

The future of Manufacturing: Selected Excerpts from Studies, Reports, Press, and Blogs

**Symposium on
The Future of Manufacturing:
Implications for Education and Training**

Covington, Kentucky, October 1-2, 2012

**Trans-Atlantic Technology and Training Alliance
Gateway Community and Technical College
Regional Technology Strategies
Danish Agency for Universities and Internationalisation**

Table of Contents

	Page
I. The Situation	3
II. Options, Opportunities	9
III. Pessimistic or Realistic?	16
IV. Skill, Talent, and Education	20
V. Voices of Advocates	26

With support from....

Kentucky Community and Technical College System

Manufacturing Extension Partnership, National Institute of Standards and Technology

Kentucky Science and Technology Corporation

Automotive Manufacturing Technical Education Collaborative

Duke Energy

Northern Kentucky Chamber of Commerce

Republic Bank

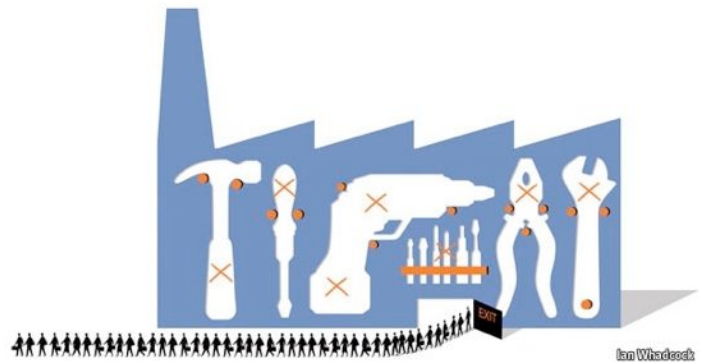
Cover art by David Suter

I. The Situation

“The Plight of American Manufacturing,” Richard McCormack, *American Prospect*, December 21, 2009

Something has gone radically wrong with the American economy. A once-robust system of "traditional engineering" -- the invention, design, and manufacture of products -- has been replaced by financial engineering. Without a vibrant manufacturing sector, Wall Street created money it did not have and Americans spent money they did not have. Americans stopped making the products they continued to buy: clothing, computers, consumer electronics, flat-screen TVs, household items, and millions of automobiles.... Since 2001, the country has lost 42,400 factories, including 36 percent of factories that employ more than 1,000 workers (which declined from 1,479 to 947), and 38 percent of factories that employ between 500 and 999 employees (from 3,198 to 1,972). An additional 90,000 manufacturing companies are now at risk of going out of business.

Has U.S. manufacturing declined because its companies are not competitive? Hardly. American companies are among the most efficient in the world. The nation's steel industry, for instance, produces 1 ton of steel using two man-hours. A comparable ton of steel in China is produced with 12 man-hours, and Chinese companies produce three times the amount of carbon emissions per ton of steel.... But American companies have difficulty competing against foreign countries that undervalue their currencies, pay health care for their workers; provide subsidies for energy, land, buildings, and equipment; grant tax holidays and rebates and provide zero-interest financing; pay their workers poverty wages that would be illegal in the United States, and don't enforce safety or environmental regulations.... The rapid relocation of the world's manufacturing belt from the U.S. to China has also meant a shift in these nations' technological capacities. As foreign manufacturers flock to China to take advantage of its cheap labor, devalued currency, and manufacturing subsidies, they have also shifted their research and development endeavors to China. Georgia Tech's biennial "High-Tech Indicators" study found that China



In The Economist, April 21, 2012

improved its technological standing by 9 points (on a scale of 100) between 2005 and 2007, moving that nation ahead of the United States in technological capability for the first time since Georgia Tech started keeping score two decades ago.

What domestic manufacturers want is for the United States government to shift its economic policies away from consumption to incentives that favor investment in new factories, equipment, and jobs in the United States. They want the United States to abandon policies that favor geopolitical global interests that have no regard for the economic health of the United States and its millions of taxpayers and retirees.

**“Is anything made in the U.S.A. anymore? You'd be surprised,”
Stephen Manning *International Herald Tribune*, February 20, 2009**

In January [2009], 207,000 U.S. manufacturing jobs vanished in the largest one-month drop since October 1982. U.S. factory activity is hovering at a 28-year low.... But manufacturing in the United States is not dead or even dying. It is moving upscale, following the biggest profits and becoming more efficient, just as Henry Ford did when he created the assembly line to make the Model T car. The United States remains by far the world's leading manufacturer by value of goods produced. It hit a record \$1.6 trillion in 2007 - nearly double the \$811 billion of 1987. For every \$1 of value produced in China factories, the United States generates \$2.50.

So what is made in the U.S.A. these days? The United States sold more than \$200 billion worth of aircraft, missiles and space-related equipment in 2007, and \$80 billion worth of autos and auto parts. . . . Then there are energy products like gas turbines for power plants made by General Electric, computer chips from Intel and fighter jets from Lockheed Martin. Household names like GE, General Motors, International Business Machines, Boeing and Hewlett-Packard are among the largest manufacturers by revenue.

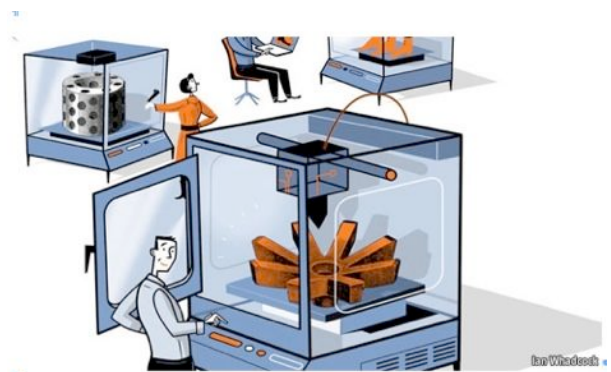
Several trends have emerged over the decades: The United States makes things that other countries cannot. Today, "Made in U.S.A." is more likely to be stamped on heavy equipment or the circuits that go inside other products than the televisions, toys, clothes and other items found on store shelves. U.S. companies have shifted toward high-end manufacturing as the production of low-value goods has moved overseas. This has resulted in lower prices for shoppers and higher profits for companies. . . . When demand slumps, all types of manufacturing jobs are lost. Some higher-end jobs - but not all - return with good time. . . . About 12.7 million U.S. workers, or 8 percent of the labor force, still held manufacturing jobs as of last month. Fifty years ago, 14.6 million people, or 28 percent of all U.S. workers, were employed in factories. The numbers - though painful to those who lost jobs - show how companies are making more with less. Thirty years ago, U.S. producers made 80 percent of what the country consumed, according to the Manufacturers Alliance/MAPI, an industry trade group. Now it is about 65 percent. U.S. factories still provide much of the processed food that U.S. households consume, everything from frozen fish sticks to cans of beer. And U.S.

companies make a considerable share of the personal hygiene products like soap and shampoo, cleaning supplies and prescription drugs that are sold in pharmacies. But many other consumer goods now come from outside the United States. In the 1960s, the United States made 98 percent of its shoes. It now imports more than 90 percent of its footwear. The iconic red Radio Flyer wagons for children are now made in China. Even the Apple iPod comes in a box that says it was made in China but "designed in California."

“In Pursuit of Nissan, a Jobs Lesson for the Tech Industry?,” Bill Vlasic, Hioroko Tabuchi, and Charles Duhigg, *New York Times*, August 4, 2012

The migration of Japanese auto manufacturing to the United States over the last 30 years offers a case study in how the unlikeliest of transformations can unfold. Despite the decline of American car companies, the United States today remains one of the top auto manufacturers and employers in the world. Japanese and other foreign companies account for more than 40 percent of cars built in the United States, employing about 95,000 people directly and hundreds of thousands more among parts suppliers..... The United States gained these jobs through a combination of public and Congressional pressure on Japan, “voluntary” quotas on car exports from Japan and incentives like tax breaks that encouraged Japanese automakers to build factories in America. . . . In the auto industry, the belief that American workers could not match Japanese workers has long since faded. “A big part of the reluctance of Japanese automakers to come to the U.S. was the belief that their manufacturing systems could only work with loyal Japanese employees,” said Dr. Cohen, the American University professor. “Everybody was surprised how quickly the systems were adopted here.”... To train its new American engineers, Nissan flew workers to its Zama factory in eastern Japan. There the Nissan officials, assisted by English-speaking Japanese workers called “communication helpers,” imparted the intricacies of the company’s production techniques to the Americans. . . . This year, Nissan held an internal competition to decide where to produce a new Infiniti-brand luxury sport utility vehicle. The plant in Smyrna was vying against one in Japan. The surprising winner: Smyrna. . . .

But consumer electronics are different. Though some jobs have moved to Asia, many were never here to begin with. And the biggest technology importers — like Apple, Hewlett-Packard, Dell and Microsoft — are American companies. Today, many consumers do not know or care where their smartphones are made. “Where it was built, what it means for politics, how it affects the economy,” said Raymond Stata, a founder of Analog Devices, one of the largest semiconductor manufacturers, “that’s not something people think about when they buy.”



In The Economist, April 21, 2012

“Manufacturing and innovation: A third industrial revolution,” *The Economist Special Report*, April 21, 2012

As manufacturing goes digital, it will change out of all recognition, says Paul Markillie. And some of the business of making things will return to rich countries

Factories are becoming vastly more efficient, thanks to automated milling machines that can swap their own tools, cut in multiple directions and “feel” if something is going wrong, together with robots equipped with vision and other sensing systems. . . . “The days of huge factories full of lots of people are not there any more.” As the number of people directly employed in making things declines, the cost of labour as a proportion of the total cost of production will diminish too. This will encourage makers to move some of the work back to rich countries, not least because new manufacturing techniques make it cheaper and faster to respond to changing local tastes. The materials being used to make things are changing as well. Carbon-fibre composites, for instance, are

replacing steel and aluminium in products ranging from mountain bikes to airliners. And sometimes it will not be machines doing the making, but micro-organisms that have been genetically engineered for the task.

As manufacturing goes digital, a third great change is now gathering pace. It will allow things to be made economically in much smaller numbers, more flexibly and with a much lower input of labour

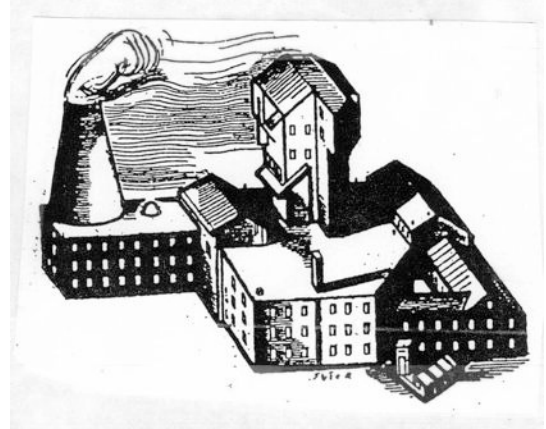
The consequences of all these changes, this [*Economist Special Report*] will argue, amount to a third industrial revolution. . . . As manufacturing

goes digital, a third great change is now gathering pace. It will allow things to be made economically in much smaller numbers, more flexibly and with a much lower input of labour, thanks to new materials, completely new processes such as 3D printing, easy-to-use robots and new collaborative manufacturing services available online. The wheel is almost coming full circle, turning away from mass manufacturing and towards much more individualised production. And that in turn could bring some of the jobs back to rich countries that long ago lost them to the emerging world.

Manufacturing still matters, but the jobs are changing

In the decade to 2010 the number of manufacturing jobs in America fell by about a third. The rise of outsourcing and offshoring and the growth of sophisticated supply chains has enabled companies the world over to use China, India and other lower-wage countries as workshops. Prompted by the global financial crisis, some Western policymakers now reckon it is about time their countries returned to making stuff in order to create jobs and prevent more manufacturing skills from being exported. That supposes two things: that manufacturing is important to a nation and its economy, and that these new forms of manufacturing will create new jobs. . . .

A lot of the jobs that remain on the factory floor will require a high level of skill, says Mr Smith, Rolls-Royce's manufacturing boss. "If manufacturing matters, then we need to make sure the necessary building blocks are there in the education system." His concern extends to the firm's suppliers, because companies in many countries have cut down on training in the economic downturn. To get the people it wants, Rolls-Royce has opened a new Apprentice Academy to double the number of people it can train each year, to 400. In America firms have cut back on training so savagely that "apprenticeships may well be dead," . . .



Making things with a 3D printer changes the rules of manufacturing

Freed of the constraints of traditional factories, additive manufacturing allows designers to produce things that were previously considered far too complex to make economically. That could be for aesthetic reasons, but engineers are finding practical applications too. For example, fluids flow more efficiently through rounded channels than they do around sharp corners, but it is very difficult to make such channels inside a solid metal structure by conventional means, whereas a 3D printer can do this easily. . . . Weight savings are part of the attraction of 3D-printed parts. With objects being built up. . . . GE has developed an additive system to print the transducer. This will greatly reduce production costs and allow new, inexpensive portable scanners to be developed, not only for medical use but also to inspect critical aerospace and industrial structures for cracks.

The boomerang effect: As Chinese wages rise, some production is moving back to the rich world

... for some manufacturers low wage costs are becoming less important because labour represents only a small part of the overall cost of making and selling their products. Researchers ... took apart an iPad and worked out where all the various bits inside came from and what it had cost to make and assemble them. They found that a 16-gigabyte 2010 iPad priced at \$499 contained \$154-worth of materials and parts from American, Japanese, South Korean and European suppliers (Apple has more than 150 suppliers in all, many of which also make or finish their parts in China). The researchers estimated the total worldwide labour costs for the iPad at \$33, of which China's share was just \$8. Apple is constantly tweaking its products so the figures shift all the time, but not by much.

"Skilled Work, Without the Worker," John Markoff, New York Times, August 18, 2012

A new wave of robots, far more adept than those now commonly used by automakers and other heavy manufacturers, are replacing workers around the world in both

manufacturing and distribution. Factories like the one here in the Netherlands are a striking counterpoint to those used by [Apple](#) and other consumer electronics giants, which employ hundreds of thousands of low-skilled workers. . . .

The falling costs and growing sophistication of robots have touched off a renewed debate among economists and technologists over how quickly jobs will be lost. . . .

“The pace and scale of this encroachment into human skills is relatively recent and has profound economic implications,” [Erik Brynjolfsson and Andrew McAfee] wrote in their book, “[Race Against the Machine](#).” In their minds, the advent of low-cost automation foretells changes on the scale of the revolution in agricultural technology over the last

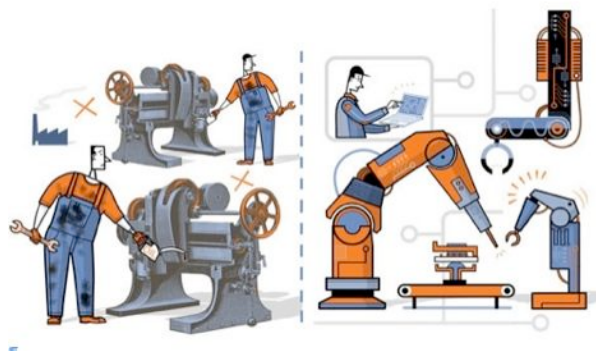
century, when farming employment in the United States fell from 40 percent of the work force to about 2 percent today. The analogy is not only to the industrialization of agriculture but also to the electrification of manufacturing in the past century, Mr. McAfee argues. “At what point does the chain saw

If the United States does not compete for advanced manufacturing in industries like consumer electronics, it could lose product engineering and design as well.

replace Paul Bunyan?” asked Mike Dennison, an executive at [Flextronics](#), a manufacturer of consumer electronics products that is based in Silicon Valley and is increasingly automating assembly work....

Government officials and industry executives argue that even if factories are automated, they still are a valuable source of jobs. If the United States does not compete for advanced manufacturing in industries like consumer electronics, it could lose product engineering and design as well. Moreover, robotics executives argue that even though blue-collar jobs will be lost, more efficient manufacturing will create skilled jobs in

designing, operating and servicing the assembly lines, as well as significant numbers of other kinds of jobs in the communities where factories are. And robot makers point out that their industry itself creates jobs. A report commissioned by the [International Federation of Robotics](#) last year found that 150,000 people are already employed by robotics manufacturers worldwide in engineering and assembly jobs. But American and European dominance in the next generation of manufacturing is far from certain...



In The Economist, April 21, 2012

II. Optimism, Options and Opportunities

“Made in America Again: Why Manufacturing will Return to the U.S.,” Harold L. Sirkin, Michael Zinser, and Douglas Hohner, Boston Consulting Group, August 2011

For more than a decade, deciding where to build a manufacturing plant to supply the world was simple for many companies. With its seemingly limitless supply of low-cost labor and an enormous, rapidly developing domestic market, an artificially low currency, and significant government incentives to attract foreign investment, China was the clear choice. Now, however, a combination of economic forces is fast eroding China’s cost advantage as an export platform for the North American market. Meanwhile, the U.S., with an increasingly flexible workforce and resilient corporate sector, is becoming more attractive as a place to manufacture many goods consumed on this continent.

“Making Manufacturing Sexy,” Karin Lindner, founder of Karico Performance Solutions, January 3, 2011

The goal of every progressive leader should be to fully engage the entire workforce in creating and delivering the highest possible customer value through relentless innovation. . . . According to a recent study, engaged employees have productivity rates that are 70% higher than those who are not; they enjoy a 78% higher safety record; 70% lower turnover; 86% high customer satisfaction; and their companies are 44% more profitable. Can you just imagine the competitive advantage that an engaged workforce can have on your own organization?

Now more than ever employees feel less connected to their workplace and have little motivation to suggest improvements out of fear that they may replace themselves if they do more within a shorter time period with fewer resources and less manpower.... The perception, she said, is still that of a dirty and unsafe industry. In fact, even 80 percent of the top-level manufacturing executives she interviewed for her book admitted that they wouldn't want their children to work in manufacturing. . . . "So what if we start painting a different picture for people so that they want their children to pursue a career in manufacturing?," . . . "What we need is skilled production workers, engineers, scientists. And the industry has to do a better job working together with our schools in order to achieve that. I believe 100 percent that we can create a ripple effect, one person at a time, one company at a time, one manager at a time, one worker at a time. And this is how we will create change. . . I believe passionate people in the industry who care about our tomorrow have to take the first step."

The Manufacturing Mandate: Unleashing a Dynamic Innovation Economy, Association for Manufacturing Technology, 2011

How does American manufacturing move forward in the next decade? AMT believes cooperation and innovation are the keys. How do we achieve this vision? By developing a clear path that AMT calls the Manufacturing Mandate. AMT is calling for a federal policy of collaboration between government, industry and academia. The federal policy



Photo by Erich Schrempp, Courtesy of Winzeler Gear, Chicago

would incentivize innovation and R&D in new products and manufacturing technologies; assure the availability of capital; increase global competitiveness; minimize structural cost burdens; enhance collaboration between government, academia, and industry; and build a better educated and trained “smartforce.” . . . A consistent cohesive approach to managing the government’s manufacturing technology initiatives is lacking. We need a central manufacturing policy structure within the Executive Branch to develop policy, focus research, and coordinate implementation of the manufacturing mandates strategies.

“Print me a Stradivarius: How a new manufacturing technology will change the world,” *The Economist*, February 10, 2011

The industrial revolution of the late 18th century made possible the mass production of goods, thereby creating economies of scale which changed the economy—and society—in ways that nobody could have imagined at the time. Now a new manufacturing technology has emerged which does the opposite. Three-dimensional printing makes it as cheap to create single items as it is to produce thousands and thus undermines economies of scale. It may have as profound an impact on the world as the coming of the factory did. . . . The beauty of the technology is that it does not need to happen in a factory. Small items can be made by a machine like a desktop printer, in the corner of an office, a shop or even a house; big items—bicycle frames, panels for cars, aircraft parts—need a larger machine, and a bit more space.

Three-dimensional printing makes it as cheap to create single items as it is to produce thousands and thus undermines economies of scale.

The additive approach to manufacturing has several big advantages over the conventional one. It cuts costs by getting rid of production lines. It reduces waste

enormously, requiring as little as one-tenth of the amount of material. It allows the creation of parts in shapes that conventional techniques cannot achieve, resulting in new, much more efficient designs in aircraft wings or heat exchangers, for example. It enables the production of a single item quickly and cheaply—and then another one after the design has been refined. . . . By reducing the barriers to entry for manufacturing, 3D printing should also promote innovation. If you can design a shape on a computer, you can turn it into an object. You can print a dozen, see if there is a market for them, and print 50 more if there is, modifying the design using feedback from early users. This will be a boon to inventors and start-ups, because trying out new products will become less risky and expensive. And just as open-source programmers collaborate by sharing software code, engineers are already starting to collaborate on open-source designs for objects and hardware, , , , Just as nobody could have predicted the impact of the steam engine in 1750—or the printing press in 1450, or the transistor in 1950—it is impossible to foresee the long-term impact of 3D printing. But the technology is coming, and it is likely to disrupt every field it touches. Companies, regulators and entrepreneurs should start thinking about it now. One thing, at least, seems clear: although 3D printing will create winners and losers in the short term, in the long run it will expand the realm of industry—and imagination.



Photo by Erich Schrempp, Courtesy of Winzeler Gear, Chicago

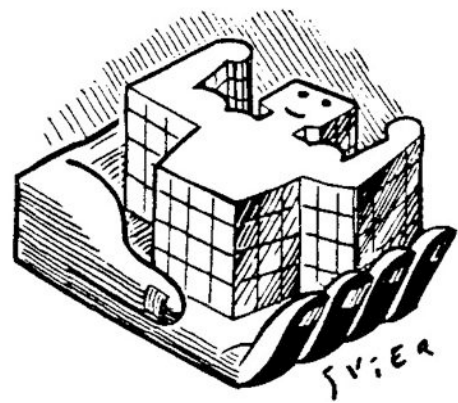
Factory@Home: The Emerging Economy of Personal Fabrication, Hod Lipson and Melba Kurman, U.S. Office of Science and Technology Policy, December 2010.

Personal manufacturing machines, sometimes called “fabbers,” are the pint-sized, low-cost descendants of factory-scale, mass manufacturing machines. Personal-scale manufacturing machines use the same fabrication methods as their larger, industrial ancestors, but are smaller, cheaper, and easier to use. Home-scale machines, such as 3D printers, laser cutters, and programmable sewing machines, combined with the right electronic design blueprint, enable people to manufacture functioning products at home, on demand, at the press of a button. In just a few hours, these mini-factory machines can produce a simple object like a toothbrush, or make complex machine components, artisan-style jewelry or household goods. Within a few years, personal manufacturing machines may be sophisticated enough to enable regular people to manufacture complicated objects such as integrated electronic devices. A number of converging forces are bringing industrial-scale design and manufacturing tools to a tipping point

where they will become cheap, reliable, easy, and versatile enough for personal use. The rapid adoption of personal manufacturing technologies is accelerated by low cost machinery, active online user communities, easier-to-use computer aided design (CAD) software, a growing number of online electronic design blueprints, and more easily available raw materials.

Emerging manufacturing technologies will usher in an industrial “evolution” that combines the best of mass and artisan production models, and has the potential to partially reverse the trend to outsourcing.

Personal manufacturing technologies will profoundly impact how we design, make, transport, and consume physical products. As manufacturing technologies follow the path from factory to home use, like personal computers, “personalized” manufacturing tools will enable consumers, schools and businesses to work and play in new ways. Emerging manufacturing technologies will usher in an industrial “evolution” that combines the best of mass and artisan production models, and has the potential to partially reverse the trend to outsourcing. Personal manufacturing technologies will unleash “long tail” global markets for custom goods, whose sales volumes will be profitable enough to enable specialists, niche manufacturing, and design companies to make a good living. Underserved communities will be able to design and manufacture their own medical devices, toys, machine parts and other tools locally, using local materials. At school, personal-scale manufacturing tools will empower a new generation of innovators, and spark student interest in science, technology, engineering and math (STEM) education.



“The Future of Manufacturing is in America not China: How new technology is driving a U.S. industrial comeback,” Vivek Wadhwa, *Foreign Policy*, July 17, 2012

Technical advances will soon lead to the same hollowing out of China's manufacturing industry that they have to U.S industry over the past two decades. Several technologies advancing and converging will cause this. . . robots are now capable of performing surgery, milking cows, doing military reconnaissance and combat, and flying fighter jets. Several companies, such as Willow Garage, iRobot, and 9th Sense, sell robot-development kits for which university students and open-source communities are developing ever more sophisticated applications. . . artificial intelligence (AI) -- software that makes computers, if not intelligent in the human sense, at least good

enough to fake it. . . . Neil Jacobstein, who chairs the AI track at the Silicon Valley-based graduate program Singularity University, says that AI technologies will find their way into manufacturing and make it "personal": that we will be able to design our own products at home with the aid of AI design assistants. He predicts a "creator economy" in which mass production is replaced by personalized production, with people customizing designs they download from the Internet or develop themselves.... A type of manufacturing called "additive manufacturing" is now making it possible to cost-effectively "print" products. In conventional manufacturing, parts are produced by humans using power-driven machine tools such as saws, lathes, milling machines, and drill presses, to physically remove material until you're left with the shape desired. . . advances in nanotechnology. . . change the equation further. Engineers and scientists are today developing new types of materials, such as carbon nanotubes, ceramic-matrix nanocomposites, and new carbon fibers.

All of these advances play well into America's ability to innovate, demolish old industries, and continually reinvent itself. The Chinese are still busy copying technologies we built over the past few decades. They haven't cracked the nut on how to innovate yet. (http://www.foreignpolicy.com/articles/2012/07/17/the_future_of_manufacturing_is_in_america_not_china)

“Sustainability in business today: A cross-industry view,” Chris Park and Kathryn Pavlosky, Deloitte, 2012

Our survey suggests that many companies are still working to define a cohesive and consistent approach to sustainability, subscribing to broad principles when defining sustainability while focusing implementation efforts on a narrower set of activities. For

example, despite the fact that many respondents defined sustainability according to the concept of the triple bottom line – pursuing performance in economic, social, and environmental spheres – most also reported that their companies invested primarily in environmental initiatives.

We believe that it is becoming an imperative for companies to consider broadening their sustainability efforts in the communities in which they operate as well as to the physical environment. Attention to social sustainability issues should help organizations in their efforts to drive for competitive advantage. . .

We believe that it is becoming an imperative for companies to consider broadening their sustainability efforts in the communities in which they operate as well as to the physical environment. Attention to social sustainability issues should help organizations in their efforts to drive for competitive advantage by helping them establish or maintain a “Social License to Operate” in their target communities and markets: that is, to gain the support of the people who live and work in these communities and/or markets. . . . Many respondents reported that their companies were engaged in efforts to improve their products’ energy efficiency and/or to develop new lines of green products

altogether. In our view, however, successfully targeting the green consumer depends on more than cost. It also requires understanding particular customer segments' purchase drivers, crafting and communicating a strong brand and value proposition, and integrating sustainability throughout the value chain.

While the importance of specialized technical skills should not be minimized, our respondents, for the most part, did not believe that a "green" workforce would emerge as a significant segment of the labor pool. Rather, they believed that sustainability would be integrated into existing roles and job descriptions as a prerequisite for employability: Jobs in the future, respondents thought, will require people to bring a certain basic level of familiarity with sustainability issues and competence in skills related to sustainability to the table.

"Declining as a Manufacturer, Japan Weighs Reinvention," Martin Fackler, *New York Times*, April 15, 2012

A few years ago, the densely built-up coastal region around this port was called Panel Bay because of its concentration of factories making the sophisticated flat-panel screens that were symbols of Japan's manufacturing prowess. But now the area has become a grim symbol of its industrial decline. "It is time for Japan to find a new model for its economy," said Masatomo Onishi, a professor of business at Kansai University.

"We can follow the United States into a more postindustrial economy, or we can follow Germany into high-end manufacturing, but we shouldn't be trying to compete with China in mass production." These are questions that go to the core of the identity of a nation that has long prided itself on its tradition of craftsmanship known as "monozukuri," or "making things."

"We can follow the United States into a more postindustrial economy, or we can follow Germany into high-end manufacturing, but we shouldn't be trying to compete with China in mass production."

"Hollowing out is a myth," Mr. Nakazawa said. Instead, he and others say that what is happening is actually a shift away from televisions and other commodity products that can be churned out more cheaply by assembly lines elsewhere in Asia. He said the surviving Japanese companies are moving to more quality-sensitive products, like industrial robots and high-end bicycle gears, where Japan still enjoys a formidable lead. . . . This is the new strategy of Panasonic. . . . Now, Panasonic says it will outsource a large chunk of its flat-panel production to lower-cost companies elsewhere in Asia, while focusing its own production lines on more profitable products like factory equipment and batteries for electric cars. "One lesson we learned is we should not try to make every kind of product ourselves," said Atushi Hinoki, a spokesman for Panasonic. "But there are still many things we make well."

“The Future of Manufacturing Is Local,” Allison Arieff, *New York Times Online Opinionator*, March 27, 2011

Think manufacturing, and most likely your brain defaults to abandoned factories, outsourcing and economically devastated regions like the Rust Belt. So strong is our tendency to focus on American manufacturing as something that’s been lost that a chorus has risen up to decry the prevalence of “ruin porn” — those aestheticized versions of the decidedly un-pretty, with a particular focus on the once-triumphant automotive center of the universe, Detroit. But there are many parts of this country where manufacturing is very much alive, albeit in a different form. The monolithic industry model — steel, oil, lumber, cars — has evolved into something more nimble and diversified. As this country continues to figure out how to crawl out of its economic despair, we could benefit from focusing on the shift. . . .

I saw people lose the ability to support themselves. I saw my peers run far from manufacturing. Now I see people coming out of elite schools who want to go into manufacturing. “Let’s help the public understand what we have,” she continues. “The job potential is huge.”

More easily understood as something akin to terroir, geographic ingredient branding emphasizes “pride of place,” which runs deep in cities like San Francisco and New York. “I saw this as a way to ‘brand’ the history, culture, personality and natural beauty of our city as a means to uniquely differentiate our local manufacturers,” says Dwight. “I coined the term ‘geographic ingredient branding’ as an emulation of successful technology ingredient branding campaigns such as ‘Intel Inside.’” . . . Things made in places like San Francisco or New York command a desire-by-association (though I’m also sure creative individuals in less name-brand locals could adopt many of the business synergies and sustainable efforts discussed here). To be sure, there may be a higher cost of doing business in major metropolitan centers like these, but at the same time what gets made is largely driven by design and by consumer demand. . . . SFMade and Made in N.Y.C. remain cautiously optimistic about their ability to strengthen something so many have given up on or forgotten. “I grew up in the ‘70s in Buffalo and saw the mass exodus,” says Sofis. “I saw people lose the ability to support themselves. I saw my peers run far from manufacturing. Now I see people coming out of elite schools who want to go into manufacturing. “Let’s help the public understand what we have,” she continues. “The job potential is huge.”

Interview with Willy C. Shih, professor of management practice, Harvard Business School in “Can America Compete?” Harvard Magazine (September-October 2012)

So why did everyone start outsourcing? When the Asian economy—specifically China—opened up, the labor-cost differential was so great and there was such a limitless supply, seemingly everybody focused on labor arbitrage. My fully loaded labor cost in Rochester in the late 1990s was more than 100 times higher than China’s. Everybody just moved their manufacturing over there. Now what happens if your engineers and designers have to be close to manufacturing? Well, we just fill the sky with planes. If you’re on the product side of Apple, you spend a lot of time in China—near the factories, working out problems. The core question is whether this affects your ability to innovate. *If you wander around in factories around the world (since the beginning Gary and I think there is an impact, especially in leading-edge technologies where manufacturing processes are not yet mature. . . .*

If you wander around in factories around the world (since the beginning of 2011 I’ve been in more than a hundred factories), you see some very sophisticated knowledge work

Part of the problem is that people don’t think of manufacturing as *knowledge work*. They think of it as someone putting in four screws 2,400 times a day—and there is a lot of that in the more mature assembly areas. But in a lot of

manufacturing, a lot of value is created in commercialization and advanced manufacturing; a lot of *that* is sophisticated knowledge work. If you wander around in factories around the world (since the beginning of 2011 I’ve been in more than a hundred factories), you see some very sophisticated knowledge work. In some of the advanced semiconductor fabrication lines in Asia, you have masters in engineering running production tools that cost as much as an airplane—\$65 million, \$70 million. They’re extremely sophisticated and complex, and a lot of engineering goes on *on* the factory floor. So one of the things we call out is that conception that manufacturing is not knowledge work. For some types of manufacturing, it is very important to maintain production capability because it’s tied to your ability to innovate.



Photo by Stuart Rosenfeld

III. Pessimistic or Realistic?

“Manufacturing jobs are never coming back,” Robert Reich, *Forbes*, May 28, 2009

It doesn't make sense for America to try to enlarge manufacturing as a portion of the economy. Even if the U.S. were to seal its borders and bar any manufactured goods from coming in from abroad--something I don't recommend--we'd still be losing manufacturing jobs. That's mainly because of technology. When we think of manufacturing jobs, we tend to imagine old-time assembly lines populated by millions of blue-collar workers who had well-paying jobs with good benefits. But that picture no longer describes most manufacturing. I recently toured a U.S. factory containing two employees and 400 computerized robots. The two live people sat in front of computer screens and instructed the robots. In a few years this factory won't have a single employee on site, except for an occasional visiting technician who repairs and upgrades the robots....

Factory jobs are vanishing all over the world. Even China is losing them. The Chinese are doing more manufacturing than ever, but they're also becoming far more efficient at it. They've shuttered most of the old state-run factories. Their new factories are chock full of automated and computerized machines. As a result, they don't need as many manufacturing workers as before. . . .

We should stop pining after the days when millions of Americans stood along assembly lines and continuously bolted, fit, soldered or clamped what went by. Those days are over. And stop blaming poor nations whose workers get very low wages. Of course their wages are low; these nations are poor. They can become more prosperous only by exporting to rich nations. When America blocks their exports by erecting tariffs and subsidizing our domestic industries, we prevent them from doing better. Helping poorer nations become more prosperous is not only in the interest of humanity but also wise because it lessens global instability.

“AAR Corp., an aviation-parts manufacturer in the Chicago area, has 600 openings for welders and mechanics but can't find skilled workers to fill them,” Rahm Emanuel, *Wall Street Journal*, December 19, 2011

The Chicago area has near 10% unemployment, but more than 100,000 unfilled jobs. Like the rest of the country, Chicago suffers from a skills gap that undermines our economic competitiveness and threatens our future prosperity. Despite stubborn unemployment, we have companies offering well-paying jobs that have to go begging for skilled applicants. This is because our community college system, which was a worker's ticket into employment and the middle class during the postwar boom, has

failed to keep pace with today's competitive jobs market. . . . For example, AAR Corp., an aviation-parts manufacturer in the Chicago area, has 600 job openings for welders and mechanics but can't find skilled workers to fill them. As mayor of one of America's largest cities, I find it unacceptable that at a time of high unemployment, more than 80% of manufacturers say they can't find skilled workers to hire. This situation will only get worse. In the next 10 years, the Chicago area will need 9,000 additional computer-science workers, 20,000 new transportation workers and 43,000 new health-care workers, including 15,000 nurses. In order to fill these jobs, we need to modernize our community colleges so that Americans no longer regard community colleges as a last ditch effort for a remedial education, but as their first choice for high-skill job training.... last week I announced a series of partnerships between our community colleges and our top employers that will draw on their expertise to develop curricula and set industry standards for job training in high-growth sectors...

“When Machines Do Your Job,” Antonio Regalado, *Technology Review*, July 11, 2012

Are American workers losing their jobs to machines? That was the question posed by *Race Against the Machine*, an influential e-book published last October by MIT business school researchers Erik Brynjolfsson and Andrew McAfee. The pair looked at troubling U.S. employment numbers—which have declined since the recession of 2008-2009 even as economic output has risen—and concluded that computer technology was partly to blame. . . .

How should businesses react to the trend toward more automation? I think the companies that succeed going forward are the ones that figure out what mix of human and digital labor is going to be the right mix. And I think that that proper mix is going to involve more, and more types of, digital labor than we are using right now.

...companies that succeed going forward are the ones that figure out what mix of human and digital labor is going to be the right mix. And I think that that proper mix is going to involve more, and more types of, digital labor than we are using right now.

What is your advice to the individual, or to the parent educating a child? To the parent, make sure your kid's education is geared toward things that machines appear not to be very good at. Computers are still lousy at programming computers. Computers are still bad at figuring out what questions need to be answered. I would encourage every kid these days to buckle down and do a double major, one in the liberal arts and one in the college of sciences.

“U.S. losing high-tech manufacturing jobs to Asia,” *Washington Post* 1-17-12 By [Peter Whoriskey](#)

The number of high-tech manufacturing jobs in the United States has declined by 687,000, or 28 percent between 2000 and 2010, according to the report. Although the

long decline of manufacturing employment in the United States is often attributed to the cheaper wages in developing countries, China and developing countries in Asia have in recent years sought to lure more sophisticated manufacturing operations — and better jobs — by expanding their engineering prowess through government investment in education and research. The decline in U.S. manufacturing as a share of the nation's economy and employment over the past decade "is not solely due to low-wage competition," the president's Council of Advisors on Science and Technology wrote recently. "We cannot remain the world's engine of innovation without manufacturing activity."

“ ‘Reshoring’ of Jobs Looks Meager,” David J. Lynch, *Bloomberg Businessweek*, July 5, 2012

In trumpeting this “reshoring” of jobs from abroad, the administration points to employers, including General Electric and Caterpillar, that have shifted some manufacturing to the U.S. The president also cited an April online survey by Boston Consulting Group showing that 37 percent of manufacturers with sales of more than \$1 billion and almost half of those with more than \$10 billion “plan to or are actively considering bringing back production from China to the U.S.” Yet there’s little data to back up claims of a reshoring rush. . . . The net effect of this two-way traffic on the labor market has been “zero,” says Michael Janssen of the Hackett Group, a business consulting firm that released a contrarian report on reshoring in May. “Some of these jobs that are coming back get a lot of press,” he says. “There are just as many that get no press coverage still going offshore.” . . . No one knows how many of the manufacturing jobs created since 2010 actually made a round trip from the U.S. to a

foreign address and back. And if jobs are returning, they’re doing so slowly. At the current pace of recovery, it will take 25 years for the U.S. to regain all the factory jobs lost since 2000.

“The next president of the United States, whoever he is, will end his term with fewer Americans working in manufacturing than he inherited.”

So far, many of the jobs China is losing aren’t heading to the U.S. but to other low-cost Asian nations. Rising wages in China led Coach to start looking for alternate places to make its wallets and handbags. By 2015 the company aims to reduce China’s share of its production to about 50 percent from almost 80 percent today. New orders will be sent to factories in Vietnam, Indonesia, Thailand, and the Philippines. Reshoring to somebody else’s shores will be more common in coming years than jobs returning to the U.S., says Tim Leunig, who teaches economic history at the London School of Economics: “The next president of the United States, whoever he is, will end his term with fewer Americans working in manufacturing than he inherited.”

Magical Manufacturing Thinking: Manufacturing NOT the Bright Spot in the U.S. Economy, Rob Atkinson, January 6, 2012

<http://www.innovationpolicy.org/magical-manufacturing-thinking-manufacturing>

When the Labor Department reports December employment numbers on Friday, it is expected that manufacturing companies will have added jobs in two consecutive years. Until last year, there had not been a single year when manufacturing employment rose since 1997. But what Norris overlooks is the loss of manufacturing jobs in this recession was the largest ever with a loss of 15 percent. Compare that to the '90-'91 recession where manufacturing lost just 3 percent of its jobs. So of course manufacturing jobs will come back somewhat.

Yet compared to other recessions, they are not coming back all that strong. According to the BLS, since the end of the recession, manufacturing has added less than 1 percent of new jobs. Compare this to the recessions in 1969, 1974, and early '80s when after 29 months manufacturing added 6.6 and 8 percent, respectively. . . . The reality is if America wants a manufacturing rebound, it can't just hope, wish and pray. It has to act. And that means putting in place robust tax incentives for companies to invest in R&D and new capital equipment in America so that we lower the effective U.S corporate tax rate while also giving companies the incentive to invest in the building blocks of growth and competitiveness. It means much tougher enforcement of our trade laws against rampant mercantilists like China. It means expanding, not cutting, funding for important programs like [NIST's Manufacturing Extension Partnership](#). And much, much more. Manufacturing can come back. Manufacturing needs to come back if the recovery is to get any real traction. But it will not come back by magical thinking.

IV. Skills, Talent, and Education

Boiling point?: The skills gap in U.S. manufacturing, Deloitte, The Manufacturing Institute, 2011

<http://www.themanufacturinginstitute.org/~media/A07730B2A798437D98501E798C2E13AA.ashx>

The skills gap problem comes into sharper focus when considering the changing nature of manufacturing work during the past five years. Many manufacturers have redesigned and streamlined production lines while increasingly automating processes. While some remaining job roles will require less technically skilled workers, ironically, these trends and innovations actually demand more skilled workers, such as maintenance engineers. This changing nature of work is consistent across industries and companies of different size, and can make it difficult for workers to keep up with employment demands. . . . Many industries, not just manufacturing, are feeling the talent crunch. It's been widely reported that high school students have demonstrated a lack of proficiency in math and science. But when we asked respondents what they considered to be the most serious skill deficiencies in their current employees, inadequate problem-solving skills topped

the list. It was followed by a lack of basic technical training and inadequate basic employability skills. Notably, inadequate math, reading, and writing skills weren't seen as being as serious as other concerns.

When asked which factors would help improve their businesses the most over the next five years, a highly skilled and flexible workforce topped the list for manufacturers, ranking ahead of product innovation, increasing market share, low-cost producer status, and even supply chain integration. . .

While the national curriculum may be discretely addressing certain skills, there continues to be a lack of broader problem-solving abilities. Many manufacturers and other employers are learning that skills such as critical thinking not only allow an individual to digest, analyze, and communicate information, but are needed across a broad range of disciplines. . . . The changing nature of work, and the ensuing need for improved workforce skills, has become a focal point for companies as they plan for their future results. When asked which factors would help improve their businesses the most over the next five years, a highly skilled and flexible workforce topped the list for manufacturers, ranking ahead of product innovation, increasing market share, low-cost producer status, and even supply chain integration with suppliers, among other factors (see Figure 10). In an era when many companies have spent significant time and resources to streamline operations and improve innovation and customer service, this result highlights the effort that should be considered by most manufacturers to combat the expected severity and impact of future skills gaps.

This may be an area of concern to manufacturers since retaining, hiring, and developing that skilled workforce will likely be difficult in the face of aging demographics. As more and more older and experienced employees retire, finding younger talent to replace them has become increasingly difficult, exacerbating the talent crunch. The anticipated retirement exodus could seriously hurt manufacturers in specific workforce segments over the next five years. The areas of skilled production (machinists, operators, and technicians) and production support (industrial and manufacturing engineers, and planners) would be hardest hit according to survey respondents (see Figure 11). Manufacturers are also feeling the pinch when it comes to highly specialized and innovative employees, such as scientists and design engineers. Their shortage could affect new manufacturing processes and production development.

“New Industry Can Thrive With Better Training,” Robert Reich, *New York Times* Room for Debate, August 5, 2012

Manufacturing is coming back to America. As wages rise in China and decline in the United States, and as producers see advantages in being close to American customers, more stuff is being made here. A survey by the Hackett Group found that 46 percent of executives at European and North American manufacturing companies said they were considering returning some production to the United States from China, while 27 percent more said they were planning for, or were in the midst of, such a shift. But it won't be the same as before. Forget the old assembly lines. The new wave of manufacturing in America is mostly small and specialized. It produces precision components customized for particular users, like advanced medical devices, laboratory testing equipment, and high-end parts for aircraft. Manufacturing has shifted from high volume to high value.

Precision manufacturing depends on a skilled work force. But more needs to be done to help workers get those skills. In this sense, then, American manufacturing isn't really "back." It's quite new -- closer to the precision, high-value manufacturing that thrives

This new manufacturing won't involve as much of the American work force as manufacturing used to, nor will it have the same high union wages and benefits. But it can create millions of technical jobs and add jobs businesses that serve it

in Germany, despite its high wages, than to the vast assembly operations in Asia. And it depends on skilled workers -- technicians who install, operate, and repair the advanced equipment; engineers who design and continuously improve the equipment and the systems that link it together; and process specialists who make those systems more efficient. This new manufacturing won't involve as much of the American work force as manufacturing used to, nor will it have the same high union wages and benefits. But it can create millions of technical jobs and add jobs businesses that serve it. The biggest bottleneck is finding the skilled workers. Employers are reluctant to invest in training for fear the newly trained will carry their skills elsewhere. And the unemployed and under-employed don't have the money to pay for the training.

“A Blueprint for a 21st Century Workforce,” Richard Florida, *the atlanticcities.com*, February 17, 2012

America will add just 357,000 jobs in “production” over the decade, as the share of Americans who actually make things is projected to fall from 6 percent in 2010 to 5.5 percent by 2020. And, not all manufacturing jobs are good jobs - far from it. The average pay for production workers is just \$33,770. . . . Part of the problem is that many of the manufacturers that are bringing jobs back to America have instituted two tier pay systems in which new workers make much less than their senior colleagues.

Overall, the economy is on track to generate more than 20 million new jobs by 2020, according to the BLS. And nearly 55 million existing jobs will open up as a result of retirements or workers changing jobs and careers. Some seven million of those new jobs will be good, high-paying ones in the knowledge, professional, and creative class sectors – including science and technology, management, and the arts. By 2020, those knowledge, creative and professional jobs, with an average pay of \$70,890 today, will make up a third of the workforce. . . . The U.S. will add even more jobs, nearly 10 million of them, in much lower-wage, lower-skill service work.... The growing salary divide will only worsen America's inequality. The only real solution is providing workers with the skills they need to turn their low-wage, low-skill jobs into better-paying, higher-skill ones.

The manufacturing jobs that pay best today look a lot more like knowledge work than traditional factory work.

The manufacturing jobs that pay best today look a lot more like knowledge work than traditional factory work. In fact, high-paid

manufacturing work – guiding and maintaining advanced machinery, engaging in problem solving, and continuous improvement with other workers and engineers – increasingly is knowledge work.... But the skill with the biggest effect on wages is the "social intelligence skill." Much more than being friendly or outgoing, it includes the ability to help develop people, to organize them around goals, to recruit and lead teams and mobilize the right people for a project.

“Making It in America,” Adam Davidson, *The Atlantic* Jan-Feb 2012

How, exactly, have some American manufacturers continued to survive, and even thrive, as global competition has intensified? What, if anything, should be done to halt the collapse of manufacturing employment? And what does the disappearance of factory work mean for the rest of us? Across America, many factory floors look radically different than they did 20 years ago: far fewer people, far more high-tech machines, and entirely different demands on the workers who remain. The still-unfolding story of manufacturing’s transformation is, in many respects, that of our economic age. It’s a story with much good news for the nation as a whole. But it’s also one that is decidedly less inclusive than the story of the 20th century, with a less certain role for people like Maddie Parlier, who struggle or are unlucky early in life. . . .

Productivity, in and of itself, is a remarkably good thing. Only through productivity growth can the average quality of human life improve. Because of higher agricultural productivity, we don't all have to work in the fields to make enough food to eat. Because of higher industrial productivity, few of us need to work in factories to make the products we use. In theory, productivity growth should help nearly everyone in a society. When one person can grow as much food or make as many car parts as 100 used to, prices should fall, which gives everyone in that society more purchasing power; we all become a little richer. In the economic models, the benefits of productivity growth should not go just to the rich owners of capital. As workers become more productive, they should be able to demand higher salaries.

Throughout much of the 20th century, simultaneous technological improvements in both agriculture and industry happened to create conditions that were favorable for people with less skill. . . . The double shock we're experiencing now—globalization and computer-aided industrial productivity—happens to have the opposite impact: income inequality is growing, as the rewards for being skilled grow and the opportunities for unskilled Americans diminish. . . .

. . . the rewards for being skilled grow and the opportunities for unskilled Americans diminish.... This may be the worst impact of the disappearance of manufacturing work.

This may be the worst impact of the disappearance of manufacturing work. In older factories and, before them, on the farm, there were opportunities for almost

everybody: the bright and the slow, the sociable and the awkward, the people with children and those without. . . . That wind seems to be dying for a lot of Americans. What the country will be like without it is not quite clear.

“Riding the Small Wave in Manufacturing to More Good Jobs and a More Diverse Economy,” Susan Christopherson, *Big Ideas for Job Creation*, Institute for Research on Labor and Employment at the University of California-Berkeley, 2012

The primary prescription for influencing the location of manufacturing operations, according to most economists and many policymakers (aside from firm-based subsidies), lies in solving labor supply problems and what they describe as the “skill mismatch” problem. This entails providing training to build a workforce that can meet manufacturers’ need for the middle- and higher-level skills required in many U.S. manufacturing companies. There is plenty of evidence to support putting a priority on skill development. Since 2007, while effective unemployment has stood at its highest level since the Great Depression of the 1930s, surpassing that of most of the recessions of the 20th century, there has been a continued shortage of workers able to fill advanced manufacturing jobs. This problem will only increase if more manufacturers begin to look for potential U.S. sites in which to manufacture or to source inputs. In fact, one of the most important barriers to the return of manufacturing to the United States is the paucity of manufacturing skills and capacity, a “use it or lose it” phenomenon.

A particular need has been identified for what are referred to as “middle-skill workers.” These are workers who have credentials and training beyond the secondary school level but whose work does not require a bachelor’s degree. Nearly half of all U.S. employment is in middle-skill occupations, and workforce projections indicate fast growth for those occupations that require an associate’s degree. Many of these occupations could be in manufacturing, and they could begin to fill the yawning gap that has opened up in our now polarized labor market. . . . Again, the most acute manifestation of the problem lies with the SMEs — those small and medium-size manufacturers that have not been willing or able to pay the wages and benefits offered by larger companies, and yet require advanced manufacturing skills to meet the demand for more sophisticated products and services. . . . To address the need for middle-skilled workers, the

immediate steps recommended by manufacturers, unions, educational institutions and intermediaries include “earn to learn” programs (which also stimulate employment) and apprenticeships, not just

Providing training in technical skills and making those skills more portable through national credential systems and “stackable” credentials remain critical to both the short-term attraction of workers and long-term capacity building in U.S. manufacturing.

training. States must change their policies on how the performance of community colleges is assessed, evaluating them as a source of job-oriented credentials and not just as a steppingstone to a four-year degree, and enabling them to provide noncredit training courses. Providing training in technical skills and making those skills more portable through national credential systems and “stackable” credentials remain critical to both the short-term attraction of workers and long-term capacity building in U.S. manufacturing.

“Assembly Line,” Paul Fain, *Inside Higher Ed*, July 18, 2012

One of the most promising alternative credentialing movements – the manufacturing industry’s system of stackable certificates – has...led to a deeper, more symbiotic relationship between employers and colleges. The growing partnership has also given rise to a blended model of higher education, where the manufacturing industry takes the lead on standards for competency-based education, with a helping hand from colleges, which then provide the traditional degree path. . . . But many companies feel higher education has failed to create a pipeline of skilled workers. An estimated 600,000 manufacturing jobs are currently unfilled. “We’re dealing with an industry that has lost a lot of faith in working with education,”. . . manufacturers have been frustrated with the dismantling of vocational education. So the institute decided to take matters into its own hands, and came up with standards for the education of manufacturing employees. . . in 2009. The “stackable” credentials include four tiers of competency for applicants and veteran employees to demonstrate, ranging from basic aptitude – like showing that they can get to work on time and work in teams – to proving that they have high-tech skills in specialized manufacturing fields, like machinery or medical technology. But there’s a problem: manufacturers themselves have been slow to recognize the certification,

relying on the old standby of college-issued certificates and degrees, many of which do not address the key competencies needed in manufacturing jobs. The institute's stackable credentials are designed to match up with curriculums at colleges (as well as high schools at the entry level). . . . Early returns have been positive, with manufacturers backing the degree.

Part of the reason companies can't find applicants who are prepared to enter manufacturing is that relatively few college students are interested in the industry, often because they have outdated ideas about it and think the jobs are dirty, menial and probably dead-ends. So the college decided to create a stackable, and portable, system of credentials where students can give manufacturing a whirl and "find out if they really like it," Ender said. While manufacturing may be a tough sell, the promise of a paid internship help[s]. College officials worked with industry partners to create an entry-level certificate [and. . . designed several more-specialized certificates in four fields: mechatronics/automation, precision machining, metal fabrication and supply chain management. . . about 115 institutions, mostly two-year colleges, have incorporated elements of the institute's system into academic programs. . . . "Eventually we'll get to the point where this is the standard for manufacturing education."

But the sluggish start for the system has shown that the business sector probably needs higher education to get an alternative credential off the ground. As further proof, few industries are more geared to going it alone than manufacturing. Information technology and certified financial planning also are industries where companies and associations issue credentials. . . . Observers said the ideal outcome of partnerships like those between the manufacturers and colleges is degree programs that are better geared to jobs, and that test competencies that are vetted by employers.

<http://www.insidehighered.com/news/2012/07/18/manufacturing-industry-taps-colleges-help-alternative-credential>

V. Voices of Advocates

Facts about Modern Manufacturing, 8th Edition, Manufacturing Institute, 2009

The United States still has the largest manufacturing sector in the world, and its market share (around 20 percent) has held steady for 30 years. One in six private sector jobs is still in or directly tied to manufacturing (Figure 8). Moreover, productivity growth is higher in manufacturing than in other sectors of the economy. Due largely to outstanding productivity growth, the prices of manufactured goods have declined since 1995 in contrast to inflation in most other sectors, with the result that manufacturers are contributing to a higher standard of living for U.S. consumers. Manufacturing still pays premium wages and benefits, and supports much more economic activity per dollar of production than other sectors. . . . Because of the increasingly sophisticated technologies and processes it employs, U.S. manufacturing increasingly relies on a more educated workforce (Figure 33) and pays higher wages and better benefits than other sectors (Figures 10 and 11). The application of modern management practices and cutting-edge technology has steadily improved safety in the workplace. . . . The facts clearly illustrate that U.S. manufacturing plays a critical role in our economic future. Still, that future is not without its challenges: rising external costs, corporate tax rates, rising health care costs and the highest pollution abatement costs compared to its major trading partners.

Make: An American Manufacturing Movement, The Council on Competitiveness, December 2011

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,

. . . 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.

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'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. . . . 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.

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.

Sources of Excerpts

- “The Plight of American Manufacturing,” Richard McCormack, *American Prospect*, Dec. 21, 2009
- “Is anything made in the U.S.A. anymore? You'd be surprised,” Stephen Manning, *International Herald Tribune*, February 20, 2009
- “In Pursuit of Nissan, a Jobs Lesson for the Tech Industry?,” Bill Vlasic, Hioroko Tabuchi, and Charles Duhigg, *New York Times*, August 4, 2012
- “Manufacturing and innovation: A third industrial revolution,” *The Economist Special report*, April 21, 2012
- “Skilled Work, Without the Worker, John Markoff, *New York Times*, August 18, 2012
- Made in America Again: Why Manufacturing will Return to the U.S.*, Harold L. Sirkin, Michael Zinser, and Douglas Hohner, Boston Consulting Group, August 2011
- Making Manufacturing Sexy, Karin Lindner, founder of Karico Performance Solutions, Jan. 3, 2011
- The Manufacturing Mandate: Unleashing a Dynamic Innovation Economy*, Association for Manufacturing Technology, 2011
- “Print me a Stradivarius: How a new manufacturing technology will change the world,” *The Economist*, February 10, 2011
- Factory@Home: The Emerging Economy of Personal Fabrication*, Hod Lipson and Melba Kurman, U.S. Office of Science and Technology Policy, December 2010.
- “The Future of Manufacturing is in America not China: How new technology is driving a U.S. industrial comeback,” Vivek Wadhw, *Foreign Policy*, July 17, 2012
- Sustainability in business today: A cross-industry view*, Chris Park and Kathryn Pavlovsky, Deloitte, 2012
- “Declining as a Manufacturer, Japan Weighs Reinvention,” Martin Fackler, *New York Times*, April 15, 2012
- “The Future of Manufacturing Is Local,” Allison Arieff, *New York Times Online Opinionator*, March 27, 2011
- “Manufacturing jobs are never coming back,” Robert Reich, *Forbes*, May 28, 2009
- “AAR Corp., an aviation-parts manufacturer in the Chicago area, has 600 openings for welders and mechanics but can't find skilled workers to fill them,” Rahm Emanuel, *Wall Street Journal*, December 19, 2011
- “When Machines Do Your Job,” Antonio Regalado, *Technology Review*, July 11, 2012
- U.S. losing high-tech manufacturing jobs to Asia, Peter Whoriskey, *Washington Post* January 12, 2012
- “‘Reshoring’ of Jobs Looks Meager,” David J. Lynch, *Bloomberg Businessweek*, July 5, 2012
- “Magical Manufacturing Thinking: Manufacturing NOT the Bright Spot in the U.S. Economy,” Rob Atkinson, January 6, 2012
- Boiling point?: The skills gap in U.S. manufacturing*, Deloitte, The Manufacturing Institute, 2011
- “New Industry Can Thrive With Better Training,” Robert Reich, *New York Times*, Room for Debate, August 5, 2012

“A Blueprint for a 21st Century Workforce,” Richard Florida, *the atlanticcities.com*, February 17, 2012

“Making It in America,” Adam Davidson, *The Atlantic*, Jan-Feb 2012

Riding the Small Wave in Manufacturing to More Good Jobs and a More Diverse Economy, Susan Christopherson, Big Ideas for Job Creation, Institute for Research on Labor and Employment at the University of California, Berkeley, 2012

“Assembly Line,” Paul Fain, *Inside Higher Ed*, July 18, 2012

Facts about Modern Manufacturing, 8th Edition, Manufacturing Institute, 2009

Make: An American Manufacturing Movement, Washington, DC” The Council on Competitiveness, December 2011

Compiled by Stuart Rosenfeld, Regional Technology Strategies, who accepts sole responsibility for the selection of excerpts included.