

The Value of Manufacturing Extension Programs in America

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with
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Abstract

This paper reviews the importance of manufacturing to the U.S. economy, presents indicators of performance for the U.S. manufacturing sector, examines the lagging performance of small and midsize manufacturing establishments, and supports manufacturing extension initiatives as a means for improving small firm performance and spurring U.S. economic growth.

Manufacturing matters to America. Making what the world wants makes the United States a prosperous nation. And smaller manufacturers matter particularly. America's 381,000 manufacturing establishments of less than 500 workers employ nearly 12 million people and produce over half of all U.S. manufacturing output. These smaller firms form the nation's industrial base, supplying parts, components and tooling to large manufacturers, and anchoring good jobs in cities and towns across America.

Small and midsize manufacturers constitute a crucial and expanding share of America's goods producers. But the performance of smaller manufacturers needs improvement. U.S. manufacturing establishments that employ fewer than 500 workers significantly lag behind larger manufacturers in terms of productivity. The evidence: From 1967 to 1992, productivity growth for smaller manufacturers averaged 2.1 percent per year compared to 2.9 percent for larger manufacturers as measured by value added per employee. In 1992, the value added per worker at smaller manufacturers amounted to two-thirds the value added per worker at larger firms. Smaller U.S. plants trail their foreign counterparts, as well. The problems stem in large part from a lack of state-of-the-market technology and modern techniques at small and midsize manufacturing facilities in America.

The performance gap between smaller and larger manufacturing establishments is broad and growing. It demands attention. Without improvement, poor productivity among smaller manufacturers will continue to drag down overall U.S. competitiveness. American manufacturing will be made stronger if tens of thousands of small firms accelerate the modernization of their design, production, marketing and management capabilities. Smaller manufacturers need resources and an infrastructure to support them as they identify and adopt new techniques and technologies and move to the high road of increased productivity, improved worker skills and better pay.

Now, a growing number of small firms can secure expert assistance through the beginnings of a nationwide manufacturing extension system. This network of regional and local organizations, currently under development, provides comprehensive, hands-on, technical support to modernizing small and midsize manufacturers as they upgrade their equipment, improve their production processes and strengthen their business performance. Manufacturing extension centers have undertaken an important task and a crucial mission--improving manufacturing in America.

Manufacturing Matters

Manufacturing drives much of the U.S. economy. National leaders in both the private and public sectors have come to recognize once again that the state of manufacturing profoundly affects the state of the nation. Small wonder, given the size and reach of the manufacturing sector.

In 1993, manufacturing contributed \$1.12 trillion dollars to the nation's gross domestic product. It is estimated that manufacturing directly generates almost one in five dollars of total U.S. output (18

percent) and accounts for almost one in five private-sector jobs. Those manufacturing jobs provide workers -- especially workers who lack a college education -- with better pay and benefits than they could secure in other sectors of the economy. In fact, while manufacturing makes up 19 percent of total private sector employment, it produces 23 percent of all private sector wages and salaries.

The impact of manufacturing on jobs and payroll also extends to other sectors of the U.S. economy. For example, manufacturing firms create jobs when they purchase raw materials and services from other companies, services such as design and engineering work, advertising, legal advice, maintenance and security help, and payroll processing. The National Association of Manufacturers estimates that every \$1 million in final sales of manufactured goods generates more than eight jobs outside the manufacturing sector, and every \$1 in final sales for manufacturing creates another \$1.30 in economic activity elsewhere in the economy.

And manufacturing rates high for the United States when it comes to international trade. Manufacturing goods made in this country and sold to the rest of the world account for 61 percent of total U.S. exports and 83 percent of total goods exported. Goods made elsewhere and sold to the United States constitute 71 percent of all U.S. imports. Improved manufacturing performance in this country could boost the U.S. economy by increasing exports and reducing imports.

A Need for Improved Performance

Manufacturing is again recognized for its importance to the overall U.S. economy, but the comeback in manufacturing performance has been less dramatic. America must make every effort to keep

manufacturing strong and growing stronger. Data on productivity, exports, wages and employment show room for improvement.

In terms of productivity, manufacturing has made only modest progress since 1967. Manufacturing output per hour worked rose at an average annual rate of 3.0 percent from 1989 to 1995, up just two-tenths of a percentage point from the average annual growth rate of 2.8 percent in the 22 years from 1967 to 1989, according to manufacturing productivity data released in early 1996 by the U.S. Bureau of Labor Statistics (BLS). Manufacturing productivity has shown improvement over the last two years, but the upswing has been no more dramatic than for other periods of economic expansion and not enough to pull the average annual rate of increase above its long-term mark.

Even without much increase in productivity, the U.S. manufacturing sector has dramatically boosted its foreign sales. The inflation-adjusted value of manufactured goods exported from the United States jumped almost two and a half times from 1985 to 1995, rising from \$172 billion to \$425 billion. This development has had an important and positive impact on the U.S. economy.

However the sharp climb in manufacturing exports rests on shaky ground. Research on U.S. exports from 1986 to 1992, conducted by Richard Lester of the Industrial Performance Center at the Massachusetts Institute of Technology (MIT), suggests that at least three-fourths of the jump in sales to other countries stemmed from a drop in the value of the dollar compared to foreign currencies. Currency values have continued to drive exports, with the dollar falling almost 60 percent in value against the Japanese Yen and 45 percent against the German Mark from 1985 to 1994. When the value of the dollar declines and the value of foreign currencies increases, U.S. goods become cheaper for foreign buyers, who purchase more of them. While American manufacturing has improved some

in the last decade, the MIT analysis indicates that another swing in currency values could quickly erase most of the recent gains in U.S. manufacturing exports.

What's more, manufacturing employment and wages have fallen. In 1995, after four years of economic recovery in the United States, manufacturing employment stood at 3,000 jobs below the level of 18,406,000 during the recession year of 1991. Monthly manufacturing employment in February 1996 was down more than 1.2 million from the cyclical peak in January 1989 and down a staggering 2.9 million from the overall peak in manufacturing employment in June 1979. Employment numbers for the machine tools and apparel industries have fallen to half their 1979 levels.

A major portion of the overall decline in manufacturing employment stems from increases in manufacturing productivity, which allow manufacturers to produce more output with fewer workers. Increases in productivity can have a dramatic impact on employment. For example, if manufacturing value added per employee had remained constant at its 1967 level instead of increasing, the manufacturing sector would have needed more than 32 million workers to generate the amount of value added it produced in 1992 with just 18.2 million employees.

But employment can grow as productivity rises if manufacturing firms use gains in output per worker to capture greater worldwide market share or to develop new markets. Unfortunately U.S. manufacturing has not expanded as fast as the overall economy and now accounts for less of America's gross domestic product than it did in the past, dropping from 21.3 percent in 1978 to about 18 percent today. By contrast, in Japan the value added from manufacturing has risen from 28.8 percent of that country's gross domestic product in 1978 to 30.4 percent in 1993, according to data from the international Organization for Economic Cooperation and Development. Not

surprisingly, manufacturing employment in Japan grew, increasing more than 1.8 million from 1980 to 1991, even as manufacturing productivity there rose faster than in the United States.

U.S. manufacturing wages, too, have dropped. Average hourly compensation for manufacturing workers in early 1996, adjusted for inflation, was below its level during the deep recession in 1982 and well below its levels during both 1979 and 1973 -- peak years in the economic cycle for the United States. This decline reflects more than just falling wages among contracting manufacturing industries. Research from Richard Lester at the Massachusetts Institute of Technology shows none of the U.S. manufacturing sectors that enjoyed stable or rising employment levels between 1987 and 1994 paid higher wages, adjusted for inflation, at the close of that period than at the start. Real wages fell for all the industries with rising employment levels. The living standards of America's manufacturing workers have suffered.

Growth among Smaller, Less Productive Manufacturers

Manufacturing employment has grown among small and midsize firms that employ fewer than 500 workers even as manufacturing jobs overall dropped in the last several decades. Every five years, the U.S. Census Bureau gathers in-depth statistics on the nation's manufacturing firms. The most recent data from the 1992 Census of Manufactures show that while manufacturing employment declined by 2.0 million at large plants in the 25 years from 1967 to 1992, it grew by 1.7 million at smaller firms. By 1992 manufacturers with fewer than 500 workers accounted for 98.6 percent of all manufacturing establishments (up from 98.1 percent in 1967), 64.9 percent of all manufacturing employment (up from 54.5 percent), 56.9 percent of

manufacturing's annual payroll (up from 48.4 percent), and 54.9 percent of manufacturing's value added (up from 48.7 percent).

The good news is that growth among small and midsize manufacturers moderated manufacturing job losses. But the bad news is that this shift in manufacturing to small and midsize plants has slowed U.S. productivity growth because manufacturing establishments with fewer than 500 workers lag behind larger plants in terms of output per worker. Between 1967 and 1992, value added per worker rose just 2.1 percent per year on average at small and midsize manufacturing establishments compared to 2.9 percent at large plants. Consequently the value added per worker at small and midsize plants in 1992 stood at \$66,170, just 65.7 percent of the \$100,640 in value added per worker for larger manufacturers. The lagging performance by small establishments lowered overall value added per manufacturing employee to \$78,260 in 1992. Value added for small compared to large manufacturers registered at 79.4 percent in 1967 and 70.8 percent in 1982.

These data on productivity from the Census of Manufactures look at manufacturing establishments by size. A small or midsize establishment is a plant or other facility that employs fewer than 500 workers on site. Consequently, smaller establishments include small facilities owned by large manufacturing firms, such as a small General Motors parts plant, for example. The numbers show even greater gaps in productivity for small and midsize firms than for establishments. In 1992, the value added per employee at small and midsize firms stood at just 54.1 percent of the large firm level.

The gap in payroll per worker between smaller and larger manufacturers has grown as well, with the level for smaller firms dropping to 71.3 percent compared to larger firms in 1992 (\$26,915 versus \$37,738), down from 78.5 percent in 1967.

The growing productivity gap between smaller and larger firms is neither necessary nor universal. In Japan, value-added per employee rose slightly faster in plants with fewer than 300 workers than in larger plants during most of the 1953-92 period, according to reports from Japan's Ministry of International Trade and Industry

Several related factors appear to drive the productivity and pay gaps among smaller and larger U.S. manufacturers. First, small and midsize firms use much less technology than large ones. They are less likely than larger manufacturers to know about and implement off-the-shelf, state-of-the-market technology that could boost production performance. For example, a Census Bureau study from 1988 compared U.S. metalworking shops of fewer than 100 workers with those that employed 500 or more and found that the smaller shops were about half as likely to use numerically controlled machinery, one-quarter as likely to use personal computers, and one-sixteenth as likely to use robots.

America's small and midsize manufacturers also make less use of computer-based technologies than smaller manufacturers in Europe and Japan. Another study from the late 1980s compared U.S. manufacturing plants of 50-499 workers with Japanese firms employing fewer than 300 people and found the American companies were four times less likely to use automated storage and retrieval systems, computer-numerically controlled machining centers, and robots. The U.S. firms were 40 percent less likely to use computer-numerically controlled machine tools.

Second, small and midsize U.S. manufacturers lag behind their larger counterparts in awareness and implementation of modern management and shop floor methods, such as work teams, just-in-time and cellular manufacturing, inventory management and control, quality systems, bottle-neck scheduling, and planned preventative maintenance. In addition,

smaller manufacturers in general are less likely to use progressive workforce practices, including pay-for-knowledge compensation systems, profit-sharing and shop-floor training.

The lagging use of technology among many small and midsize manufacturers in the United States creates a vicious cycle. Less technology and less modern methods mean lower productivity growth for smaller firms. Lower wages follow, making it more difficult for smaller manufacturers to attract and keep skilled workers, and undercutting the incentive that these firms otherwise might have to invest in labor-saving, productivity-boosting technology. Because many small shops lack technology and high-quality workers, the larger manufacturing companies that purchase goods from small firms come to think of them as suppliers of simple parts and assemblies. In this role as commodity producers, small manufacturers face narrow profit margins, which further dampen prospects for higher wages and investment in technology and continue to undermine productivity growth.

A Boost for Smaller Manufacturers

The productivity of America's small and midsize manufacturers must increase more rapidly. Smaller shops need to master modern technologies, management techniques, and methods of work organization in order to improve their own competitiveness and to strengthen U.S. manufacturing overall. Their progress will benefit the entire country.

Consider the potential payoff from an increase of even one-tenth of one percentage point in average annual productivity growth for small and midsize manufacturers. Sustained for five years, this increase of 0.1 percentage point would mean the customers of these smaller

manufacturers--both firms and individual consumers--could realize a total of \$6.7 billion in savings over the period, and workers at these smaller firms could receive a total of \$3.8 billion more in payroll over the five-year period without cutting into their shops' profitability.

This small increase in the productivity growth rate could payoff not only for smaller manufacturers and their workers but for taxpayers, too. Depressed productivity growth among small and midsize manufacturers means foregone federal revenues. Federal receipts from all sources could increase \$2.7 billion, or almost \$230 per employee at small and midsize plants, as a result of the 0.1 percent increase in productivity growth sustained for five years.

These calculations are based on data from the Census Bureau's Census of Manufacturers for value added and employment and data from the Tax Foundation for federal receipts. They assume that smaller manufacturers pass half of their lower costs from productivity increases on to customers through lower prices, that payroll for workers accounts for about 57 percent of the revenue to smaller manufacturers, and that the federal government taxes away about 20 percent of each new, or marginal, dollar generated in the economy. For the calculations, the rate of growth in value added per worker for smaller manufacturers was held constant at historical levels of 2.1 percent annually until 1997 and then increased to 2.2 percent from 1997 to 2001, and employment was held at its 1992 level.

The objective of a 0.1 percent increase in productivity growth for smaller manufacturers is attainable. If the productivity growth rate were to be increased by 2 percent per year above the historical norm at even 18,000, or 5 percent, of all small and midsize manufacturers for the period from 1997 to 2001, the resulting rise in value added per worker would average out to a 0.1

percent increase for small and midsize manufacturers as a whole.

Manufacturing Extension Matters

America clearly stands to gain from increased productivity for small and midsize manufacturers. Unfortunately, market forces alone have failed to erase or even narrow the performance gap between smaller and larger firms. Smaller firms have more difficulty than larger ones identifying and carrying out high-priority improvement projects. They lack the in-house expertise, time, technical information and funds required to change their operations for the better, according to a 1993 report from the National Research Council.

Many smaller manufacturers have little or no experience working with outside consultants and cannot find appropriate technical experts to provide high-quality, unbiased assistance. Many consultants and consulting firms choose to work with larger manufacturers and overlook the small-firm market because of the high cost of sales involved in identifying clients and providing services to smaller manufacturers, especially those with fewer than 100 employees.

As the leaders of small and midsize manufacturing firms commit their companies to continuous modernization, they would benefit from the support of resourceful organizations dedicated to their success. A national network of centers with some public support can extend services to smaller manufacturers, overcome the cost of sales barrier that discourages private sector consultants from working with smaller firms, and enable market forces to drive modernization of the industrial base.

The Manufacturing Extension Partnership of the National Institute of Standards and Technology is a strong start to the necessary national resource network for small and midsize manufacturers. The NIST

MEP awards limited federal funding on a competitive basis to private, non-profit manufacturing extension centers that serve firms in specific states and local areas. Each center tailors its services to meet local needs. The MEP centers provide technical expertise and hands-on assistance for projects relating to appropriate technology, production process improvement, quality assurance, business information systems, plant layout, market development, computer-aided design and computer-aided manufacturing, waste reduction, material engineering, work force development, and other priority manufacturing issues.

The federal government's recent commitment to small U.S. manufacturers through the NIST MEP comes decades after our major foreign competitors established similar programs in their own countries. Other nations have long recognized the important contributions smaller manufacturers make to output, living standards and competitiveness. Japan started its Kosetsushi program for small manufacturers in 1923 and invested \$982 million in 178 centers in fiscal year 1994. The Japanese centers logged more than 11,000 plant visits that year using their own staff of 5,200 and another 4,000 private-sector consultants.

Here in this country, the NIST MEP system now includes more than 70 affiliated manufacturing extension centers serving firms in all 50 states and Puerto Rico. During the last six months of 1995, the centers served 12,574 small and midsize manufacturers with a median size of 48 workers. This is a promising commitment to the task of providing ongoing service to scores of thousands of smaller U.S. manufacturing firms interested in industrial modernization.

Continued public investment in manufacturing extension for smaller manufacturers, and continued federal and state investment in the NIST MEP and its network of manufacturing extension centers, offers smaller manufacturers an important

resource in their drive for improved performance. As the NIST MEP network grows and matures, it will contribute greatly to the continued vitality of America's manufacturing sector and in this way strengthen the U.S. economy overall.

Sources of Data and Information

This article drew upon the sources listed below for data and information. Special thanks to Dan Luria of the Industrial Technology Institute and Christopher Heye at Nexus Associates for their assistance. The 1992 data on manufacturing value-added, employment, payroll and establishments by size come from unpublished U.S. Census Bureau information. Calculations made to adjust for inflation in the manufacturing sector used the manufacturing implicit price deflator, 1992=100.

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