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Chairman Wolf and members of the Subcommittee, my name is Jim Phillips. Thank you for inviting me to appear here today. It is a rare privilege to have the opportunity to comment to you on the importance of advanced manufacturing and restoring U.S. competitiveness quickly to revitalize our most important economic engine of innovation.

I have had the opportunity to be involved in some of the most exciting developments of the digital revolution that have transformed our everyday lives. By way of background, I helped lead the teams that created and launched instant messaging, the cable modem, broadband, immersive imaging — the technology that makes virtual tours possible, the eBay imaging system, and many other now-ubiquitous products. I now serve as Chairman and CEO of NanoMech, a leading nano-manufacturing and research company.

NanoMech is a highly innovative nano-manufacturing firm, based in Northwest Arkansas, down the street from the likes of Walmart and Tysons headquarters, with a portfolio of international award winning inventions and commercial products, including innovations in machining and advanced manufacturing, lubrication and energy, packaging for a fresh produce supply chain, biomedical implant coatings, and strategic military applications. We feel we are poised for dramatic expansion of our manufacturing operations.

The United States is locked in a moon race with other major countries trying to take the lead in material science and bio nanoscale engineering research, development and commercialization in what is sure to be the next industrial revolution of progress. While these competitive countries lost out. to an extent, to the U.S. in the Information Technology revolution, they are determined to put enormous amounts of public and private capital to work to win this even more important race. Given the monopolistic efforts of China alone to control all of the world's dwindling resources, the U.S. is now at a great risk in not having material and rare earth metals that are core to our most important manufactured goods that are essential to our daily lives. Nanoscale engineering is our greatest hope in providing a way to do more with less in amazing and sustainable ways to keep America secure and the world leader in commerce, technology and defense.

Manufacturing Today

Over the past two years, I have had the opportunity to participate in the Council on Competitiveness U.S. Manufacturing Competitiveness Initiative, which developed and released the report, MAKE, late last year. The report contains many important insights, some of which I'd

like to share with you today, as I take this opportunity to offer my perspective as an entrepreneur, innovator and manufacturer.

Much of manufacturing in the United States centers on higher value-added activities that require highly-skilled workers, unique knowledge from innovators or sophisticated infrastructure. Other U.S. manufacturers are in sectors that require proximity to end consumers due to transportation or other factors. Still other producers have unique quality-assurance relationships with larger firms or support America's defense base.

Ironically, despite an ongoing recession and unemployment hovering around 8.6 percent, U.S. manufacturers face a significant talent shortage. A recent study by Deloitte and the Manufacturing Institute found that 5 percent of manufacturing jobs remain unfilled simply because people with the right skills are not available. That translates to 600,000 available U.S. jobs.

Not only are manufacturing and services interdependent, they are distributed globally. For most of the 20th century, "Made in America" meant just that: design, development, fabrication and associated transactions were performed in U.S. factories and offices by U.S. workers. Today, many goods are no longer designed, produced and sold within a single country. Instead, the activities needed to bring a product from concept to consumption are routinely performed in different countries.

Many manufacturers believe that global competition has made them stronger, more productive and more competitive. Gains in productivity and output, however, are not translating into broader economic gains.

Furthermore, many U.S. states and localities do too little to attract manufacturing facilities, imposing complicated and time-consuming procedures on top of federal rules to site and build production facilities. The permitting process for a manufacturing facility in the United States might take months, if not years, whereas in some countries, the time required is merely a few weeks or less.

Manufacturing also suffers from its public image. Many American's still think about manufacturing in terms of product fabrication—humming factories for the transformation of materials into new products, basically, "bending metal" in operations that are easily sent elsewhere. However, manufacturing today is part of a much more complex, high value-added and tightly integrated global web.

Consider, for example, NanoMech's product platforms. We are developing cutting edge technology that enable more efficient industrial processes, and therefore, can save billions of dollars across several industries while dramatically increasing performance. These include:

- **Lubricant Additives**: We have developed advanced nano-lubricant additives that dramatically reduce friction in machines to the point of near zero, and thus deliver extraordinary energy savings. This work supports multiple industrial sectors including heavy

machinery, advanced machining, gas and oil transport, wind turbines, transportation, and others.

- **Machining and Coatings**: NanoMech has developed the world's first cubic boron nitride coating for manufacturing cutting tools allowing them to cut up to 1000% longer and in ways that allow the creation of new type machines. It is not only an alternative for machining hardened steels but it enhances productivity by orders of magnitude. Through this innovation, the company has also developed strategic know how in ultra fast coating of nanoparticles for various applications such as machining, wear resistant surfaces, and anti-corrosion.
- **Additives for Sustainable and Security Products:** NanoMech has developed additives for fabric, polymers, and wood-polymer composites for delivering sustainability and security. For example, NanoMech is currently providing an anti-microbial coating for armor vests for defense systems as well as for use in the food industries.
- **Metal Nanopowders:** Metals are a strategic commodity for the United States. Nanoparticles of metals allow us to deliver "more value for less usage." We have the ability to produce large quantities of metal nanopowders including copper, nickel, and rare earths such as lithium, silver-indium alloy, aluminum, selenium and others. These materials are strategic and critical for multiple U.S. industries including energy, aerospace propulsion, electronics, and agriculture.

A broad array of government polices both foreign and domestic have important impacts on the innovation and production process, from research funding to taxes to market access. Presently, U.S. policies are not aligned with the full life-cycle perspective of innovation that includes production at scale.

The policies, programs, strategies and business models that worked in the past are inadequate to secure America's future in the digital and nano age. Government, business, labor and academic leaders must rethink and retool the nation's business environment to seize arising opportunities and address several shortcomings. The leveling effects of globalization are diminishing the lost cost advantages offered in emerging economies and potentially opening the door to increased manufacturing in the United States.

Structural Changes in the Global Economy Create Opportunities and Challenges

The global migration toward free enterprise and open markets is driving growth in emerging economies. Several nations have rapidly developed into formidable manufacturing competitors. China's manufacturing output, for example, is now approaching that of the United States. As development spreads, a new consumer class is burgeoning around the world. About 1.8 billion people occupy the consumer class today. By 2030, this number could reach 5 billion, with 95 percent of the growth occurring in emerging and developing economies—creating large new demands for manufactured goods.

Global companies see significant sales and investment opportunities in emerging economies. Emerging market's share of global foreign direct investment (FDI) inflows has grown from about 20 percent in 2000 to more than half today. In the 2011 "World Investment Prospects Survey," global companies saw China, the United States, India, Brazil, Russia and the United Kingdom as top prospects for future foreign investment.

U.S.-based operations must also compete with aggressive mercantilist policies from foreign governments. Many countries have put in place policies and financial incentives to attract investment, manufacturing facilities, foreign intellectual property and talent while protecting domestic business interests.

The digital revolution and the pace of technological change also profoundly impact the way that business and production are organized. Digital technologies have made many facets of the global economy nearly borderless. In an earlier era, the location of natural resources often determined where manufacturing would take place. In today's economy, knowledge, know-how, technology, creativity and capital are the most important resources for production, and they are highly mobile.

Put together, these trends—emerging manufacturing nations, growing consumer class, neo-mercantilist policies and revolutions in digital and other technologies—create a hyper-competitive manufacturing environment. Not surprisingly, firms are growing more sophisticated in their ability to react to these changes and, where possible, leverage them to their advantage in the marketplace.

Global firms are becoming more sophisticated and recalculating the total cost of production

Successful global firms rely on their ability to react rapidly to changes across the global marketplace. In the early stages of offshoring, inefficient manufacturing operations were often relocated from higher-cost economies to low-cost labor economies to maximize returns and ensure that products were price-competitive.

Fortunately for America, neither the marketplace nor corporate decision-making is static. Many firms are recalculating their total cost of production to take into account changing conditions and new factors. The wage gap, for example, between the U.S. and key competitors is narrowing. Many factors influence where companies invest in new manufacturing capacity, including labor costs, supply networks, financial, tax, legal and regulatory systems, access to skills and resources; speed to market, intellectual property protection and market access.

The factors that might incentivize a return to or a departure from U.S.-based manufacturing will vary by firm and industry. Industries that rely on intellectual property are drawn to the strong protection offered by the U.S. after experiencing the challenge of piracy elsewhere. Other firms have found that long supply lines in Asia add cost and reduce flexibility to serve customers in North America and Europe. Still others seek access to cutting edge U.S. automation and robotic technology.

Talent is one of the key drivers for manufacturing competitiveness.

The United States needs highly-skilled workers to realize the productivity gains essential to remain globally competitive. Yet current and anticipated human capital deficiencies exist across the board. Not only are current openings for highly skilled workers challenging, manufacturing workers are retiring at a much faster rate than they are being replaced. The growing shortfalls

represent a critical need for a wide range of skills across many occupational cuts, from the most rudimentary to the most sophisticated PhD level.

Current and future realities command an intergenerational approach toward developing homegrown talent. Two of the biggest pressures on joblessness and job generation are the bookends of the workforce: the would-be new entrants, 16-24 year olds who need the skills to take on increasingly complex tasks, and mature workers, 55 years and older who are now the dominant demographic group in the workforce and exploding in numbers. Mature workers will fuel over 90 percent of the increase in the U.S. labor market between 2008 and 2018.

Current and future talent and skills requirements can be met. Old stigmas associated with vocational training must be cast aside. Career and Technical Education (CTE) coursework, certifications and just-in-time training on the job, in the classroom, at experiential training centers or online offer the most expedient and often most effective pathway for acquiring necessary skills. This is true for both new entrants and incumbent workers. The most effective community colleges have long been engaged with the local business community, responding to the needs of employers by tailoring curricula to workplace demands. But to respond to America's manufacturing challenge, community colleges must take an even more active role in forging these connections, rather than in pockets as happens today.

Another major focus continues to be graduating more students with advanced degrees in Science, Technology, Engineering and Mathematics (STEM) disciplines, as well as improving STEM literacy in general. The U.S. Department of Commerce expects STEM occupations to grow 17 percent over the next several years, compared with 10 percent in other occupations. The White House Office of Science and Technology Policy recently inventoried federal STEM promotion programs, counting 252 programs across 13 federal agencies valued at $3.5 billion annually.

Current visa policies are reversing decades of openness to foreign scientific excellence. Foreign nationals with advanced degrees from American institutions are returning to their countries of origin and pursuing employment opportunities unavailable to them in the U.S. With them, they take the skills and knowledge necessary to create next-generation goods and services, and reduce America's competitive advantage while increasing that of the country to which they return. No one disputes the need for safe-guards and assessment of foreign entrants. However, a system that is transparent and efficient and also offers fresh incentives for the best and brightest can offset current obstacles.

America Must Leverage its Edge in Innovation, Technology and Computing

America's technology and innovation capacity remains among the greatest in the world. In crucial fields like biotechnology, biomimicry, nanotechnology, materials science and computing, U.S. researchers and entrepreneurs define the leading edge. American universities and research laboratories are unparalleled, pushing the boundaries of knowledge in life, physical and social sciences. Despite the nation's budget woes, Congress has thus far been reluctant to impose drastic cuts to scientific research funding that is viewed correctly as an engine of economic growth. America remains the world's largest investor in R&D and is among the upper ranks in R&D investment as a share of GDP.

At the same time, other nations are making rapid progress relative to the United States in the talent, investment and infrastructure needed to foster innovation. On several education performance metrics, the United States trails its global competitors. Furthermore, a number of policies and practices limit American innovation today. Licensing practices, export controls and immigration policy, for example, were designed for a different era. Removing those impediments could generate greater levels of innovation and commercialization from today's assets and investments. In addition, the United States had the most generous R&D credit of any nation in the 1980s, but today, 16 other nations have a more generous tax break for R&D, which means many U.S. firms are sending R&D overseas.

In 1960, the United States accounted for more than two-thirds of global R&D. Today, two-thirds of global R&D is performed somewhere other than the United States. Although a more prosperous and innovative world is a welcome trend, the shift has significant implications for U.S. manufacturing and security interests. America has long been the global leader in creating new, high value-added goods and services. That lead will undoubtedly narrow and the greater issue will become whether Americans continue to develop and produce sufficient numbers of high-margin products to sustain and improve living standards.

America Also Must Better Leverage Its Entrepreneurial Enterprise

By combining innovation, entrepreneurism and risk capital, America has spawned more globally-recognized brands in more sectors than any other economy over the past several decades. The U.S. entrepreneurial enterprise is a critical advantage, since as much as one-third of the difference in economic performance among countries is attributed to the difference in their levels of entrepreneurial activity. Highly skilled entrepreneurs and business start-ups also create middle-skill jobs though the number of new businesses has declined significantly.

Consistent with other facets of the hyper-competitive manufacturing environment, many nations around the world—plus states and localities—are working to narrow the U.S. entrepreneurship advantage. They are creating tax incentives, sovereign wealth funds, skilled immigration incentives, regional innovation clusters and global collaboration forums with varying levels of success.

The Global Entrepreneurship and Development Index (GEDI) ranks the United States third overall out of 71 countries—first in entrepreneurial aspirations, sixth in entrepreneurial attitudes and eighth in entrepreneurial activity. According to the Index, American entrepreneurship is slowing due to three key factors: the end of the 1990s high-tech bubble and fewer tech startups, the current recession and lack of investment, and immigration policies that have limited the entry of skilled workers into the United States.

America must do more to enable entrepreneurs to take risks and to translate ideas into innovation. America is still leaving ideas on the table. On average, only one in ten U.S. patents is ever commercialized. Thousands of inventions lie dormant in the hands of universities, research centers and private companies. For those ideas that are pursued commercially, only seven out of

every 1,000 business plans receive funding. And even fewer are scaled to full production in the United States.

As I have noted, NanoMech develops "platform technologies" which can be customized for multiple industrial sectors. What that means is that the public benefit is broader than any single industrial application. In the area of lubricant additives, that means we are developing specific formulations for automotive engine lubrication, wind turbine gear boxes, aviation oils and greases – if it has an engine, it can benefit from our product. Collaborating with industrial end users too early in a product's development often results in that product embodying a lower-risk, single, narrow application of the technology that ties up the underlying IP. This outcome precludes us from realizing the technology's benefits for other key applications necessary to advance nanomanufacturing. The development timeline would also likely be much longer. In other words, if we engage with an industrial end-user too early, we will not be able to develop the technology for the many other sectors –which often include defense—that will reap substantial economic and energy benefits. Public funding for early development and testing at commercial production scale preserves our ability to market to multiple industrial sectors, which maximizes the impact of the technology.

Remember, the science underlying NanoMech's products represents the best of the American R&D enterprise. When the resulting innovative products proliferate through the industrial base, the economic benefits are a return on the taxpayer's investment. Furthermore, because NanoMech's products are enabling technologies that will improve the energy efficiency of industrial processes, we can actually help to restore competitive advantage to industries that have lost out to global competitors in the last few decades.

America Falls Short of Its Potential as a Market for Manufacturing Investment

Like so many manufacturing trends, the data on investment in U.S.-based manufacturing paint a picture open to different interpretations. As noted earlier, the U.S. remains the world's top recipient of foreign direct investment and the largest share of that investment is in manufacturing. In 2010, foreign manufacturing investment to the United States surged 36 percent from the prior year. Plus, America's venture-capital (VC) community remains a critical strategic advantage. Despite these encouraging metrics, the reality explained in recent Council on Competitiveness dialogues by American executives, entrepreneurs and investors paints a different picture. These leaders indicate that the nation is underperforming in at least three crucial areas of manufacturing investment:

1. Production at scale for innovative start-ups: Risk capital firms regularly condition investing in a start-up on a commitment to produce overseas. U.S. tax policy, regulatory delays, structural costs and more competitive offshore incentives are commonly cited as threats to the capital firm realizing a return on its investment.
2. Domestic expansion and retooling of existing facilities: Tight credit lending, uncertainty over future U.S. policies and non-competitive structural costs are causing many firms to delay investment or increase capacity overseas.
3. Attracting production facilities to serve global markets: Although the United States remains competitive as a global manufacturing export platform for several key products, many suspect

America underperforms in drawing investment for this purpose. Across the globe, some manufacturing has to be performed in-country to serve that market. Manufactured goods in other sectors, however, are also produced for global or regional export, not all of which is low-margin or labor intensive. In these cases, the less competitive U.S. tax, regulatory and structural environment likely causes a loss of investment.

The American marketplace also is competing against aggressive, coordinated and well-funded foreign efforts to attract manufacturing facilities. America needs pro-growth fiscal and monetary policies that spur private sector investment, expand R&D capacity, grow capital expenditures for manufacturing at scale and increase savings. These policies should be informed by competing policies and cost structures overseas.

There are four primary stages of innovation and production where investment is needed:

- the technology creation stage, where the federal government plays a major role.
- technology transfer, where there is typically limited funding.
- the early commercialization stage, where angel investors and venture firms like to engage.
- the scale-up to full production stage.

Getting a new innovation to market often stumbles due to technology transfer functions with limited resources that struggle to connect researchers with limited business backgrounds to outside technologists, entrepreneurs and investors.

The availability of government funds decreases abruptly after the technology or knowledge is created because the government views subsequent investment as the domain of the private sector. This drop-off of investment occurs at the same time that the investment needs of a company or entrepreneur are growing to test, develop and begin commercializing the technology. This is the traditional valley of death referred to in the innovation process.

Often overlooked, however, is a second valley of death. A few of my colleagues from the Council on Competitiveness have suggested that this second valley emerges at roughly the point of scaling up production beyond $100 million to $150 million in revenue. Many firms are finding it more difficult to obtain scale-up capital in the United States than overseas. To capture the full fruits of the U.S. innovation ecosystem, the U.S. must bridge both valleys.

Conclusion

By many measures, the United States remains mired in the most prolonged economic slump since the 1930s. Despite improvement in fits and starts, unemployment remains high, household incomes are flat or falling and economic growth remains slow by historic standards. As part of a highly-connected global economy, America's economic health is not immune from the debt struggles of Europe or from the strength of emerging economies that are increasingly a destination for American exports and investment.

It is time for America to lead. Some, even many perhaps, question whether America has the resolve and resources to right its own ship, let alone lead a global recovery. The Council harbors

no illusions about America's daunting economic challenges, but believes steadfastly that the challenges are solvable and that Americans and their leaders will summon the will to act decisively.

That action should start by correcting the macro challenges outlined in this strategy—reducing the debt to sustainable levels, reforming the tax system and repairing infrastructure. Those steps alone, however, are not enough. America also must coalesce around a new vision focused on innovation and leadership in high value-added, next-generation manufacturing.

For more than 200 years, the United States has prospered because it is the home for people from every nation who are drawn to freedom, confident in their abilities to carve out a better life. That "can do" optimism for which America is known is more than a cliché; it is a deep-seated cultural belief reinforced by experience on battlefields and in boardrooms, in classrooms and laboratories…and on the factory floor. It remains within America's ability to make its future.

We must capitalize immediately on our great University system, our National Labs, and tremendous agencies like the National Science Foundation, to be sure this unique and best in class innovation ecosystem, is organized in a way that promotes tech transfer and commercialization in dramatic and laser focused ways so that we capture the best ideas into patents quickly, that are easily transferred into our capitalistic economy so that our Nation's best ideas and inventions are never left stranded, but instead accelerated to market at the speed of innovation so that we build good jobs and improve the quality of life and security for our citizens faster and better than any other country on our planet. The America Way.

Thank You.