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Council on
Competitiveness

Make

An American Manufacturing Movement

Full Report
December 2011

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UNIFYING

THRILLING

COLORFUL



Make: An American Manufacturing Movement

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The **U.S. MANUFACTURING COMPETITIVENESS INITIATIVE (USMCI)** is led by a CEO-level leadership council and steering committee, comprised of chief executives from industry, academia, organized labor and national laboratories.

An equally diverse and expert advisory committee is helping to shape the substantive aspects of the initiative, as well as providing ongoing counsel and support to the steering committee and Council staff.

Together, these individuals will frame the critical questions, provide the strategic direction, and develop a comprehensive set of actions to ensure a vibrant manufacturing base for America's future.

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Make

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Tesla Motors was founded in 2003 by a group of intrepid Silicon Valley engineers who set out to prove that electric vehicles could be awesome. The Model S is designed and built in California.

Top photograph by Steve Jurvetson. (Flickr)



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America's Call to Action

The Council on Competitiveness is pleased to present *Make: An American Manufacturing Movement*. We transmit this strategy to the President, members of Congress, governors and stakeholders across the country in business, academia and labor.

Ultimately, though, we are issuing a call to the American people with a renewed sense of urgency and resolve. Manufacturing is a cornerstone of American independence, economic prosperity and national security that we must not surrender.

Americans are makers—a nation of tinkerers, inventors, craftsmen and entrepreneurs. Our call for a robust manufacturing sector stems not from a nostalgic yearning for the past, but a clear-eyed determination to forge a dynamic future for Americans through a new era of production excellence. Manufacturing remains a driver of innovation and job creation, even as automation and technology make manufacturing more efficient. The United States must implement sound policies to grow the manufacturing sector.

We applaud the increased public and political attention given to manufacturing, though we remain deeply concerned that the United States has yet to understand and fully respond to the challenges affecting the American economy. America's economic portfolio requires a healthy and growing manufacturing sector to tackle the grand macro-economic problems facing the country, like job creation, debt reduction and infrastructure investments.

AMERICA MUST SOLVE URGENT MACRO-ECONOMIC PROBLEMS

Create 21 million jobs in 10 years to reduce unemployment to 5 percent.

An Economy that Works: Job Creation and America's Future
McKinsey Global Institute, June 2011.

Reduce government debt by \$4 trillion over 10 to 12 years to ensure the solvency of the United States.

President Obama's speech at The George Washington University, April 13, 2011.

Invest \$2.2 trillion in infrastructure needed to improve competitive advantage.

2009 Report Card for America's Infrastructure, American Society of Civil Engineers, March 25, 2009.

We urge the President and Congress to act with us to implement this strategy and do their part to unleash America's manufacturing potential. This strategy is powerful because it includes input from the highest levels of industry, academia, research and labor—rep-



The image of manufacturing as dumb, dirty, dangerous and disappearing is far from accurate. Today, manufacturing is smart, safe, sustainable and surging.

The F-35 Lightning II, also known as the Joint Strike Fighter (JSF), integrates advanced very low observable stealth into a supersonic, highly agile 5th generation fighter. The capabilities built into the F-35 Lightning II provide the pilot with unprecedented situational awareness and unmatched lethality and survivability. The world's most experienced aerospace industry leaders (Lockheed Martin, Northrop Grumman, BAE Systems and the Fighter Engine Team—Pratt & Whitney and GE Rolls-Royce) combine sophisticated manufacturing, engineering and technological capabilities to develop the F-35 Lightning II. This, along with global partnerships, has been an integral part of the JSF Program. Setting the stage for reliability and maintainability, the F-35's built-in sustainment establishes new levels of operational readiness and helps meet the needs across the spectrum of military operations. With its host of next-generation technologies and unprecedented capabilities, the F-35 is the world's most advanced multirole fighter. Photo courtesy of Lockheed Martin Corporation.

representing sectors across the manufacturing landscape. These leaders and experts agree that manufacturing is critical for American prosperity and national security. We must take immediate action to remain globally competitive.

The image of manufacturing as dumb, dirty, dangerous and disappearing is far from accurate. Today, manufacturing is smart, safe, sustainable and surging. It has evolved to encompass a wide range of digital, mechanical and materials technologies that infuse every step of designing, developing, fabricating, delivering and servicing manufactured goods. This includes high-tech modeling and simulation as well as robotics, artificial intelligence and sensors for process control and measurement. Manufacturing is about managing global supply chains and digital networks. And, more than ever, manufacturing is about engaging with employees and customers to create new tailored products and experiences to meet the discerning needs of customers around the world.

In this global, knowledge intensive and consumer-oriented economy, the competitiveness of U.S. manufacturing has never been more uncertain or more important—nor have policy prescriptions been more contentious. All

Americans would benefit from getting this right. A new era of manufacturing excellence offers hope for good jobs, new innovations and a higher standard of living. America would benefit from faster economic growth, a more secure industrial and defense base and an ability to produce solutions to national challenges in energy, health, environment and the economy. A robust American manufacturing sector can also spur global economic growth as well as help supply safe food and water to a global population that could reach more than nine billion people in the next 50 years.¹

America cannot rely forever on a consumption-based, debt-fueled economy. America needs to put its fiscal house in order, invest strategically, and produce more goods and services for consumers at home and around the world.

Although America remains the world's top producer, our nation has surrendered important manufacturing sectors. They were not all lost in the pursuit of cheaper labor or as a result of products becoming low-margin commodities. We have lost production of cutting-edge innovations developed in America because of tax, regulatory, skill, finance and infrastructure limitations that make production elsewhere more competitive.

Americans have always been pioneers, risk-takers and makers. Our task is to set those impulses free and embrace production once more. We must create a business environment that fosters breakthrough innovations, rapid commercialization and manufacturing at scale. Americans have proven adept at rising to the economic challenge of their time. Such a time is now for manufacturing—and we are confident that Americans will set in place the policies to ignite a new era of competitive and sustainable manufacturing.

Sincerely,



Samuel R. Allen
Chairman and CEO
Deere & Company



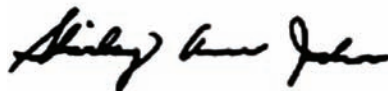
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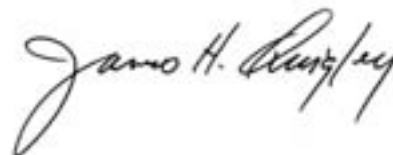
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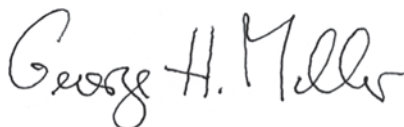
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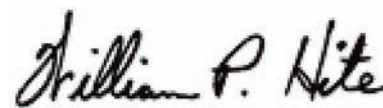
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We are grateful to the hundreds of dedicated, fascinating and passionate people who have contributed their time and expertise to *Make: An American Manufacturing Movement*.

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Chad Evans

William Bates
Matt Clark
Thorsten Roettger

Michael Bernstein
Annie Furr
Alison Walsh

Developing *Make: An American Manufacturing Movement*

The Council's U.S. Manufacturing Competitiveness Initiative (USMCI) was launched in June 2010 to begin a new dialogue on the policies and practices necessary to ensure the long-term success of American manufacturing. The Council, in partnership with Deloitte, created the *Global Manufacturing Competitiveness Index*. The *Index* reflects the views of more than 400 senior manufacturing executives worldwide who make decisions on whether and where to invest in research facilities, plants, equipment, technology and the workforce. (See page 22.)

The *Ignite 1.0–3.0* report series, another collaboration with Deloitte, followed next. *Ignite* is a multi-part, interview-driven project collecting insights from CEOs, university presidents, national laboratory directors and labor leaders. The *Ignite* reports capture several areas where these diverse perspectives converge on actions needed to invigorate American manufacturing.

Council members across the country also hosted a series of provocative “Out of the Blue” strategic manufacturing dialogues, bringing together hundreds of experts and practitioners to confront conventional wisdom about U.S. manufacturing. These participants challenged themselves and the nation to re-think what can and should be done to achieve America's full manufacturing potential. Their efforts revealed unexpected solutions.

The Council also drew on its other initiatives to develop this strategy, bringing together the best minds from American industry, academia, labor and national laboratories:

- The Technology Leadership and Strategy Initiative (TLSI), which convenes more than 40 chief technology officers to understand technology investment drivers and strategies for the 21st century, and to establish a new paradigm for collaboration between the public and private sectors to optimize America's investments in research, talent and technology.
- The Economic Advisory Committee, which assembles more than 40 chief economists to suggest actions to spur U.S. economic growth and to shape the Council's flagship publication, the *Competitiveness Index*.
- The High Performance Computing Initiative, which focuses on providing advanced modeling and simulation tools to manufacturing enterprises throughout the supply network.
- The Workforce Initiative to transform K-12 education, boost performance in science, technology, engineering and mathematics disciplines, improve workforce training and development, and tap the talents of mature workers.

Make: An American Manufacturing Movement also builds on the heritage of two landmark Council efforts of the past decade. The 2004 National Innovation Initiative identified advanced manufacturing as an over-the-horizon issue to be addressed in order to preserve U.S. innovation capacity. The 2009 Energy Security, Innovation and Sustainability Initiative yielded important insights about securing the future of U.S. manufacturing.



Executive Summary and Recommendations

American manufacturing is either in steep decline, doing reasonably well or poised to grow. Widely available reports and analyses support each of these conflicting views. Depending on the data used or time periods examined, various conclusions can be drawn about the health and importance of American manufacturing. So it is no wonder that policy prescriptions for manufacturing are in disarray.

In reality, elements of all three perspectives are likely true. The United States remains the world's top producer as measured by productivity, though some reports suggest China has edged ahead in output. Other emerging economies are developing significant innovation and manufacturing capabilities that threaten U.S. competitiveness. America's vast lead in value created and productivity, however, are drivers of long-term prosperity.

U.S. manufacturing is more important than ever, employing more than 11 million Americans directly, and creating close to seven million additional jobs in related industries.² Manufacturers contributed \$1.7 trillion to the U.S. economy in 2010.³ Manufacturing also boasts the highest multiplier effect among economic sectors, pays higher wages and drives innovation. Manufacturing accounts for nearly 60 percent of U.S. exports, and those export-related jobs pay even higher wages than non-export manufacturing jobs.⁴

This Council on Competitiveness strategy aims to explain where U.S. manufacturing has been, what forces are shaping its future, and what solutions are required for manufacturing to strengthen America's competitiveness, standard of living and national security.

Transformation of American Manufacturing

American manufacturing was the bedrock of a century of American prosperity and security. Wealth generated per American since 1900 has skyrocketed more than eight-fold in constant dollars, creating the most prosperous society in the world.⁵ The nation built unmatched scientific entrepreneurial and educational enterprises that fueled manufacturing and created the American middle class.

During the past 25 years, however, the global economy has changed dramatically. The end of the Cold War saw nations open their economies to trade and investment like never before. Those nations also invested in education and infrastructure, supplied benefits to domestic businesses and offered incentives to overseas investors. At the same time, the information revolution enabled radically new levels of global collaboration, new ways to conduct business, and insights about markets and customers.

These developments altered the competitiveness landscape. They required business executives to rethink the optimal way to organize a global firm. They prompted government officials outside the United States to rethink and redouble their efforts to build an industrial base for their nation, state or locality—efforts not always matched by their U.S. counterparts.

The shift toward a more market-based global economy lifted hundreds of millions of people from poverty worldwide. More nations have a stake in a peaceful, rule-based global economy than at any time in human history. Despite the recent economic downturn, Americans can now sell to a rising global consumer class and invest in lucrative emerging markets. In fact, American-owned firms have no choice but to be engaged in the global economy if they are to meet investor expectations and operate on a scale that enables them to be competitive.

Without an adequate manufacturing base to support the services sector, the United States could face an extended period of slower economic growth and job creation.

This new global economy increased pressure on U.S.-based economic activity, particularly manufacturing, and created a productivity conundrum. To compete, U.S.-based manufacturing must generate more output per worker and more output per dollar invested. Profits, wages and economic growth rely on productivity, but as productivity rises through automation and other factors, fewer workers are needed to generate the same—in fact, increasing—output. From 1987 to 2010, output per hour in U.S. manufacturing increased an average of 4 percent annually.⁶ So although productivity can preserve many American jobs from moving overseas, fewer manufacturing jobs will ultimately remain, unless conditions enable the launch of a sufficient number of new firms needing similar skills. That has not yet happened, causing manufacturing's share of U.S. employment to fall from about 28 percent in 1961 to 9 percent in 2010.⁷

A popular narrative is that global manufacturing moves to where wages are low. To some degree this is undoubtedly true, but the reality is far more complex. Manufacturing job loss in the United States also results from demand shifts, value of the dollar, automation and productivity gains. The total cost of production includes labor, but it also includes other factors such as taxes, trade rules, regulations, land, capital, energy and transportation systems. All play critical roles in whether a manufacturing enterprise is cost-competitive.

In fact, the largest share of U.S. foreign investment dollars remains in high-cost European economies. The total U.S. investment in Ireland over the past 10 years, for instance, is more than three times greater than investment in China during the same period.⁸ The skills and education of workers are essential, as is intellectual property protection, research infrastructure and access to local markets and suppliers. The impact of such factors varies by industry and firm, as indicated in the *2010 Global Manufacturing Competitiveness Index*.

Americans adjusted to these evolving economic conditions by changing their skills, launching new innovations and moving largely into service sector professions. Companies adjusted by distributing their operations—such as design and component production, assembly, transactions and marketing—across the globe in large horizontal operations to locations that offered the greatest value.⁹ Despite this restructuring, however, manufacturing and services remain interdependent even while globally fragmented.¹⁰

America cannot rely solely on the service components of the production process. Because manufacturing enterprises have deeper supply chains than other business sectors, manufacturers support more output from other sectors of the economy than other types of businesses. In the United States, every manufacturing job supports five other jobs, and every dollar in total manufacturing value added supports \$1.40 in output in other sectors of the economy.¹¹ No other sector comes close as a multiplier. Without an adequate manufacturing base to support the services sector, the United States could face an extended period of slower economic growth and job creation.

“We have to make manufacturing a priority. It’s the foundation of everything associated with the economy.”

Alan Mulally

President and CEO of Ford Motor Company

New Possibilities to Ignite American Manufacturing

Through an 18-month series of Council interviews, dialogues and initiatives, national leaders painted a manufacturing horizon with both silver linings and dark clouds. This strategy aims to tease out key trends and offer solutions that enable Americans to leverage opportunities and address shortcomings.

Several of these trends offer hope for a resurgent U.S. manufacturing sector. As wages rise overseas, other factors of production help tip the equation toward investment in America. Firms are rethinking their total cost of production to include factors like worker productivity, supply chain resilience and intellectual property protection—and deciding to bring production back to America. U.S. firms are at the forefront of new technologies, production processes, customized manufacturing and the use of high performance computing that could lead to a manufacturing renaissance.

America is also in the early stages of a natural gas boom that is luring manufacturing investment to capitalize on stable, low-cost energy supplies. Furthermore, the U.S. holds aces in its research, innovation and venture capital assets that remain world-class despite certain limitations. Wise policies and practices could unleash this potential to commercialize and produce new technologies at much higher rates.

By contrast, a number of dark clouds remain that threaten to dim America’s manufacturing future. Federal tax, trade and immigration policies are inadequate or outright counterproductive to investment in U.S.-based manufacturing. Tort and regulatory regimes are investment deterrents that add cost and delay to American

production. These burdens could be reduced significantly while preserving the essential protections they were intended to provide.

American manufacturers also lack people with the necessary education and know-how to fill thousands of jobs, including skilled laborers, technicians, scientists and engineers. Closing these skill gaps remains an urgent priority.

Overshadowing both the opportunities and challenges for American manufacturing is the fact that the United States cannot forever be a debt- and credit-driven economy. Over time, government and consumer debt curtail customer demand and slow economic growth. Alarmingly, America’s current policies dictate a fiscal path that, if unchanged, could lead to a sovereign default, or to the imposition of significantly higher borrowing costs for the sale of U.S. treasuries. For the average person—or a manufacturing enterprise—a U.S. default would destroy wealth on a massive scale and severely limit economic opportunity. The longer U.S. leaders defer fiscal reform, the more painful the solutions will be.

America’s political leaders and manufacturers must tackle these problems and more. Aggressive policies in competitor nations have evolved to favor domestic producers and attract business investment. Global talent, science, technology, infrastructure and capital are more widely distributed than ever before. These trends also challenge America’s defense, intelligence and homeland security agencies in their efforts to deploy best-of-breed capabilities and manufacture classified technologies domestically.

Summary of Challenges and Solutions

This strategy puts forth five critical challenges facing American manufacturing and offers specific solutions to address them. Some of these solutions are familiar, while others provide new insights. The Council's leaders view this strategy as a starting point and envision a multi-year effort with key decision-makers to implement and evolve the solutions.

America's future requires a dramatically improved business environment in which to build an integrated national ecosystem for high-performance production with new technologies, designs, processes and materials. More effective collaboration will be essential between managers, employees, suppliers, researchers and educators. Government and regional support organizations also have crucial roles as conveners, connectors and policymakers—supporting conditions for a dynamic manufacturing base.

There are enormous opportunities to increase production and grow exports. The digital, biotechnology and nanotechnology revolutions are unleashing vast opportunities for innovation and manufacturing. They will enable new business formation, product development and job creation. In some cases they will serve as platforms for entirely new industries and markets.

Implementing this strategy will require changing the national conversation, embracing new competitive realities and resolving to take meaningful action to unleash America's production potential. Doing so is not ultimately about supporting specific companies, though we should celebrate their success. Nor is the chief aim to solely move the needle on macroeconomic metrics, though we must measure progress. This strategy is about igniting a manufacturing sector that forges good jobs for Americans and a prosperous future for their families.

MANUFACTURING IS...

Golden Artist Colors, Inc.

Sam Golden was one of the first to make acrylic paint in the USA. He pioneered the development of acrylic in a shop located in Manhattan. In 1980, Sam came out of retirement to

start what is now Golden Artists Colors, Inc. Commonly considered some of the finest acrylic paint in the world, Golden is a leader of innovative acrylic products.

Located in its 100,000-square-foot facility in rural Columbus, N.Y., Golden's 147 employees are committed to producing materials that encourage exploration of form and concept, while assuring archival integrity. Golden takes pride in the fact that its Custom Lab is the only facility of its kind, dedicated to designing products to the specifications of individual artists.

(www.goldenpaints.com)



ARTISTIC



Call to Action: Five Challenges and Solutions to Make an American Manufacturing Movement

Detailed recommendations begin on page 60.

Priorities

The priority recommendations from the five challenges are:

1. Congress should permanently replace the current world-wide double taxation system with a territorial tax system to facilitate the repatriation of earnings and restructure the corporate tax code to increase investment, stimulate production at scale and neutralize sovereign tax incentive investment packages.
2. Congress, the administration and industry should intensify efforts to support the President's goal to double exports from \$1.8 to \$3.6 trillion and reduce the trade deficit by more than 50 percent.
3. Federal, state and local governments along with high-schools, universities, community colleges, national laboratories and industry should prioritize Career and Technical Education (CTE) programs and push for greater integration of community colleges in the innovation pipeline.
4. Congress and the administration should leverage R&D investments across the federal research enterprise to solve challenges in sustainable smart manufacturing systems and to ensure a dynamic discovery and innovation pipeline.
5. Congress and the administration should drive the private sector to develop and utilize all sources of energy on a market basis while enforcing efficiency standards to ensure a sustainable supply of energy to manufacturers.

CHALLENGE

Fueling the Innovation and Production Economy from Start-up to Scale-up.

SOLUTION

Enact fiscal reform, transform tax laws and reduce regulatory and other structural costs and create jobs.

1. Congress should require agencies to begin reducing the costs and burdens of current and proposed regulations.
2. Congress should immediately reform section 404 of the Sarbanes-Oxley Act to increase entrepreneurs' access to U.S. public capital markets and grow new companies.
3. Congress should reduce the costs of tort litigation from the current level of almost two percent of GDP—some \$248 billion—down to one percent by 2020.
4. Congress and the administration must take action on fiscal reform to achieve \$4 trillion in debt reductions by 2021.

CHALLENGE

Expanding U.S. Exports, Reducing the Trade Deficit, Increasing Market Access and Responding to Foreign Governments Protecting Domestic Producers.

SOLUTION

Utilize multilateral fora, forge new agreements, advance IP protection, standards and export control regimes to grow high-value investment and increase exports.

1. Industry CEOs and government leaders should elevate and advance U.S. technical standards and the voluntary consensus standards-setting process.
2. Congress and the administration should ensure the President's Export Control Reform Initiative is completed by the end of 2012 and push for improved foreign export control systems.
3. Focus on actions to encourage China make permanent the special intellectual property rights campaign it ran from October 2010 to June 2011.

CHALLENGE

Harnessing the Power and Potential of American Talent to Win the Future Skills Race.

SOLUTION

Prepare the next generation of innovators, researchers and skilled workers.

1. Congress should implement immigration reform to ensure the world's brightest talent innovate and create opportunities in the United States.
2. Congress, states, academia, industry and national laboratories should renew efforts to expand STEM education and create opportunities to integrate into the workplace.
3. The Small Business Administration (SBA) should create a program modeled after the SCORE program for retired business executives to mentor and counsel entrepreneurs.
4. Industry and labor should develop state-of-the-art apprenticeship programs for 21st century manufacturing.
5. The administration should create a Veterans in Manufacturing Program to create opportunities for America's soldiers.
6. Academia, industry and government should launch the American Explorers Initiative to send more Americans abroad to study, perform research and work in global businesses.
7. Congress should create opportunities and incentives for older Americans to remain vibrant contributors in the workforce.

CHALLENGE

Achieving Next-Generation Productivity through Smart Innovation and Manufacturing.

SOLUTION

Create national advanced manufacturing clusters, networks and partnerships, prioritize R&D investments, deploy new tools, technologies and facilities, and accelerate commercialization of novel products and services.

1. Congress, the administration, industry, academia and labor should develop partnerships to create a national network of advanced manufacturing clusters and smart factory ecosystems.
2. Congress, the administration, national laboratories and universities should advance the U.S. manufacturing sector's use of computational modeling and simulation and move the nation's High Performance Computing capabilities toward Exascale.
3. The U.S. Department of Commerce through the Economic Development Administration, in partnership with the Council on Competitiveness should expand the Midwest Project for SME-OEM Use of Modeling and Simulation through the National Digital Engineering and Manufacturing Consortium (NDEMC).
4. Accelerate innovation from universities and national laboratories by facilitating greater sharing of intellectual property and incentivizing commercialization.

CHALLENGE

Creating Competitive Advantage through Next Generation Supply Networks and Advanced Logistics.

SOLUTION

Develop and deploy smart, sustainable and resilient energy, transportation, production and cyber infrastructures.

1. Congress should increase the number of public-private infrastructure partnerships and explore opportunities to privatize large infrastructure projects.
2. Congress should authorize the Export-Import Bank to fund domestic infrastructure projects.
3. Congress should develop and implement a national strategy to reduce overall energy demand by rewarding efficiency and improving transmission infrastructure.
4. Congress and the administration should create a Joint Cyber Command to improve cyber infrastructure and protect traditional defense, commercial and consumer interests.

Introduction

America was still a young nation in 1832, expanding westward into a vast wilderness of forest and prairie. At Fort Dixon, Illinois, a lean 23-year old shopkeeper named Abraham Lincoln enlisted in the state militia to serve in the Black Hawk War. Lincoln saw no combat and would later poke fun at himself for “surviving a good many bloody struggles with mosquitoes and leading dashing assaults on wild onion patches.”¹² He did, however, come across battlefields of the brief conflict and bury dead militia—a testament to the raw frontier of the time.

Four years later and a few miles up the Rock River from Fort Dixon, a 32-year old blacksmith from Vermont journeyed alone to the small village of Grand Detour. The blacksmith found work shoeing animals and repairing farm equipment, his family joining him once established. From this humble beginning would grow one of America’s oldest and most successful manufacturing companies—a brand known worldwide, and bearing the blacksmith’s name.

John Deere learned that farmers of the area struggled to turn the heavy, sticky soil of the prairie with cast iron plows designed for the light, sandy soil of New England. Deere devised a highly polished plow with an innovative shape designed to scour itself as it cut furrows. He fashioned such a plow in 1837 from a broken saw blade and tested it successfully on a local farm. The plow proved to be the answer to cultivating the western frontier. By 1841, Deere produced 100 such plows annually and demand continued to grow.

Deere’s ingenuity in solving problems for his neighbors and his pioneering approach to business set him and his firm apart. Like successful manufacturers today, Deere insisted on high quality standards and continual innovation in both production and business process. Blacksmiths of the day, for example, typically built tools on order for customers. Deere manufactured plows



Part of the Smithsonian Natural Museum of American History collection, this steel plow from 1838 is the oldest John Deere plow known to exist. Its sharp steel blade cut through the tough, root-filled sod of the Midwest, while its smooth, “self-scouring” moldboard prevented the sticky soil from clogging the plow.

before he had orders and took them to the farmers to be sold—a new approach to manufacturing and selling that spread the word of his superior plows.

Despite the business challenges of the frontier—few banks, poor transportation, slow communication and a scarcity of steel—Deere would not be deterred, and his first plows were produced with whatever pieces of steel he could locate. In 1843, while still in Grand Detour, he opened an international supply line by arranging for a shipment of special rolled steel from England. The steel had to be shipped across the Atlantic Ocean by steamship, up the Mississippi and Illinois Rivers by packet boat and overland by wagon 40 miles to the little plow factory. By 1846, the first slab of cast plow steel ever rolled in the United States was made for John Deere and shipped from Pittsburgh to Moline, Illinois where it was ready for use in the new factory opening there.¹³ In 1850, approximately 1600 plows were made, and the company was soon producing other tools to complement its steel plow.¹⁴



Deere 2600 Series Disk Tiller. Photograph courtesy of Deere & Company.

Deere & Company still builds tools in Moline to harvest the land. The company manufactures across the United States and operates in more than 30 countries, with extensive supply, sales, service and distribution networks. Deere's wide range of products and services remain dedicated to those linked to the land—farmers and ranchers, landowners, builders and loggers. Net income attributable to Deere was \$2.8 billion in fiscal year 2011.¹⁵ To remain competitive well into its second century, the company relies heavily on being innovative and productive.

“Modern farm machinery is truly a sophisticated productivity tool. Today's large John Deere tractors have more lines of software code than early space shuttles! Our GPS technology can guide a tractor and implement in the field with near-perfect precision. This means less overlap in tillage and chemical application, saving on time, money and environmental impacts,” says Samuel R. Allen, Chairman and CEO Deere & Company. “Or consider the dramatic gains we've seen in harvesting technology. John Deere's smallest combines today are more productive than the largest sold

in 2000. Today's typical combine does three times more work than the harvesters of a generation ago in a similar amount of time.”¹⁶

The story of John Deere illustrates the complexity of competing in manufacturing. Several factors are constants, such as competing on quality, cost and innovation. The factors that drive quality, cost and innovation, however, are ever evolving and becoming much more globally distributed. While much manufacturing remains “bending metal,” it is so much more—it is developing and managing intellectual property, finding and training people with critical skill sets and operating sophisticated supply, sales and service networks across the globe.

And that just scratches the surface. *Make: An American Manufacturing Movement* aims to explain the manufacturing landscape of today and the principal forces shaping its future—a future that will be very bright if Americans tap into a pioneering spirit that overcomes obstacles, adapts to new environments and seizes opportunities at hand. The Council stands ready to plow forward.

MANUFACTURING IS...**Mag Instrument, Inc.**

A champion of free enterprise and U.S.-based manufacturing, Anthony Maglica is the President of Mag Instrument, Inc., and the creator of the Maglite® flashlight, now an icon of classic American design. Mag Instrument is the only flashlight company with significant market share that still manufactures its entire line of flashlights in the United States. More than 800 workers operate from a 400,000-square-foot facility in Ontario, California. Exports have grown significantly in recent years and now comprise about 25 percent of total sales. Maglite® products are proof that the world is craving American-made goods and services, provided they include distinctive designs and are precision crafted with uncompromising quality. (www.maglite.com)

ILLUMINATING

Photograph courtesy of Pete Dunkel.

MANUFACTURING IS...**McIlhenny Company**

TABASCO® brand products are made by McIlhenny Company, founded in 1868 by Edmund McIlhenny on Avery Island, Louisiana, and still family-owned and operated on that very site. A food lover and avid gardener, McIlhenny was given seeds of *Capsicum frutescens* peppers that had come from Mexico or Central America. Over 140 years later, TABASCO® Sauce is still made on Avery Island. In fact, about half of the company's 200 employees actually live on Avery Island, with many of their parents and grandparents having worked and lived there as well. Labeled in 22 languages and dialects, sold in over 160 countries and territories, added to soldiers' rations, and put on restaurant tables around the globe, it is the most famous, most preferred pepper sauce in the world. (www.tabasco.com)

HOT

Photograph by Angie Garrett. (Flickr)

Transformation of American Manufacturing

Continued Vitality

American manufacturing constitutes one of the great success stories of the 20th century—one that continues to contribute to the U.S. economy by adding \$1.7 trillion to GDP, or nearly 12 percent of the nation's total economic output.¹⁷ Despite many challenges, America's share of global manufacturing output since 1970 has remained fairly constant at around 22 percent. That number, however, recently dipped below 20 percent.¹⁸

Manufacturing firms pay higher wages than those in other sectors and employ 11.8 million U.S. workers. Manufacturing also supports nearly 7 million jobs in other industries. Due to substantially larger supply chains than other sectors, manufacturing firms have the highest multiplier effect on the U.S. economy of any industry (Figure 1).¹⁹

Many U.S. manufacturing firms remain at the technology frontier, especially in computers, medical devices, chemicals, machinery, aerospace and military equip-

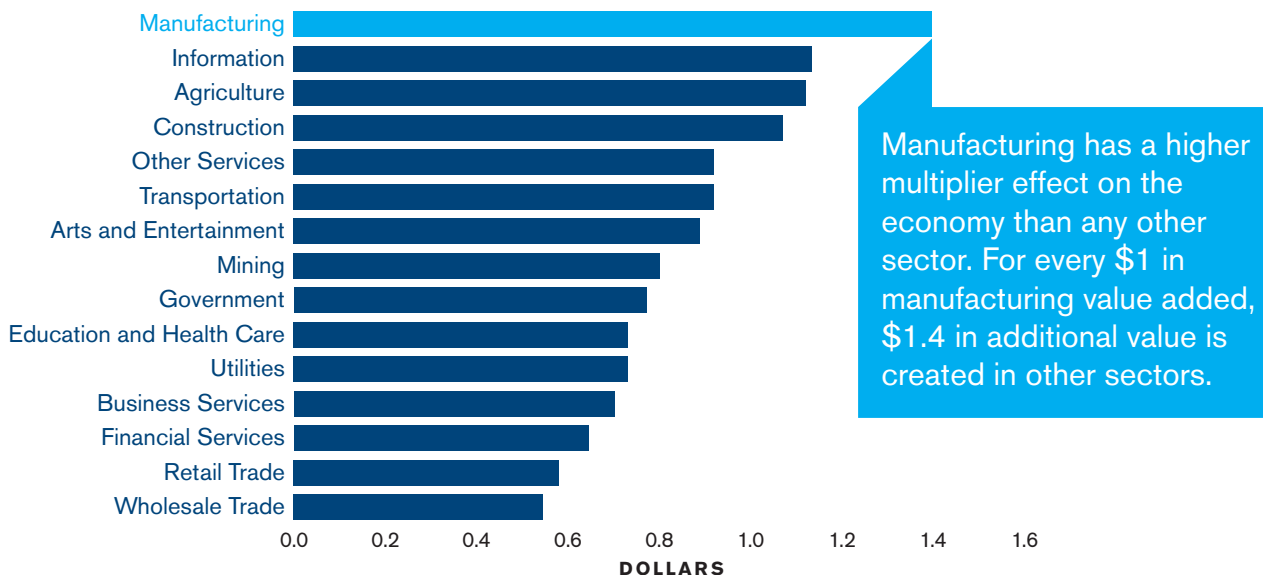
“We cannot solve our problems with the same thinking we used when we created them.”

Albert Einstein

ment—though this advantage is narrowing. Manufacturers account for roughly two-thirds of U.S. R&D expenditures and employ more engineers and scientists than any other private sector industry. Manufactured goods also represent two-thirds of U.S. exports and drive more net wealth creation than any other sector.²⁰

Figure 1. Multipliers for Sectors of the Economy

Source: U.S. Department of Commerce, Bureau of Economic Analysis



A Brief History

Manufacturing and ingenuity built an American economy that remains the envy of the world. Mechanization and electrification spawned an industrial age that replaced more than 3,000 years of human and animal labor with factories where a rise in manufacturing correlates to a growth in GDP per capita (Figure 2).²¹ Industry and capital gave rise to many iconic American brands—such as Ford, Deere, General Electric, Boeing and DuPont—and drove the creation of a vibrant middle class.

America competed during much of the Industrial Age using capital and mass-production facilities that delivered standard products at low cost. Process innovations like those introduced by Henry Ford not only increased wages, they offered new products and conveniences to millions of consumers at affordable prices. The United States also established unparalleled

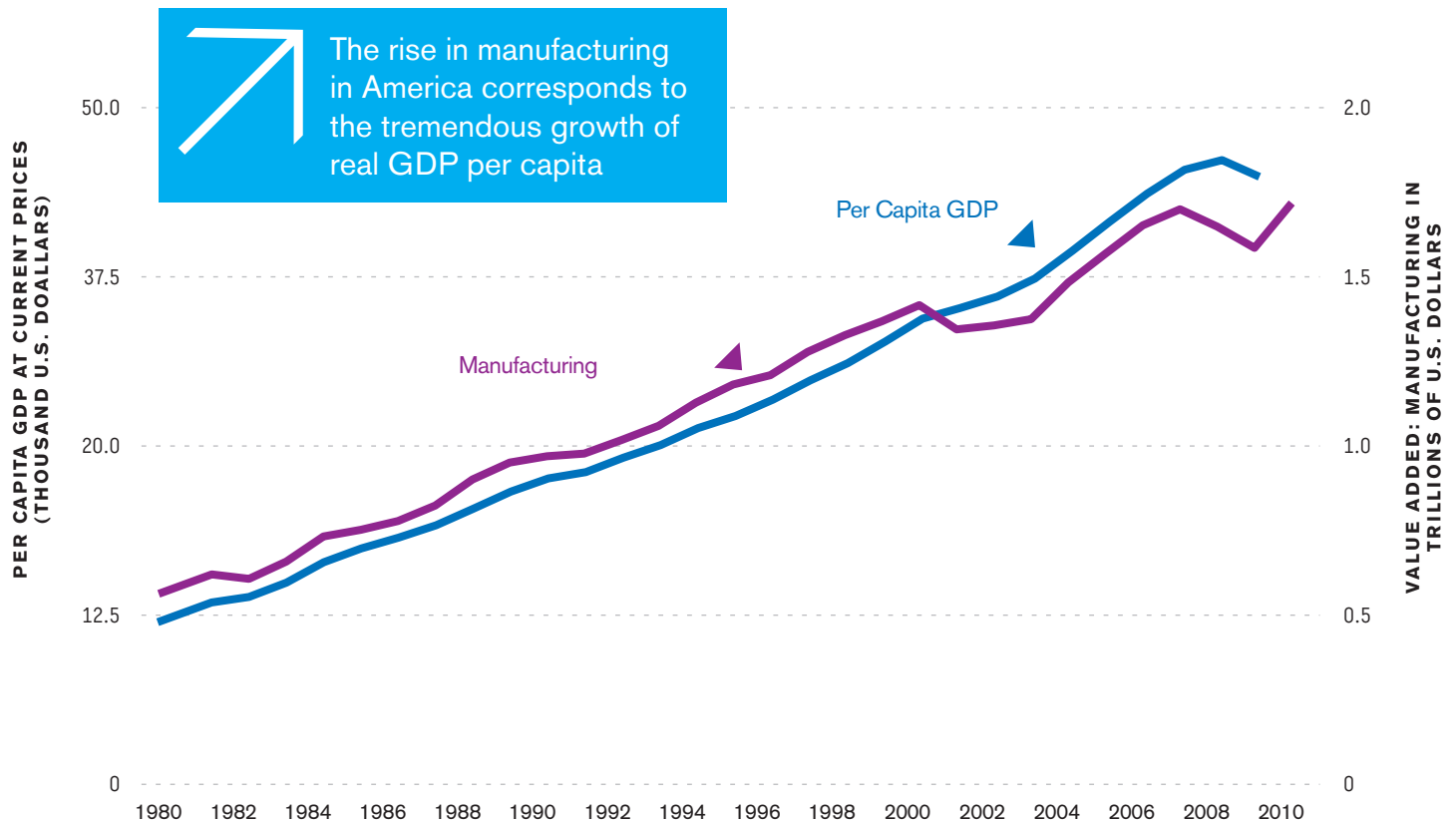
science, technology and educational enterprises where scientists, engineers and educators pushed the boundaries of knowledge—moving America in one lifetime from a horse-and-buggy society to one that landed a man on the moon.

America's industrial might escalated throughout the 20th century due to factors like economic freedom, immigration, abundant resources, two world wars and an absence of strong global competition. Although college enrollment increased in the post-World War II decades, millions of Americans could earn a middle-class wage in manufacturing without a formal education. That began to change with the growth of Japan and Germany as manufacturing- and export-driven economies.

After World War II, America saw its economic and security interests tied to a more prosperous, democratic world. The United States and its allies encouraged market economies and greater global political coordination. Institutions such as the United Nations, the

Figure 2. Value Added: Manufacturing vs. Per Capita GDP

Source: Unidata A World of Information/U.S. Department of Commerce, Bureau of Economic Analysis



World Bank, the International Monetary Fund and the World Trade Organization reflect this push. Countries like Japan and Germany transformed from enemies into prospering allies and economic competitors.

Greater competition pushed U.S. firms to become more productive in order to compete, which has had an inverse effect on employment. Profits, wages and economic growth rely on productivity, but as productivity rises, fewer workers are needed to meet the demand for a firm's products (Figure 3).

During the past 20 to 30 years, U.S. manufacturing employment has declined due to dramatic productivity improvements through automation, global competition in labor-intensive goods from low-cost producers and rapid growth in overseas markets, talent, investment and infrastructure.

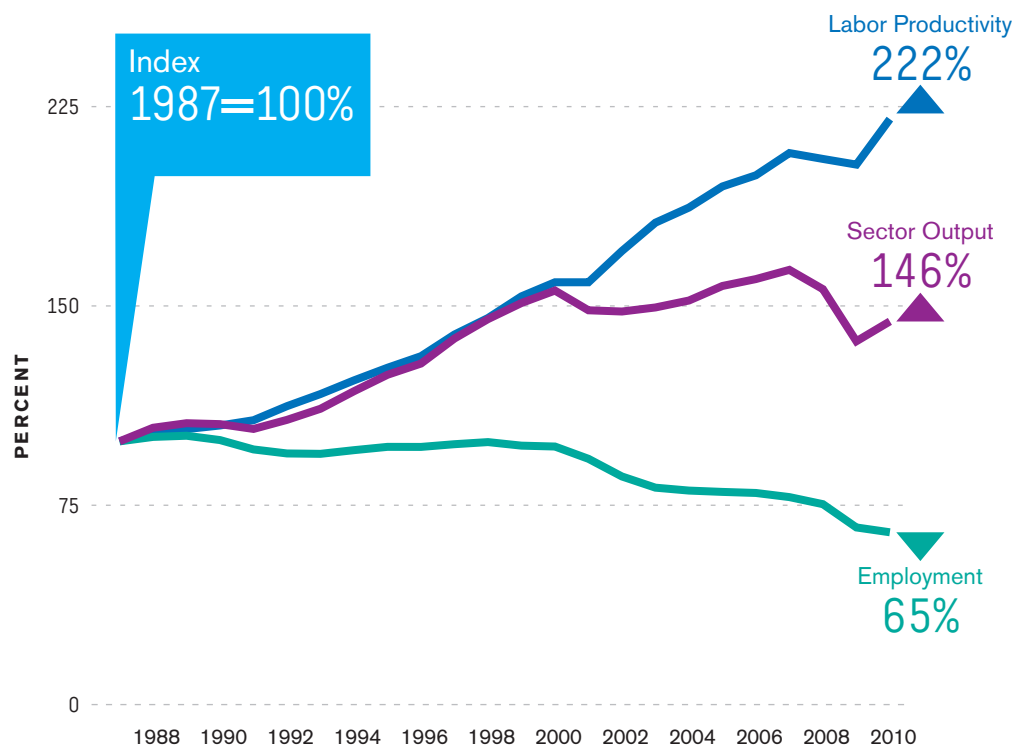
Manufacturing Today

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.²² That translates to 600,000 available U.S. jobs. David Arkless, president of corporate and government affairs for ManpowerGroup suggests part of the problem is,

Figure 3. U.S. Manufacturing (Labor) Productivity and Output Have Risen While Employment Has Declined

Source: Bureau of Labor Statistics



As dramatic increases have taken place in both productivity and output, the opposite has occurred in employment. From 1987 to 2010, output per hour in manufacturing increased an average of 4 percent annually and from 2000 to 2007, the increase was even greater—an average of 6 percent annually.

While productivity growth slowed at the onset of the Great Recession, levels have recently approached 5 percent or higher.

During the same period, the United States lost about 7 million manufacturing jobs.

“We’re producing too many graduates with the wrong kinds of degrees. We’re not producing enough people with technical and vocational skills.”

As manufacturing productivity soared and jobs declined, Americans transitioned into the service sector. The interdependence between manufacturing and services, however, is substantial and complex. The service sector supports product value networks, transactions in manufacturing industries and systems that integrate the innovations of producers and service developers. In addition, product-service integration is increasingly a platform for innovation. For example, the 2012 Ford Focus will offer, in partnership with Microsoft, a voice-activated SYNC® entertainment and communications system that will allow customers to easily operate MP3 players and Bluetooth®-enabled phones with simple voice commands.

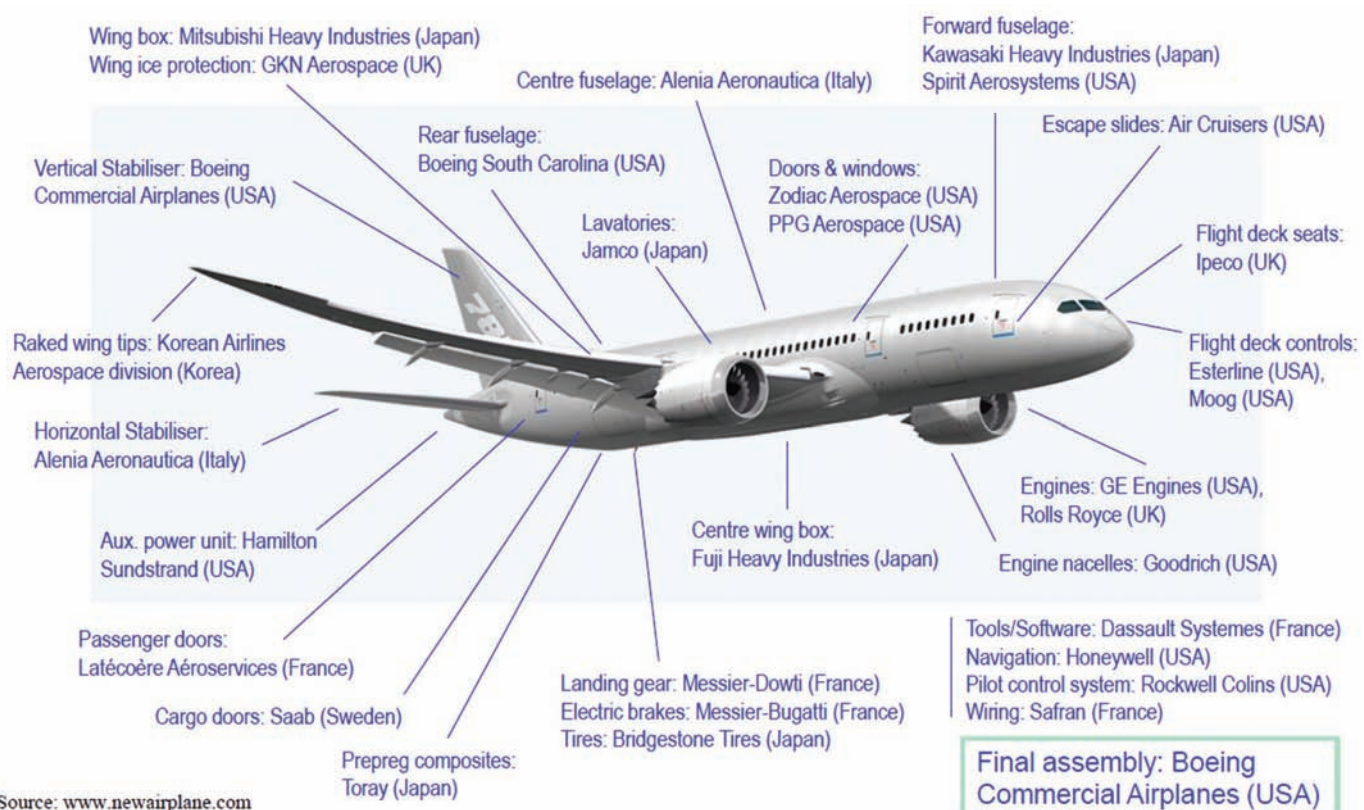
Not only are manufacturing and services interdependent, they are distributed globally. For most of the 20th century, “Made in America” meant just that:

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 countries²³ as illustrated by Boeing’s new 787 Dreamliner (Figure 4).²⁴

Sam Palmisano, Chief Executive Officer of IBM, explains that the shift is a reaction to many countries removing trade and investment barriers. “The emerging globally integrated enterprise is a company that fashions its strategy, its management, and its operations in pursuit of a new goal: the integration of production and value delivery worldwide...[this] is forcing companies to choose where they want the work to be performed and whether they want it performed in-house or by an outside partner,”²⁵ Palmisano said.

Figure 4. Fragmentation of Production: The Example of the Boeing 787 Dreamliner

Source: www.newairplane.com



Source: www.newairplane.com

ENCOURAGING HEADLINES

GE to Increase Jobs, Investment in Appliances Unit

Wall Street Journal October 18, 2010

Intel Corp. Invests \$8 Billion to Lead the Next Generation of the Semiconductor Industry

Money Morning, October 20, 2010

Ford Confirms \$1.1B Investment to Build Transit Van in Kansas City

Autoblog, October 21, 2011

Outsourcing Shifts Into Reverse: Caterpillar Brings Production Back From Japan = +1,000 New Jobs

Daily Markets, November 12, 2011

NJ Sensor Manufacturer Expands Production, Gains Market Share with “Made in U.S.A.” Products

PR.com, November 19, 2011

Toyota Celebrates 25 Years as Manufacturer in Kentucky

MarketWatch November 18, 2011

Neil Auerbach, founder and managing partner of Hudson Clean Energy Partners, offers another perspective, “If you walk the factory floor of manufacturing plants in China, most of the equipment is German, American, Italian and Swiss. Where manufacturing is taking place is deceiving. The majority of tools are developed in areas of high cost of labor but very skilled people.”²⁶

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.

The extended economic downturn and lackluster job growth have caused many to question key factors that built America into an economic superpower—industry, capital, entrepreneurship, and openness to global trade and investment. A rising rhetoric urges a turn towards global disengagement coupled with higher taxes and tighter restrictions on corporations. Doing so, however, would slow economic recovery and further limit the employment and wage prospects for America’s middle class.

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.

Everyone wishes to protect public safety and the environment, but America must find better ways to achieve those ends while also serving its citizens’ economic interests. Product cycles are accelerating—particularly the time it takes for a product to move from a high-margin innovation to a low-margin commodity. For many products, the risk of waiting months or years for regulatory approval drives manufacturing and jobs offshore. Firms cannot afford to lose the enormous benefits of being first to market, especially innovative start-ups that have incurred development debts and need to attract venture backing.

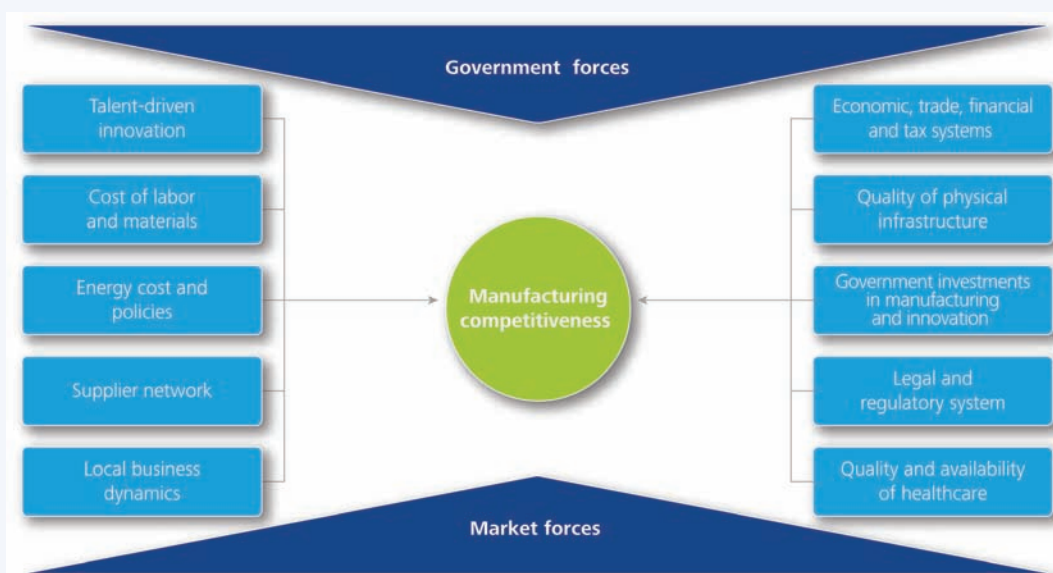
These new dynamics are causing heated debate. Henry Nothhaft, serial entrepreneur and author of “Great Again”, observes that the dramatic growth in

2010 Global Manufacturing Competitiveness Index

Launched in 2010, the first-ever Global Manufacturing Competitiveness Index, a collaboration between Deloitte Touche Tohmatsu and the Council on Competitiveness, gathered insights from more than 400 CEOs and senior business leaders on the global competitive landscape for manufacturing.

The classic factors of production—labor, materials and energy—are the most important drivers of global manufacturing competitiveness, with the availability of talented people—scientists, researchers, engineers and production workers—topping the list. The next four are “contributory” government forces: economic, trade, financial and tax systems; the quality of physical infrastructure; government investments in manufacturing and innovation; and the legal and regulatory system. The final three drivers are more “localized”: the supplier network; the dynamics of the local business environment, including the size of the market opportunity and the intensity of local competition; and the quality and availability of health care.

Most Important Drivers of Manufacturing Competitiveness



The United States Currently Ranks 4th and Could Fall to 5th Place in 5 Years

Current competitiveness

Rank	Country	Index score	
		10=High	1=Low
1	China	10.00	
2	India	8.15	
3	Republic of Korea	6.79	
4	United States of America	5.84	
5	Brazil	5.41	
6	Japan	5.11	
7	Mexico	4.84	
8	Germany	4.80	
9	Singapore	4.69	
10	Poland	4.49	

Competitiveness in 5 years

Rank	Country	Index score	
		10=High	1=Low
1	China	10.00	
2	India	9.01	
3	Republic of Korea	6.53	
4	Brazil	6.32	
5	United States of America	5.38	
6	Mexico	4.84	
7	Japan	4.74	
8	Germany	4.53	
9	Poland	4.52	
10	Thailand	4.35	



The balancing facility at Alstom's turbine manufacturing facility in Chattanooga, Tenn. Photograph courtesy of ALSTOM.

Interested in the future of American manufacturing? Look no further than Alstom's new turbine facility, a showcase of cutting-edge clean energy manufacturing in Chattanooga, TN. Here's 21st century American innovation in action.

Technology leadership:

- Producing the world's largest and most efficient turbines for new fossil steam, nuclear, gas and hydro power plants—as well as advanced systems/equipment to upgrade the country's aging fleet of power generation stations.
- Featuring the world's largest balancing facility, capable of spin balancing rotors up to 350 metric tons.

Sustainable and clean:

- In Chattanooga, equipment is manufactured that can generate more electricity using less fuel—thereby lowering power plant emissions and overall carbon footprint.
- The new manufacturing facility meets U.S. Green Building Council standards for LEED Gold certification, a benchmark of environmental excellence in the manufacturing sector. The campus features material recycling, indoor air quality, energy and water efficiency, and low-emission transportation targets.

Building a strong domestic supply chain, able to support a nationwide network of advanced manufacturing sites:

- Superior infrastructure assets in Chattanooga were key to Alstom's \$300 million-plus investment decision. Unique advantages include an impressive network of railway, highways, and waterways. For instance, 80% of U.S. nuclear plants are accessible via the site's 1000 ton crane and barge dock located on the banks of the Tennessee River.
- Our unique product designs and manufacturing processes provide a domestic market for heavy-equipment suppliers—like Finkl & Sons in Chicago—helping to create or preserve high-skill U.S. manufacturing jobs.
- And enabled by a welcoming political and business climate, Alstom's investment is creating up to 350 high-quality jobs in the short term.

<http://www.alstom.com/us/locations/chatt/>

the American economy during the 20th century might have been an anomaly and today's environment is the new norm. Without significant structural changes, that observation might become true.

Manufacturing also suffers from its public image. Although the majority of Americans consider manufacturing important, a Deloitte study finds that less than 20 percent of those surveyed think there is a future for manufacturing or would encourage their children to enter manufacturing related fields.²⁷ But this image of manufacturing does not match the reality. Many Americans 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.

Manufacturing is central to the life-cycle process that brings solutions to customers. This involves cutting-edge science and technology, design, modeling and simulation through advanced computing, systems engineering, testing and verification and the contributions of complex supply networks. It also involves a wide range of services and transactions, transportation, maintenance and energy, plus the talent of many occupations—all of which is in addition to “bending metal.” Firms that commercialize new technologies and scale production grow faster, are more profitable and create more jobs than other firms do, according to the Organization for Economic Co-operation and Development (OECD).²⁸

Unfortunately, government policies and programs tend to focus almost exclusively on R&D, technology transfer and, in some ways, early stage commercialization. These phases are all critically important, but manufacturing at scale is typically not considered a part of the innovation ecosystem. In fact, it is often discounted, creating a negative ripple throughout the manufacturing value chain (Figure 5).

Manufacturing business models evolved where production and innovation became separate. Manufacturing was viewed as a cost to be minimized rather than optimized for competitive advantage. Conventional wisdom emerged that as long as high-value added work—e.g. engineering and design—remained in the United

States, and government focused on small business, then the economy would grow and large-scale production could be left to its own devices.

This model, however, is not sustainable. A broad array of government policies 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.

Without strong public and private support for the complete life-cycle innovation and production process, the United States cannot maximize the return on its innovation investments—a return measured in jobs, growth and tax revenue. Today, foreign investors—especially through sovereign wealth funds—acquire production of U.S.-developed technologies and innovations. Even domestic investors typically condition their investment in new technologies on a business plan that directs manufacturing abroad. Participants in the Council's “Out of the Blue” Dialogues expressed frustration that production so often cannot be done competitively in the United States.

The policies, programs, strategies and business models that worked in the past are inadequate to secure America's future. 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.

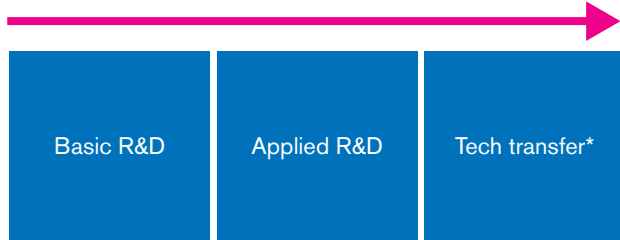
Will Americans act so that their best ideas from research labs and drawing boards end up on factory floors in Ohio and Michigan rather than—or in addition to—Asia and Europe? Will the future dim or become brighter for American manufacturing?

Figure 5. Manufacturing At Scale Should Be Viewed as an Integral Part of the Innovation Ecosystem

Source: Council on Competitiveness

U.S. innovation / production cycle is often viewed as linear and separate

INNOVATION PROCESS

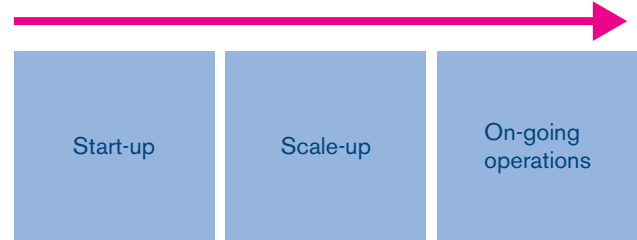


Significant national focus

- Innovation clusters and government agency support
- Multiple collaborative efforts
- Government and private sector investments

*including commercialization

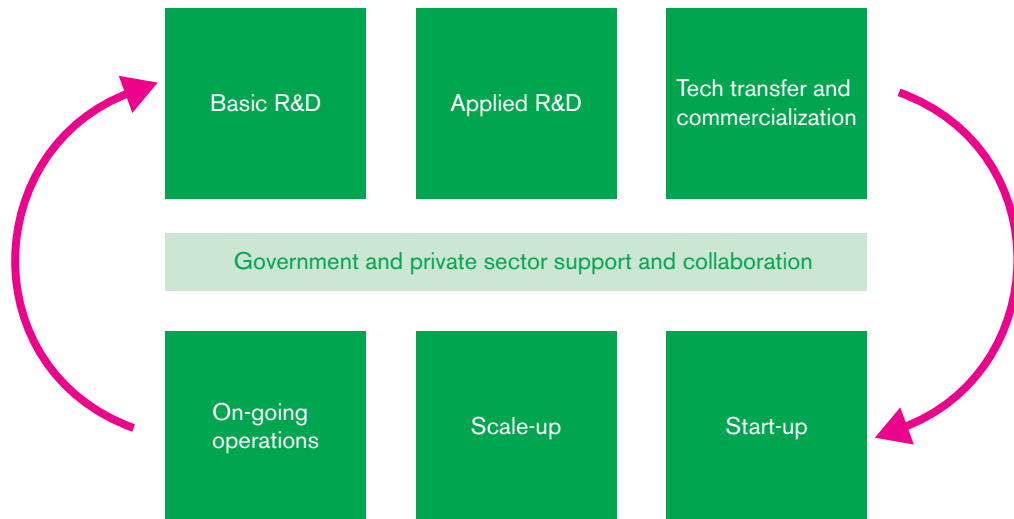
PRODUCTION PROCESS



Limited national focus

- Lack of coordinated efforts
- Barriers to production at scale
- Few government investments and incentives
- Regulatory and tax policy hurdles

U.S. innovation and manufacturing require full life-cycle support to maximize return on innovation



For illustrative purposes.

New Possibilities to Ignite American Manufacturing

The forces that will govern whether America's manufacturing future shines bright are indeed complex. Several structural changes are reshaping the global economy, and firms are becoming more sophisticated in adapting and contributing to that change. Tectonic shifts in technology and talent are changing what, how and where products are manufactured—and the dynamics vary by sector. America's edge in innovation and entrepreneurship is narrowing, and another valley of death has opened where startups struggle to find capital for domestic production at scale. Further complicating the environment is the promise of an energy boom in natural gas, the dark shadow of America's struggle to curb its debt and the need to invest in people and infrastructure.

A recent study by Booz & Company grouped U.S. manufacturing sectors into four categories based on levels of global competitiveness (Figure 6). According to the study, nearly half of the current U.S. manufacturing base and U.S. manufacturing jobs are at risk. Conversely, the study suggests that American factories still produce competitively about 75 percent of the goods sold in the United States and roughly 20 percent of goods sold globally.²⁹

The volume of concurrent trends and conflicting metrics makes it very difficult to capture a clear, coherent picture of U.S. manufacturing. Despite offshoring and the growth of other manufacturing nations, the U.S. remains the top recipient of foreign direct investment in the world, securing more than double the amount invested in China in 2010.³⁰ In fact, the largest share of the inbound investment to the United States in 2010 was in manufacturing.³¹

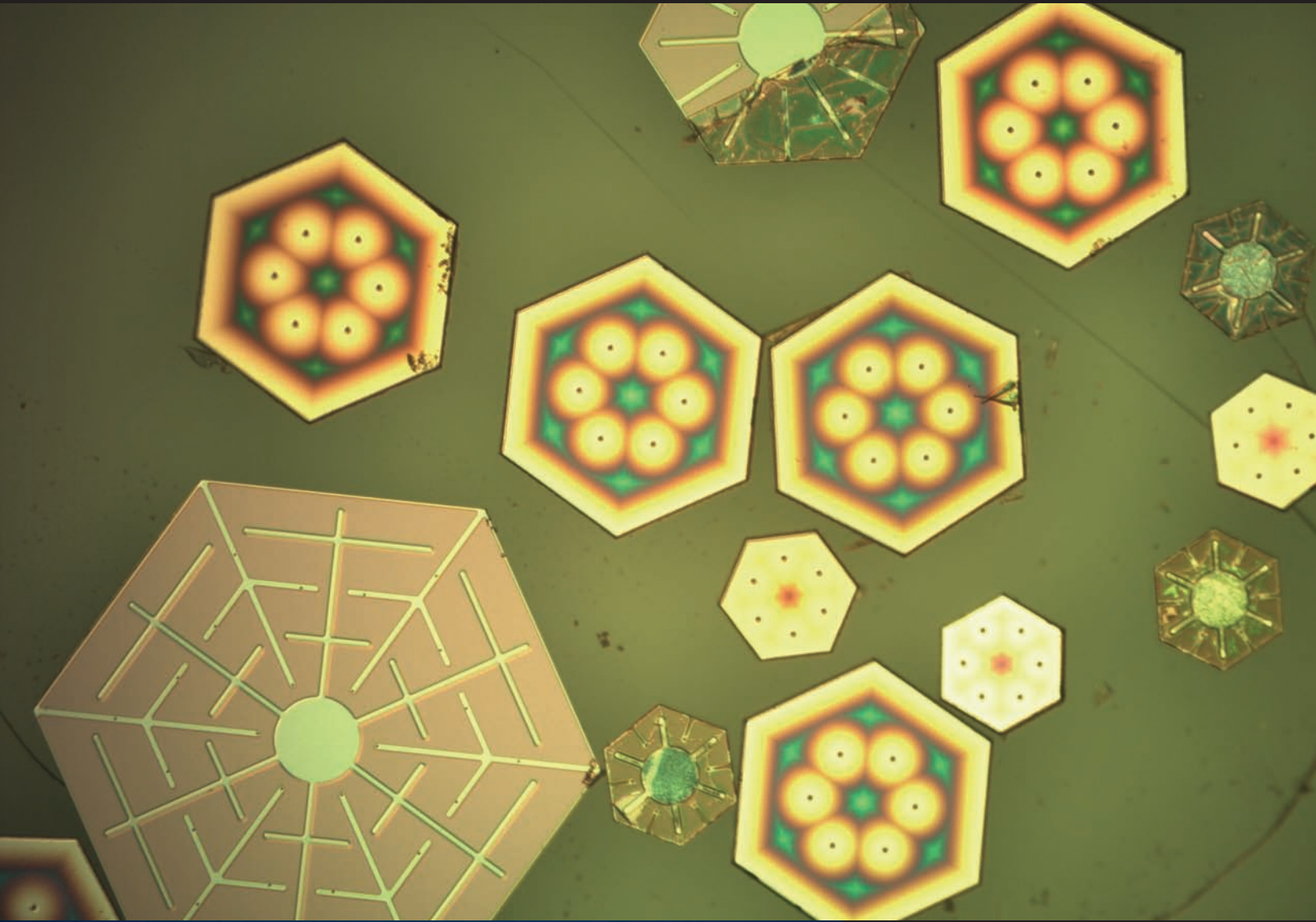
“For every complex problem there is an answer that is clear, simple and wrong.”

H.L. Mencken

Despite Mencken's warning, the Council on Competitiveness aims to supply answers that are clear, if not always simple, and correct, if not all-encompassing. The first step is to understand key trends that could energize or erode American manufacturing. Some trends offer opportunity, if seized, for American manufacturing to surge ahead of its competitors. Others require U.S. policy reform just to catch up and level the playing field.

Before reviewing the trends, however, two ideas are worth repeating:

1. Even if U.S. public and private sector leaders make all the right decisions to spur investment in U.S.-based manufacturing, significant production operations will remain distributed across the globe to take advantage of strategic opportunities. America's aim should be to achieve its maximum manufacturing potential, a goal on which the nation falls dramatically short.
2. Manufacturing lies at the core of any economy as a value creator and economic multiplier—supporting the service sector, the research enterprise and thousands of firms in supply networks. “We have to make manufacturing a priority. It's the foundation of everything associated with the economy,” says Alan Mulally, president and CEO of Ford Motor Company.



Photographs courtesy of Sandia National Laboratories.

ABOVE: Representative thin crystalline-silicon photovoltaic cells—these are from 14 to 20 micrometers thick and 0.25 to 1 millimeter across. (Photo by Murat Okandan)

AT LEFT: Sandia project lead Greg Nielson holds a solar cell test prototype with a microscale lens array fastened above it. Together, the cell and lens help create a concentrated photovoltaic unit. (Photo by Randy Montoya)

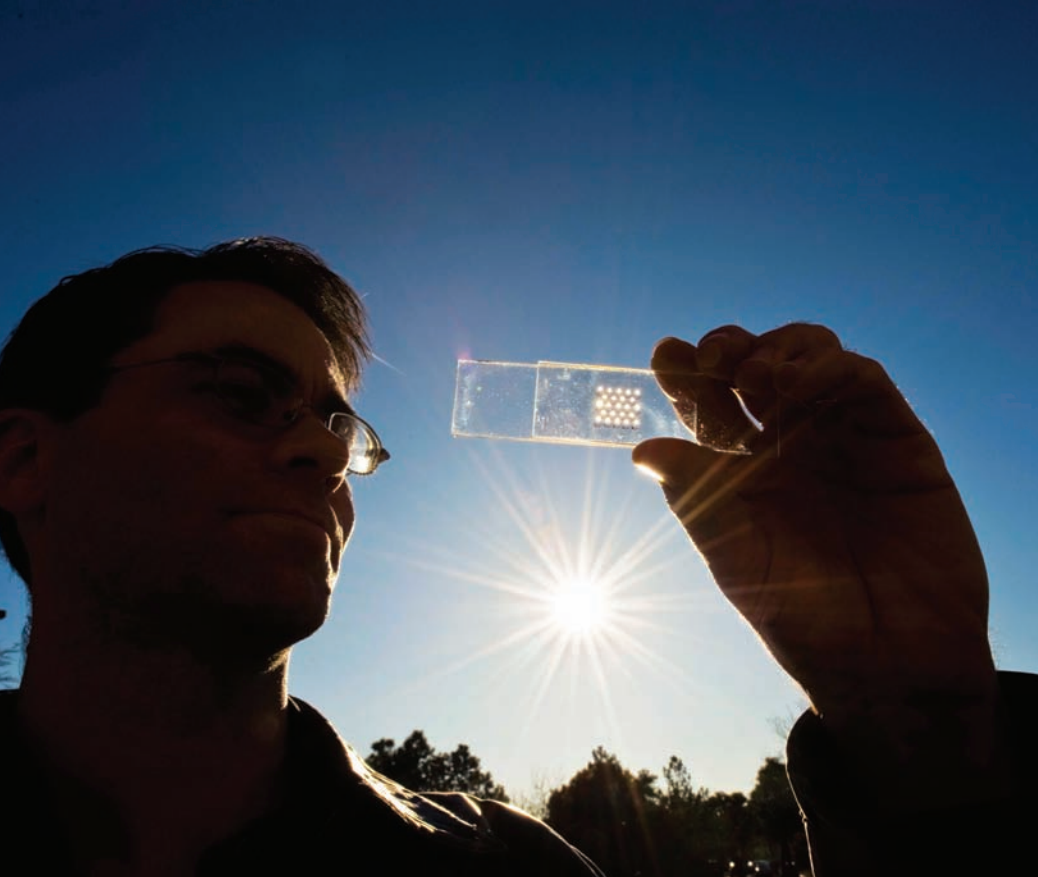


Figure 6: Excerpt from Manufacturing's Wake Up Call

Arvind Kaushal, Thomas Mayor and Patricia Riedl. *Strategy + Business*, Issue 64, August 2011

Four Kinds of Industries

With unit labor costs playing a smaller part in manufacturing decisions, other factors—including talent availability, market accessibility, innovation, regulations, intellectual property protections, barriers to entry and exit, and scale of operations—increasingly drive decisions about where to place and expand factories. Based on the relative economics for each segment, we charted which U.S. industries can compete as exporters, which can be dominant in the regional North American market, which can survive but are threatened by foreign competitors, and which are already mostly overseas but can still manufacture in the U.S. to serve niche markets.

- **Global leaders: aerospace, chemicals, machinery, medical equipment, and semiconductors.** Companies in these industries have a critical worldwide advantage stemming from their high investment scale, established intellectual property, skilled workforces, and close ties with customers. For example, the U.S. commercial aerospace segment (primarily Boeing Company and its suppliers) benefits because aircraft development is so costly and knowledge-intensive that few new companies can compete. In addition, aerospace manufacturing requires uniquely qualified labor, substantial participation from corporate R&D, and proprietary technology efforts, often with national security implications. Thus, much overseas production is ruled out. However, even this sector could lose manufacturing to overseas sites if demand in emerging markets skyrockets, providing a sound economic rationale for some global leaders to establish manufacturing bases in China or elsewhere.
- **Regional powers: food, beverages and tobacco, nonmetallic mineral products, wood products, and petroleum/coal.** Focusing on North American demand will continue to be a lucrative strategy for many U.S. manufacturers. The United States is the world's largest market – wealthy and still growing (albeit not as fast as emerging economies) – and Mexico and Canada offer additional opportunities. For food, beverages, tobacco, and many other consumer products companies, the incremental disadvantages of importing (for example, the cost of transporting products to the U.S., plus long shipment lead times and product safety concerns) outweigh pro-offshoring factors such as the higher cost of U.S. production. For nonmetallic mineral and wood products segments, product transportability requirements and proximity to the supply base give U.S. factories a leg up.
- **Sectors on the edge: paper, plastics, electrical equipment and components, fabricated metal products, pharmaceuticals, automotive vehicle parts, other transportation equipment, final assembly of motor vehicles, printing, and electronics.** These manufacturing segments feel the presence of low-cost overseas rivals nipping at their heels. To compete effectively, they need simplified government regulations and permitting processes, as well as more certainty and speed in gaining approval to expand old plants and build new facilities. In addition to better government support, many companies in these sectors must rethink their strategies, investing in the specific U.S. markets where they are best suited to compete. Some industries, such as printing, can maintain a foothold in the U.S. for specialized or customized products targeted at the North American market. Meanwhile, they can produce mass-quantity products with less stringent delivery schedules in lower-cost countries.
- **Niche players: textiles, apparel, furniture, computer equipment, and appliances.** Most companies in these sectors have moved production outside the United States. The remaining activity generally serves small-scale, highly specialized niche markets. For example, the small company Timbuk2 Designs Inc. allows customers to design their own briefcases, backpacks, and totes; it has a strong customer community among cyclists on the West Coast. The furniture segment is similarly bifurcated. Flat-pack furniture for the U.S. market is mostly made in China, whereas preassembled furniture is more likely to be made domestically.

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 (Figure 7).³² As development spreads, a

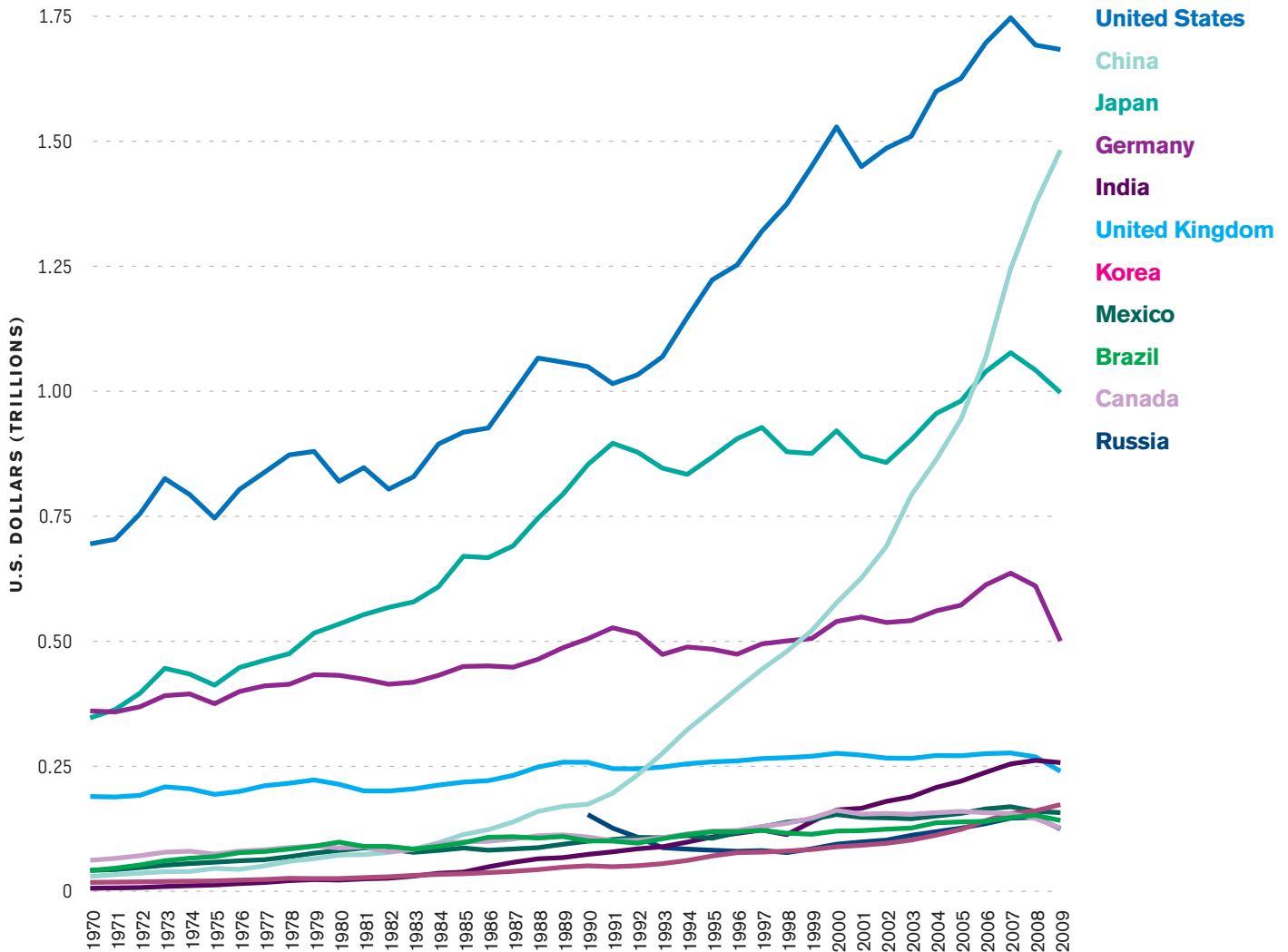
new consumer class is burgeoning around the world. About 1.8 billion people occupy the consumer class today. By 2030, this number could reach 5 billion, with 95 percent of the growth occurring in emerging and developing economies—creating large new demands for manufactured goods.³³

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

Figure 7. Manufacturing Output by Country (Constant 2005 Prices in U.S. Dollars), 1970-2009

Source: United Nations Statistics Division, National Accounts Main Aggregates Database

China has attracted foreign direct manufacturing investment at an unprecedented rate, raising manufacturing output to a level on par with the United States.



more than half today.³⁴ 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.³⁵

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. China for example, is suspected of keeping the Renminbi weak to spur exports and acting outside of international protocols to gain control of foreign technologies. China also uses indigenous innovation policy, forced technology transfer and government procurement without adherences to World Trade Organization principles to keep their market closed and build national industrial champions. “Intellectual property, counterfeiting, and enforcement are big issues around the world. It is something that we spend a tremendous amount of resources on in my company,” said Ellen Kullman, Chair and CEO of Dupont.

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.

The pace of technological change is transforming not only product life-cycles and time-to-market pressure; it is also pushing firms to compete by using technology to improve their manufacturing processes and business models.

Companies like NanoMech are transforming the face of modern manufacturing. Founded in 2002, the company offers breakthrough nano innovations in machining and manufacturing, lubrication and energy, packaging for fresh produce, biomedical implant coatings and strategic military applications. “We don’t split atoms; we sort of move atoms around. And when you do, it gives you the ability to make anything better, cheaper and more durable—maybe even do things that have never been done before,” says NanoMech CEO Jim Phillips.

“Executives who are planning a new factory in China to make exports for sale in the U.S. should take a hard look at the total costs. They’re increasingly likely to get a good wage deal and substantial incentives in the U.S., so the cost advantage of China might not be large enough to bother—and that’s before taking into account the added expense, time and complexity of logistics.”

Harold L. Sirkin

Boston Consulting Group, senior partner, author of *GLOBALITY: Competing with Everyone from Everywhere for Everything*.

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.

Photographs courtesy of SRC Holdings, Inc.



Global firms are becoming more sophisticated.

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. “All over China, wages are climbing at 15 to 20 percent a year because of the supply-and-demand imbalance for skilled labor,” said Harold L. Sirkin, a Boston Consulting Group senior

partner. “As a result of the changing economics, you’re going to see a lot more products ‘Made in the USA’ in the next five years.”³⁶

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.³⁷ Dan DiMicco, CEO of Nucor Steel agrees, “Today’s multinational companies are more and more seeing the benefit of domestic production because of energy costs, because of intellectual-property issues, because of transportation costs.”³⁸

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 (Figure 8). 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.

MANUFACTURING IS...

Harley-Davidson Motor Company

In 1901, William Harley, a young man living in Milwaukee, came up with the concept of meshing a small engine with a bicycle frame. After considerable trial and error, Harley, working with his friends Arthur and Walter Davidson, developed a prototype of what would later evolve into the modern motorcycle. Over the decades, Harley-Davidson has become an American icon and among the many points of pride for owners is that the motorcycles are designed and made in the United States. (<http://www.harley-davidson.com>)

COOL



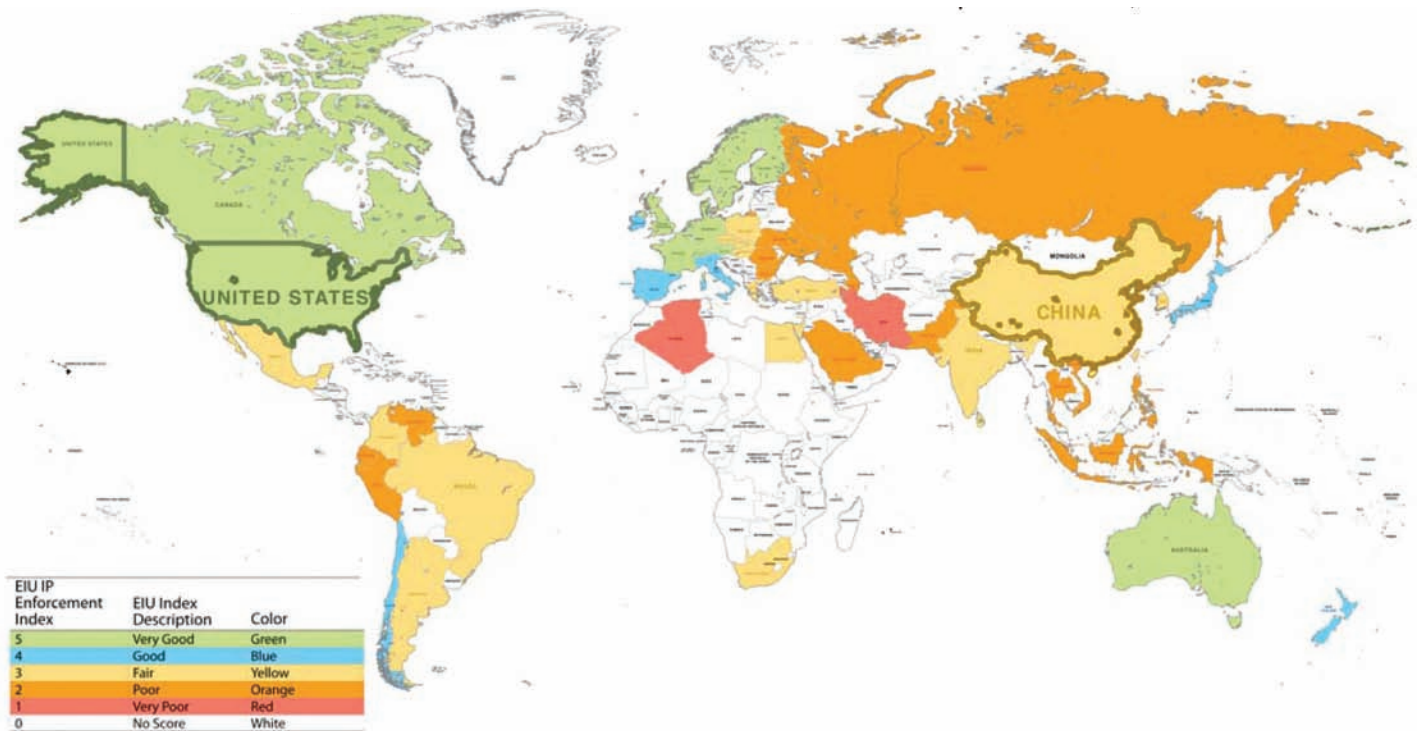
Photograph by Katsuhiko Osabe (Flickr)

Global Trade and Growing Integration of Affiliate and Domestic Operations

Cross-border trade continues to be critical for increasing manufacturing productivity, growing exports and creating jobs. Trade allows producers to specialize in goods where there is a comparative advantage and allows consumers to buy goods at lower prices. The United States exported \$1.8 trillion in 2010—\$1.2 trillion in goods and \$600 billion in services—supporting 9.2 million jobs.³⁹ U.S. industries that produce high technology products are among the largest goods exporters including transportation equipment, chemicals, computer and electronic products, machinery and electrical equipment. While the United States has maintained a balance of trade in services, it has continued to run the world’s largest trade deficit in goods, \$646 billion in 2010.⁴⁰ The European Union (EU) remains the leading destination for U.S. exports, while China is the leading source of U.S. imports in 2009.

Figure 8. EIU's IPR Protection Score for China and the United States in Comparative Terms, 2010

Source: Compiled by USITC staff; EIU "IP Enforcement" database, accessed March 30, 2011.



The U.S. International Trade Commission estimates that firms in IP-intensive businesses operating in China in 2009 reported losses of approximately \$48 billion in sales, royalties or license fees due to IPR infringement.

There remain significant barriers to trade, such as industrial policies that limit market access to other countries' markets, lax enforcement of intellectual property rights, restrictive licensing systems, government procurement restrictions, foreign equity limitations, tariffs, government subsidies to industry, domestic and foreign export controls, lack of transparency in laws and regulations, local content requirements, standards that favor domestic producers, technical regulations that favor domestic firms, in-county testing requirements and more. It is estimated that the elimination of remaining global trade barriers could increase the gain America already enjoys from trade by another 50 percent.

While important, trade is no longer the main vehicle for delivering products and services globally. In 2009, sales from foreign affiliates of U.S. based companies (\$4.88 trillion) were three times greater than U.S. exports (\$1.57 trillion).⁴¹ The U.S. must develop policies to take advantage of the growing interdependencies between trade and affiliate sales.

Even if the U.S. attracts more investment to expand U.S. based-manufacturing as firms recalculate their total cost of production, many of those firms will continue to distribute production globally. In many sectors, the most profitable way to serve a market is to have final assembly in that market rather pursuing a pure

Standards Lead to Improved Competitiveness

From design and manufacturing to distribution and marketing, all products and services are affected at some point by standardization. Standards and conformance underpin global commerce, inform the direction of innovation and impact the strength of the American workforce. In short, standards have the power to turbo-charge innovation and fuel competitiveness in the global marketplace.

The U.S. standardization system is private-sector led and driven by marketplace and societal needs. It relies upon the involvement and cooperation of diverse stakeholders—from industry, government and consumer groups—that may come to the standards-setting table with very different points of view. This diversity—and the consensus-based solutions that arise from it—are what gives the U.S. system its strength. And a strong standards system is absolutely linked to success in the global economy.

Companies that participate actively in standards development activities reduce costs, increase efficiencies, assure quality, facilitate and maintain market access and gain a more competitive advantage than those who do not participate. And demonstrating compliance with standards helps products, services and personnel to cross borders, ensuring that products manufactured in one country can be sold and used in another.

Participating in standards development activities—both in the United States and internationally—is of critical importance. Decisions made about the national standardization system and priorities for action reach far beyond one country's borders, especially when it comes to the continued success of products, services and workforce on the global stage. Particularly in high-tech manufacturing industries like electric vehicles—and alternative energy sources such as nuclear, wind, and solar technologies; smart grid; nanotechnology; and cybersecurity—standardization can help U.S. business shape enormous growth and reap the rewards from that influence. But if U.S. stakeholders do not take an active role in setting the globally relevant standards that will drive their industry sector, the competition will be setting the rules of the game.

By actively participating in the standards-setting process and relying upon private sector-led, consensus-based standards and conformance solutions, U.S. stakeholders can forge a path for sustainable economic growth for the nation, spearhead the next generation of high-tech manufacturing, create jobs of the future and open global markets for American exports.

export strategy. Toyota, for example, has prospered by manufacturing in the United States. The value of sales globally by overseas affiliates far outpaces the value of export sales (Figure 9).

“What a lot of people do not appreciate with globalization, population growth and GDP growth—specifically in Asia and in Africa—is that if you want to compete, you have to be there. You’re not going to play in the largest market in the world, China, by importing everything into that market. It isn’t going to work; you can’t get a competitive cost structure,” explained Sam Allen, chairman and CEO of Deere & Company.

There is an increasing co-dependence between domestic and foreign-based production capabilities. A U.S.-owned firm producing overseas, for example, might assemble a final product for sale in that market that is sourced from around the world, possibly including high-end components produced in America.

Unfortunately, sales revenue generated by U.S. affiliates overseas are subject to high levels of double taxation, once by the host country and again by the U.S. if that revenue is brought back (repatriated) to America. This tax policy is a powerful incentive to hold or invest large capital reserves (over \$1 trillion) overseas that might otherwise be brought home to invest in plants, employees or share value.

Leveraging Supply Networks and Small and Medium Enterprises

In a world characterized by rapid innovation across products and supply chains, few large firms compete through vertical integration. Instead, most large firms rely on integrated supply networks with smaller companies. Michael R. Splinter, chairman, president and CEO of Applied Materials, Inc. put it this way: “Big companies need small companies and small companies need big ones.”

America needs to better leverage the relationship between small companies and large companies to drive innovation and increase exports. 75 percent of U.S. manufacturers have fewer than 20 employees; 94 percent have fewer than 100 employees.⁴² In 2009, exporting SMEs had more than twice the total revenues of non-exporting counterparts.

The relationship extends beyond supply chains and into the innovation realm. Big firms often focus on improving existing product lines, while smaller firms are more

Figure 9.

According to a recent estimate, U.S. foreign affiliates have at least \$1.4 trillion in undistributed earnings trapped overseas.

Lee, Thomas J. “U.S. Equity Strategy Flash.” J.P. Morgan. June 27, 2011.

Globally, in 2010, sales by all foreign affiliates reached \$33 trillion.

United Nations Conference on Trade and Development. *World Investment Report 2011* “Selected indicators of FDI and international production, 1990–2010.” Table 1.5. 2011. 24.

In the early 1990s, there were about 37,000 of these global enterprises, and they had about 170,000 affiliates in foreign countries. By 2010, there were more than 103,000 parent companies, and their foreign affiliates had grown to more than 886,000.

United Nations Conference on Trade and Development. “Number of parent corporations and foreign affiliates, by region and economy, latest available year.” Table 34.

likely to generate radical, disruptive innovation. Consider pharmaceutical giants Pfizer and Merck. Despite R&D budgets in the billions and laboratories spread throughout the world, they still rely on hundreds of research partnerships with smaller firms. Increasingly, global firms look to small biotechnology companies to conduct early R&D on pharmaceutical products, and then license the technology or buy the company.

Small companies often have deep expertise in niche skills, but little skill or experience in entering new markets, working in large teams or managing complex projects. Large companies often have very broad technology portfolios, but insufficient depth in specific technical areas. They are experts in managing complex projects and can coordinate teams with disparate cultures, languages, skills and business processes. Small companies may be able to respond more quickly to customer needs or rapid market changes, while large firms offer broad supplier and customer networks. As

MANUFACTURING IS...

UA

The United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada, or “UA” as it is commonly known, is a multi-craft union whose members are engaged in the fabrication, installation and servicing of piping systems. There are approximately 340,000 highly-skilled United Association members who belong to more than 300 individual local unions across North America.

The United Association has been training qualified pipe tradesmen longer than anyone else in the industry. The UA boasts the premier training programs available in the industry today, including five-year apprenticeship programs, extensive journeyman training organized instructor training, and certification programs.

(www.ua.org)



UNIFYING



Photograph courtesy of the United Association of Plumbers and Pipefitters.

a result, deep collaboration and integration between large and small companies creates a competitive advantage and strength that is difficult to emulate.

Cloud Computing

Cloud computing has the potential to be a game-changing technology architecture for manufacturing firms large and small. Instead of owning and managing a complete information technology infrastructure, cloud computing enables users to purchase or access computing capability (software, storage, processing, data, etc.) over a network. The benefit of cloud computing is that it gives companies access to greater computing capability for the same or lower cost.

Many manufacturers are already exploring innovative ways to improve design work with social product

development and create new business models and customer experiences based on smart devices connected to the cloud.⁴³

“Globalization has created increased complexity and the need to deliver business services across a global supply chain with speed and agility for large, medium and small manufacturing companies,” said Bill McCracken, Chief Executive Officer of CA Technologies. “Cloud computing is today’s game changer to deliver cost-effective and agile business services regardless of company size or location.”

Cloud and social computing, as they develop and embed resilient solutions to security challenges, will transform manufacturing industry networks, facilitate collaboration across geographies and improve response times to meet challenging business demands.

Mining Data for Value

Alongside labor and capital, “big data” has become an important factor of production and represents an area where the United States maintains a competitive advantage. According to McKinsey’s Business Technology Office, better use of data is driving productivity growth, product innovation and insight on serving consumers.⁴⁴ The amount of available data has been exploding and much of it lies untapped. Harnessing these large data sets (in compliance with privacy laws) can unlock significant value by making information more usable, accurate and detailed. The data promises better inputs into advanced modeling and simulation and more informed management decisions.

Personal Manufacturing

Although supply networks will continue to draw together large and small firms, widespread access to technology, knowledge and markets is reducing barriers to entry and enabling some small or even individual producers to thrive. Personal manufacturing and user-based innovation could be poised to be the next megatrend.

In the industrial age, the world was divided into producers and consumers, with the former in control. But the center of gravity is shifting as innovation and manufacturing become more decentralized and customization the norm. Access to data and computing through the cloud, along with new tools and technologies like rapid additive printing are reviving a “maker” culture in America.

PERSONAL MANUFACTURING

There is a growing cultural movement in America to make things. Imagine millions of manufacturing firms, one in every home, unleashing unbridled creativity and discovery.

Efforts such as Maker Faire and Etsy combine a rejection of traditional mass commoditization with new tools and technologies to level playing fields and create new products.

The tagline says it all: “If it’s made, it’s displayed at Maker Faire... [which] takes arts, crafts, engineering, food, music, science and technology projects and the Do-It-Yourself (DIY) mindset to the next level.”

<http://www.thehenryford.org/events/makerFaire.aspx>

For example, there are more than six million hearing aids now in use that were custom manufactured in real time using 3D printers.⁴⁵

These new models envision multi-use manufacturing facilities and manufacturing “at-home” capabilities where the customer directly drives the design, develop-

MANUFACTURING IS...

Crayola Crayons

Crayola Crayons were created after inventors Edwin Binney and C. Harold Smith won a gold medal at the 1900 World’s Fair for their creation of a dustless chalk substitute for teachers. Although the company does have some overseas production facilities, domestic crayons are still made in Easton, Penn., a factory that has churned out more than 1 billion crayons since opening in 1969. (www.crayola.com)

COLORFUL



Photograph by Paul Stein. (Flickr)

ment and production process. Many current practices allow customers to have a direct role in the design phase of a product—from simply choosing a Harley Davidson paint scheme to semi-conductor manufacturers providing customers with specialty software to design their own chips. Another example can be seen in plastics manufacturers like GE, who offer web-based tools to improve plastic products.⁴⁶

Millions of applications for smart phones and other devices are now “manufactured” daily by customers around the world. On-line auctions like eBay combine existing systems—the Internet, credit cards and package delivery—in ways that empower millions of home-based entrepreneurs and potential producers. Products like desktop publishing have already created new opportunities for customers to become innovators themselves.

The next phase of this micro-manufacturing megatrend will be to put the tools of production into the hands of consumers. Imagine the possibilities for rapid innovation and value creation with a “micro-factory” in every home.

Talent is one of the key drivers for manufacturing competitiveness.

That's according to more than 400 chief executive officers and senior manufacturing executives worldwide.⁴⁷ 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 2018.⁴⁸

Current and future talent and skills requirements can be met. Despite numerous challenges, particularly in K-12 instruction, America's overall education system remains diverse and world-class with top universities and community colleges linked with local industries, while many companies invest in their workers' educations. America also remains a magnet for immigration and must build on these strengths to expand the pool of technical and highly-skilled talent.

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 IS...

Edward Marc Chocolatier

In 1914, a young Greek couple set off from their native land to pursue the dream of a new life in America. After arriving in New York City, Charlie and Orania made their way to Pittsburgh, Pennsylvania. There they settled and made a life together relying on a skill that they carried with them from the family kitchen back in Greece—handcrafted chocolates. Nine decades later, the family proudly continues their tradition by selecting the finest ingredients and handcrafting the highest quality chocolates available anywhere. (www.edwardmarc.com)

DELICIOUS



Photography courtesy of Edward Marc Chocolatier.

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.⁴⁹ 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.⁵⁰ The administration plans to release a STEM strategy in January 2012.

MANUFACTURING IS...**Lenox—American By Design**

Since 1889 the vision of Walter Scott Lenox has guided the company he founded to set the highest standards for quality, artistry, and beauty. Today Lenox is among the world's oldest and most respected names in fine tableware and giftware – favored by presidents, displayed in museums, honored with awards, and enjoyed in homes across America. Lenox is proud to be an American company designing for Americans and is the only manufacturer of fine bone china in the United States, produced at a state-of-the-art facility in Kinston, North Carolina. The plant uses an average of 4 million pounds of clay each year and can produce 15,000 to 20,000 pieces of china daily.

(www.lenox.com)



ELEGANT



Photograph by cygnus921. (Flickr)

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.

Ray Johnson, senior vice president and chief technology officer for Lockheed Martin Corporation emphasized, "Science and engineering allow you to work on

creating the future. If you think about the things we're doing inside our corporation, we're building the only fifth-generation fighter aircraft. We're sending spacecraft to Mars to explore the planet and discover water. Engineers of the future are going to develop clean and renewable energy sources. They're going to continue to battle international terrorism. They're going to continue to create new technologies to make our lives better."

America's innovation and manufacturing enterprise needs workers of all kinds with multidisciplinary, problem-solving skills—often trained in experiential learning environments. Companies, governments, communities and unions need to work on retraining incumbent workers, tapping mature talent, strengthening the emerging talent pipeline, reforming immigration and enhancing the link between workforce and economic development.

Collaborative Business Practices Are a Competitive Necessity

It is interesting to note that management and labor relationships are changing and becoming more collaborative. Within companies, walls between business units and divisions are also falling. Across the board, public and private partnerships are rapidly expanding with multiple implications for workers and for workforce skills. It's not just about production in terms of the bottom line; it's also about expending resources. As resources become more limited, organizations are reinventing business models.

One means for encouraging small and medium-sized businesses to thrive is through exploring models of success in the United States and other economies, including economies of scale derived from pooled workforce training programs, links as part of a supplier network to larger companies, tax credits and shared export targets.

Unions are also an efficient and expedient way to tool-up the new job entrant. Training programs, such as those offered by the Plumbers & Pipefitters or the Carpenters, offer multi-month intensive programs that teach skills with immediate application to the workplace and train for jobs with living wages. Furthermore, the unions have an excellent track record of troubleshooting remedial academic needs as well.

As Bill Hite, General President of the United Association of Plumbers and Pipefitters, stated: “It’s important that we keep abreast of the latest technologies in our industry, so that we can compete against anyone. Everybody knows it’s a global economy. Training facilities such as ours separate us from the non-union elements and make us competitive in today’s market.”

America Must Leverage its Edge in Innovation, Technology and Computing

Research

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 (Figure 10).

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.⁵¹

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.⁵² Although a more prosperous and innova-

Department of Energy National Laboratory User Facilities: A Competitive Advantage

The DOE Office of Science User Facilities at its national laboratories provide the Nation’s researchers with the most advanced tools of modern science including accelerators, colliders, supercomputers, light sources and neutron sources, as well as facilities for studying the nanoworld, the environment and the atmosphere.

In 2010, more than 26,000 researchers from academia, industry and government laboratories, spanning all fifty states and the District of Columbia, utilized these unique facilities to conduct scientific discovery, use-inspired experiments and research, and transformational engineering research and development.

The Office of Science User Facilities are redefining what is possible in a host of scientific and engineering fields. Some industrial users are already leveraging these capabilities to better understand protein structures for drug application and to identify new catalysts and membranes for advanced batteries, fuel cells and emissions controls. Others have utilized supercomputing resources to optimize jet engine performance while minimizing emissions and noise. These are but a few examples in which federal research facilities help to advance the economic and competitive advantage of America’s private sector.

While a start, more U.S. companies of all sizes should take advantage of the significant R&D investment and resources offered by DOE’s Shared User Facilities, to ensure that they retain leadership and market share vis a vis global competitors.

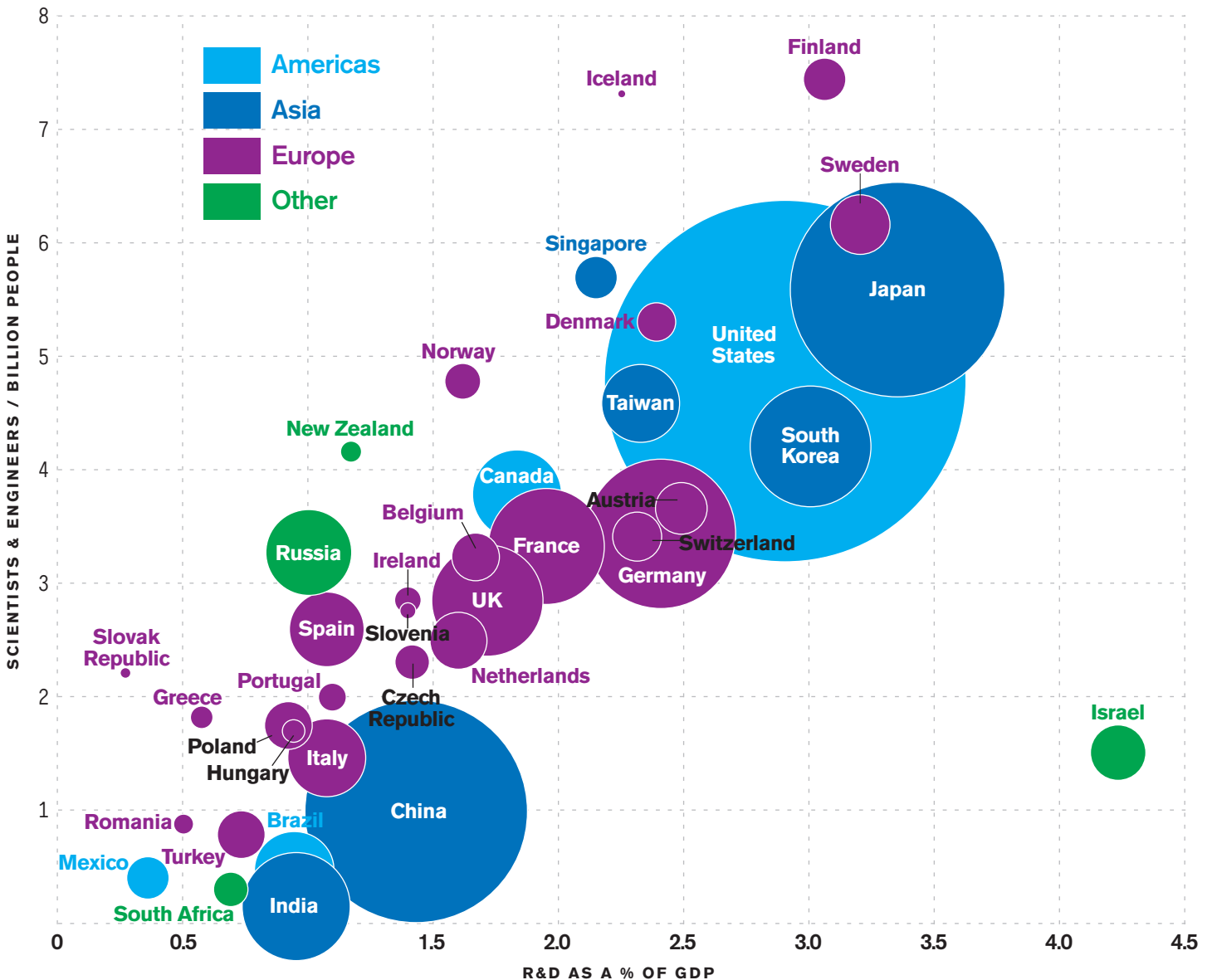
tive world is a welcome trend, the shift has significant implications for U.S. manufacturing and security interests. America has long been the global leader in creating new, high value-added goods and services. That

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.

Figure 10. World of Research and Development, 2010

Sources: 2011 Global R&D Funding Forecast, Batelle, R&D Mag, December 2010. *Economic Letter-Insights from the Federal Reserve Bank of Dallas*. Federal Reserve Bank of Dallas <http://dallasfed.org/research/eclett/2010/el1011.html>

Size of circle reflects the relative amount of annual R&D spending by the country noted.



High Performance Computing

Manufacturers in the coming decades must be able to design, develop and deploy the next generation of products as well as the next-generation of production technologies, tools, processes and equipment. An important tool to achieve these goals—high performance computing (HPC)—could give U.S. producers a distinct advantage. Although other nations have made big strides in HPC, especially China, the United States remains the global leader with six decades of experience convening scientists, engineers and mathematicians across the private sector, government and academia to tackle problems with the most powerful computers available.

HPC powers innovation through the extraordinary simulations it makes possible. Thousands of microprocessors work together to mimic physical reality. They can focus on a single water molecule or an entire ocean and make sense of data collected from billionths of a second or billions of years. Whether it's the aging of a nuclear weapon, the fusion of hydrogen isotopes or the baking of a potato chip, simulations reveal details and complex relationships with stunning clarity.

Given HPC's power to reveal and inform, the U.S. government has invested significantly in HPC, particularly at laboratories operated by the Department of Energy. The investment has paid off—HPC has become the “third leg” of science, joining theory and experiment.

Products and services linked to HPC networks will stretch across human activity—in factories and warehouses, stores, homes, hospitals, vehicles and transportation corridors. High performance computing improves efficiency and security, streamlines supply chains, makes logistics more efficient and reduces dependency on human labor in many activities. These technological trends will continue to reshape industries, firms, products and labor markets.

Programs like the Council on Competitiveness National Digital Engineering and Manufacturing Consortium (NDEMC) have been created to spread advanced modeling and simulation capabilities throughout the nation's supply chain to reduce costs, speed development times and improve product features (Figure 11).

Manufacturing and Technology Innovation Are Mutually Reliant

Nearly 70 percent of U.S. R&D relates to manufacturing and manufacturers perform 45 percent of all private sector R&D in the United States. From 2006 to 2008, 22 percent of U.S. manufacturing companies reported a new or significantly improved product, service, or process, compared with eight percent of non-manufacturing companies.

Business R&D and Innovation Survey, National Science Foundation, 2008

Smart Manufacturing

The potential for manufacturing process innovation is enormous. Smart manufacturing is an ongoing effort to integrate many of the trends described in this strategy—such as HPC, cloud computing, data mining and user-driven customization—across global production enterprises and supply networks. By marrying these technological capabilities with human insight, smart manufacturing promises to revolutionize the way production is organized and delivered. As manufacturing intelligence of this kind grows, it will inspire innovations in processes and products that will unleash new, disruptive capabilities—such as a \$3,000 automobile or a \$300 personal computer.⁵³


Smart manufacturing enables a coordinated and performance-oriented enterprise that responds quickly to the customer, minimizes energy and material use, maximizes health and safety and generates innovation. Today, smart tools and systems that generate and analyze greater amounts of data are being used to plan, design, build, operate and manage industrial facilities and networks.

Smart manufacturing is a growth engine for jobs and a sustainable economy. A \$50 billion investment in retooling factories would generate up to \$120 billion in revenue resulting from increased demand for products, according to a study by the Apollo Alliance, a business-labor coalition.⁵⁴ Manufacturers would achieve higher levels of business performance, turn resources into assets and discover unique opportunities for competitiveness.

Figure 11. Brochure Describing National Digital Engineering & Manufacturing Consortium.

National Digital Engineering & Manufacturing Consortium

NDEMC Midwest Project



NDEMC is comprised of the following partners:

OEMs

- Deere & Company
- General Electric Company
- Lockheed Martin Corporation
- The Procter & Gamble Company

Solution Partners

- Council on Competitiveness
- National Center for Manufacturing Sciences
- National Center for Supercomputing Applications (University of Illinois)
- Ohio Supercomputer Center
- Purdue University
- SCRA

State Governments

- Ohio Board of Regents

Federal Government

- The White House
 - National Economic Council/ Office of Manufacturing Policy
 - Office of Science and Technology Policy
- U.S. Department of Commerce
 - Economic Development Administration
 - National Institute of Standards and Technology
- U.S. Department of Energy
- National Aeronautics and Space Administration
- National Science Foundation

NDEMC is energizing the growth and development of small- and medium-sized American manufacturing enterprises (SMEs) by promoting public-private partnerships and encouraging skills transfer of advanced manufacturing techniques and processes that leverage computational power, simulation and cutting-edge modeling techniques. With funding through the Economic Development Administration, and as the initial project of President Obama's Advanced Manufacturing Partnership, the White House and the Council on Competitiveness are leading the effort to collaborate with SMEs to use modeling and simulation.

NDEMC brokers and promotes collaborative relationships that will sustain the growth of American manufacturing through jobs creation and enhanced competitiveness. NDEMC provides modeling, simulation and analytics education and training, access to High Performance Computing (HPC) and access to Software as a Service (SaaS). These services will be available through a distributed application to make U.S. SMEs more competitive in the global marketplace.

NDEMC has two major deliverables: a web based portal and up to 40 demonstration projects/case studies. The portal will be easy to access with features that include:

- A single point of entry to access MS&A software and HPC
- A searchable database of MS&A software (at present there are 143 types of software in the database)
- A secure business transaction capability (pay-by-use model)
- Access to unbiased advice and direction (university partners)
- A database of MS&A consultants and their areas of expertise

The first seven projects in process now are the following SMEs:

- Adams Thermal Systems
- Greenlight Optics
- Jeco Plastic Products
- Plastipak Packaging, Inc.
- Pratt Industries
- Rosenboom, Inc.
- TPI Composites

For more information, contact Dr. Cynthia R. McIntyre, Senior Vice President, Council on Competitiveness via phone at 202.969.3406 or email at cmcintyre@compete.org.



Debbie San María and Mike Haskell tend to the Tri-Lab Linux Capacity Clusters (TLCC) Juno and Minos supplied by Appro, and located in the Terascale Simulation Facility at Lawrence Livermore National Laboratory. The clusters are used by all three national defense laboratories—Los Alamos, Sandia and Livermore. The new computers provide much needed “capacity” computing, running larger numbers of smaller jobs simultaneously on a single high-performance machine. Juno and Minos are some of the first Linux clusters.

Photograph courtesy of Lawrence Livermore National Laboratory.

Though industry is adopting components of smart manufacturing, the infrastructure, capabilities and investments needed to deliver the full potential of this knowledge-based environment have yet to be developed. U.S. private and public sector leaders will need to partner in order to seize this potential advantage. "The European Union has already approved 1.2 billion Euros for a new Factories of the Future research program as part of their economic recovery plan."⁵⁵ Building and linking emerging advanced manufacturing clusters and centers of excellence across the country is a needed step to cultivate the advantages offered by smart manufacturing. The European Union is ahead of the U.S. in the race to re-industrialize their manufacturing base with smart, safe and sustainable manufacturing.

Advanced materials will play an increasingly critical role in driving and supporting the transition to smart manufacturing. These materials provide the critical coatings, composites and catalysts for industries from aerospace to oil & gas to electronics. Ongoing research in fields ranging from polymer science to nanotechnology generates new materials for new markets and applications, creating attractive opportunities for business and investors. Collaboration through national initiatives would accelerate material-based research and innovation. Open source laboratories, open source technology and open source foundries would provide access to the materials and equipment needed to conduct advanced R&D. Developing advanced materials requires upstream discovery and continues into downstream effective ways to recycle, reuse and remanufacture these materials. As alloys and other advanced properties, such as rare earth minerals and lithium become more essential for manufacturing, the recycling process also becomes a greater imperative.

America Must Better Leverage Its Entrepreneurial Enterprise

Even before its founding as an independent nation, America drew people to its shores in search of opportunity and economic freedom. A cultural faith thrives to this day that individuals can determine their futures through their own ambition and initiative. This powerful idea and entrepreneurial spirit has become a strategic advantage for the American economy that has proven difficult for many nations to emulate.

MANUFACTURING IS...

Gibson Guitar Co.

Nothing screams rock 'n' roll quite like an electric guitar. Founded in 1896 in Kalamazoo, MI, the Gibson Guitar Co. created the first electric guitar in 1936. Known globally for its signature Les Paul edition and used by rock stars from Jimmy Page to Paul McCartney, Gibson is an ax of choice for many musicians. 500 employees in Nashville, TN handcraft as many as 2,500 Les Pauls, Flying Vs, Explorers, SGs and Firebirds each week. (www.gibson.com)

ROCKIN'



The Heritage Cherry Sunburst from Gibson's Les Paul Classic Plus line.

Following World War II, the U.S. not only built an unprecedented university and national laboratory research system, it also led a largely unheralded entrepreneurial revolution. A French immigrant, Georges Frederic Doriot, co-founded and was named president in 1946 of the first modern venture capital firm, the American Research and Development Corporation (ARD). During the war, Doriot had served as the Director of Military Planning, leading R&D efforts that found substitutes for critical raw materials and developed innovative items like water-repellent fabrics, sunscreen and K-rations. He rose to the rank of Brigadier General.

His experience in the war convinced Doriot that worthy ideas and small companies with potential lacked the capital and management savvy to flourish. Budding entrepreneurs of the time were stymied by conservative bank lending practices and a scarcity of wealthy family investors. ARD ushered in a new, organized way to launch start-ups and proved that a public venture firm could earn significant money by nurturing and investing in small, unproven companies.⁵⁶

By combining innovation, entrepreneurship 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.⁵⁷ Highly skilled entrepreneurs and business start-ups also create middle-skill jobs though the number of new businesses has declined significantly (Figure 12).

In fact, many new jobs come from a relative handful of fast-growing companies. During the 1990s startups and gazelles within knowledge-and technology-based sectors of the economy were the primary engine of job growth. New businesses and gazelles—companies growing at over 20 percent a year over a four-year period—accounted for 80 percent of net employment growth from 1992 to 1996. Knowledge economy sec-

tors are expected to generate nearly three times more jobs than the older industries, growing 3.6 percent annually from now through 2008.⁵⁸

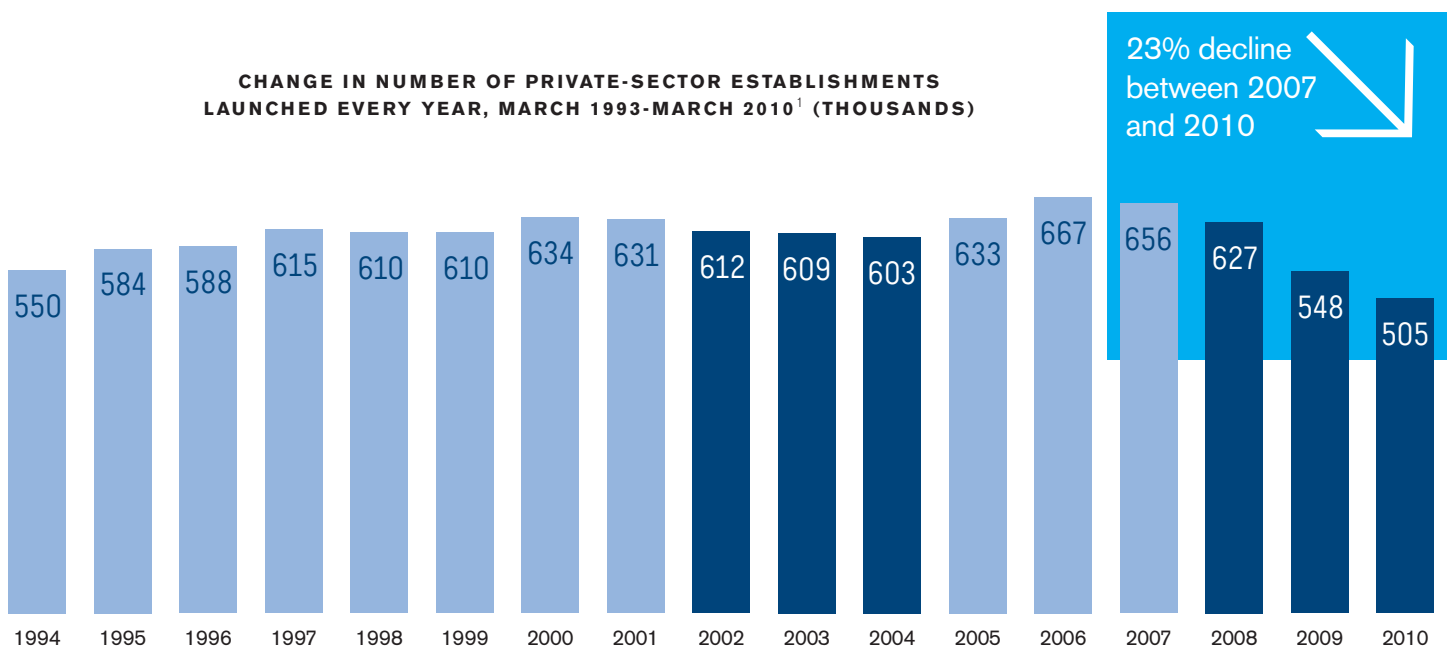
Consistent with other facets of the hyper-competitive manufacturing environment, many nations around the world—plus states and localities—are working to narrow the U.S. entrepreneurship advantage. They are creating tax incentives, sovereign wealth funds, skilled immigration incentives, regional innovation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

Figure 12. The Number of New Business Has Declined Sharply in this Recession

Source: U.S. Bureau of Labor Statistics; McKinsey Global Institute analysis

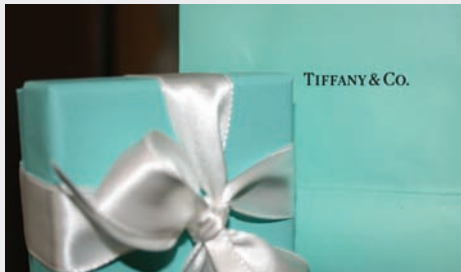
There were 100,000 start-ups in America in 1950; by 2000 there were 800,000. The average yearly business failures went from 10,000 in 1978 to 100,000 in 1994. The American entrepreneurial spirit drives the American economy. However, the current recession has resulted in a stormy climate for new businesses, creating the largest drop in young businesses in recent memory.



1. Calculated using U.S. Bureau of Labor Statistics Business Employment Dynamics data set. The annual number indicates the number of businesses less than one year old that were in existence in March of that year.

MANUFACTURING IS...**Tiffany & Co.**

Since 1837, Tiffany & Co. has been the world's premier jeweler and America's house of design. The silver, gold and platinum used in Tiffany & Co.'s workshops (all of which are located in the United States) come from two principal sources: in-ground, large-scale deposits of metals that have been responsibly mined in Utah and Montana and metals from recycled sources. (www.tiffany.com)

BEAUTIFUL

Photograph by Jill Clardy. (Flickr)

MANUFACTURING IS...**J. Lloyd International, Inc.**

For generations, the Big Wheel[®] has been a family favorite in providing children's fun, play and development of early learning motor-skills. The Big Wheel[®] was first developed by Louis Marx Toys and presented to the public at the 1969 New York Toy Fair. Today's Big Wheel[®], manufactured in Cedar Rapids, Iowa, was redeveloped with the original 1969 model in mind with added safety features and appeal for modern families. (www.originalbigwheel.com)

FUN

Photograph by John Morgan. (Flickr)

and immigration policies that have limited the entry of skilled workers into the United States. The authors of the study write, "[Other] countries...have been more pragmatic by giving strong incentives to attract educated, skilled workers to their shores...and to keep them there with offers of residency and citizenships."⁵⁹

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.⁶⁰ 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.⁶¹ And even fewer are scaled to full production in the United States.⁶²

University incubators and centers for entrepreneurship could focus their resources on the fusion between younger, aspiring entrepreneurs and more seasoned

talent. Mature talent can offer the know-how, industry-specific experience, networks, access to capital and wisdom born of failures that breeds success. In the start-up world, and in tech start-ups, specifically, they have been strikingly successful, compared to their 20- and 30-something year old counterparts. Younger talent interested in developing and taking innovation and discoveries to market can best commercialize these efforts by teaming up with mature entrepreneurs who mentor them in the market.

Americans must take additional steps to enable better collaboration between companies, laboratories and universities. Too many regulations impose high costs on small start-ups and deter initial public offerings. The Council also has begun a dialogue with the venture capital community about the most important steps that should be taken to encourage investment in production at scale in the United States.

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 in this report, 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.⁶³ Plus, America's venture-capital (VC) community remains a critical strategic advantage (Figure 13). Despite these encouraging metrics, the reality explained in Council 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.

In fact, according to the 2011 Structural Costs of Manufacturing in the United States Study, the structural cost burden of U.S. manufacturers relative to com-

Figure 13.

The ability of VC-backed companies to outperform their non-venture counterparts flows from venture capital's focus on highly innovative, emerging growth companies. The 500 largest public companies with venture roots increased their collective market capitalization by approximately \$700 billion, rising from \$2.1 trillion in 2008 to \$2.8 trillion in 2010.

Venture Impact: The economic Importance of Venture Backed Companies to the U.S. Economy, A joint study by the National Venture Capital Association, 2011.

petitors in the nine largest trading partners increased to 20 percent, up from 17.6 percent in 2008.⁶⁴ The U.S. tax on corporate profits is significantly higher than the average of Organization for Economic Co-operation and Development (OECD) high-income countries, and higher than many other U.S. competitors.⁶⁵ The annual cost of federal regulations was more than \$1.75 trillion in 2008 or 14 percent of GDP, further impeding investments in U.S. manufacturing.⁶⁶ Product liability laws are also stifling production, innovation and competition with a \$248 billion estimated cost of the U.S. tort system in 2009 or nearly 2 percent of GDP.⁶⁷

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.

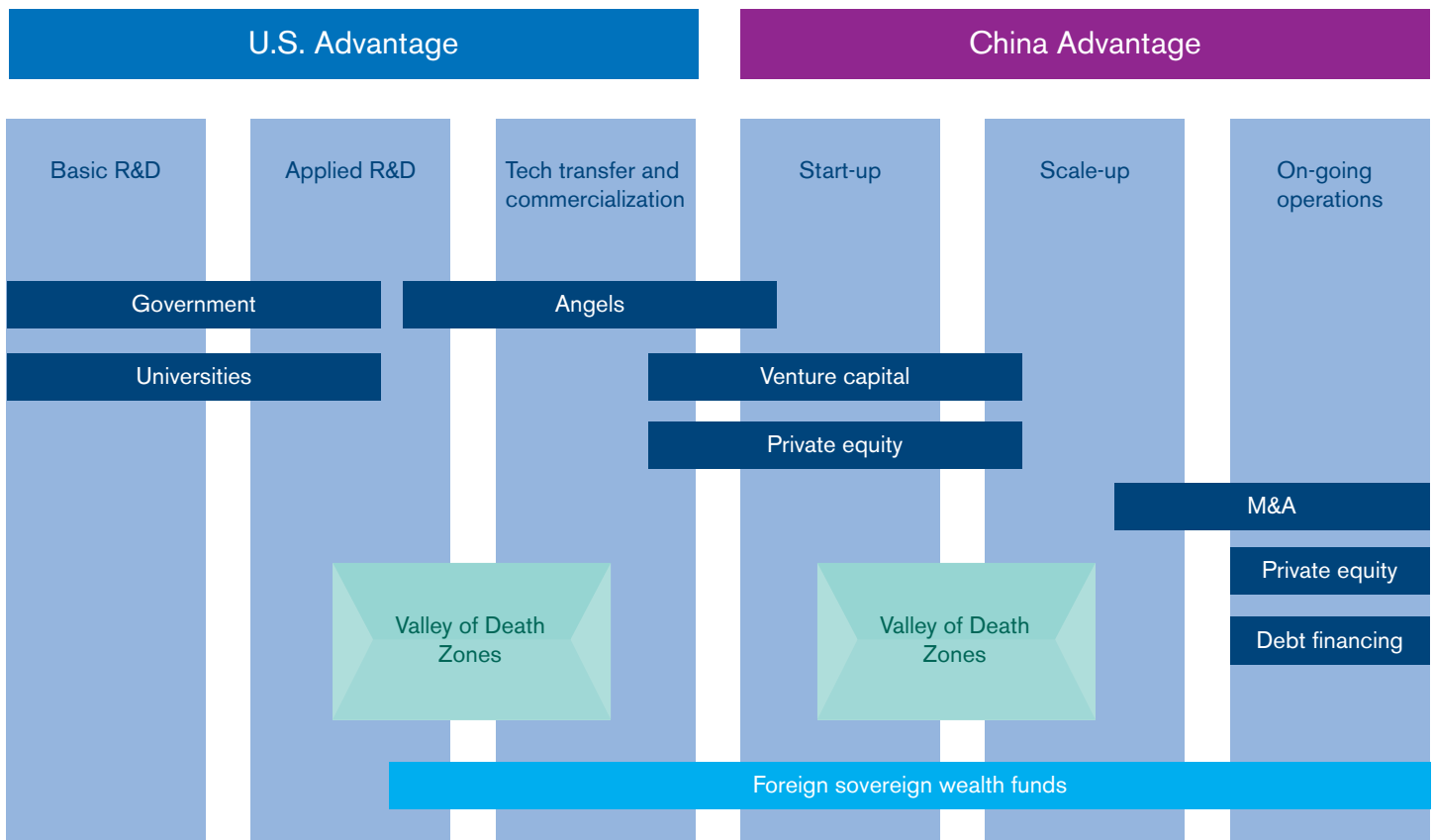
The availability of government funds decreases abruptly after the technology or knowledge is created because the government views subsequent investment as the domain of the private sector. This drop-off of investment occurs at the same time that the investment needs of a company or entrepreneur are growing to test, develop and begin commercializing the technology. This is the traditional valley of death referred to in the innovation process (Figure 14). Dr. Shirley Ann Jackson, President of Rensselaer Polytechnic Institute said, “We clearly need a new financial model for startups, as venture capitalists increasingly prefer to invest in less risky, later-stage enterprises, and entrepreneurs refer to a widening “valley of death,” when no financing is obtainable.”

Often overlooked, however, is a second valley of death. A few Council members 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.

A combination of domestic and global forces is colliding in a perfect storm to make investment in U.S.-based production more difficult than ever. Some of the most heated debates over the reasons for a decline in initial public offerings (IPOs) revolve around the Sarbanes-Oxley Act (SOX) passed in 2002. SOX requirements seem to have created a tipping point for small businesses where the cost of compliance causes a delay or outright inability to pursue an IPO strategy. The last few years have eased some of the SOX burden on small companies, and several bills now before Congress seek to reform some of the more onerous requirements.

Figure 14. U.S. Innovation and Manufacturing Life-Cycle Faces Multiple Investment Valleys of Death

Source: Council on Competitiveness



Illustrative and signals bulk of investment focus. Exceptions can always be found.

MANUFACTURING IS...**Lockheed Martin Corporation**

traces its roots to 1913, when Allan and Malcolm Loughhead flew the first Lockheed plane over San Francisco Bay. Today, Lockheed Martin is a global security company that employs about 126,000 people worldwide and maintains 572 facilities in 500 cities and 46 states throughout the United States. Lockheed Martin has been selected by NASA to design, build and operate the spacecraft for NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN) program. Scheduled to launch in late 2013 and arrive at Mars in the fall of 2015, NASA's newest mission will analyze the upper atmosphere and past climate change on Mars. The spacecraft will circle Mars as it studies current atmospheric losses, with an emphasis on the role of the solar wind. These present-day losses will give insight to the massive climate change Mars experienced in the past. (www.lockheedmartin.com)



SCIENTIFIC



Photograph courtesy of Lockheed Martin Corporation.

Many critics also cite provisions in the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act as a deterrent to spurring investment. One such provision makes it harder for business start-ups to raise seed capital from wealthy individuals who want to invest directly in a new business. Start-ups depend on these “angel” investors, since many new businesses lack the collateral for bank loans and aren't ready for IPOs.

Additional changes in market structure also may have resulted in the reduced numbers of IPOs (Figure 15). In the late 1990s, for example the incentive lessened for underwriters to bring small businesses public because of decimalization, new order-handling rules and the rise of online trading.

Figure 15.

The actual number of IPOs of U.S.-owned companies listed on the NYSE or NASDAQ was 425 in 1983, versus 38 in 2009. The number of companies listed on the major domestic exchanges peaked in 1997 at more than 7,000 and it's been falling ever since. It's now down to about 4,000 companies. However, it should be noted that a possible recovery may underway with about 100 IPOs produced in 2010

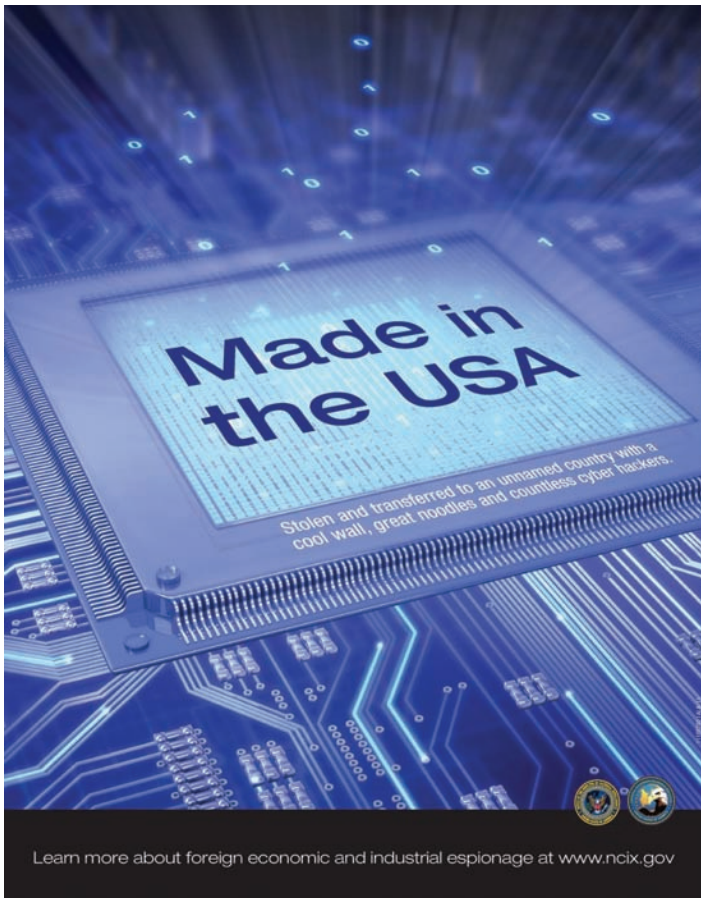
America Needs a Strategic Infrastructure Investment Plan.

U.S. manufacturers depend on a wide range of infrastructure to deliver products to the marketplace—from energy infrastructure to power manufacturing plants, to transportation infrastructure to move people, materials and produced goods, to telecommunications and cyber infrastructure for company, factory and supply chain management.

Currently, there is no clear path forward on national infrastructure policies. Some of this uncertainty is due to a lack of government research into what sectors need the most improvement as well as a general lack of public funding for improvement projects. Greatly expanding public private collaboration on infrastructure issues is needed.

In the World Economic Forum's recent Global Competitiveness Report, the United States ranked 24th in the quality of overall infrastructure, lower than many key competitors.⁶⁸ The lack of maintenance and failure to modernize has left much of the physical infrastructure outdated and crumbling. Systems crucial to manufacturing—aviation, roads, rails, ports, hazardous waste and wastewater—are in poor condition. An estimated \$2.2 trillion will be needed over five years to bring U.S. infrastructure to good condition, yet current spending is about half of what is needed.⁶⁹

America's rapidly expanding telecommunication and data networks are inextricably linked to the successful daily operation of its businesses and by extension, its economic security. These networks govern



In October 2011, the Office of the National Counterintelligence Executive issued a report to Congress on foreign economic collection and industrial espionage, 2009–2001. The report is entitled, “Foreign spies stealing U.S. Economic Secrets in Cyberspace.”

As part of this effort, a series of posters, similar to this one by the Office of the Director of National Intelligence, have been developed to remind workers across industries to be mindful of this growing threat.

the nation's transportation, water and power systems; govern the transmission of critical financial, health and legal data; and afford Americans a lifestyle of convenience. Alarming, these critical infrastructures are increasingly threatened by malicious cyber activities.⁷⁰ America's intellectual property, banking institutions and health data are being pillaged on an unprecedented scale through cyber attacks. In fact, in a recent Senate hearing, Director of National Intelligence James Clapper stated that nearly two-thirds of America's firms reported being targets of cybersecurity incidents or information breaches.⁷¹

America's vulnerability to cyber attacks, and the consequences for breaches of security continue to increase, even as its information systems become more extensively networked through common and often unsecured systems. To combat these threats, new and effective solutions must constantly be identified, developed and deployed throughout the nation's cyber infrastructure.

The cyber arena has become the forum in which new ideas and business transactions most frequently occur, making it an especially attractive target for unwelcome foreign data collection and industrial espionage attacks. These threats compromise America's security and prosperity, impacting companies of all sizes and sectors.⁷² Malicious actors can rapidly siphon large volumes of data from off-shore locations, immune from U.S. police jurisdictions and legal systems. Without highly-sophisticated and constantly evolving countermeasures, U.S. competitiveness in intellectual property rich—and often high value added—sectors will be lost.⁷³

An Energy Revolution Is Underway That Promises Stable, Low-Cost Domestic Supplies

Manufacturing firms need access to low-cost, dependable energy sources. The United States needs a system that develops domestic energy resources—renewable, traditional or otherwise—along with efficiency efforts, to achieve energy security. The transmission grid currently wastes a third of energy produced. Domestic energy resources may represent one of the most promising frontiers for American workers. Rising demand, rollercoaster prices and national security concerns argue for domestic energy supplies.

“I truly believe the U.S. can achieve energy security through investment in energy infrastructure and R&D, and I also know we can create jobs through energy efficiency retrofit and other programs,” Jeffrey Immelt, Chairman, President and CEO of General Electric Corporation, said.

The Council does not believe there is a single solution to providing abundant, secure, clean and reasonably priced energy.⁷⁴ Therefore, the United States should continue advancing alternative energy sources and systems while utilizing all sources of energy. An energy revolution is underway in natural gas, however, that stands out in its potential to revitalize U.S. manufacturing.



Photograph courtesy of ITC Holdings Corp.

ITC Holdings Corp. is the nation's largest independent electricity transmission company. Based in Novi, Mich., ITC invests in the electric transmission grid to improve system reliability, expand access to markets, lower the overall cost of delivered energy and allow new generating resources to interconnect to its transmission systems. ITC's regulated operating subsidiaries include ITC Transmission, Michigan Electric Transmission Company, ITC Midwest and ITC Great Plains.

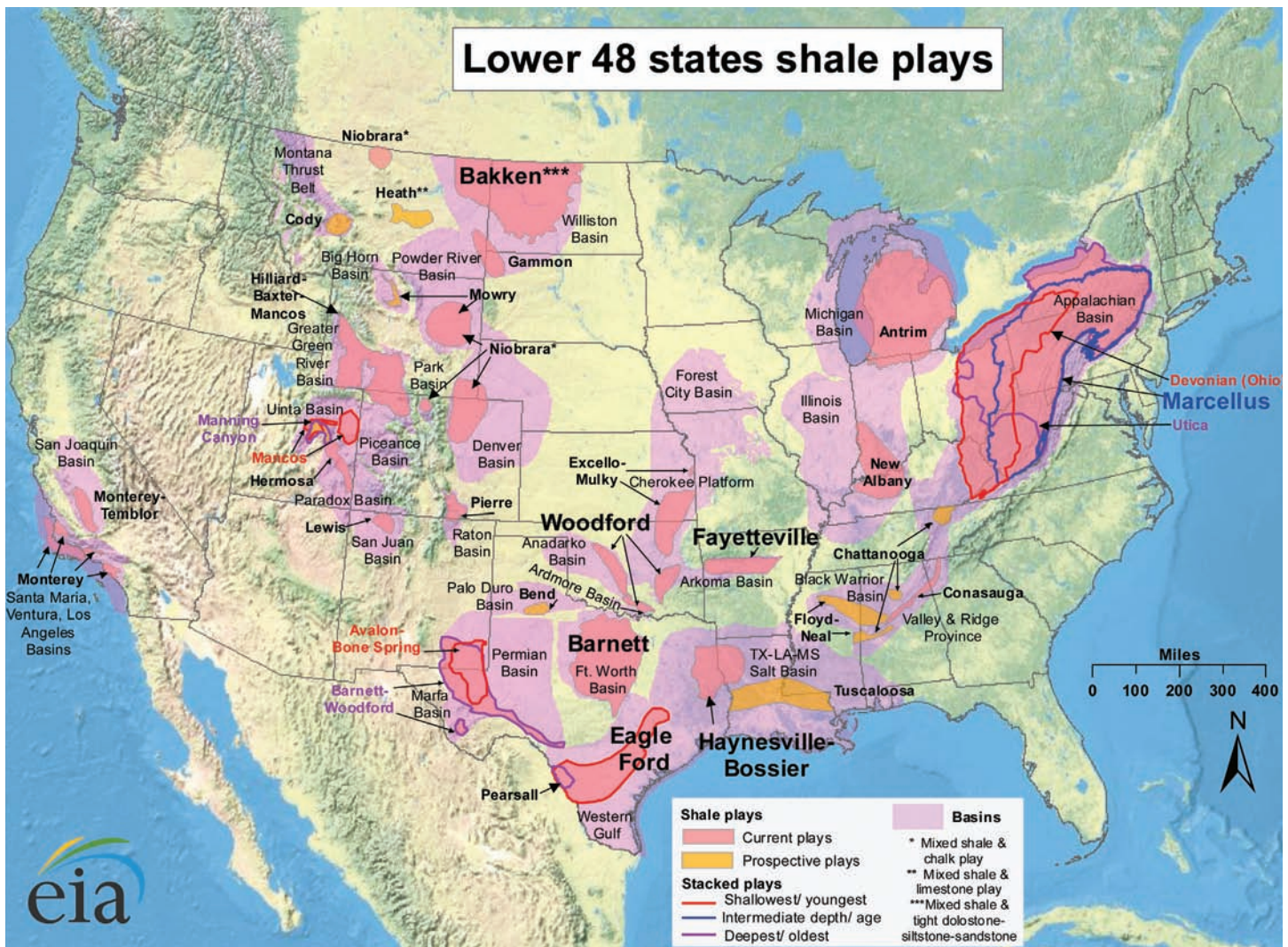
ABOVE: The operations control room in Novi, Mich.

Technological advances to extract natural gas—horizontal drilling and hydraulic fracturing—are opening exciting opportunities. Huge domestic shale formations are creating employment and investment booms in the gas industry and in industries that supply gas extraction technologies. The new extraction technologies also have led to the reversal of the long-term decline in oil production from onshore conventional fields. Furthermore, large scale investment in rural areas of several U.S. states is spurring consumer spending on manufactured goods like farm equipment.

Shale production in the United States has increased from negligible levels as recently as 2000, to more than 13 billion cubic feet per day, or about 30 percent of the country’s natural gas supply today. In 2009, the U.S. surpassed Russia to become the world’s largest

producer of natural gas and in the coming years, it is predicted that shale production will represent closer to 50 percent of America’s natural gas supply. An Energy Department advisory panel estimated in August 2011 that more than 200,000 jobs, directly and indirectly, have been created in recent years by the domestic production of shale gas.⁷⁵

Energy considerations are critical for manufacturers as the sector uses approximately one-third of the energy consumed in the United States, according to the National Association of Manufacturers (NAM). “We use natural gas not only as a source of electricity, but as a feedstock for products such as plastics, fertilizer and pharmaceuticals. Affordable natural gas provides manufacturers with the ability to expand their facilities, increase production and create even more jobs.”⁷⁶



Source: Energy Information Administration based on data from various published studies. Jupdated: May 9, 2011

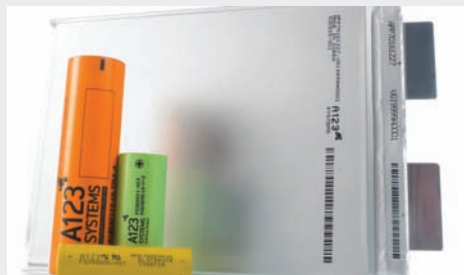


MANUFACTURING IS...**A123 Systems**

A123 Systems, Inc. (Nasdaq: AONE) develops and manufactures advanced lithium-ion batteries and energy storage systems that deliver high power and energy density, long life, and excellent safety performance. The company's game-changing technology enables customers to commercialize innovative products for the transportation, electric grid and commercial markets.



CLEAN



A123 Battery Cell Family.

Energy-intensive manufacturers that produce chemicals, plastics and steel are beginning to bring home operations that they exported years ago. More plentiful gas supplies priced at around \$4 per thousand cubic feet have allowed Dow to announce multibillion-dollar expansions of facilities in Louisiana and Texas, according to James R. Fitterling, Dow's executive vice president. "We expect to employ up to 1,300 workers per project to construct our two new propane dehydrogenation units and a new ethylene cracker," he told an energy conference in Houston. "We also expect between 400 and 500 new, long-term Dow jobs to operate and maintain the facilities."⁷⁷ That's just one chemical company.

U.S. Steel is investing in Ohio to make tubes for oil and gas wells, committing \$100 million to revitalize a plant that first started production in 1905. The benefit for U.S. Steel is not only supplying the gas industry. John Surma, Chief Executive Officer of U.S. Steel, explained recently how the company has been substituting cheap gas for expensive coal in its blast furnaces, saving tens of millions of dollars a year.⁷⁸

Domestic gas production has also had a dramatic impact on chemical producers that rely on ethylene. "Natural gas is to the chemicals industry as flour is to a bakery," said Cal Dooley, president of the American Chemistry Council. International and American companies now view the United States as a preferred location for new investment, he added. Royal Dutch Shell plans to build an ethylene plant in the Appalachia region for instance, while Chevron and ConocoPhillips also are considering new plants.⁷⁹

In order to fully capture the economic benefits of shale gas production, a balanced regulatory regime and enforcement capability needs to be established that ensures best practices to protect water supplies while not hampering development. Some environmental groups and companies are working together on model regulations to ensure best practices are used in the casement of wells and the processing of flowback-water injected into the well through the "fracking" process.

If environmental issues are addressed, shale gas promises significant environmental benefits as coal-fired electrical plants are replaced by gas-fired units. Fred Krupp, President of the Environmental Defense Fund, noted recently that, "natural gas burns cleaner than coal, emits less in the way of greenhouse gases and avoids mercury and other pollutants."⁸⁰

Cleaner energy supplies of this magnitude are a game changer—creating jobs, drawing new investment, and beginning to reverse the trade deficit on a significant scale. These growth trends also help address America's budget deficit, public debt and high levels of consumer debt. Jobs and growth generate tax revenue and result in fewer Americans relying on public benefits. Individuals and families are more able to save and pay down debt. These very positive developments, however, will not be enough alone to solve America's debt burden. That will require a concerted effort by America's elected leaders.

Government and Consumer Spending and Debt Is No Longer Sustainable

Over the past several decades, the United States has become a debt-driven economy. Failing to correct the paths of government and consumer insolvency would have a distinctively negative impact on manufacturing and other sectors of the economy. (See Figure 17 on the following page.) Cash-strapped governments cannot invest adequately in research, infrastructure or education on which manufacturers rely. Governments also are forced turn to higher taxes that either dampen consumer demand or get passed on into the price of products, making U.S.-based production less competitive. Cash-strapped citizens will purchase fewer manufactured goods and have less to save and invest, raising the cost of capital.

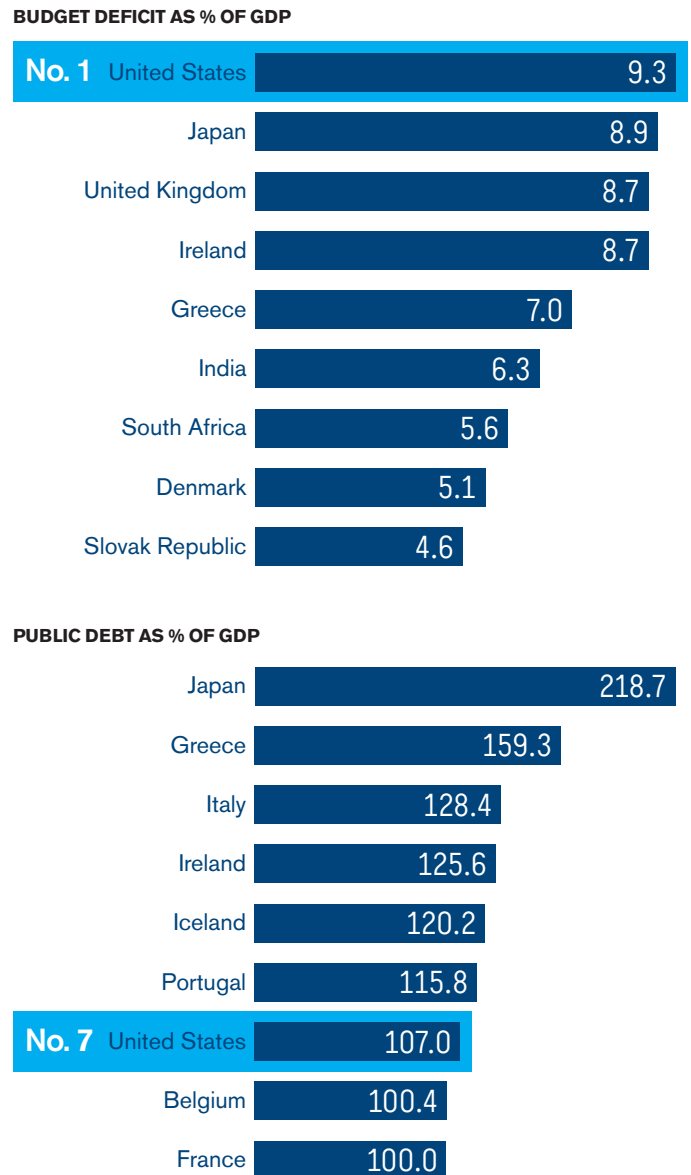
Government debt is on an unsustainable path for several reasons, the most important being the projected cost of health-care entitlement programs. Health-care inflation, a retiring baby boom generation that lives longer and fewer working age Americans to pay taxes means that the Medicare program is projected to generate more cost over time than markets will permit the nation to borrow or that the economy can generate in tax revenue—even at substantially higher rates for all Americans. Tax changes could contribute to a debt solution, but not solve it alone. America cannot escape the calamity of sovereign default without reforming its health and pension entitlements, especially Medicare.

Among the ten largest economies, the United States ranks first in budget deficit as a percentage of GDP and seventh in public debt as a percentage of GDP (Figure 16).⁸¹ And while the debt to GDP ratio is alarming, an equally grave challenge is who owns the debt. The Japanese own their debt while America's debt is owned by foreign governments, one of the largest being China. This adversely impacts America's ability to address bilateral disagreements, including those related to manufacturing.

A balanced solution to America's mounting debt crisis will require an approach that reforms entitlement programs, raises revenue, reduces discretionary spending and preserves strategic investments that contribute to economic growth.

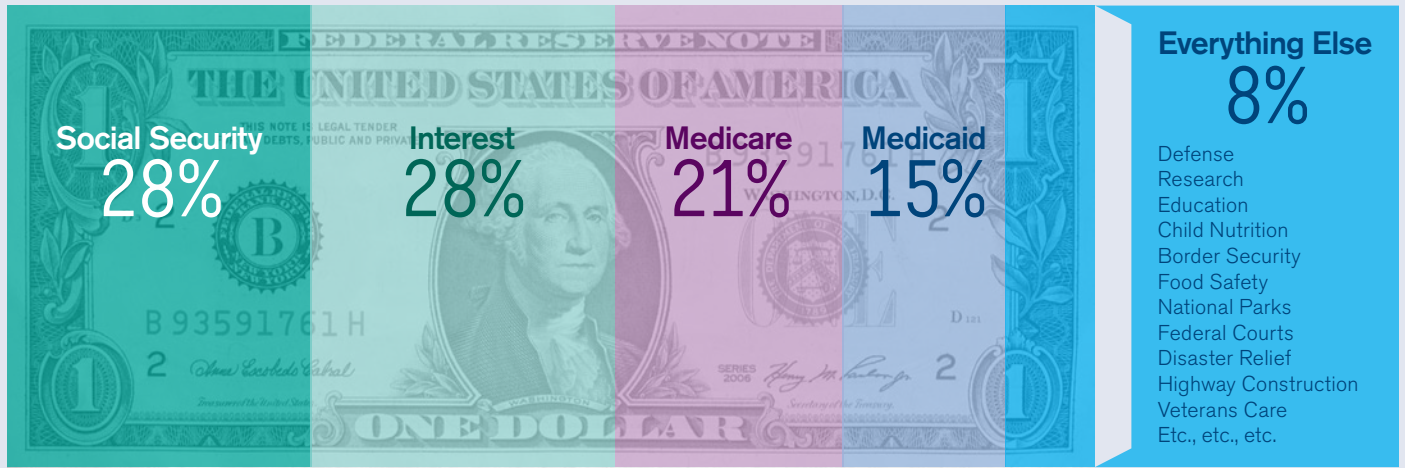
Figure 16.

Source: OECD Projections for 2012.



Consumer debt has been fueled by easy access to credit, credit-fueled rises in home values and rising higher education costs. At a time when America needs a more educated and well-trained workforce, the amount of student loans outstanding will exceed \$1 trillion for the first time this year.⁸² Americans now

By 2020, Four Items Could Consume 92% of the Federal Budget.



Government Accountability Office

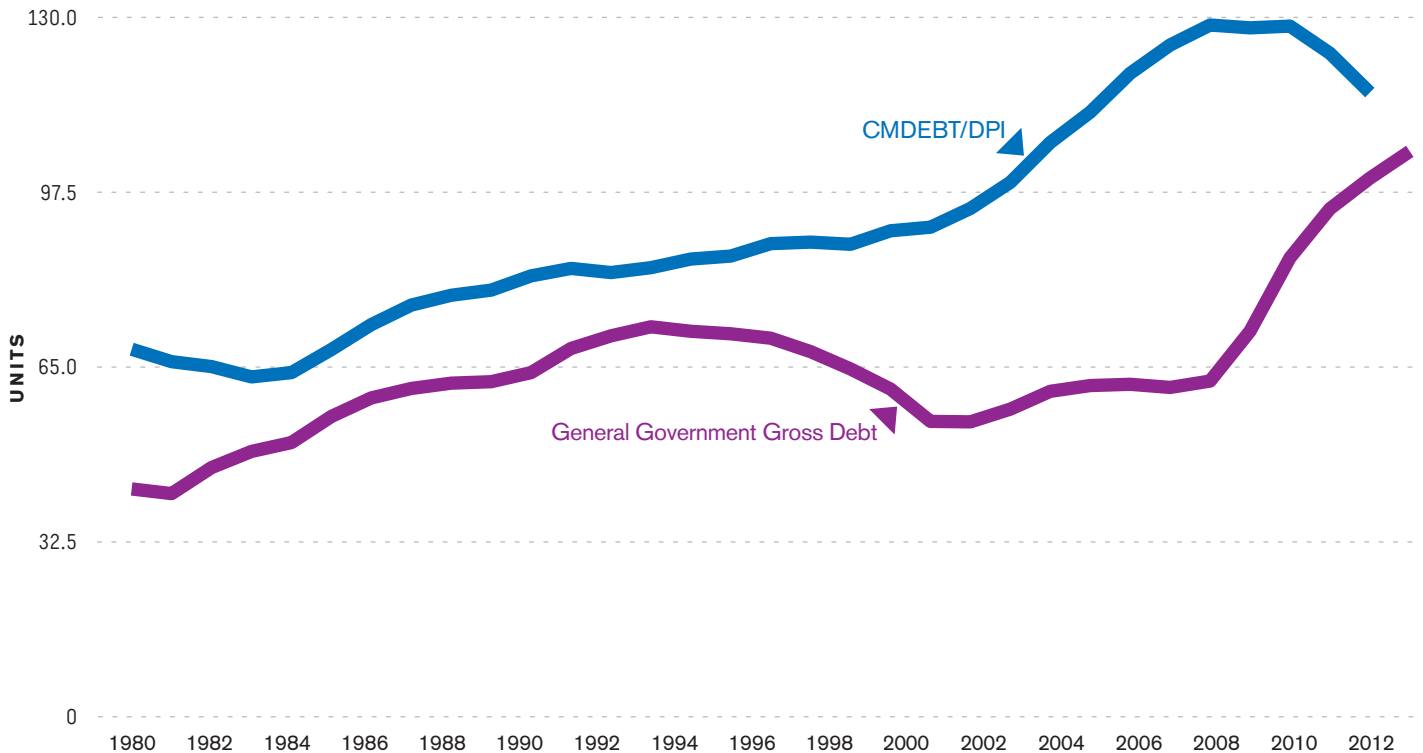
owe more on student loans than on credit cards, according to the Federal Reserve Bank of New York, the U.S. Department of Education and other sources.

The collapse of the consumer credit and housing price bubbles brought an end to debt-driven economic growth, leaving both households and governments

straining under massive debt burdens. The turning point was in 2002 when consumer debt burdens exceeded 100 percent of disposable personal income. Even if U.S. households reduce debt to a manageable level, it would still take at least a decade to bring those debt-levels somewhere close to a historical norm.⁸³

Figure 17. Significant Growth in Government and Household Debt

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Board of Governors of the Federal Reserve System



Convergence of the military and commercial industrial complex

America's debt crisis and manufacturing challenges raise serious concerns for national security and defense. The defense industrial base has long been a source of strategic advantage for the United States. American defense companies have not only created the world's most advanced military technologies and systems, but also contributed to the development of technologies with wide commercial application like computers, satellites, lasers and the Internet. In many cases, the U.S. defense establishment acts as an initial market for technologies that gain economies of scale and time to break into commercial markets.

For several years, however, a reverse dynamic has been underway where U.S. military, intelligence and homeland security agencies work as much to keep pace with commercial advances as they do developing new technologies. Many of those advances are developed and/or manufactured overseas—a challenge when striving to deploy best of breed technology and maintain superior capability over adversaries.

The challenges are myriad and several are linked to manufacturing. They include:

- keeping abreast of relevant technology advances occurring outside the defense industrial base in corporate, university and other laboratories worldwide
 - retaining domestic manufacturing capacity for critical technologies and materials
 - training the next generation of American scientists, engineers, and technicians capable of developing, producing and deploying classified technologies
 - enabling small, innovative companies to navigate the defense procurement process and still retain their ability to engage in non-defense business
 - transitioning where practical from development and procurement strategies to acquisition and co-creation strategies
- engaging allies across the globe to leverage technology advances in those nations and ensuring that coalition forces operate well
 - learning from the private sector about managing massive data flows from which intelligence and decisions need to be extracted
 - retaining offensive and defensive cyber warfare superiority
 - countering asymmetric warfare techniques used by enemies with access to inexpensive, widely available commercial technologies

These challenges require greater collaboration between the American security establishment and the private sector on a global basis. One issue raised by Council members is the negative impact of the current export control regime. Members noted that outdated and overreaching control lists restrict American firms from producing many technologies outside the U.S. or manufacturing them domestically for export. This opens the door for overseas substitutes that seize global markets for innovations developed in America. The administration has put forward an ambitious export control reform strategy that should be enacted.

MANUFACTURING IS...

The importance of sustainable manufacturing, to both producers and consumers, is growing across the United States. In 2011, the **American Small Manufacturing Coalition** reported that 59.2 percent of manufacturers consider sustainability to be important or highly important to their future, a drastic increase from the 35.1 percent reported in 2009. And almost half of American manufacturers have company specific sustainability strategies. This may represent both the capitalization on demand for greener products and an increased knowledge of the cost-savings aspect of lower energy consumption and re-using products. An awareness of the importance of sustainability has led to an increase in the percentage of manufacturers near or at world-class sustainability levels (20 percent in 2009 vs. 28 percent in 2011).

The Manufacturing Performance Institute (MPI) and the American Small Manufacturers Coalition (ASMC). *2011 Next Generation Manufacturing Study: National Executive Summary*.

Leadership in Energy and Environmental Design (LEED) is an internationally-recognized green building certification system developed by the **U.S. Green Building Council** (USGBC). While many commercial and residential buildings are known for meeting high sustainability standards, manufacturing facilities are gaining ground in the field as well. **Alstom Inc.'s Chattanooga factory** meets the standards for LEED Gold certification, a benchmark of environmental excellence in the manufacturing sector. The facility, which produces the world's largest and most



Photography by theaucitron. (Flickr)

efficient turbines for new fossil steam, nuclear, gas and hydro power plants, is a superior site that features material recycling, indoor air quality, energy and water efficiency, and low-emission transportation targets.

Another facility with LEED Gold certification is **Ford's River Rouge Complex**, which boasts a 10.4 acre "living roof," composed of tens of thousands of plants, that decreases energy consumption by 7 percent and improves air quality by up to 40 percent. The same roof helps to clean up to 20 billion gallons of water every year. Both companies exceptionally exhibit how manufacturing can be a productive, clean, efficient and sustainable part of the American economy. (www.hfmgv.org/rouge/leed.aspx)

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.

Call to Action

CHALLENGE: Fueling the Innovation and Production Economy from Start-up to Scale-up.

SOLUTION: Enact fiscal reform, transform tax laws and reduce regulatory and other structural costs and create jobs.

Recommendation: Congress should permanently replace the current world-wide double taxation system with a territorial tax system to facilitate the repatriation of earnings and restructure the corporate tax code to increase investment, stimulate production at scale and neutralize sovereign tax incentive investment packages.

- Reduce taxes on repatriated earnings to less than 5 percent in line with other Organization of Economic Co-operation and Economic Development (OECD) economies to stimulate long-term investment in new U.S.-based manufacturing facilities, modernizing existing facilities and purchasing manufacturing equipment.

Recommendation: Congress should restructure the corporate tax code to increase investment, stimulate production at scale and neutralize sovereign tax incentive investment packages.

- Enact a statutory corporate tax rate of 22 percent; in-line with the upper quartile of other OECD economies.
- Make permanent the R&D tax credit, increase it from 12 to 15 percent and include applied research related to U.S. manufacturing.
- Allow 100 percent expensing for manufacturing plant, property and equipment; institutionalize accelerated depreciation treatment for all capital investments.

- Make the capital gains tax rate permanent at 15 percent to reduce the cost of capital and incent investment in new businesses.

Recommendation: Congress should require agencies to begin reducing the costs and burdens of current and proposed regulations.

- Codify into law guidance for the development, review and transparency of federal regulations and require federal regulatory agencies to assess and reduce unnecessary complexity, time and costs.
- Require regulatory agencies to seek approval from Congress for exceeding set maximum thresholds for compliance costs. Doing so would improve transparency and make federal government officials more accountable for the costs of major new regulations.
- Require by law, a second agency review of the economic impact assessments for significant rules (exceeding \$100 million in compliance costs) to be facilitated by the Office of Information and Regulatory Affairs (OIRA).

Recommendation: Congress should immediately reform section 404 of the Sarbanes-Oxley Act to increase entrepreneurs' access to U.S. public capital markets and grow new companies.

- Allow public companies with market valuations below \$500 million to opt out of regulations within section 404 of Sarbanes-Oxley for the first ten years after going public.

Recommendation: Congress should reduce the costs of tort litigation from the current level of almost two percent of GDP—some \$248 billion—down to one percent by 2020.

- Revise U.S. liability laws to balance the needs of offering protections, encouraging the development of new technologies.

Five Challenges and Solutions to Make an American Manufacturing Movement

- Enact class-action reform that would eliminate treble damages and frivolous law-suits.

Recommendation: Congress and the administration must take action on fiscal reform to achieve \$4 trillion in debt reductions by 2021.

- Reduce discretionary spending and restructure tax and entitlement programs—Social Security, Medicare, and Medicaid—while continuing to make high-priority strategic investments in talent, R&D and infrastructure.

CHALLENGE: Expanding U.S. Exports, Reducing the Trade Deficit, Increasing Market Access and Responding to Foreign Governments Protecting Domestic Producers.

SOLUTION: Utilize multilateral fora, forge new agreements, advance IP protection, standards and export control regimes to grow high-value investment and increase exports.

Recommendation: Congress, the administration and industry should intensify efforts to support the President's goal to double exports from \$1.8 to \$3.6 trillion and reduce the trade deficit by more than 50 percent.

- Launch trade liberalization negotiations with Brazil, China, India, the EU, Japan, and Trans Pacific Partnership Countries—Australia*, Brunei Darussalam, Chile*, Malaysia, New Zealand, Peru, Singapore, Vietnam. (*already in place).
- Begin negotiations to deepen and broaden the North American Free Trade Agreement (NAFTA).
- Increase use of anti-dumping measures and countervailing duties to provide relief from unfairly priced or subsidized imports.

- Encourage China, Russia, India, Vietnam and others to upgrade the existing 1996 Government Procurement Agreement (GPA).

- Increase intellectual property protection through the Anti-Counterfeiting Trade Agreement (ACTA). Priority countries include China, India, Russia and Brazil.

Recommendation: Industry CEOs and government leaders should elevate and advance U.S. technical standards and the voluntary consensus standards-setting process.

- Reinforce the principles laid down in the WTO Technical Barriers to Trade Agreement.
- Encourage industry-led standards for interoperable manufacturing and logistics systems.
- Develop technical standards for emerging technologies and promote global technological collaboration.

Recommendation: Congress and the administration should ensure the President's Export Control Reform Initiative is completed by the end of 2012 and push for improved foreign export control systems.

- Implement a U.S. export control regime with a single, streamlined control list, a primary enforcement agency, a single licensing agency and a unified information technology system. The new regime should also enable foreign doctoral-candidate researchers to participate in a wider scope of defense-related projects where their participation would not pose a national security risk.
- Renew efforts to negotiate and enforce enhanced rules on foreign government export restrictions that are currently being used by other countries to manipulate and distort markets.

Recommendation: Focus on actions to encourage China make permanent the special intellectual property rights campaign it ran from October 2010 to June 2011.

- Create a senior directorship in the Chinese Ministry of Commerce with adequate staff and funding. The Directory should be driven by metrics to reduce counterfeiting and required report progress regularly and publicly.

CHALLENGE: Harnessing the Power and Potential of American Talent to Win the Future Skills Race.

SOLUTION: Prepare the next generation of innovators, researchers and skilled workers.

Recommendation: Federal, state and local governments along with high schools, universities, community colleges, national laboratories and industry should prioritize Career and Technical Education (CTE) programs and push for greater integration of community colleges in the innovation pipeline.

- Encourage and support high school students' participation in engineering and manufacturing projects oriented towards work in production-related fields.
- Integrate academic and technical education programs across universities and community colleges and ensure that students who participate in CTE programs are taught to a rigorous standard aligned with technical and industry requirements.
- Expand the President's Jobs Council fast-track "Right Skills Now Initiative" that will help community colleges target specific skills gaps and provide accelerated training to unemployed and transitioning workers as well as filling the immediate needs of business.
- Build effective public-private partnerships, in which community colleges collaborate with local industry to create degree programs essential to support economic development efforts.

Recommendation: Congress should implement immigration reform to ensure the world's brightest talent innovate and create opportunities in the United States.

- Align temporary work visas to quickly respond to industry needs.
- Encourage and allow foreign students who receive graduate or post-graduate degrees in scientific and engineering disciplines from U.S. institutions to become citizens.

Recommendation: Congress, states, academia, industry and national laboratories should renew efforts to expand STEM education and create opportunities to integrate into the workplace.

- Enhance STEM teaching capabilities and reverse the student drop-out rate by more aggressively leveraging federal scientific agencies and the national laboratories and public research institutes.
- Develop programs that provide access to mentors, STEM professionals, facilities, simulators and equipment to give both teacher and student hands-on experience in the lab, on the factory floor and in the field.
- Study and support programs that integrate arts education into traditional STEM instruction, sometimes known as STEAM. Studies suggest that exposure to the arts is linked to higher student performance in traditional STEM disciplines.
- Initiate K-12 pilots and programs that emphasize team-based, experimental and inter-disciplinary learning geared toward problem solving. Promotion through such programs should be based on mastery of material.
- Raise the profile of STEM careers with a national awareness campaign including extensive social media outreach designed to motivate students, attract job seekers and retain talent.
- Encourage more industry leaders to coordinate their STEM promotion and education efforts through programs such as "Change the Equation", a network of more than 100 CEOs, focused on widespread literacy in STEM as a national investment.

Recommendation: The Small Business Administration (SBA) should create a program modeled after the SCORE program for retired business executives to mentor and counsel entrepreneurs.

- Develop a national network of retired business leaders to mentor and counsel entrepreneurs on how to carry a new concept from product design through manufacturing and aftermarket support. Include modeling and simulation analysis and high performance computing to bridge a product from development to commercialization.

Recommendation: Industry and labor leaders should develop state-of-the-art apprenticeship programs for 21st century manufacturing.

- Launch a national manufacturing apprenticeship program maintained and operated through shared staffing and financial contributions from both labor and industry.

Recommendation: The administration should create a Veterans in Manufacturing Program to create opportunities for America's soldiers.

- Create a public-private partnership through the Department of Defense to identify opportunities for newly returning and older veterans to skill up for the manufacturing workforce and allow the younger and older generations to cross train each other, where possible.

Recommendation: Academia, industry and government should launch the American Explorers Initiative to send more Americans abroad to study, perform research, and work in global businesses.

- Expand significantly the Fulbright Program to include undergraduate students.
- Send an additional 250,000 American students—undergraduates, graduates and post-doctoral candidates—to participate in work or education programs at universities, laboratories and companies in key trading partnerships with emerging nations.

Recommendation: Congress should create opportunities and incentives for older Americans to remain vibrant contributors in the workforce.

- Lift taxes that penalize older Americans for re-entering the workforce.
- Expand Small Business Administration (SBA) loans to mature entrepreneurs.

- Revise the Workforce Investment Act (WIA) to generate a public-private partnership in providing skills assessments and training, as well as career advisory services, to mature job seekers.

CHALLENGE: Achieving Next-Generation Productivity through Smart Innovation and Manufacturing.

SOLUTION: Create national advanced manufacturing clusters, networks and partnerships, prioritize R&D investments, deploy new tools, technologies and facilities, and accelerate commercialization of novel products and services.

Recommendation: Congress and the administration should leverage R&D investments across the federal research enterprise to solve challenges in sustainable smart manufacturing systems and to ensure a dynamic discovery and innovation pipeline.

- Sustain federal investment in key agencies that support basic research, infrastructure and STEM education. Agencies include the National Science Foundation, the National Institute of Standards and Technology, the National Aeronautics and Space Administration, the Department of Defense, the Department of Energy Office of Science and the National Institutes of Health.
- Establish cross-sector research collaborations and public-private partnerships to develop and commercialize breakthrough advanced manufacturing tools, processes and applications. These include “materials by design,” automation and intelligent robotics, modeling and simulation, complexity and data analytics, sub-atomic to extreme systems engineering, cyber security and operation logistics and business management.

Recommendation: Congress, the administration, industry, academia and labor should develop partnerships to create a national network of advanced manufacturing clusters and smart factory ecosystems.

- Develop blueprints for smarter factories and industrial communities. Modernize the aging industrial base with information technology-enabled smart manufacturing processes.

- Create incentives for multi-user advanced manufacturing facilities, capable of rapid reconfiguration to support fabrication of a wide range of products. Provide broad access to cost-effective prototyping, testing and low volume manufacturing for small businesses, entrepreneurs and small innovators.
- Use cross-sector consortia with industry, academic, national laboratories and federal agency partners, to identify and solve critical technical challenges in developing advanced manufacturing tools, technologies and processes.
- Develop and deploy agile manufacturing techniques to transition all levels of U.S. industries from one technology generation to the next faster and more efficiently than competitors.
- Establish operational modeling and simulation pilots for small and medium-sized enterprises in all six Economic Development Agency regions of the United States by 2015.
- Develop a strategic partnership between the Manufacturing Extension Partnership and NDEMC to engage SMEs across the United States in 2012.
- Develop strategic partnerships between large U.S. OEMs and NDEMC to support collaboration with SMEs on the use of advanced modeling and simulation manufacturing.
- Use NDEMC to support Department of Defense programs such as Advanced Manufacturing Enterprise, Model Based Engineering and Open Manufacturing.

Recommendation: Congress, the administration, national laboratories and universities should advance the U.S. manufacturing sector's use of computational modeling and simulation and move the nation's High Performance Computing capabilities toward Exascale.

- Develop and increase access to simplified, cost-effective design and engineering tools, visualization technologies, modeling and simulation and collaborative platforms that can be used more widely by U.S. innovators and manufacturers through open and virtual campus facilities.
- Facilitate and measure progress in adopting these technologies through the Manufacturing Extension Partnership (MEP) at the National Institute of Standards and Technology. MEP should report that more than 15,000 small and medium-sized manufacturing enterprises are using these tools by 2015.
- Sustain federal investment in moving the nation's computational capabilities to the exascale level and incent private investment as needed to ensure that the United States maintains international leadership in High Performance Computing.
- Accelerate innovation from universities and national laboratories by facilitating greater sharing of intellectual property and incentivizing commercialization.
- Shift a greater percentage of investments at national laboratories and research universities to end-use inspired basic research.
- Amend the missions of federal R&D agencies to support U.S. industry as stipulated in the National Competitiveness Technology Transfer Act and associated legislation.
- Facilitate access to labs and universities to engage potential partners and make information on research projects more widely available.
- Coordinate federal funding streams to innovation hubs that center on a particular set of challenges and condition hub location on funding and policy support by state and local governments.
- Establish formal procedures for laboratory and university employees that ease their ability to establish firms and transition to the private sector.
- Establish a process for rapid identification, assessment and removal of unnecessary regulatory barriers to new technology commercialization and establishment of manufacturing facilities.

Recommendation: The U. S. Department of Commerce through the Economic Development Administration, in partnership with the Council on Competitiveness should expand the Midwest Project for SME—OEM Use of Modeling and Simulation through the National Digital Engineering and Manufacturing Consortium (NDEMC).

CHALLENGE: Creating Competitive Advantage through Next Generation Supply Networks and Advanced Logistics.

SOLUTION: Develop and deploy smart, sustainable and resilient energy, transportation, production and cyber infrastructures.

Recommendation: Congress should increase the number of public-private infrastructure partnerships and explore opportunities to privatize large infrastructure projects.

- Provide incentives or joint ownership opportunities for private-public partnerships to invest in infrastructure projects benefiting U.S. manufacturing broadly such as ports, railroads, roads, nuclear facilities, the electric grid, information technology and cyber infrastructures.

Recommendation: Congress should authorize the Export-Import Bank to fund domestic infrastructure projects.

- Authorize the Bank to accept for funding any infrastructure project with a potential federal commitment of \$75 million to \$100 million or more.
- Issue infrastructure bonds and provide loan guarantees to state or local governments issuing debt to finance-qualified infrastructure projects.

Recommendation: Congress should develop and implement a national strategy to reduce overall energy demand by rewarding efficiency and improving transmission infrastructure.

- Encourage region-appropriate methods of power generation to avoid loss of generated energy through independent regional planning authorities overseen by FERC.
- Replace and upgrade sections of the grid prone to the greatest efficiency losses to improve reliability and reduce overall energy demand.

- Develop smart grid technology standards allowing advanced metering technologies to operate on any smart grid infrastructure, which supports infrastructure continuity for rapid repair and upgrades.
- Focus R&D in grid-related technologies, incorporating relevant tools such as High Performance Computing to model and simulate solutions to generate, transport and distribute energy.
- Streamline the siting, permitting and building processes for new energy-related infrastructure.
- Maintain incentives for manufacturers to reduce their energy footprint through efficiency measures or new long-term capital investments.

Recommendation: Congress and the administration should create a Joint Cyber Command to improve cyber infrastructure and protect traditional defense, commercial and consumer interests.

- Shift funding priorities to develop next generation cyber security protocols and portals; and support state-of-the-art innovation in data management and distribution systems.
- Encourage high-speed communications and innovation through broadband infrastructure investment.
- Accelerate development, expansion, hardening and maintenance of national cyber infrastructures to eliminate vulnerabilities.
- Ensure trusted manufacturing of critical cyber infrastructure and a trusted manufacturing supply-chain for defense components and others.



Photographs courtesy of Walla Walla Community College.

Founded in 2000, the Enology and Viticulture program at Walla Walla Community College is a job-ready degree program which provides students with hands-on experience in winemaking, viticulture, wine sales and marketing. The ultra-modern Center houses a world-class teaching/commercial winery, College Cellars. Grapes are sourced from Southeastern Washington's Walla Walla Valley—a premier wine growing area with more than 150 wineries established since 1977.

This esteemed program was honored as the recipient of the 2006 Governor's Award for Best Practices in Workforce Development and recognized in 2007 by the U.S. Department of Commerce for Best Practices in Rural Economic Development. For their contributions to the Washington wine industry, two WWCC Enology and Viticulture faculty have been inducted into The Legends of Washington Wine Hall of Fame. (www.collegecellars.com)



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2010

September 14, 2010: Fall 2010 Meeting of the U.S. Manufacturing Competitiveness Initiative Executive Advisory Committee at the National Institute of Standards and Technology in Gaithersburg, MD.

Hosted by Patrick D. Gallagher, Director, National Institute of Standards and Technology; and Under Secretary of Standards and Technology, U.S. Department of Commerce.

2011

March 21, 2011: Spring 2011 Meeting of the High Performance Computing Initiative Advisory Committee at Lawrence Livermore National Laboratory in Livermore, CA.

Hosted by George H. Miller, Director, Lawrence Livermore National Laboratory.

April 25-26, 2011: Out of the Blue Dialogue "Ensuring a Globally Competitive Workforce" at the United Association of Plumbers and Pipefitters' Training Facility in Mokena, IL.

Hosted by William P. Hite, General President, United Association of Plumbers and Pipefitters.

May 2-3, 2011: Spring 2011 Meeting of the U.S. Manufacturing Competitiveness Initiative Executive Advisory Committee at Sandia National Laboratories Microsystems & Engineering Sciences Applications (MESA) Facility in Albuquerque, NM.

Hosted by Paul J. Hommert, President & Laboratories Director, Sandia National Laboratories.

May 5-6, 2011: Out of the Blue Dialogue "Ensuring Access to Investment and Risk Capital" at the offices of Fulbright & Jaworski LLC in New York, NY.

Hosted and chaired by William H. Bohnett, President, Whitecap Investments LLC.

May 23-24, 2011: Out of the Blue Dialogue "Accelerating Life-Cycle Commercialization" at Pacific Northwest National Laboratory in Richland, WA.

Hosted by Steven F. Ashby, Deputy Director for Science and Technology, Pacific Northwest National Laboratory.

May 25-26, 2011: Out of the Blue Dialogue "Strategic Resources and Advanced Materials" at the Lawrence Berkeley National Laboratory in Berkeley, CA.

Hosted by A. Paul Alivisatos, Director, Lawrence Berkeley National Laboratory.

June 13-14, 2011: Summer 2011 Meeting of the U.S. Manufacturing Competitiveness Initiative Steering Committee at the Ford Motor Company headquarters in Dearborn, MI.

Hosted by Alan R. Mulally, President and Chief Executive Officer, Ford Motor Company.

June 20-21, 2011: Out of the Blue Dialogue "Creating Intelligent, Secure and Resilient Infrastructures" at Alstom Power Turbo Machines in Chattanooga, TN.

Hosted by Pierre L. Gauthier, President and CEO, U.S. & Canada, Alstom.

July 13, 2011: Out of the Blue Dialogue "Ensuring America's Business Environment is Competitive: Regulations, Taxes and Structural Costs" at The George Washington University City View Room in Washington, DC.

Hosted by Steven Knapp, President, The George Washington University.

July 14-15, 2011: TLSI Dialogue 5 "Ensuring U.S. Leadership in Strategic Technologies" at the Hay-Adams Hotel in Washington, DC.

Chaired by TLSI Co-Chairs: Klaus G. Hoehn, Vice President, Advanced Technology & Engineering, Deere & Company; Ray O. Johnson, Senior Vice President and Chief Technology Officer, Lockheed Martin Corporation; and Mark M. Little, Senior Vice President and CTO of GE Global Research, General Electric Company.

July 18, 2011: First Meeting of the Economic Advisory Committee at The St. Regis Hotel in Washington, DC.

Chaired by: Gene Huang, Chief Economist & Vice President, FedEx Corporation.

July 28-29, 2011: Out of the Blue Dialogue "Leveling the Global Playing Field for Investment, Standards and Trade" at the offices of Pfizer Inc in New York, NY.

Hosted by Anthony J. Maddaluna, President, Global Manufacturing, Pfizer Inc.

September 19-20, 2011: U.S.–Brazil Innovation Learning Laboratory at Duke University in Durham, NC.

September 20-21, 2011: Sustainable Manufacturing Forum at Duke University in Durham, NC.

Hosted by Richard H. Brodhead, President, Duke University.

September 28, 2011: Fall 2011 Meeting of the U.S. Manufacturing Competitiveness Initiative Executive Advisory Committee at the offices of General Electric in Washington, DC.

Hosted by Theresa Peterson, Senior Executive, and Gregory Gratson, Program Manager, External Affairs and Technology Programs, GE Global Research.

October 12-13, 2011: Fall 2011 Meeting of the U.S. Manufacturing Competitiveness Initiative Steering Committee at the Deere & Company World Headquarters in Moline, IL.

Hosted by Samuel R. Allen, Chairman and CEO, Deere & Company.

October 25, 2011: Fall 2011 Meeting of the High Performance Computing Advisory Committee Meeting at the offices of the University of California in Washington, DC.

Hosted by the Mark G. Yudof, President, University of California.

October 23-24, 2011: TLSI Dialogue 6 "RESOLVE: Changing the U.S. Innovation Landscape, the Path from Words to Deeds" at the campus of the U.S. Naval Academy in Annapolis, MD.

Hosted by Vice Admiral Michael H. Miller, Superintendent, U.S. Naval Academy.

Out of the Blue Strategic Manufacturing Dialogues

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The Council on Competitiveness is the only group of corporate CEOs, university presidents and labor leaders committed to ensuring the future prosperity of all Americans and enhanced U.S. competitiveness in the global economy through the creation of high-value economic activity in the United States.

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- Identifying and understanding emerging challenges to competitiveness
- Generating new policy ideas and concepts to shape the competitiveness debate
- Forging public and private partnerships to drive consensus
- Galvanizing stakeholders to translate policy into action and change

End Notes

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