Sridhar Kota
Executive Director – MForesight: Alliance for Manufacturing Foresight
Herrick Professor Emeritus of Engineering, University of Michigan.
Founder & CEO, FlexSys Inc., Inspire Rx LLC.

Chairman Cardin, Ranking Member Paul, distinguished Committee Members—thank you for the opportunity to appear before you today to discuss the supply chain crisis and how to better prepare for the next crisis.

I would like to focus my testimony on small manufacturers who are the economic engines of our local communities, and backbone to the entire manufacturing sector. Challenges facing manufactures are broad, deep and systemic. We need government action that is commensurate with the challenge to prepare for the next crisis. No single federal agency can truly fix the supply chain crisis by itself, and SBA is no exception. The supply chain crisis has its roots in gradual erosion of our manufacturing sector over four decades. Therefore, creating yet another federal program or increasing funding for an existing program might give some satisfaction but it will not fix the underlying problem. It takes a whole of government approach. It demands an effective national strategy to create industries of the future. It needs sustained investment, not spending, by the federal government.

To highlight the nature of this challenge, I quote Akio Morita, co-founder and Chairman of Sony Corp. "American companies have either shifted output to low-wage countries or come to buy parts and assembled products from countries like Japan that can make quality products at low prices. The result is a hollowing of American industry. The U.S. is abandoning its status as an industrial power." This was said in 1986. The slippery slope we have been for the past 4 decades has only made matters much worse. It is not surprising that we did not have adequate masks and ventilators that we desperately needed during the Covid-19 crisis. To ensure that we will be better prepared for the next crisis, be it health, military or natural, it is crucial that the federal government takes a holistic approach to develop a real solution, not a piecemeal approach that is likely to fail.

The pandemic is new but the gross inadequacies in our domestic supply chains across almost every manufacturing sector are, unfortunately, not new. With heavy reliance on global supply chains and foreign manufacturers, the pandemic has interrupted shipping of parts and materials to nearly 75% of U.S. companies. Modernizing our ports and distribution channels will streamline the flow of goods from other countries the next time we face crisis. But that will only provide a false sense of security when faced with a different type of crisis. Already, our new normal celebrates when an Amazon Warehouse moves to town, but the nation simply cannot maintain its living standards based on low-paying jobs in warehousing, distribution, and sales of American innovations made in offshore factories.

For decades, we have steadily offshored manufacturing to low-wage countries. That strategy has worked and continues to work well for private sector companies that remain focused on

short-term profits. For too many companies, manufacturing could be done cheaper abroad, avoiding the capital costs and operational expenses of building and running factories while destroying good-paying domestic jobs resulting in stagnant incomes for nearly 50 years. By offshoring manufacturing, we have slowly but surely eroded our manufacturing know-how, infrastructure, precision machinery and engineering skills – all of them collectively called "industrial commons" or what we used to call American ingenuity. As a result, we also eroded our military preparedness with growing dependence on other countries for critical military components and systems. For instance, a report by the Senate Armed Services Committee in 2012 documented the vast number of counterfeit parts in defense supply chains, typically imported by third and fourth tier suppliers. There were several other reports and studies since, but the downward trajectory has only intensified. More recently, we all realized our vulnerabilities in health security during the Covid crisis.

Personally, I had a frustrating experience in 2020 when I tried to identify U.S.-based manufacturers of electric motors for a device I co-invented to treat Covid-19 patients while preventing virus transmission to health care workers. After over a month of failed attempts, I reluctantly entertained offers from China. I found them to be technically thorough with very attractive delivery options and pricing (unit and volume), which, understandably, would have been enough for most customers to place the order. But I was determined to keep manufacturing here, and, fortunately, after additional efforts, I was able to identify a manufacturer based in Kentucky. Such lack of domestic producers is a common phenomenon in almost every manufacturing sector for over two decades, but only aggravated by the Covid crisis.

Between 2007 and 2019, manufacturing output fell 1.3 percent, a worse performance than during the Great Depression. Productivity rose only 0.4 percent per year compared to 3.7 percent in the prior 20 years. In 2018 the Food and Drug Administration (FDA) listed 90 drugs in short supply; in September 2020, the number had jumped to 119. Output from a key industry during the pandemic, medical equipment and supplies, fell 10 percent. A more granular analysis of 40 manufacturing industries found that only one—wood containers and pallets—increased employment between 2002 and 2018, but only by 1.2 percent. Every other industry examined, including advanced industries like semiconductors, communications equipment, and computers, experienced large drops in the number of establishments and employment. Meanwhile, production in China continued to grow, to roughly double U.S. output.

Covid-19 has aggravated and surfaced the underlying systemic challenges in our manufacturing supply chains. Domestic manufacturers of all sizes have experienced shortages of raw materials, components, sub-systems or machinery and tools that are routinely imported from other countries, particularly from Asia. Additionally, the shortage of skilled workers at all levels continue to plague the manufacturing sector. These challenges are intertwined – fixing one or the other will not improve our resiliency when the next crisis arises. An effective way to prepare for the next crisis is to take a holistic approach that begins with a national strategy to strengthen not only emerging technologies and industries of the future but also the foundational industries and capabilities that are critical to our national security, as well as

economic, health security and energy security. It is the federal government's role, not the role of the private sector, to secure and advance our national interests.

A good example of such a federal initiative is the current bipartisan efforts to strengthen domestic manufacturing of semiconductors and electric vehicles. Likewise, if we have a national strategy that identifies other critical sectors, we can identify specific technologies, both emerging and foundational technologies, that we must develop to ensure robust and cost-effective supply chains on-shore and/or near-shore to minimize the impact of future shortages. Such a strategy could direct federal investment and public-private partnerships in building knowledge and physical infrastructure just as we are witnessing in electric vehicles and semiconductors.

Although the U.S. remains a large manufacturer, accounting for nearly 17 percent of global output, over two-thirds of revenue is generated in just three industries: Chemicals (including oil and gas products), Food & Beverages, and Transportation. It's no coincidence that the first two are anchored here by their dependence on local raw materials and agriculture production. The silver lining is the Auto industry, accounting for over 20 percent of U.S. manufacturing. That is because it still has the installed base of talent, infrastructure and supply chains built over a hundred-year history. Once supply chains move away it is very difficult to lure them back quickly even with tax incentives or tariffs.

But contrary to the Washington consensus, it is not high wages, taxes, unfair trade, regulations, or automation that have decimated American manufacturing. Consider Germany, Japan, and South Korea: these advanced nations continue to have strong manufacturing and innovation ecosystems despite having higher wages, higher taxes, higher energy costs, strict regulations, and more automation than in the United States. Governments and the private sector in these advanced nations invest with a long-term strategy. In fact, foreign multinationals, German and Japanese in particular, continue to invest in manufacturing facilities in the U.S.

Small and medium sized manufacturers (SMMs) serve as the backbone to the entire manufacturing sector. Most SMMs have never had a "China strategy" and are less likely to shift production abroad. They produce key components and sub-systems that OEMs integrate into finished products and systems. They are severely constrained in resources to make necessary investments in R&D or to upgrade their machinery and equipment to be globally competitive. With the spread of lean manufacturing, they also tend to have limited inventory, so the supply chain crisis has affected them even more severely. SMMs face significantly more challenges in attracting and retaining skilled workforce at all levels.

Government has an important role to play in building a strong and globally competitive manufacturing sector by supporting SMMs in a meaningful way. This may include: grants and low-interest loans to upgrade equipment; federal vouchers to subsidize training on the use of Industry 4.0 technologies, hire talented workers including veterans, semi-retired or retired engineers and managers; partnerships with vocational training programs for talent

development; partnerships with R&D institutions to bring inventions to production and access to capital, government procurement and export markets.

Rather than continue to fund programs that have not yielded desirable results in decades, government needs to launch a series of Listening Tours across the nation, rather than heeding lobbyists in DC, to understand the real-world challenges faced by SMMs and entrepreneurs. This will help identify gaps in our innovation pipeline and supply chains. In 2018, MForesight did just that. We convened diverse groups of experts via numerous round table discussions in various cities across the country which informed us, among other insights, the need for investment in translational R&D, and scaling up 4-yr polytechnic universities that provide both education and training.

In our Austin roundtable, we learned that nano-electronics technology developed by UT-Austin researchers, is now being scaled in Japan by Canon. The research was initially funded by NSF and later by NIST's ATP program. Despite demonstrating the potential of the technology, federal funding dried up and no U.S. companies showed interest. Canon saw the long-term potential, took the risk, and invested $10 million in this nascent technology, only to make the resulting products in Japan. Representatives from Canon who were at the roundtable explained in detail how the United States lacks the manufacturing know-how, precision machinery, and engineering skills needed to scale the technology, despite continued preeminence in research. Therefore, all the production jobs, high-value product sales, capital investment, and supplier contracts are captured in Japan, not to mention the tacit learning gained from actual production.

Such transfer of technology, willingly, has only accelerated since China joined the WTO. Blaming universities is not the answer. Government that invested taxpayer dollars in R&D should institute proper metrics and policies to ensure a return on investment back to taxpayers. It also must create programs to fund technologies beyond just basic research. Otherwise, we will continue to silently witness other countries picking our winners. A study of 150 manufacturing startups from MIT during the last decade found that of those startups that managed to scale, 70% of them scaled in China and none in the U.S. This is due to lack of capital, skills and infrastructure. We may still be the most inventive country in the world but not the most innovative – at least in hardware. Innovation is about transforming a promising invention into a product manufactured at scale.

Current and pending legislation to create Regional Innovation Hubs, the new Directorate for Technology, Innovation and Partnerships at the National Science Foundation and a new Manufacturing Office in SBA are all very encouraging signs. However, if these programs, like every other federal program and agency, act in silos, the results will be mediocre at best. For instance, the SBA Manufacturing Office can play an effective role in not only helping current SMMs but also helping entrepreneurs and small manufacturers advance technologies developed by other agencies and helping initiate pilot production in the U.S.

For some, the idea of the federal government even considering developing a strategy for industrial competitiveness runs counter to free-market principles that we all believe in. The private sector pursues what is in its best interest and, understandably, cannot be responsible for national interests. The term "industrial policy" was derided by policymakers for decades. Yet, Oil and gas, Telecommunications, and Aerospace have benefited from favorable tax treatment, trade barriers, federal research, and defense procurement. Tesla got its start through a government loan. The federal government has a long history of building strong national industries through a combination of sustained R&D and procurement contracts. Aviation, semiconductors, computers and the internet are obvious examples. The Department of Defense helped create Silicon Valley. Government can make a positive impact again whether we call it industrial policy or not.

Of all the manufacturing sectors, only aerospace has consistently generated a trade surplus, and it is the only manufacturing sector that has enjoyed long-term, consistent government support. Led primarily by defense, the federal government has invested in both basic and translational research, engineering development, technology demonstrations, deployment, procurement, policies and programs that have made sure that aerospace completes the innovation cycle and wins in international markets. Regardless of the party in power, every President helps this industry market and sell both defense and commercial products when they visit other countries. This is successful, high-profile industrial policy we have enjoyed for nearly a century even if we pretend it isn't. We should replicate this policy boldly to other sectors critical to national interests.

We can rebuild a strong manufacturing sector especially because we still have some of the core ingredients such as basic research prowess and institutions, creativity, policies that attract the best and the brightest to our shores and entrepreneurship in our collective DNA. But the longer we delay, the greater the loss of industrial commons critical to robust and resilient supply chains.

We have numerous well-established and well-funded federal agencies and institutions, but each is focused on its own mission. It is like having a team of great players - but we don't have a coach. There is no entity in the federal government focused on U.S manufacturing competitiveness. To ensure that the U.S establishes the industries of the future, let alone prepare for the next crisis, we need a "coach" – that is a new entity in the federal government whose sole focus is to strengthen U.S. manufacturing competitiveness and to ensure that what is invented here is manufactured here. The goal is not to add another layer to the federal bureaucracy but to streamline 58 different "manufacturing" programs across 11 agencies and do so with a real national strategy and meaningful metrics which we currently lack. Federal programs must identify proper metrics that capture what needs to be accomplished but not how to accomplish it. For instance, in the context of R&D or entrepreneurship, patents, licenses and even start-ups are necessary first steps to generate returns, but they are poor proxies at best for economic impact because by themselves they do not create national wealth, jobs or national security. We need to manufacture our inventions at scale just like other countries have scaled our inventions.

We had at least two “Sputnik moments” in the recent past – Covid-19 and China 2025. These could be positive tipping points if we take the right steps to create a stronger, wealthier nation that is better prepared to confront the next crisis, be it medical, military or a natural disaster.