points that I think have been made today. The first one I want to make is a sense of urgency. I think that we have an understanding that we really need to do a collaborative project here. This is going to take government, it is going to take industry, it is going to take academia, take the civil society.

But we have an urgent moment here, because I think the U.S. is at an inflection point. And we have done so much over the last few years to rebuild this manufacturing base, to build momentum.

We now have hundreds of new facilities being built. We have a whole new crop of manufacturing startups that are really changing the face, particularly in AI. All of that momentum must continue. And if we can get aligned and ensure that we don't have too much disruption or changing of the rules midstream, I think that we are really going to be able to accelerate the work here and succeed with our tipping point.

And so I want to also just emphasize that the path forward is really an investment in the technology, but it is also an investment in our workers, and those together will help us do this.

Mrs. CAMMACK. Excellent. Thank you.

The floor is yours.

Mr. OXMAN. Thank you, Congresswoman. I think the one issue that didn't come up today that I just want to mention is tax policy. And I realize this is not the tax -riting committee, but everyone here is going to have an opportunity to vote on taxes at some point.

The expiration of the provision in the 2017 Tax Cuts and JOBS Act that allows companies to deduct the investment that they make in research and development——

Mrs. CAMMACK. Absolutely.

Mr. OXMAN [continuing]. In the year in which that investment takes place, the expiration of that provision has been enormously harmful to the ability of companies to invest in R&D here in the U.S. Restoring that provision will be kind of the fuse that ignites a renaissance of investment in manufacturing and other industries here in the U.S. So that is the one thing that I would mention.

Mrs. CAMMACK. And thank you for mentioning that. As someone who represents one of the top biotech hubs and incubators in the world, the R&D tax credit deduction is absolutely important and critical to so many industries.

So thank you all so much for your time and expertise today. And the future is bright. I am so glad that we are not having a doomsdayer conversation today. So thank you.

And, with that, Mr. Chairman, I yield back.

Mr. BILIRAKIS. I appreciate it very much. And that was a great move, Kat. Thank you for giving them the opportunity to elaborate on these issues. We appreciate it very much.

Next, we have—we don't have anybody on the Democrat side. Dr.—oh, yes, yes. I am sorry. Mrs. Houchin. She is a great, a valuable member of our committee, and we are very fortunate to have her. And we will be working on quite a few issues together.

I will recognize you for 5 minutes of questioning.

Mrs. HOUCHIN. Thank you, Mr. Chairman. I am pleased to be a member of the subcommittee.

And thank you to the ranking member and to our witnesses for your testimony today.

My home State of Indiana is one of the most manufacturing-intensive States in the country. According to the Indiana Manufacturers Association, manufacturing makes up 28 percent of Indiana's GDP and 17 percent of our workforce. When you account for the broad impact beyond the workforce that it directly employs, more than half of all jobs in Indiana do have a connection to the manufacturing sector.

It is no secret, however, that the industry has had its challenges, from international competitors like China that seek to undermine our U.S.-based companies to the difficulties facing domestic supply chains. The manufacturing sector must have necessary tools to compete in a global economy.

Fortunately, AI offers a potential solution to several of these problems. In its applications in American manufacturing, AI has been found to reduce costs, improve workforce efficiency, and make U.S. States like Indiana better places to do business.

And I acknowledge that this technology is new and rapidly advancing. I am excited by the opportunities it presents manufacturers back home as we look to bring jobs back to the United States.

Mr. Kinder, my question for you is, Much of the manufacturing that happens in districts like mine come from small to midsize businesses. When you are engaging and working with manufacturers of this size, if you could just highlight a few of the challenges that you think—the biggest challenges they face.

Mr. KINDER. Thank you for your question, and great to be a fellow Hoosier.

Small and medium-size manufacturers face global competition even though they may operate in, you know, Columbus, Indiana. And they don't want to fall behind, yet for them to be able to invest and keep up the pace, it is a challenge. They don't have the economies of scale, and they don't have, you know, a government that may be completely subsidizing the investments that they are trying to make.

So the challenges that I see or that we hear from our customers, our small and medium-size customers, is they want to invest, they want to be as efficient as they can, but that requires often new processes, new equipment, new factories, new software. And that is an investment, a hurdle for them to get over to be able to invest in what we call digital transformation, of which AI is just another next step in it.

Now, the promise of AI, the beautiful promise of AI is it can make our small and medium-size enterprises more competitive. It can take out some of the cost that they would pay, have to pay manually that larger companies or global manufacturers wouldn't have to.

Mrs. HOUCHIN. Is that something that you think the R&D tax credit could play a part in helping them make some of those investments?

Mr. KINDER. I think tax credits that help to support investment in R&D absolutely can help, yes.

Mrs. HOUCHIN. So we want our small businesses to remain competitive, and you have touched on this a little bit, how adopting AI for technologies and processes can be helpful.

Could you talk a little bit about Autodesk, how that helps manufacturers access AI? What are some of the challenges that are inherent in adopting that technology, and then what steps, if any, should Congress take to support our small and medium-size manufacturers in adopting AI?

Mr. KINDER. I think what we do at Autodesk in terms of introducing AI is we try to solve specific problems. So we look at, you know, industrial-level data, constrained datasets, not kind of large amounts of data, that apply to the manufacturing process.

And we figure out what the problems are that these small and medium-size manufacturers face and solve those, such as automated drawings. We recently rolled out automated sketch constraints. When you are building a table or modeling a table and you change the dimensions, you want the legs to move too at the same time. You can do all of that using AI, and it speeds up the overall process.

Mrs. HOUCHIN. Great. Well, as we work to make the United States the best possible place to work and build things, we also have to look at the resiliency of our supply chains, making it easier for companies to adapt when disruptions happen.

Ms. Humpton, what role can AI play in the optimization of resources and processes within manufacturing supply chains, with the few seconds we have remaining?

Ms. HUMPTON. What I would tell you is that we all know that our supply chain and logistics experts have become heroes over the

last few years. Giving them the superpower to analyze networks and understand where bottlenecks are, find alternatives, AI can help them every single day.

Mrs. HOUCHIN. Thank you.

Thank you, Mr. Chairman. I yield back.

Mr. BILIRAKIS. Thank you, Mrs. Houchin, appreciate it very much.

Now we have the vice chairman of the full committee, my very good friend and fellow Pittsburgh Pirate fan, Vice Chairman Joyce, John Joyce. Thank you, Doctor, appreciate it. I will recognize you for your 5 minutes of questioning.

Mr. JOYCE. First, I want to thank you, Chairman Bilirakis, for allowing me to waive onto this important hearing.

As we have covered in several hearings across multiple Energy and Commerce subcommittees, the AI revolution is here, and it will ultimately influence so many aspects of our lives with everything from medical services to manufacturing optimization. AI adds the efficiency and precision that will allow Americans to receive faster results and have a more productive and dynamic economy.

In the changing geopolitical climate that we live in, it is critical that we stay ahead of our adversaries. The competition for the fastest and most capable AI is heating up. And China has made it clear of its intentions to dominate in this space.

America and the free world can't afford to fall behind and allow the Chinese Communist Party to be the leader in this critical sector for the future of our economy and for our national security.

Fortunately, America has a strong advantage. As tech leaders like Elon Musk have said, AI could lead energy demand as much as twice of what it is currently. And that energy, that energy that Elon Musk referenced, exists today under the feet of my constituents in Pennsylvania.

The access to energy and energy infrastructure is the tide that will lift all boats. We have already begun to see this in my home State with data center agreements between AWS and Talen Energy at the Susquehanna nuclear generation facility and the reopening of Three Mile Island, thanks to a purchase power agreement between Constellation Energy and Microsoft.

These deals will lead to billions of dollars of investment in these communities, and they will provide family-sustaining wages, jobs that are so necessary. They will also provide revenue, revenue for schools, for libraries, for police stations, firehouses, and hospitals.

As we look forward to engaging not only our merchant nuclear assets for AI but the robust natural gas electricity generation we have in this country, opportunities for rural America will only continue to grow, and grow we must.

AI has a large role to play in bringing back American manufacturing. President Trump has made it clear: In this new golden age of America, we need to ensure products are made right here and that family-sustaining jobs stay here.

Increases in efficiency and worker productivity that the use of AI will give American companies the edge that they need to compete and they need to win. The faster that we develop AI and build the needed data centers, the better we can protect our Nation's inter-

ests and bring back the economic opportunities that America has not seen in the past 4 years.

Mr. Oxman, from the AI perspective, why is getting our energy policy right important for securing American leadership in artificial intelligence?

Mr. OXMAN. Dr. Joyce, thank you for the question, and grateful to you for highlighting what ITI member companies like AWS and Microsoft are doing in the Commonwealth of Pennsylvania to bring this energy discussion to the forefront because, to your question, AI is not in a vacuum. It exists because of data centers, and those data centers are the key to continued U.S. domination of AI innovation worldwide.

Data centers do require a lot of power, like all of the other activities that we engage in on a daily basis. And finding new energy solutions, including nuclear, are key to continued U.S. growth and economic activity around AI.

So thank you for raising that issue, and thank you for your leadership on making sure that those energy pathways for data centers are available.

Mr. JOYCE. Thank you for your answer.

Ms. Humpton, in the global economy that Siemens participates, we have seen other countries manipulate currency, we have seen unfairly subsidized industry, we have seen the theft of intellectual property, we have seen countries ignore environmental regulations and use captive labor to gain advantages for their domestic manufacturing.

How can large companies like Siemens that follow the rules, how can they invest and make sure that AI allows you to outcompete these known bad actors?

Ms. HUMPTON. Thank you, Congressman, for that question. And in fact, first I will say that the U.S. is Siemens' largest market. I like to brag about this. We are responsible for about 25 percent of Siemens' work all around the globe. But, as you say, we are a global company and working in accordance with the regulations and principles that truly lift up the role of manufacturing globally in the way it is done.

AI, industrial AI in particular, can be essential in making workers in these developed and friendly countries that we work with so closely, to help make all of our workers more productive.

When we do that, we know that we all succeed. We are in a moment in time when bringing back American manufacturing in particular and taking advantage of American workers through AI, we are going to be able to enhance their ability to produce in a much more efficient way, and that makes us far more competitive here and at home.

Mr. JOYCE. And that efficient way will allow so many Americans to appreciate the new golden age of America.

I thank all the witnesses for being present here today.

Mr. Chairman, thank you for allowing me to waive on. I yield back.

Mr. BILIRAKIS. That is a good way to end it. So we appreciate you so very much. I think that this committee is off to a great start. I think my ranking member will agree.

And I want to thank the witnesses. You did an outstanding job, were very informative. So we will continue this discussion.

I ask unanimous consent that the documents on the staff document list be submitted for the record.

Without objection, so ordered.

[The information appears at the conclusion of the hearing.]

Mr. BILIRAKIS. I remind Members that they have 10 business days to submit questions for the record, and I ask the witnesses to respond to the questions promptly. Members should submit their questions by the close of business February 26th.

So, without objection, the subcommittee is adjourned. Thank you. Thank you, everyone, we appreciate it very much.

[Whereupon, at 2:03 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

Documents for the Record

Subcommittee on Commerce, Manufacturing, and Trade Hearing

"AI in Manufacturing: Securing American Leadership in Manufacturing and the Next Generation of Technologies."

February 12, 2025

1. National Association of Manufacturers, "Working Smarter: How Manufacturers Are Using Artificial Intelligence," Submitted by the Majority.
2. National Association of Manufacturers, Statement for the Record, Submitted by the Majority.


Working Smarter:
How Manufacturers Are
Using Artificial Intelligence
Key Findings and
Insights from
Manufacturers
MAY 2024
NATIONAL ASSOCIATION OF
Manufacturers

Working Smarter:
How Manufacturers Are Using Artificial Intelligence
May 2024

Key Findings and Insights from Manufacturers
National Association of Manufacturers

A Letter from the Chair

Artificial intelligence has dominated the headlines in recent years, and people are truly beginning to grasp the possibilities and power of this technology. The launch of ChatGPT and other generative AI tools has made the technology even more accessible, putting it in the hands of everyday Americans.

Manufacturers have been at the forefront of developing and implementing intelligent systems and AI technologies, including machine learning, deep learning, natural language processing, machine vision, digital twins and robotics. This has positioned manufacturers uniquely as both developers and deployers of AI innovations, providing invaluable insights into the effective and responsible use of these technologies.

AI can be a force multiplier—and a force for good. At Johnson & Johnson, for example, AI has been used effectively in a number of areas, ranging from the drug development process to restocking hospitals. It helps us sort through massive amounts of data, yielding insights for the improved health and wellness of people around the world. It aids us in creating targeted treatments and getting them to the right patients at the right time. When we conduct clinical trials, AI helps us more efficiently establish safety and effectiveness guardrails, while allowing us to conduct trials at a larger scale. AI also gives us a far stronger mastery over our supply chains. Overall, it helps our people do a better job of living up to our commitment of improving health care outcomes and making our towns, country and world a better place.

AI functions best with humans as the core decision-makers within AI-enhanced processes. These operators must be knowledgeable, well-trained and able to utilize the technology safely and to its fullest potential. Early on, Johnson & Johnson developed an ethical AI framework, as well as a data science academy to enhance our teams' digital acumen and equip them with AI engagement skills. As manufacturers upskill and train more team members to work with AI, the technology will empower those workers to be more innovative and productive.

As you'll read in this paper, manufacturers of all sizes have found similar ways to use AI to amplify their operations and live up to their own commitments. With AI supporting us, manufacturers can do so much more to improve the quality of life for everyone.

Given the importance of this generational technology, policymakers must develop sensible, carefully thought-out frameworks for various AI applications—and they should lean on manufacturers' years of experience to engineer those frameworks. We need a policy environment that supports innovation and growth in manufacturing AI, because it will bolster U.S. competitiveness and leadership in this critical emerging field.

All possible futures for modern manufacturing in the U.S. involve AI. This technology is a game-changer, and it will continue proving itself to be an essential partner on the shop floor. This paper offers policymakers a window into the future of AI in modern manufacturing—and a roadmap to help us get there.

Kathryn Wengel
Executive Vice President and Chief Technical Operations & Risk Officer, Johnson & Johnson
Chair of the Board, National Association of Manufacturers

Key Insights

- Artificial intelligence tools are used widely across the industry and are key to advancing modern manufacturing.
- Manufacturers are consumers, developers and deployers of AI throughout their production processes.
- The potential applications for AI in manufacturing are expansive and can help industry leaders improve efficiency, product development, safety, predictive maintenance and supply chain logistics.
- AI refers to a large umbrella of technologies that include machine learning, machine vision and deep learning. These tools allow manufacturers to make their shop floors safer, improve work experience and create innovative products that solve global challenges.
- Manufacturers are implementing and testing AI programs in a way that keeps workers as the central drivers and decision-makers for AI processes or products.
- To remain a global leader in advancing AI and supporting manufacturing innovation, the U.S. should take a cautious approach to AI regulation, tailor any regulation to specific use cases and risks, right-size compliance burdens, support R&D and new workforce pathways and ensure that regulatory frameworks are aligned globally.

What Is AI?

Innovation is what drives manufacturing, and as a result, manufacturers have always been at the forefront of new technologies, striving to operate more efficiently and effectively. Now manufacturers are leading in the adoption and use of artificial intelligence. AI is a broad umbrella term, defined by the National Institute of Standards and Technology as a "system that can, for a given set of objectives, generate outputs such as predictions, recommendations or decisions influencing real or virtual environments."[1] These systems use data and human-built algorithms to simulate how humans perceive, learn and respond to questions and prompts. AI systems are often connected to other machines and respond to the digital and physical world to support processes that can either be very simple or complex.[2]

> **"We see AI as a key strategic enabler for our effectiveness, to do things better, faster and more economically, while delivering essential products to our customers."**
> – Sreedhar Sistu,
> Vice President, AI Offers,
> Schneider Electric

While recent advancements in large language models and chatbots, such as ChatGPT and Google Gemini, have placed a spotlight on generative AI technology, these applications represent but a fraction of the types of AI currently in use. In fact, manufacturers have been developing and deploying intelligent systems and AI technology for many years, in the form of machine learning and deep learning, natural language processing, machine vision, digital twins and robotics, all further explained in the following pages. These innovations are often categorized under the banner of "advanced manufacturing" or "Manufacturing 4.0." AI integration into manufacturing processes has contributed already to significantly improved operations and to the development of new products.[3]

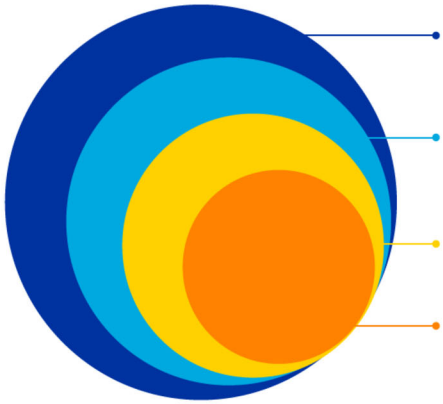
AI represents a tremendous opportunity for the manufacturing industry. AI technologies can help manufacturers improve their operations by upgrading how they analyze large datasets, identifying knowledge gaps, providing solutions and enabling teams to develop new efficiences at scale. Widespread implementation of AI across the industry could lead to more efficient processes, increased sustainability, more innovative products and safer workplaces. These innovations will both grow the economy and bolster U.S. global leadership in manufacturing. Given the vast potential of AI, policy approaches to AI should further the development of these technologies and support their responsible use by manufacturers across a wide range of applications—strengthening innovation and, in turn, supporting U.S. competitiveness on the world stage.

This report reviews how AI has evolved within manufacturing and how manufacturers are developing and deploying AI technologies to innovate within their business operations and across the industry. Manufacturers are a leading voice on the opportunities presented by AI and have much to share about their experiences. This report concludes with policy recommendations that would best equip the manufacturing industry to take advantage of the immense opportunities AI technology has to offer. The NAM supports a policy environment for AI that encourages safe, responsible development while promoting the innovative growth of the technology.

[1]National Institute of Standards and Technology, *Artificial Intelligence Risk Management Framework (AI RMF 1.0)* (Washington, D.C.: Department of Commerce, 2023), 1, https://nvlpubs.nist.gov/nistpubs/ai/NIST.AI.100-1.pdf.
[2]Tom Culver, Lee Green and Jim Redden, "Peering into the Future of Intelligent Systems," *Research-Technology Management* 62, no. 3 (May 2019): 21-30, https://www.tandfonline.com/doi/abs/10.1080/08956308.2019.1587322.
[3]Haili Zhang, Xiaotang Zhang and Michael Song, "Deploying AI for New Product Development Success," *Research-Technology Management* 64, no. 5 (August 2021): 50-57, https://www.tandfonline.com/doi/full/10.1080/08956308.2021.1942646.

How Did We Get Here?

AI in manufacturing is made possible by the connected nature of machines and tools in manufacturing operations. Widespread digital integration, using connected sensors and instruments to collect data across shop floors, enables machine learning, a type of AI that was developed as early as the 1980s.[4] A machine learning system analyzes data and recognizes patterns to train itself to make decisions and perform tasks efficiently. Deep learning, an extension of machine learning that evolved through the 2010s, incorporates multiple layers of reasoning and data analysis to mimic how the human brain works.[5] Machine learning and deep learning are the basis for most of the AI tools manufacturers use. As of October 2023, 74% of surveyed manufacturers had invested or were planning to invest in machine learning.[6]



Artificial intelligence: a technology that can, for a given set of objectives, generate outputs such as predictions, recommendations or decisions that emulate human behavior

Machine learning: a model that uses advanced algorithms to analyze data and recognize patterns to train itself to make decisions and perform tasks

Deep learning: a system that incorporates multiple layers of reasoning and data analysis to mimic how the human brain works

Generative AI: a tool that uses deep learning to create content, such as text, images or code, based on detected patterns in large datasets

[4]Jim Davis, "Putting Intelligence Back into AI," Manufacturing Leadership Council (Dec. 8, 2020), https://manufacturingleadershipcouncil.com/putting-intelligence-back-into-ai-17349/?stream=all-news-insights; Michael Platz and Shanton Wilcox, "Achieving Impact from End-to-End Digitalization," *Manufacturing Leadership Journal* (January 2023), https://manufacturingleadershipcouncil.com/achieving-impact-from-end-to-end-digitization-31586/?stream=ml-journal.

[5]"What is deep learning?," IBM, accessed Jan. 30, 2023, https://www.ibm.com/topics/deep-learning.

[6]Penelope Brown, "SURVEY: Manufacturers Go All-In on AI, Manufacturing Leadership Council (Oct. 1, 2023), https://manufacturingleadershipcouncil.com/survey-manufacturers-go-all-in-on-ai-35350/?stream=ml-journal.

How Do Manufacturers Use AI?

Manufacturers are collectors of knowledge. They bring together the skills and ideas of people, sometimes from all around the world, to create new products. These goods can be as small and simple as a bolt or as large and complex as an automobile. The modern shop floor is interconnected and technologically advanced. This enables manufacturers to collect data about their operations and enhance their production processes. In short, the technological innovations of modern manufacturing enable machines to amplify the productive power of manufacturing workers—and AI is the next step in this innovative journey.

In 2023, the NAM's Manufacturing Leadership Council, a global network of executives in the manufacturing industry, conducted surveys on how manufacturers use AI in their operations to explore some of the ways AI is already making an impact. When asked about why they were investing in M4.0 technologies or digitally integrated innovations such as AI, respondents pointed to cost reduction, operational awareness and process optimization, as shown in Figure 1.[7] This includes visibility into operations by collecting and analyzing data to develop insight into the performance of a manufacturing process, and using digital technology and data to determine a process's efficiency, speed, equipment utilization, materials usage, waste, etc., and making decisions on how any of those facets could be improved.

Figure 1: What Are the Most Important Reasons Your Company Invests in Transformative M4.0 Technologies? (Check Top Three Reasons)

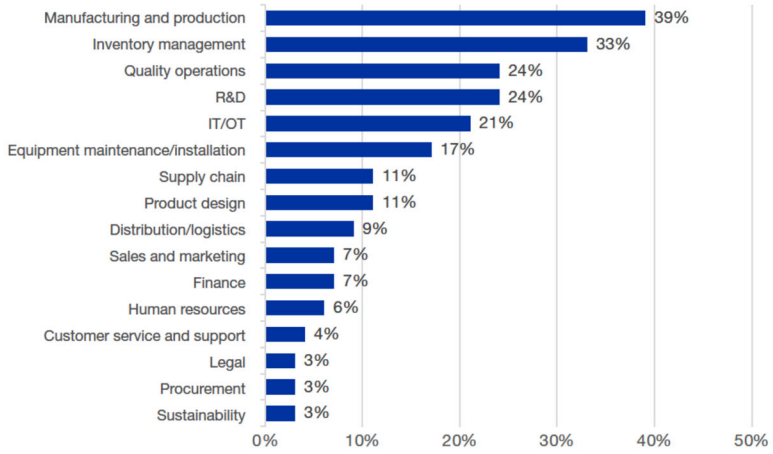
Where possible, manufacturers develop their own AI tools to accomplish these tasks. Others purchase AI products from technology companies. Regardless of whether manufacturers develop AI technology or deploy AI technology—or both—they find that AI helps ease the burden of repetitive tasks, allowing manufacturing workers to devote their energy and time to more complicated and forward-thinking activities and projects.

[7] Ibid.

As displayed in Figure 2, respondents noted a wide range of uses for AI in their operations, the top three of which were manufacturing and production, inventory management and quality operations/R&D.[8]

To implement AI, manufacturers work to identify which AI system is best suited to help them tackle their challenges; how to responsibly and transparently collect the data necessary to train and run the AI model; and where to implement AI to transform current processes. In this context, modern manufacturers view data as a critical input that can be leveraged and utilized to discover new efficiencies. AI is helping to transform that data and deploy solutions at a scale not possible for humans alone.

Figure 2: Which of the Following Corporate Functions Have Begun the Adoption of AI? (Select All That Apply)



With the large amounts of data collected on the shop floor and throughout their operations, manufacturers use AI to design production processes, predictive maintenance programs and logistics decision-making models, among many other examples. These companies are pushing the boundaries of what AI systems can do. This puts manufacturers in a unique position to guide the development of the AI policy landscape.

[8]David Brousell, Jeff Puma and Paul Tate, *The Future of Industrial AI in Manufacturing* (Washington, D.C.: Manufacturing Leadership Council, 2023), https://www.manufacturingleadershipcouncil.com/wp-content/uploads/2023/06/The-Future-Of-AI-In-Manufacturing-MLC-2023.pdf.

Efficiency

The continued, expanded implementation of early AI technologies, such as machine learning, has improved manufacturers' efficiency. Greater efficiency allows manufacturers to allocate resources in a more cost-effective manner, improve shop floor processes, implement more sustainable practices and discover new opportunities for growth. In interviews conducted by the NAM, one chemical production company stated that the application of machine learning to data collected from chemical reactors enables operators to make better decisions about how to operate them. The AI model alerts operators when it is optimal to make changes in the process, rather than manually keeping track of all sensors or depending on a specific operational timetable. Human operators are still at the center of decision-making and operations, but AI has helped improve the reliability of their processes and the quality, delivery and safety of their products.

> **"Hitachi is focused on applying AI, machine learning and related technologies toward addressing real-world challenges in industrial and societal domains. Functional areas include maintenance and repair, operations optimization, quality assurance, safety management, supply chain management and automation and control, among others. The goal is the end-to-end optimization of key industrial processes."**
> – Chetan Gupta, GM of the Advanced AI Innovation Center, Hitachi, Ltd. and Head of the Industrial AI Lab at Hitachi America

Machine vision is a more recent advancement in AI, enabling industrial equipment to "see" by gathering and analyzing visual data in its environment to form conclusions. Almost 80% of MLC survey respondents had invested or planned to invest in vision systems.[9] One logistics company uses machine vision to sort packages, depending on AI-enabled robots to respond to and make decisions based on ever-changing situations and conditions rather than simply repeating the same patterns. Many companies are also using machine vision to perform quality control, quickly reviewing parts and materials for defects that are more difficult for humans to detect. For some manufacturers, this has been a paradigm shift and has allowed their machines and processes to work more efficiently and respond to new situations and problems more quickly.

AI models can also perform predictive analytics using data collected from digitally enabled devices. A result of this analysis can be predictive maintenance, or identifying parts that are not performing efficiently so that they can be replaced before they break. More than half of MLC survey respondents stated that predictive maintenance is a key AI application in their operations.[10] Such efficiencies can prevent unplanned downtime for production as well as enhance sustainability by enabling more energy-efficient processes, lowering waste and decreasing emissions.

[9]Brown, "SURVEY: Manufacturers Go All-In on AI."
[10]Ibid.

Safety

Manufacturers are interested in using AI to improve safety for employees and operations. One automotive manufacturer is using AI and machine vision to monitor intersections of production lanes, letting workers know if a forklift or other machinery is coming around the corner, outside of the periphery of their vision. This use of AI helps to prevent human mistakes and greatly improves safety on the shop floor. For individual workers, ergonomic assistance, like a robotic exoskeleton that collects and learns from data on the wearer's movements and the environment, can enhance human strength and prevent injuries. Over time, these tools have the potential to improve worker safety, make jobs less physically demanding and reduce health care costs, which are key concerns for employers.

> **"AI gives us the ability to combine digital and physical teams and to help our people by reducing repetitive tasks and physical stress while promoting safety."**
> – Joel Stenson, Senior Vice President of Operations Technology, UPS

Other companies use connected devices and AI modeling to improve the customer experience. In fact, 47% of surveyed manufacturers plan to deploy more customer-facing AI tools in the next two years.[11] One automotive company has already begun collecting data from their newest vehicle models and alerting customers when the AI identifies changes in the performance of the vehicle, allowing users to prevent costly, inconvenient and potentially dangerous problems later.

Product Development and Design

Researchers have found that product development can benefit from using AI models to learn from accumulated data and that higher AI usage in the development process increases success.[12] Manufacturers in many different industry subsectors are utilizing AI to develop new products. A supplier of automotive parts has created an AI tool that processes wheel geometry data, allowing the company to more quickly develop wheel designs that perform better and are produced more efficiently. AI allows this company to bring products to market faster, respond to design changes more quickly and better apply the knowledge of their engineering team, unlocking continuous innovation and learning.

One pharmaceutical company shared that it is using AI models to identify new ways to develop molecules and advance individualized treatments for disease. This company is developing their own AI models to find more precise endpoints for treatments, which make clinical trials safer, more effective and with a greater margin for success.

Training

Manufacturers want to keep the work of people, not computers, at the center of their operations. The ingenuity of workers is a key component in any AI processes or products. When it comes to AI in manufacturing—workers are the drivers and decision-makers, and AI works to make their jobs easier and more efficient. Many companies have found that their best AI outcomes result from enriching employees' experience at work, thus improving their output. AI technology is often used to complement and augment the work of humans, like a co-pilot. This approach enhances worker efficiency while still prioritizing human experience and ingenuity—ultimately

[11] Ibid.
[12] Zhang, Zhang and Song, "Deploying AI for New Product Development Success."

increasing trust and confidence in AI systems.[13] The most effective AI models are human-centered, allowing them to learn and unlearn, continuously improving to meet the needs of their human operators.[14]

Manufacturers are upskilling their workforce actively to meet the opportunities of AI. Many companies, from logistics to pharmaceuticals, are setting up training programs to help employees develop their confidence and competency in the use of AI systems. These training programs include a focus on safety and control, to limit risks to workers and to protect companies' intellectual property in the face of the increased cybersecurity risks that come from an interconnected shop floor.

Recruitment of new employees has also changed. One automotive supplier noted that they have increased their hiring of the data scientists necessary to build and implement AI systems.

The most effective AI models are human-centered, allowing them to learn and unlearn, continuously improving to meet the needs of their human operators.

At the end of workers' careers, companies can use AI systems to manage knowledge as key personnel enter retirement. As of 2019, nearly one-quarter of the manufacturing workforce was over 55,[15] and one electrification and emerging technology company is using AI-utilizing systems for knowledge management and to train new employees on the skills of legacy workers. They are also using AI models to identify future challenges and predict which skills will be needed, identifying how many employees will need to be trained in these new skills.

Supply Chain

Manufacturers are using AI models to predict, prevent or mitigate disruptions in their supply chains and make more informed decisions about their logistics plans. These tools allow the industry to be more resilient to risk, prevent production stoppages or shortages and effectively deliver products to customers. This is a growing area of AI implementation, with 21% of surveyed manufacturers already using AI in their supply chain management and 60% planning to deploy it in the next 12–24 months.[16]

[13]Jim Euchner, "Little ai, Big AI—Good AI, Bad AI," *Research-Technology Management* 62, no. 3 (May 2019): 10-12, https://www.tandfonline.com/doi/full/10.1080/08956308.2019.1587280.
[14]Davis, "Putting Intelligence Back into AI."
[15]The Manufacturing Institute and Alfred P. Sloan Foundation, *The Aging of the Manufacturing Workforce* (Washington, D.C., July 2019), https://themanufacturinginstitute.org/research/the-aging-of-the-manufacturing-workforce/.
[16]Brown, "SURVEY: Manufacturers Go All-In on AI."

In application, AI tools in the supply chain can help companies make the most of their inventories. One technology and computing company built and integrated an AI program that used machine learning to assess the common parts across different areas of their operations, identifying when and where parts could be shifted from one area to another as needed. Because spare parts had been scrapped previously if unused, using machine learning to assess hundreds of parts and greatly reduced potential waste—an unfeasible task for a human team—has saved this company millions of dollars in replacement and sourcing costs. The company hopes to expand this project to include further advancements in AI technology, including deep learning and graph neural networks.

In the aerospace sector, AI, specifically machine learning, has evolved to deliver solutions in the areas of autonomy, such as obstacle avoidance and automatic vehicle taxiing, as well as optimization of cargo in airplanes that are connected digitally, and many other areas. These advancements, leveraging deep learning, continue providing solutions to technology gaps that would otherwise be hard to achieve with traditional approaches.

More widely, using models that take global and national trends and disruptions into account, manufacturers can make swift changes to their supply chain decisions. This allows them to be more resilient to unexpected changes, with models able to identify new shipping patterns, altered supplier choices or inventory shocks.

How Are Manufacturers Testing AI Systems?

As manufacturers expand the use of AI technology, they are finding more robust ways to guarantee that these technologies are safe and reliable for their employees and customers to use. Many companies are approaching AI through the same kind of proven risk-management frameworks that they use for their IT and cybersecurity programs. Companies are also developing their own internal governance programs.

Manufacturers are using testing groups, bringing together AI, IT and operations professionals, to identify where algorithms might be inaccurate and to validate that their systems meet high thresholds of success. When testing new AI systems, one shipping and logistics company found that internal facility safety teams and their third-party testing organizations both needed to develop a new knowledge base and upskill together.

In this way and others, manufacturers are building their own governance programs for data and AI systems, maintaining data privacy and conducting internal testing before new programs are deployed. This is true especially for heavily regulated industries, such as automotive, pharmaceuticals and aerospace, that already must meet many of the safety benchmarks applicable to the development and testing of safe AI systems. Many are working directly with the government already to develop certifications for critical technologies that do not disrupt their deployment of AI.

What Should We Do Now?

Manufacturers are committed to the responsible development and deployment of AI. AI has become critical to modern manufacturing, and AI technologies and capabilities are still evolving quickly; policymakers should therefore foster a policy environment that supports manufacturing growth through AI innovation and adoption. Further, policymakers should leverage the industry's expertise throughout the policymaking process. A policy ecosystem that supports innovation and growth in manufacturing AI will bolster U.S. competitiveness and leadership in this critical emerging field.

Review Existing Laws Before Enacting New Ones

Policymakers should not assume that existing laws and regulations are insufficient to address AI-related policy concerns. Instead, they should take stock of these laws and regulations—whether they are focused on privacy, IP, fraud, safety or other critical topics—to determine to what extent regulations need to be clarified or supplemented in the AI age. This would avoid creating duplicative and burdensome requirements.

AI Is Context-Specific; AI Regulation Should Be Too

To the extent that regulations will be developed, they should differentiate among the variety of use cases of AI. One key factor will be risk, which depends on the specific context in which an AI system is deployed (e.g., what data it is trained with, what data it computes to operate, what its function is, whether it operates autonomously or under human supervision or how it interacts with or is used by workers or consumers).

Manufacturers are taking this approach already, developing their own internal governance structures to manage varying risk levels across AI use cases. Focusing policymaking on specific uses of AI also means not taking a rigid approach to regulating the underlying technology, which could be used in a host of applications with different purposes and risk profiles. The private sector has embraced the AI Risk Management Framework of the National Institute of Standards and Technology, which can be used voluntarily by companies that develop or deploy AI systems to assess and manage the associated risks, precisely because it is an excellent example of this risk-based approach.

Right-Size the Compliance Burden

Policymakers keen on spurring AI innovation and use should be mindful of the potential compliance burdens that both developers and deployers of AI could face. One key test will be whether companies will be required to undergo third-party audits to demonstrate compliance, which are costly and cumbersome. Additionally, policymakers should remain mindful that the deployers of an AI system would depend on representations (about the system's design, capabilities, training data, etc.) made by the system's developer, so regulatory frameworks should allow developers and deployers to collaborate with each other to ensure compliance is seamless.

Maintain U.S. Global Leadership

Manufacturers operate globally, which is why they need a globally aligned regulatory environment, rather than a patchwork of redundant or incompatible laws. Policymakers should leverage industry standards and best practices where possible—as NIST did when it developed its risk management framework—to enhance regulatory certainty and ensure ease of compliance. Countries are competing to set the standard for AI guidelines. The U.S. can and should be a leader in adopting policy approaches to AI that support innovation. The NAM is committed to working with policymakers to ensure the growth of industrial AI innovation while maintaining regulatory certainty for manufacturers. The U.S. must take the lead in passing and enforcing AI policy that is transparent, democratic and inclusive of the industry to defend against approaches that are top-down, opaque or overly restrictive.

Invest in R&D and Workforce Pathways

Manufacturers are investing already in upskilling their current workforce to meet the opportunities AI provides. Manufacturers also are recruiting workers who are trained in AI, data science and related fields. Manufacturers are committed to employing people in the U.S. and ensuring that they remain competitive

enough to do so. Policymakers should support the industry's moves toward digitization and Manufacturing 4.0 by supporting the career and technical education institutions that train the industry's shop floor workforce.

In fact, a December 2023 report on smart manufacturing by the National Academies emphasized that "continuous education and workforce development are paramount to the success of smart manufacturing and ultimately the U.S. manufacturing ecosystem."[17] Manufacturers must be supported and have the resources to maintain the progress they have been making with AI.

Protect Personal Data

Data continues to be a critical input and byproduct of modern manufacturing. Maintaining the privacy of personal data is important to manufacturers, who resoundingly support efforts to craft a federal privacy law that would advance individuals' privacy, prevent a patchwork of state privacy laws and provide much needed legal clarity to support continued innovation and competitiveness. Any such standard should take a risk-based approach to data privacy while also protecting manufacturers from frivolous litigation.

Without clarity from federal law, uncertainty will continue for our industry, causing manufacturers to sort through conflicting state privacy laws across the country and around the world. To provide greater legal clarity, and not obstruct interstate commerce, federal privacy legislation should preempt state privacy regulations to resolve conflicting requirements in different states. The White House's AI Bill of Rights supports these goals and sets a standard for future federal guidance. Additionally, manufacturers require harmonization of standards internationally to remain competitive. The more disparate the approach to AI across our neighbors and allies, the more time, energy and investment companies will need to spend on dealing with misalignments. This is a direct impediment to U.S. manufacturers' growth and leadership in AI.

[17]Committee on the National Plan for Smart Manufacturing, Options for a National Plan for Smart Manufacturing: Consensus Study Report Highlights (Washington, D.C.: The National Academies Press, December 2023), https://nap.nationalacademies.org/resource/27260/RH-smart-manufacturing.pdf.

What's Next?

AI is unlocking incredible opportunities across manufacturing: for consumers, for our workers and for companies of all sizes. As leading developers and deployers of AI technologies, the experiences of manufacturers are critical for policymakers as they consider actions that could affect AI. The industry stands for the responsible development and deployment of AI, especially as the technology continues to rapidly evolve and innovators develop new applications that will improve efficiency, safety, product design and supply chain resiliency. Manufacturers are also committed to keeping people—not machines—at the center of operations, using AI to enhance human capabilities. To ensure that the U.S. leads the world in the innovation and job creation associated with new applications of AI, the NAM is committed to working with policymakers to craft context-specific AI laws and right-sized compliance burdens, while also supporting investments in R&D and new workforce pathways.

This report was written by Mary Frances Holland, associate director for economic research for the National Association of Manufacturers. The NAM produced this report, with guidance and insights from thought leadership at the Manufacturing Leadership Council and the Innovation Research Interchange. The NAM conducted in-depth expert interviews with manufacturers in many sectors to better understand how AI is being used in the current marketplace.

NATIONAL ASSOCIATION OF Manufacturers

Statement for the Record

of the

National Association of Manufacturers

for the

U.S. House of Representatives
Committee on Energy and Commerce
Subcommittee on Commerce, Manufacturing and Trade

Hearing on AI in Manufacturing:
Securing American Leadership in Manufacturing and the Next Generation of Technologies

Wednesday, February 12, 2025

The National Association of Manufacturers ("NAM") thanks the Subcommittee on Commerce, Manufacturing and Trade of the Committee on Energy and Commerce for focusing on the role that artificial intelligence ("AI") plays in modern manufacturing and on how we can maintain American leadership in this area, and appreciates this opportunity to provide its perspective on manufacturers' use of this transformative technology. We ask that this statement and the attached NAM report, "Working Smarter: How Manufacturers Are Using Artificial Intelligence," be entered into the record of this hearing.[1]

The NAM is the largest manufacturing association in the United States, representing manufacturers of all sizes across all 50 states and in every industrial sector. Manufacturing contributes $2.93 trillion to the U.S. economy annually and is the most innovation-dependent sector of the economy, accounting for 53% of private-sector research and development. It employs nearly 13 million people in the U.S., who earn on average almost $103,000, i.e., 18.5% more than in all private nonfarm industries. The NAM advocates for a policy agenda that helps manufacturers compete in the global economy and create jobs across the United States.[2]

AI has become a subject of central importance to manufacturers for two reasons: manufacturers are at the forefront of developing and implementing AI systems, and, as such, AI has become integral to modern manufacturing.

How manufacturers are using AI

As our report explains, manufacturers use AI in myriad ways, including:

- The impact of AI on the shop floor is and will continue to be a game-changer. The digitalization of the shop floor—the embedding of sensors into manufacturing equipment and their connection to high-speed communication networks—enables the collection and transmission of large amounts of data about every aspect of production operations. AI

[1] The report can also be found at https://nam.org/wp-content/uploads/2024/05/NAM-AI-Whitepaper-2024-1.pdf
[2] See Facts About Manufacturing, available at https://nam.org/manufacturing-in-the-united-states/facts-about-manufacturing-expanded/

systems can then process this data to give manufacturers new insights, which allows these operations to be designed and carried out in an optimal fashion. This means more efficient shop floor operations, optimal equipment maintenance, enhanced quality of outputs, better cost control and more sustainable production processes.

- The use of AI in relation to shop floor operations also yields significant benefits for operational and worker safety, both by assisting in the design of inherently safer production processes and in helping prevent accidents by alerting operators in real-time to mistakes and dangers.

- AI augments manufacturers' product research, development and design, allowing them to bring better products to market faster and more cheaply.

- Manufacturers use AI systems to optimize how they manage their supply chains. This makes them more resilient and allows them to prevent production stoppages or shortages and to efficiently deliver products to customers.

- AI systems enhance how manufacturers provide after-sale customer support and product maintenance. Modern, connected products can generate data about their use and performance, which AI can analyze to predict rather than merely react to anomalies, alerting the user and preventing costly, inconvenient and potentially dangerous problems.

The range and importance of uses of AI—transforming every aspect of the core of manufacturers' operations—make it clear that AI has become integral to manufacturing. With the right federal policies, U.S. manufacturers will continue to devise new and exciting ways to leverage AI to lead and innovate and stay ahead of their global competitors.

The impact of AI on the manufacturing workforce

Manufacturers face a shortage of skilled labor. First, the industry had 412,000 unfilled manufacturing jobs in November 2024. Simply put, manufacturers' challenge is to find workers to fill open jobs to meet customer demand.

Second, it is critical not to conflate AI and automation: automation is for straightforward and highly repeatable processes that do not depend on sophisticated data analytics to be performed; by contrast, AI is much more cognitive and depends on extracting insights from data to support decision-making in unique situations.

Manufacturers are keen to maintain the work of people, not computers, at the center of their operations. This "human-in-the-loop" approach means that manufacturers most often use AI to complement and augment the work of humans in the workplace, to make them more efficient, and to support their decision-making while still prioritizing human experience and ingenuity.

As a result, AI in manufacturing requires a workforce with improved education and training:

- Manufacturers need more workers with higher education degrees in data science and computer science to develop and deploy AI systems.

- Manufacturers need employees with improved, AI-ready knowledge and skills everywhere, from product designers and developers, to supply chain managers, to the workers operating on the shop floor. In particular, manufacturers hire most production workers from career and technical education institutions, like community colleges. Manufacturers often partner with these institutions to ensure that the curriculum is regularly updated to fit their workforce

needs. When it comes to AI that means critical thinking, problem solving and understanding concepts of data input and output. Manufacturers work closely with career and technical education institutions to ensure that they graduate workers who have the skills our industry needs.

As manufacturers continue to struggle to fill jobs, they need more workers to fill them—and they need more of them to be AI-ready.

Policy implications of the use of AI in manufacturing

Manufacturers are utilizing AI in myriad ways on the shop floor and throughout their operations. The diverse use-cases of AI in manufacturing suggest a need for a cautious regulatory approach to this groundbreaking technology: one that supports innovation and U.S. leadership in AI while providing context-specific, risk-based, right-sized rules of the road for manufacturers.

First, policymakers should always review existing laws and regulations before enacting new ones, because most uses of AI correspond to tasks and objectives (e.g. operational safety, or after-sale customer support) that industry has faced for a long time and that are thus highly likely to have already been addressed by existing laws and regulations. This means that companies likely can apply existing rules to their uses of AI, obviating the need for new, duplicative requirements.

Second, AI is context-specific, so AI regulation should be too: the diversity of use-cases of AI makes manufacturers particularly sensitive to any policy or regulatory approach to AI that is one-size-fits-all. Indeed, an underlying AI technology could be used in a host of applications with different purposes and risk profiles. If and when new AI regulations are truly necessary, they should apply to specific uses of AI and be appropriately calibrated for context and risk, rather than impose inflexible and ill-fitting requirements that would hamper innovation.

Similarly, policymakers must right-size any compliance burden associated with AI regulation. The ubiquitous use of AI throughout modern manufacturing, as well as manufacturing's dependence on innovation, underscore the need for rules that enable rather than hinder manufacturers' development and adoption of AI systems. Notably, the overwhelming majority of manufacturers are small and medium-sized companies,[3] which are particularly affected by regulatory burdens—indeed, smaller companies already bear a disproportionate share of the industry's regulatory burden, with federal compliance costs surpassing $50,000 per employee per year for small manufacturers.[4] Limiting compliance burdens associated with AI-specific policies will ensure that small and medium-sized manufacturers are not left behind as AI continues to transform manufacturing; appropriately tailored rules are also crucial for maintaining U.S. global leadership in setting AI standards and policy, which will help manufacturers reap the economies of scale of a globally aligned regulatory environment.

Congress can also take affirmative steps to support the development, adoption and deployment of AI in manufacturing:

- To ensure that manufacturers have the AI-ready workforce necessary to support AI-driven innovation and growth, Congress should support the career and technical education institutions that train this workforce. In particular, the NAM supports the bipartisan and bicameral Stronger Workforce for America Act, which would reauthorize the Workforce Innovation and Opportunity Act and was passed by the House on a bipartisan basis in the

[3] See point 3 of Facts About Manufacturing, available at https://nam.org/manufacturing-in-the-united-states/facts-about-manufacturing-expanded/
[4] The Cost of Federal Regulation to the U.S. Economy, Manufacturing and Small Business, by Nicole V. and W. Mark Crain, October 2023, available at https://nam.org/wp-content/uploads/2023/11/NAM-3731-Crains-Study-R3-V2-FIN.pdf

118th Congress. This bill would increase funding available to the manufacturing industry to upskill, recruit and retain its workforce, and supports industry working together and with training institutions to create collaborative solutions.

- Additionally, Congress should address increases in the demand for more computing power and data center processing to service AI systems by ensuring a reliable and resilient power grid. Access to the energy necessary to power AI is critical to the continued growth of manufacturing and to manufacturers' use of AI systems. That is why manufacturers support comprehensive permitting reform, which would unlock new sources of energy and pave the way for the deployment of new energy infrastructure.

Finally, while many uses of AI do not implicate personally identifiable information, it is nevertheless crucial that Congress take steps to maintain the privacy of personal data when utilized in AI contexts. Manufacturers strongly support efforts to enact a comprehensive federal privacy law that protects consumers while enabling innovation and commerce. A federal standard should avoid a patchwork of state-level rules by fully preempting state privacy laws; it also should protect manufacturers from frivolous litigation.

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The NAM commends the Subcommittee for recognizing the importance of the AI-powered transformation of modern manufacturing. Manufacturers look forward to working with Congress to advance policies that support this transformation.