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The Multiplier Effect:



By Keith D. Nosbuch and
John A. Bernaden

ROCKWELL AUTOMATION
MAR 2012





The Multiplier Effect:

*There Are More
Manufacturing-
Related Jobs
Than You Think*

.....
The embrace of smart
manufacturing techniques will
turn conventional wisdom about
indirect jobs creation on its head
and change the image of
the industry itself.

.....
By Keith D. Nosbusch and
John A. Bernaden



Keith D. Nosbusch is chairman and CEO of Rockwell Automation.



John A. Bernaden is director of corporate communications at Rockwell Automation.

Smart manufacturing is rapidly transforming the global competitive landscape by marrying industrial automation with information technology (IT) to optimize the efficiency, productivity, and output of plants and supply networks.¹ This trend will continue to increase the flexibility of plants, reduce the use of energy, improve environmental sustainability, lower the cost

of products, and deliver additional benefits such as better product quality and increased worker safety.

However, one important benefit from smarter manufacturing has tremendous potential to improve the image of manufacturing as it answers the top economic question on most people's minds today: How do we create more jobs?

The answer is smart manufacturing. That might sound surprising, since the industrial automation revolution has been a leading contributor to major declines in direct manufacturing employment during the past decade.² However, new studies discussed in this article show that as smart manufacturing advances, the employment multiplier significantly increases. Thus, the next generation of smart manufacturing will generate a dramatic ripple effect through the indirect creation of jobs in the industries that supply, support, and service smart manufacturers. These are well-paid, skilled labor or professional jobs created outside manufacturing but totally dependent on it. This smart

manufacturing ripple effect can put millions of unemployed people back to work and improve the economic vitality of nations that act now to seize its promise.

The ripple effect runs counter to public perceptions of manufacturing. Until 1980, there was a strong correlation between manufacturing output and jobs, according to a recent study by Wells Fargo economists.³ As manufacturing output increased from World War II until about 1980, there was a corresponding increase in direct manufacturing employment. That's why most people still measure the health of the manufacturing sector today from the sole perspective of direct manufacturing jobs. Since 1980, however, the correlation between production and direct manufacturing jobs has been inverted, according to the Wells Fargo report.

A three-decade-long, steady decline in manufacturing jobs in regions like the U.S. (see Chart 1) leads most people to believe—incorrectly—that manufacturing is dead or

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dying. To try to change this inaccurate, negative public perception, some industry leaders point to the three decades of relatively strong long-term increases in manufacturing output. But those efforts have failed to explain the value of a less labor-intensive manufacturing sector to the general public and many politicians. Even after President Obama recently called for insourcing more manufacturing back into the U.S., numerous leading economists rebutted in national media that it wouldn't

fix the unemployment problem because re-turning factories will be highly automated.

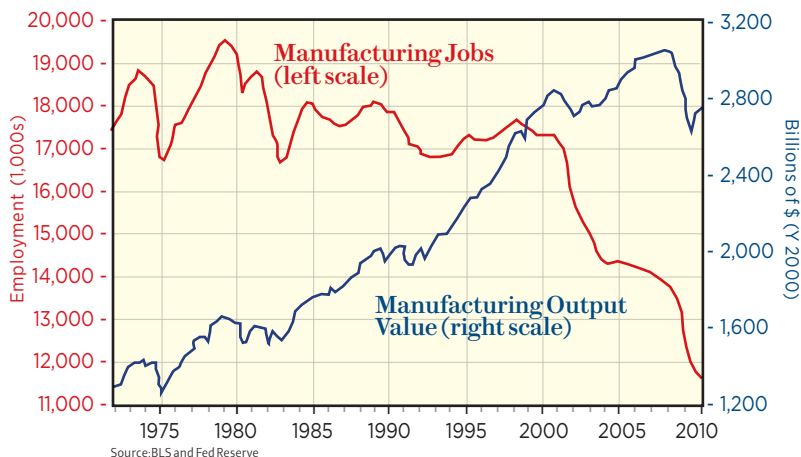
"Manufacturing jobs are never coming back. Thus, it doesn't make sense for America to try to enlarge manufacturing as a portion of the economy," argued Robert Reich, former Secretary of Labor under President Clinton, in a 2009 *Forbes* magazine opinion piece.⁴

That's why it's time to show a new line on Chart 1, called "indirect jobs."

21st Century Manufacturing Ecosystems

Many 20th century business managers tried to minimize indirect jobs by vertically integrating their operations and supply chains. Industrial giants acquired or developed as much of their supply chain as possible, sometimes including even tangential service suppliers such as consumer finance companies, on-site health care for employees, or corporate-owned real estate firms. Even amid that vertical integration, manufacturing has always had a higher employment multiplier than any other economic sector. Now, this

CHART 1:
U.S. Manufacturing: Output vs. Jobs
January 1972 to November 2009



already high employment multiplier is starting to rise. Outsourcing or TQM efficiencies may be part of the reason for the multiplier starting to rise, but the technology trends toward more advanced and smart manufacturing amount to a much greater driver.

The vertically integrated business model is evolving toward smart manufacturing hubs surrounded by layers of dynamic supplier networks, external support firms, and outside service organizations. Even though direct manufacturing jobs may continue to decline in increasingly productive smart factories, they provide the essential nucleus driving this ripple effect, creating waves of indirect jobs necessary to supply, support, and serve them.

Statistically, a large percentage of these indirect jobs are classified as non-manufacturing jobs, but they are wholly dependent on a healthy, competitive manufacturing sector. Understanding these new manufacturing ecosystems will enable industry leaders to illustrate once again the pivotal role of manufacturing in creating jobs—not just direct jobs for the few, but indirect jobs for the many. Making this point is essential in our efforts to garner both public

1 *Manufacturing Executive Leadership Journal*. "The 'Smart' Manufacturing Revolution." Sujet Chand and Jim Davis. November 2010. A detailed discussion of smart manufacturing and its benefits can also be found at <http://www.rockwellautomation.com/news/get/TIMEMagazineSPM-coverstory.pdf>. "What is Smart Manufacturing?" TIME magazine cover wrap. Sujet Chand and Jim Davis. July 2010.

(For further information, see <http://smart-manufacturing.com/>)

2 Heritage Foundation Background Report No. 2476. "Technology Explains Drop in Manufacturing Jobs." James Sherk. Oct. 12, 2010.

3 Wells Fargo Securities Economics Group. "Is U.S. Manufacturing In Decline?" Scott Anderson, Michael A. Brown, and Kaylyn Swankoski. Nov. 3, 2011.

4 *Forbes* magazine. "Manufacturing Jobs Are Never Coming Back." Opinion piece by Robert B. Reich. May 28, 2009.

5 Council on Competitiveness. "Make: An American Manufacturing Movement." December 2011.

and political support for strategies to create globally competitive business climates required to attract major, long-term investments in the next generation of smart manufacturing technology.⁵

Job Creation as Job #1

Manufacturing has always had a higher employment multiplier than any other economic sector. Now, this already high employment multiplier is starting to rise.

Indirect manufacturing jobs are part of the narrative for the U.S. jobs czar.⁶ As chair of the President's Council on Jobs and Competitiveness, Jeffrey Immelt, chairman and CEO of General Electric, talked about increased factory automation and manufacturing employment multipliers during an Oct. 9, 2011, interview with Lesley Stahl on *60 Minutes*.

Touring a new factory in Batesville, MS, where GE is building jet engines for the Boeing 787 Dreamliner, Immelt acknowledged Stahl's observation that the highly automated plant requires fewer direct employees than factories of old.

"You're going to have fewer people that do any task," Immelt said. "In the end, it makes the system more productive and more competitive. But when you walk through Mississippi, for every person that

was in that plant, there are probably seven or eight jobs in the supply chain."

Immelt's reference to supply chain jobs highlights a critical element of the indirect jobs story. Both professionals and skilled-trades people are employed in the supply chain. When an enterprise purchases goods and services from other businesses, it generates an indirect jobs impact, or multiplier effect. That is distinct from what economists call induced or consumer-driven economic effects—jobs at restaurants, dry cleaners, entertainment venues, and the like that have little to no multiplier effect. Unlike those consumption-based service sector jobs, these indirect jobs are part of industry's production-based wealth-building machine with the same economic benefits as direct manufacturing employment.

A jetliner, for instance, may have as many as three million discrete components while an automobile might be comprised of 10,000 parts—from a vast array of suppliers. Some of those suppliers, in turn, receive components from other sources and assemble them into parts that are then sent on to the final assembly process for the plane, car, or other end-product. The final products, in turn, are shipped and sold around the world. That supply chain requires a host of skilled paraprofessional and professional employees in indirect non-manufacturing jobs: logistics and transportation workers, customer service and technical support specialists, regulatory affairs and safety professionals, and distribution or warehouse employees trained in the use of information technology-driven tools for receiving, storing, and picking—more often using outside firms with jobs classified as non-manufacturing.

Indirect skilled and professional positions vary by industry, but range from technicians who keep the highly automated and IT-driven manufacturing processes humming to high-

The Math: A Higher Multiplier With Smart Manufacturing

Smart manufacturing requires at least three to four times the number of indirect jobs for outside support compared with direct jobs—versus the much lower employment multiplier of traditional factories today, which is only about one-half of a non-manufacturing support job for every job in a factory. That's because smart factories typically use more non-manufactured supplies, high-tech services, IT support, transportation, and logistics companies to accommodate their significantly increased productivity and higher output, often exported globally due to its cost-competitiveness.

wage consulting roles in fields such as data analysis and financial planning. Equally important are the ties between industry and researchers. Partnerships with university researchers and private prototyping companies not only foster high-skill, high-wage jobs, but they also can ignite innovation in production processes to drive profitability and spur even greater investments and jobs growth. These relationships also promise to create new fields of smart manufacturing support jobs such as modeling and simulation experts who use high-performance computing to optimize factories of the future. Comprehensive studies show that the growth of these indirect manufacturing jobs is already beginning.

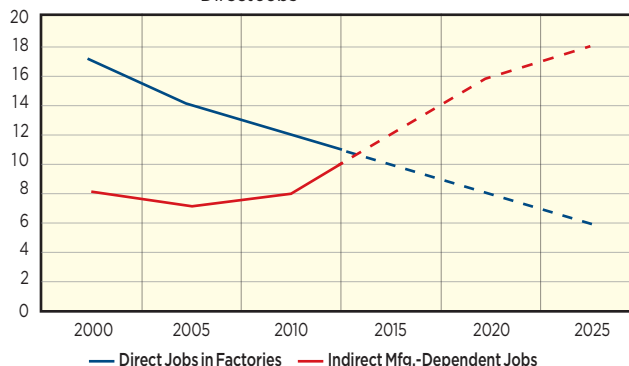
Consider Intel Corp., whose operations in Washington County, OR, directly employ 16,250 people in the design, manufacture, and marketing of microprocessors. A recent study conducted for Intel by ECONorthwest⁷ pegged the firm's jobs multiplier in the state of Oregon alone at 4.1 for 2009, the most recent year for which data is available. That means every 10 jobs at Intel support another 31 jobs in other sectors of the Oregon economy—at above-average wages, according to the study. In total, more than 50,000 indirect jobs exist in non-manufacturing companies and firms to supply, support, and service Intel's operations at that one location.

The bulk of Intel's \$5.4 billion non-payroll expenses in Oregon went toward the purchase of goods and services including utilities;

CHART 2: *Calculating Employment Multipliers*

FORMULA:

$$\frac{\text{Direct + Indirect Jobs}}{\text{Direct Jobs}} = \text{Multiplier}$$



Source: National Association of Manufacturers

wholesale and retail trade; business, professional, management, and employment services; and manufactured materials, according to the study, which was developed with access to detailed, proprietary Intel financial data.

"The average annual income for employees indirectly affected by Intel's non-payroll operational spending in 2009 is \$77,200 in Washington County, \$68,560 in Portland Metro, and \$66,900 in Oregon," the study states. The statewide average income was \$40,740 in 2009, according to state figures.⁸

Driving High Levels Of Indirect Employment

Supply-network jobs associated with GE and Intel reflect the high level of indirect employment that more automated manufacturing generates. On

⁶ CBS News 60 Minutes. "The Jobs Czar: General Electric's Jeffrey Immelt." Interview with Lesley Stahl. Aired Oct. 9, 2011.

⁷ ECONorthwest. *Economic Impacts of Intel's Oregon Operations*, 2009. Alec Josephson. October 2011.

⁸ *Oregon Blue Book*. Official Directory and Fact Book of the State of Oregon. Compiled by the Oregon State Archives. 2011.

⁹ The Manufacturing Institute. *Facts About Modern Manufacturing*, 8th Edition. 2009.

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10 Milken Institute. *Manufacturing 2.0: A More Prosperous California*. Ross C. DeVol, Perry Wong, Armen Bedroussian, Candice Flor Hynek, and David Rice. June 2009.

11 Ibid.

12 American Farm Bureau Federation, via U.S. Department of Labor.

13 U.S. Department of Agriculture, Economic Research Service. *Productivity Growth in U.S. Agriculture*. Keith O. Fuglie, James M. MacDonald, and Eldon Ball. September 2007.

14 MIT Roundtable. *The Future of Manufacturing Innovation—Advanced Technologies*. Held in cooperation with the Council on Competitiveness. March 1, 2010.

15 Economist Intelligence Unit, commissioned by KPMG International. *Global Manufacturing Outlook: Relationships, Risk, and Reach*. 2010.

16 National Association of Manufacturers. *U.S. Lags as an Exporter of Manufactured Goods*. February 2011.

average, the manufacturing multiplier is 1.58, according to National Association of Manufacturers figures that place direct manufacturing employment at 11.8 million and indirect employment at 6.8 million.⁹

That means a typical manufacturing facility that employs 100 people actually supports 158 jobs, 100 directly and 58 through employment at suppliers. As factories get “smarter” and more advanced, the multiplier increases significantly. In some advanced manufacturing sectors, such as electronic computer manufacturing, the multiplier effect can be as high as 16 to 1, or 16x, meaning that every manufacturing job supports 15 other jobs.¹⁰ Highly automated, high-tech manufacturing regions already have employment multipliers closer to 3.5, according to the Milken Institute’s Manufacturing 2.0 research study.¹¹

Expanding the current employment multiplier from the 1.58 level today to 2x, 3x, or higher multipliers in the next decade equates to millions of new indirect jobs necessary to support the next generation of smart manufacturing (see Chart 2). This is the new line that we need to add to Chart 1 to show manufacturing output growth versus direct jobs decline—to illustrate the full scope of manufacturing’s effect on total employment.

Innovative Support Services Spur Indirect Jobs

To illustrate the link between technology, production, and direct and indirect employment, consider what happened as the agriculture sector became increasingly automated. In 1950, one farmer produced enough food in a year to feed 27 people. Today, one U.S. farmer produces food for 154 people per year.¹² Milk-per-cow production increased 242% from 1950 to 2000, while corn yields per acre grew 292%, due primarily to new technologies.¹³

Most Americans still regard the nation as the world’s breadbasket, thanks to an abundance of food and agricultural products, while few decry the dramatic decline in direct farm employment in the past half-century. More important, the indirect jobs growth in agriculture has affected sectors the 1950s farmer could not have imagined: from people who build and repair GPS-guided seed drills and computerized combine harvesters, to university-based soil and seed researchers, bioplastics innovators, grain-mill executives and operators, producers of processed food and beverages, leather tanners and textile manufacturers, ethanol extractors, local finance firms for multi-million-dollar machines, and crop insurance agents. This new array of agricultural support services created millions of jobs statistically counted as non-farm employment.



More productive and globally competitive smart manufacturing will, in turn, present new opportunities for exports to serve the world’s emerging markets.

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Now imagine a similar trajectory of indirect employment as manufacturers expand relationships with their support services to kindle opportunities for growth through smart manufacturing processes. Many of these support services are the small to midsize enterprises (SMEs) often heralded for their jobs creation and innovation capabilities. Too few statistics measure this symbiotic relationship between SMEs and the manufacturing sector, unless these enterprises are themselves manufacturers. For example, the growing number of computers in smarter factories creates the need for more IT support services.

Supply chains and support services will also adapt as smart manufacturing spurs innovation such as mass customization, as well as new fabrication materials including those being developed for lighter-weight, more-energy-efficient vehicles, said MIT researchers at a March 2010 innovation discussion.¹⁴ That creative process is already underway in some sectors. A recent study commissioned by professional-services giant KPMG, examining how manufacturers are adapting to the global recession, found an increased drive toward close partnerships with suppliers well beyond material and component supply or finished-goods delivery.

“More than half of respondents expect to collaborate more closely with suppliers on, or give responsibility to them for, product innovation, product development, and research and development,” KPMG reports. “That figure rises to more than 60% for cost reduction and supply chain agility. Furthermore, one-third of respondents report that their companies are increasingly becoming assemblers of parts from top-tier suppliers that in effect are managing what once would have been the lead manufacturer’s supply chain.”¹⁵



China, Too, Has Seen the Benefit

Even nations with traditionally lower labor costs like China seem to understand the bigger long-term indirect jobs benefits of smart manufacturing compared to the short-term direct jobs impact. For example, when the 2008 Olympic Committee required the mammoth old Capital Steel plant to be moved out of Beijing, which cut 18,000 tons of pollution per year before the Summer Games held there, China’s vice premier announced that two-thirds of the 65,000 workers would not be needed to operate the new highly automated, higher-output steel plant located in the new Caofeidian eco-city. A similar announcement came last summer when FoxConn decided to buy one million robots in the next three years to replace many of the nearly one million Chinese workers who currently make Apple’s iPads, iPods, and iPhones.

Greater Global Competitiveness Adds More Indirect Jobs

More productive and globally competitive smart manufacturing will, in turn, present new opportunities for exports to serve the world’s emerging markets. Exports are critical to both direct and indirect jobs growth and economic recovery, a February 2011 National Association of Manufacturers analysis noted.¹⁶

“The mature domestic market for manufactured goods is unlikely to grow rapidly enough to outpace productivity increases and create jobs,” NAM stated. “Job creation is going to depend on faster export growth—with the United States joining the major league of ‘power exporters,’ and the time to start achieving that goal is now.”

While the United States produces 20% of the world’s manufactured goods and remains the world’s largest manufacturer, it ranks only 13th among the top 15 manufacturing economies in the proportion of goods it exports, NAM noted. That puts the nation at 45% of the average export intensity among manufacturing nations.



“You’re going to have fewer people that do any task,” said GE’s Jeffrey Immelt on 60 Minutes, “but for every person that was in that plant in Mississippi, there are probably seven or eight jobs in the supply chain.”

At the same time, shifts in emerging-economy production expenses may also result in some “insourcing” or relocations into mature markets using smart manufacturing to better control costs, according to a new study by Boston Consulting Group.¹⁷ For example, wages in China are rising faster than productivity gains, making U.S. production more viable for some sectors when shipping costs and “hidden” supply chain costs are factored in, the study states.

The Boston Consulting study shows that almost every company relocating production back to the United States or constructing a new factory here does it with a comparatively higher percentage of industrial automation and information technology. As a result, these new factories will have higher employment multipliers. Boston Consulting expects up to 800,000 manufacturing jobs to be added in the U.S. by mid-decade. More importantly, they estimate that a 4x employment multiplier will create about 2.4 million indirect jobs.

“The job gains, equating to a drop of up to 2 percentage points in the U.S. unemployment rate compared with today’s figures—to around 7%—would come directly through added factory work as well as indirectly through support services,” the study’s authors state.

Let the Facts Speak

Indirect jobs associated with smart manufacturing can help put unemployed workers back to work and revitalize manufacturing’s central role in our economy. We must do a better job of telling that story. In June 2009, we participated in one of the first National Summits on Manufacturing, hosted by the Detroit Economic Club, which was co-chaired by Bill Ford of Ford Motor Co. and Andrew Liveris of Dow Chemical.

As the heads of manufacturing powerhouses examined the strong productivity and output gains that the industry has made, along with the hundreds of thousands of very good direct job opportunities available, everyone analyzed why manufacturing has such a black eye in America.

What we have, the leaders agreed, is not a manufacturing problem; it’s a public relations problem. And that presents an opportunity, because image problems can be solved more readily than fundamental manufacturing problems.

We need to inspire policymakers and others to appreciate the benefits of smarter manufacturing. Historically speaking, a smaller percentage of people working in agriculture and in manufacturing can drive competitive exports for a healthy balance of trade, create wealth to meet fiscal needs, and provide an economic nucleus for the rest of the economy—through millions of new indirect jobs. **M**

17 Boston Consulting Group, “BCG Perspectives,” commentary on the BCG study *Made in America, Again: Why Manufacturing Will Return to the U.S.* Harold L. Sirkin, Michael Zinser, and Douglas Hohner. August 2011.



What we have is *not a manufacturing problem; it’s a public relations problem.* And image problems can be solved more readily than fundamental manufacturing problems.