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Abstract

This article is based upon the U.S. Department of Commerce's report: "**Manufacturing in America – A Comprehensive Strategy to Address the Challenges to U.S. Manufacturing**" (U.S. Department of Commerce, 2004), along with the other available information. The article introduced the importance of manufacturing in U.S. economy by numerous statistical data; pointed out serious challenges facing U.S. manufacturing; discussed the major strategies to win the worldwide competitions; and emphasized the role of technology and improvements in education.

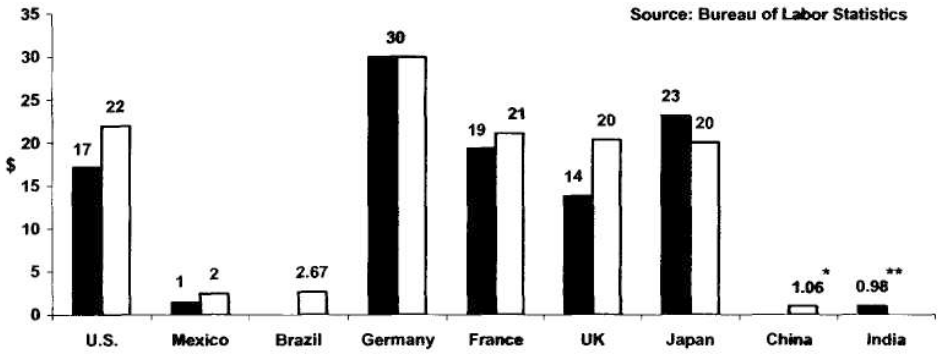
I. Importance of Manufacturing to the U.S. Economy

America's manufacturers provide our nation and our people with good jobs, a better quality of life, and inventions that have established our national identity. The manufacturing sector continues to account for 14% of U.S. Gross Domestic Product (GDP), 11% of total U.S. employment employing over 14 million workers, and accounts for over 60% of U.S. exports. The U.S. manufacturing companies offered higher compensation than most of the countries in the world (see the figure below) (Manufacturing Council Report, 2004). Standing alone, the U.S. manufacturing sector would represent the fifth-largest economy in the world.

The U.S. manufacturing sector also leads in innovation, accounting for more than 90% of all U.S. patents registered annually (See the figure below) (U.S. Department of Commerce, 2004). Investments in technology create new industries and careers in manufacturing as U.S. firms introduce products and cutting-edge manufacturing techniques.

Manufacturing sells goods to other sectors in the economy and, in turn, buys products and services from them. Manufacturing spurs demand for everything from raw materials to intermediate components to software to financial, legal, health, accounting, transportation, and other services in the course of doing business. Every $1 of final demand spent for a manufactured good generates $0.55 of GPD in the manufacturing sector and $0.45 of GPD in non-manufacturing sector (U.S. Department of Commerce, 2002). The service sector, which now makes up more than 70% of the U.S. economy,

Average Hourly Compensation Manufacturing Workers (including baseline wage and fringe)

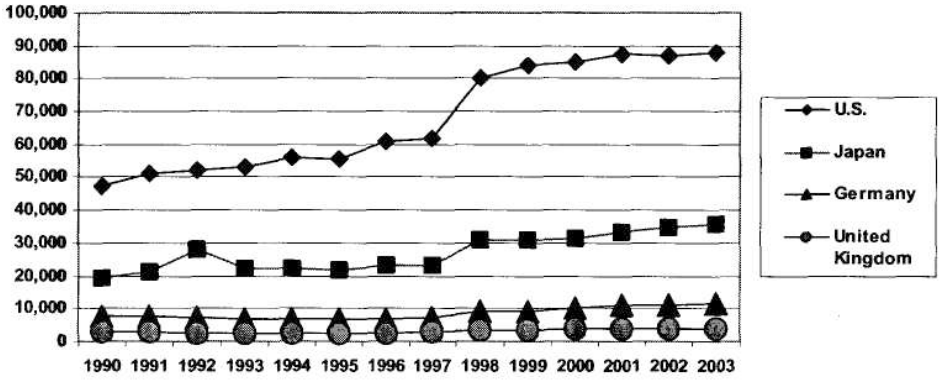


relies on U.S. manufacturers for the goods and technology that spur service sector growth.

The manufacturing sector has generated many of the innovations that have led to significant productivity gains over the past 25 years in manufacturing and throughout the economy. Increases in manufacturing productivity have consistently outpaced other sectors of the U.S. economy. From 1977 to 2002, productivity in the overall economy increased 53%, while manufacturing sector productivity rose 109%. Labor productivity in manufacturing has doubled since 1997. U.S. productivity strongly exceeds that of America's principal trading partners, such as, United Kingdom, West Germany, and France. The United States leads all countries in the absolute level of labor productivity, both per hour and per employee. This position has enabled the United States to maintain its labor cost advantage over these trade competitors despite the higher wages and benefits paid to American workers. The growth in manufacturing productivity has also had a profound effect on the U.S. standard of living. The 31% productivity advantage of the U.S. economy over Organization for Economic Cooperation and Development (OECD) members accounts for three-quarters of the per capita income difference (McGuckin & van Ark, 2002).

In year 2000, the United States reported nearly $1.7 trillion in manufacturing output in the $10 trillion U.S. economy. The manufacturing sector added nearly $6,000 to the per capita income of the American population. Each U.S. manufacturing worker generated approximately $91,525 in manufacturing value added, nearly 9 times that of manufacturing workers in China and India (SRI International, 2004). The average hourly total compensation of production workers in U.S. manufacturing is higher than the average in all other sectors. The advantage of working in the manufacturing sector has derived from the higher level of average benefits received - $8.89 per hour for manufacturing versus $5.94 for non-manufacturing. Manufacturers contribute an average of $0.81 per hour more for health insurance, $0.66 more for overtime and supplemental pay, $0.62 more for leave, $0.29 more for retirement, and $0.34 more for other benefits (U.S. Department of Labor, 2003). Manufacturing output in April 2005 was 10% above the levels in the 4th quarter of 2001. Manufacturing exports totaled $726 billion in 2004, which represents 63% of all U.S. exports of goods and services, and grew by 9.3% from a year ago. Manufacturing profits have continued their upward trend since the recession low, and rose by more than 57% in 2004 compared to 2003. Manufacturing wages and benefits have increased since the 4th quarter of 2001. Average hourly wages in manufacturing rose in May 2005 to $16.52, up 2.7% from a year ago. Benefits have increased 6.3% in the 12 months ending March 2005. Manufacturing productivity has increased 83% over the past 15 years, while productivity in the total non-farm economy has risen only 45% (U.S. Department of Commerce, 2005).

Source: U.S. Patent and Trademark Office



U.S. Leads in Number of Patents Granted per Year - Number of Patents Granted by Year and Country

Output in the United States increased fivefold and real GDP tripled. U.S. real GDP, expressed in 2000 dollars, grew from $11,672 in 1950 to $34,934 in 2002. Between 1990 and 2000, U.S. exports were up 98% and the share of world trade represented by U.S. exports actually grew 11.4% to 12.2% (International Monetary Fund, 2002). The U.S. economy grew rapidly over those same years, exceeding the pace of most other industrialized nations. From 1990 to 2002, the economy expanded at a 3% annual rate – the economy grew from $7 trillion in 1990 to $10 trillion in 2002 (U.S. Department of Commerce, 2002). During that time, the growth in U.S. exports accounted for one-sixth of all growth in the U.S. economy. In sectors such as machinery, computers and electronics, and transportation equipment, exports now make up between 50% and 60% of all sales (Bureau of the Census, 2002). The benefits of trade raised the average annual income of an American family of four by $1,300 to $2,000 (Brown, D. K., Deardorff, A. V., and Stern, R. M., 2002). A further reduction in global barriers by just one-third would increase that family's annual average income by an additional $2,500 a year (Idem, 2002). The Appendix shows comparisons among 12 countries on many economical indices. The data are based on Year 2000 statistics (SRI International, 2004).

II. Challenges Facing U.S. Manufacturers

After seeing the prospects improve in the 1990s, American manufacturing has faced harsh economic conditions. Recessions are typically hard in manufacturing. Of the eight recessions since 1950, real GDP has declined, on average, about 2%, whereas manufacturing output has declined 7%. The recession of 2001 hit the manufactur-

ing sector particularly hard. Manufacturing output declined about 6% from the 4th quarter of 2000 to the 3rd quarter of 2001, over which time real GDP fell 0.5%. Since the onset of the manufacturing employment downturn, the sector has lost 2.6 million jobs, while employment in other sectors has been relatively stable. Manufacturing employment was significantly lower in 2002 than in 1977, falling from 22% of the non-farm economy to under 12% (U.S. Department of Labor, 2002). The data for 2003 showed that the share has fallen further to about 11%. In the 3rd quarter of 2003, manufacturing employment remained 15% lower than in the period immediately before the recession (U.S. Department of Labor, 2003). It is projected that during 2002 – 2012, total U.S. employment is to increase by 21.3 million jobs or 15%. However, the majority of this growth is projected to be in the service-providing sector of the economy. Manufacturing employment is projected to decline by 1% during this period (Bureau of Labor Statistics, 2004).

With growth in world trade and increased mobility of labor, capital, and material resources, nations' competitive advantages are no longer restricted to the natural resources, capital, and labor pool within their geographic boundaries. Rather, advancements in technologies, rapid progression of knowledge in production processes, and new service delivery are creating enormous business opportunities for developing countries that were once unable to compete with developed economies. For example, in recent years, developing countries such as China and Mexico have emerged as preferred destinations for investment and, simultaneously, as major suppliers of manufactured goods for leading firms. Similarly, there has been a strong trend of transfer of technology and service sector jobs to countries like India and Russia in recent years. The rapid globalization of world markets presents American manufacturers with new challenges and opportunities (U.S. Department of Commerce, 2004).

The dynamic is reflected in the sharp decline in the U.S. share of total world R&D spending. Through the 1960s, the U.S. share of global R&D ranged between 60% and 70%. Today, by contrast, the U.S. share is 30%. The R&D intensity of the U.S. economy has remained essentially constant for 40 years, during which time the surge in foreign R&D investment has occurred. The change in R&D funding patterns in technology has led to the broad dispersion of technology worldwide. Advanced, state-of-art manufacturing facilities capable of producing high-quality, low-cost goods are now available worldwide. American manufacturers face competition not only from manufacturers of low-cost commodity products, but also from manufacturers of sophisticated products and the tools to make them (U.S. Department of Commerce, 2004).

With continued outsourcing of manufacturing functions to lower-cost alternatives outside the United States, the United States risks losing the innovation infrastructure of design, research and development, and the creation of new products and industries. Foreign governments have done an effective job of creating a rich environment for the manufacture of high-tech products, such as electronics and semiconductors. The implications are that U.S. high-tech leadership is not guaranteed. The reality is that if the U.S. lost that leadership and if the U.S. didn't have that as a driving force in its economy, the U.S. would loss the ability to maintain and further improve the standard of living in the future. Until recently the United States consumed 40% of the world's semiconductor production. In the past two years, the U.S. share has dropped to 20%, whereas Asia now represents 40% of the world's semiconductor consumption (U.S. Department of Commerce, 2004).

The significant reduction in tariff and non-tariff barriers to trade in manufactured goods globally reshapes the environment in which U.S. manufacturers compete, and creates a new challenge for U.S. manufacturers. The World Trade Organization (WTO), for example, has cut the average tariff on manufactured goods worldwide by 30%. The tariff rate for Organization for Economic Cooperation and Development (OECD) countries, which was 40% at the end of World War II, is now 4% (Organization for Economic Cooperation and Development, 1999). The creation of free trade agreements, such as the North American Free Trade Agreement (NAFTA) between the United States, Canada, and Mexico, has reinforced the trend. Over the past 10 years, NAFTA eliminated tariffs and many non-tariff barriers applicable to the largest three-way trade in the world. Since the creation of the General Agreement on Tariff and Trade (GATT) system, world exports grew from $58 billion in 1948 to $5.98 trillion in 2001. The volume of world exports increased at a compound annual rate of 5.8% in the past 25 years alone (World Trade Organization, 2002). Most of the growth in world trade has been in manufactured goods. The sector now accounts for approximately three-fourths of all trade in goods and 60% of all trade in goods and service combined (World Trade Organization, 2002). While trade in agricultural goods has grown at a relatively strong annual rate of 3% over the last 20 years, exports of manufactured goods advanced at nearly twice that rate, averaging 5.7% per year.

Imports stimulate competition and spur American manufacturing to increase its own quality and productivity. At the same time, however, stronger import competition has put extraordinary pressure on manufacturing industries, including steel, furniture, tool and die, foundry products, textiles and apparel, and automotive parts, while touching advanced technology sectors as well. In 1980, the United States, together with the European Community and Japan, dominated trade in manufacturing, accounting for nearly 75% of the value of world manufactures exports. By 2001, however, that share had fallen to 60%. China's manufactured exports increased from 0.8% of world shipments in 1980 to 5.3% in 2001. China now ranks fourth among exporters of manufacturers worldwide. The market share gains of China and other Asian nations have come at the expense of Ja-

pan and Europe, while the U.S. share of world exports of manufactured goods increased marginally between 1980 and 2001, from 13% to 13.5% (World Trade Organization, 2002).

American companies also face two other challenges related to their legacy costs – pension and the cost of healthcare. The cost of healthcare manufacturers provide to their employees has been skyrocketing, and erodes their competitiveness. The traditional American companies that have large healthcare obligations to retirees are being really harmed. In 2000, the share of U.S. GDP devoted to healthcare was 13.2%, up from 8.8% in 1980, and according to the forecasts, that share will continue to rise and reach 16% of GDP during the next five years (PricewaterhouseCoopers, 2002). The rising cost of healthcare is the biggest barrier to health coverage. The annual family health insurance premium increased to $9,068 in Spring 2003, according to a survey of 2,808 companies by the Kaiser Family Foundation and the Health Research and Education Trust. Further, monthly premiums for employer-sponsored health insurance rose 13.9% between Spring 2002 and Spring 2003. Small firms with three to nine workers, faced the largest increase of all – a 16.6% surge in premiums (Kaiser Family Foundation and the Health Research and Education Trust, 2003). Tort costs of tort claims and awards debilitate manufacturing industries. The indirect costs of tort litigation are also considerable. The tort system undermines the competitiveness of U.S. manufacturers. The U.S. tort liability system is already the most expensive in the world. In 2002, the U.S. tort system cost $223 billion – approximately 2% of the nation's GDP (Tillinghast-Towers Perrin, U.S. Tort Costs 2003 Update).

U.S. manufacturers are suffering higher regulatory costs and the related burdens versus their competitors worldwide. The Office of Management and Budget estimated that the cost of regulation imposed over the last 10 years by the U.S. Government is $35 to $39 billion per year (http://www.whitehouse.gov, 2005). A 2001 study found that U.S. manufacturing firms face a regulatory burden approximately 6 times greater than the average of a U.S. firm, and when adjusted for the number of employees, manufacturing firms face a regulatory burden per employee approximately 2 times greater than the average firm. The regulatory costs were 3.7% of U.S. GDP in 1997. About half of the cost is for compliance with environmental regulations; the remaining is for compliance with workplace safety requirements, as well as for the time spent filling out government paper work and keeping records. Total federal budget outlays for regulatory compliance activities have almost doubled in the past 13 years, from $13.7 billion in1990 to $26.9 billion in 2003. From a manufacturer's perspective, the total cost of complying with regulations in 1997 amounted to $147 billion annually, or a cost per employee of $7,904. The environmental costs accounted for nearly 50% of the total - $69 billion in 1997, or a cost per employee of $3,691. For small manufacturing companies, compliance with workplace rules amounted to $16,920 per employee, while for larger companies, this cost dropped to $7,454 per employee. The total burden of environmental, economic, workplace, and tax compliance is $160 billion on manufacturers alone (Crain, W. M. and Hopkins, T. D., 2001).

Rising energy prices and disruptions in energy supply reduce profits, production, investment, and employment for U.S. industry. Industry uses more than one-third of all the energy consumed in the United States, the majority of which is natural gas and petroleum, followed by electricity. America faces the most serious energy shortage since the oil embargoes of the 1970s. From 1991 to 2000, Americans consumed 17% more energy than they had in the previous 10 years. During the same period, U.S. production rose only 4.9%. America's energy challenge will continue to grow as the U.S. economy grows. Energy consumption in the United States is expected to rise by about 32% by 2020. With rising energy costs, consumer spending slows, lowering demand for manufactured goods. This problem was caused by nearly a decade of neglect. There was not a single major oil refinery built in the United States in nearly a generation. The United States needs 38,000 miles of new gas pipelines, along with 250,000 miles of distribution lines to match the demand for natural gas supply (U.S. Department of Commerce, 2004).

III. Strategies to Compete and Win in the 21st Century

Strengthening American manufacturing is a top priority for the President of the United States (http://www.whitehouse.gov/omb/inforreg/regpol_congress.html). President George W. Bush is committed to policies that create the business environment that encourages innovation, lowers the cost of doing business, makes our economy more flexible, and promotes economic growth. In supporting the President's plan, the Department of Commence continues making progress to ensure the competitiveness of all U.S. industry. Its recommendations can be grouped in the following categories (U.S. Department of Commerce, 2004):

1. Enhance Government's focus on manufacturing competitiveness;
2. Invest in innovation;
3. Create the conditions for economic growth and manufacturing investment;
4. Lower the cost of manufacturing in the United States;
5. Strengthen education, retraining, and economic diversification;
6. Promote open markets and fairness of trade agreements.

IV. Role of Technology

Manufacturing is one of the oldest industries in the technological world, but even the old has to continually implement new concepts and processes if it wants to maintain its competitive edge. Technological innovation is an important vehicle for rising productivity in manufacturing. The technological innovation in manufacturing comes in two forms. First, new inventions provide a leap forward in technology. Many of these inventions derive

from large investments in research and development in the manufacturing sector: manufacturing firms funds 60% of the $193 billion that the U.S. private sector invests annually in R&D. Those technologies are absorbed by the much larger service sector and drive the increasing rates of innovation and productivity growth in that sector. The second form of innovation comes from the steady improvement in products and manufacturing processes within major technology life cycles. Such improvement involves many less dramatic innovations, but collectively these innovations have a positive effect. Both major and incremental innovations improve the competitiveness of the manufacturing sector and the U.S. economy as a whole (U.S. Department of Commerce, 2004).

Global manufacturing has been fundamentally reshaped by the remarkable improvements in computing, communications, and distribution. The evidence of the computer's effect on productivity was clear. Compared with the relatively slow rates of productivity growth experienced between 1973 and 1995, labor productivity grew roughly 1.2 percentage points faster a year from 1995 through 2000, a raise of more than 80% above the previous trend line. Investments in information technology are estimated to account for 60% of that increase in productivity (U.S. Department of Commerce, 2004). The dramatic expansion of computing power and its application to an ever greater range of tasks in the business environment is without a doubt the single most powerful technological change affecting manufacturing today. The increase in computing power has revolutionized product design by introducing computer-aided design that allows much of the product development and testing to be done at a far lower cost in a virtual environment; has revolutionized manufacturing by creating a whole new family of multiple-axis machine tools that offer unmatched precision, quality, and efficiency.

Communications technologies are essential to running high-performance manufacturing operations. New communication technologies create the ability to manage just-in-time inventories and demand-pull manufacturing. Real-time communication is critical to feeding information back into a system that is designed to yield zero defects. Interoperable communication systems provide opportunities for manufacturers and their customers to collaborate in product development. Similarly, new communications technologies allow engineers to conduct real-time product development discussions with colleagues around the world. The revolution in communications has fundamentally changed the way manufacturers do business. Wireless communication means that a cellular phone and a laptop computer can replace a salesperson's office, it also contains the necessary functions to place an order and begin the manufacturing process directly from the point of sale. The communication revolution has also significantly changed the delivery of finished goods to customers. By reducing the costs of distribution, new communications technologies have reduced the cost of the end products. The application of technology has also transformed the distribution of manufactured goods and reduced the costs of transportation.

V. Manufacturing Education

The role of talent is critical to the future viability of America's manufacturing sector. Improving the competitiveness of America's manufacturing also requires the creation of a highly educated and motivated workforce. The 2001 U.S. Competitiveness Report, published by the Council on Competitiveness and co-authored by Professor Michael Porter, stated that "the priorities for sustaining U.S. economic growth and competitiveness center on strengthening the nation's innovative capability and skills of the American workers". The Report further stated that "the nation's ability to commercialize innovation, and further productivity growth, rests on the skills of its workers. But, the bar for skills is rising and demand for high skills is outstripping supply" (Page 50, U.S. Department of Commerce, 2004). Higher-level skills are essential to enable productivity and commercialize innovation. Worker skills and education will be a dominant factor in America's ability to compete in the global economy. The United States' ability to engage in the world economy must be accompanied by a commitment to boost the skills of every worker. Educational institutes must respond by giving every American the tools to prosper in the global economy.

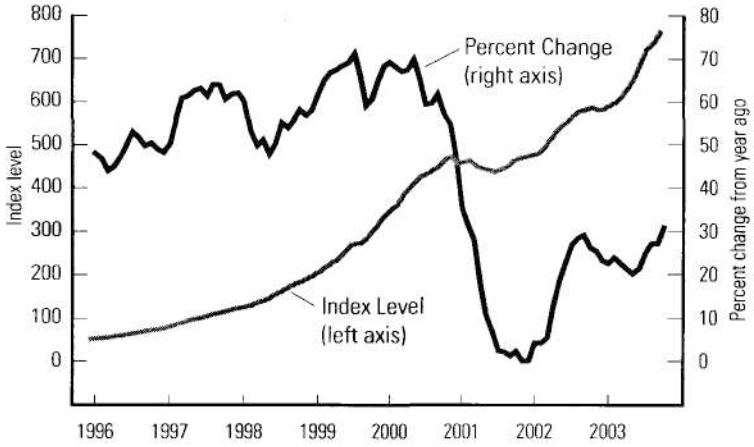
Many manufacturers now spend a considerable amount of time and resources simply training their workers to meet the basic skill levels that workers in other countries have attained by the time they enter the workforce. Even a solid high-school level education is not enough to remain relevant in today's manufacturing sector. Many manufacturing companies are looking for workers who had training beyond high school, up to and including four years of college, for entry into companies' workforce. The reason for that is the increasingly complex capital equipment involved in today's manufacturing processes. Manufacturers stressed the need to concentrate increasingly on readying students for requirements of modern manufacturing and modern marketplace. The potential threat to U.S. technological leadership is from declining numbers of engineering graduates and high school graduates with adequate technical skills to qualify for even entry-level jobs in manufacturing today. Nowadays, manufacturing is not a dirty, oily, old mess anymore. Its technicians are running high-precision equipment. High-tech industrial production is continuously increasing (See figure on next page) (Manufacturing Council Report, 2004). But a pervasive bias against manufacturing based on an old assembly-line image is causing the best and the brightest to pursue careers outside the manufacturing sector.

The comparative advantage in today's manufacturing sector has less to do with physical endowments, such as natural resources, than it has to do with human capital. One of the principal advantages Asia now holds is a very well-educated technical workforce.

Both China and India are graduating high numbers of talented scientists and engineers. In 2002 alone, 59% of all degrees awarded in China were in engineering and the physical sciences, compared with 32% in the United States (See the figure above) (Manufacturing Council Report, 2004). China's 219,600 engineering graduates accounted for 39% of all college graduates, whereas U.S. engineering graduates, a total of only 59,500 engineers, represented a mere 5% of all college graduates in the United States.
According to some U.S. firms' estimates, by 2010, as much as 90% of their research and development, design, and manufacturing will be conducted in either China or India. There is frankly little government can do through tax, cost reduction, and other policies to prevent this shift toward Asia if the United States is not at the same time providing the talent pool necessary to continue spurring innovation. In the United States, the lack of qualified labor is the biggest issue and the biggest roadblock to continuing growth (Page 49, U.S. Department of Commerce, 2004).

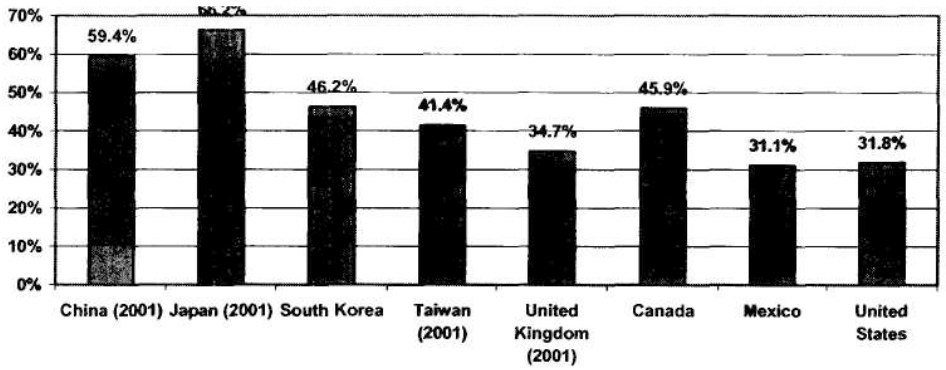
To remain globally competitive, education and workforce training strategies must be at the top of the national priority list. The U.S. Federal Administration is investing $1 billion over five years to improve math and science education. The programs, such as the Department of Commerce's Economic Adjustment Program and the Department of Labor's 21st Century Workforce Initiative Program, are linking workforce development efforts with economic development efforts. Federal programs should prepare elementary and secondary students to enter the workplace without the need for significant remedial education, and vocational-technical education should be sufficient to meet the needs of the U.S. manufacturing sector. Students should learn the necessary skills to make successful transitions from high school to college and from college to the workforce. The future workforce will have to be better trained and more technologically proficient. To maintain

Source: Board of Governors of the Federal Reserve System



High-Tech Industrial Production, 1996-2003
(Notes: High-tech industries are defined for this analysis as computers, communication equipment, and semiconductors.)

Source: OECD, Education at a Glance



Percentage of Bachelor Degrees Awarded in Science and Engineering by Country, Year 2000

increases in productivity with a shrinking workforce, U.S. manufacturers will have to invest in new capital equipment and modernize their production processes. This will require investments in training that will results in more skilled workforce. Applicants who can provide only a pair of hands or a strong back will not find many employment opportunities in manufacturing.

Conclusion

American manufacturers are a cornerstone of the American economy. The American manufacturing sector is facing significant structural challenges from the effects of rapid changing technology and adjustment to a global economy. Developing a sound strategy for the competitiveness of American manufacturing is necessary. Technological innovation is an important vehicle for rising productivity in manufacturing. The role of talent is critical to the future viability of America's manufacturing sector.

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Appendix

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Appendix

Comparisons of Economical Indices among 12 Countries

	Country	GDP (current US$)	GDP Growth (Annual %)	GDP per capita PPP (Intl. $)	GNI per capita	Industry Value added	Man-ufac-turing value added (% of GDP)	Manufacturing, value added (current US$)	Population	Labor force, total	% of Pop. that Works
1	Canada	707,000,000,000	4.56	27,492	21,720		19.00	134,330,000,000	30,800,000	16,500,000	53.57
2	China	1,080,000,000,000	8.00	3,837	840	549,000,000,000	34.51	372,687,804,000	1,260,000,000	757,000,000	60.08
3	France	1,310,000,000,000	3.78	25,126	23,990	295,000,000,000	18.37	240,638,747,000	58,900,000	26,700,000	45.33
4	Germany	1,870,000,000,000	3.00	25,807	25,130	528,000,000,000	24.04	449,506,112,000	82,200,000	40,900,000	49.76
5	India	461,000,000,000	3.95	2,388	450	112,000,000,000	15.72	72,460,994,200	1,020,000,000	451,000,000	44.22
6	Ireland	95,300,000,000	11.46	30,260	22,870	35,300,000,000	32.95	31,398,557,710	3,794,000	1,611,312	42.47
7	Italy	1,070,000,000,000	2.87	24,701	20,130	279,000,000,000	21.41	229,087,321,000	57,700,000	25,700,000	44.54
8	Japan	4,770,000,000,000	2.36	25,735	35,420	1,520,000,000,000	21.59	1,029,657,924,000	127,000,000	68,300,000	53.78
9	Korea, Rep.	462,000,000,000	9.33	15,074	9,010	196,000,000,000	31.28	144,526,305,000	47,000,000	24,000,000	51.06
10	Mexico	581,000,000,000	6.56	8,837	5,100	147,000,000,000	20.35	118,210,027,600	98,000,000	40,400,000	41.22
11	UK	1,430,000,000,000	3.04	24,466	25,200	361,000,000,000	18.65	266,652,815,000	58,700,000	29,400,000	50.09
12	United States	**9,810,000,000,000**	4.18	33,962	**34,370**	2,260,000,000,000	17.23	1,690,389,549,000	**282,000,000**	145,000,000	51.42

* Japan: employment in manufacturing: Japanese Govt data www.stat.go.jp
** Canada: Manufacturing Value added corresponds to 1999 data
*** Korea: Employment in Manufacturing: Korean Govt data http://www.nso.go.kr/cgi-bin/sws888.cgi
**** China: average number of hours in manufacturing, employment in manufacturing refer to 1999

Appendix

Comparisons of Economical Indices among 12 Countries

	Country	Average Number of Hours Worked	Number of Hours worked in Manufacturing	Employment in Manufacturing	Percentage of Total Workforce in Manufacturing	Manufacturing Value added per capita	GDP per capita	Manufacturing Productivity	GDP per Capita Adjusted by Manufacturing Productivity
1	Canada	31.6	38.90	2,187,500	13.26	4,361.36	22,954.55	61,408.00	34,212.69
2	China		37.59	34,957,000	4.62	295.78	857.14	10,661.32	7,358.44
3	France	39.0	38.63	3,842,000	14.39	4,085.55	22,241.09	62,633.72	32,500.59
4	Germany		37.90	8,141,000	19.90	5,468.44	22,749.39	55,215.10	37,709.90
5	India		47.20	6,790,000	1.51	71.04	451.96	10,671.72	3,876.23
6	Ireland	38.0	39.50	270,000	16.76	8275.89	25,118.61	116,290.95	19,769.38
7	Italy	39.3	40.50	4,060,000	15.80	3,970.32	18,544.19	56,425.45	30,079.90
8	Japan	42.7	43.70	13,210,000	19.34	8,107.54	37,559.06	77,945.34	44,102.98
9	Korea, Rep.	47.5	49.30	4,293,000	17.89	3,075.03	9,829.79	33,665.57	26,724.00
10	Mexico	43.8	44.40	5,791,000	14.33	1,206.22	5,928.57	20,412.71	26,582.31
11	United Kingdom	39.8	41.40	3,954,000	13.45	4,542.64	24,361.16	67,438.75	33,062.21
12	United States		41.60	18,469,000	12.74	5,994.29	34,787.23	**91,525.78**	34,787.23

* Japan: employment in manufacturing: Japanese Govt data www.stat.go.jp
** Canada: Manufacturing Value added corresponds to 1999 data
*** Korea: Employment in Manufacturing: Korean Govt data http://www.nso.go.kr/cgi-bin/sws888.cgi
**** China: average number of hours in manufacturing, employment in manufacturing refer to 1999