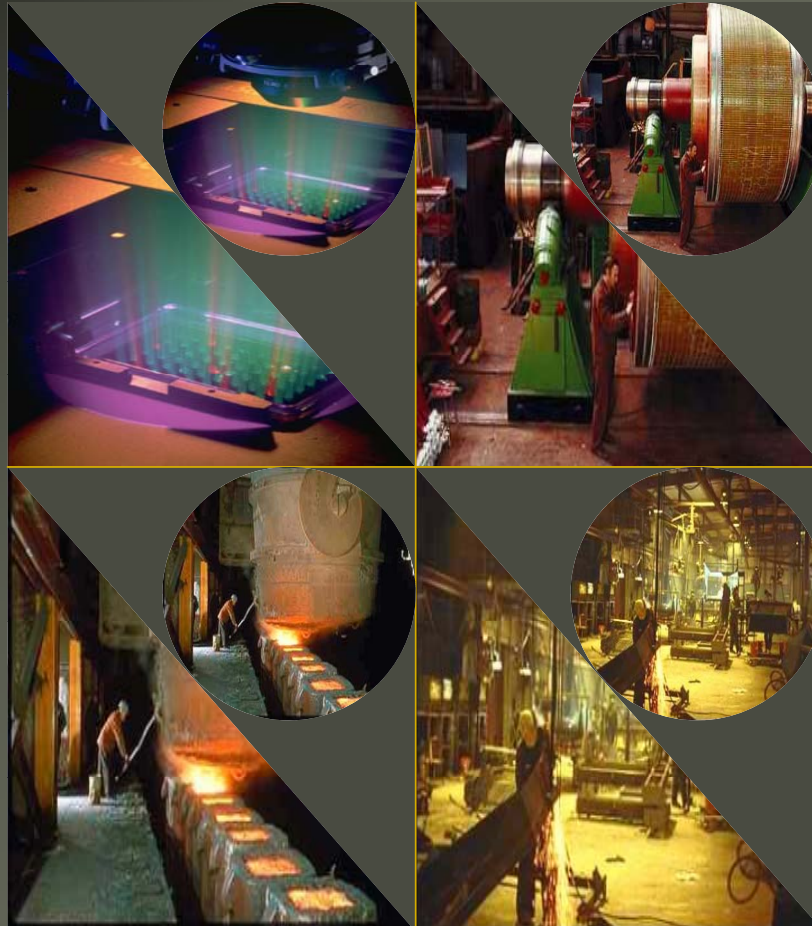


**COMPARISONS & ANALYSES
OF U.S. & GLOBAL ECONOMIC DATA & TRENDS**



Subproject D:

**Globalization: Trends and Impact Factors of
Globalization of Manufacturing Input Factors
on Future U.S. Manufacturing Capability**

March 2004



Manufacturing Extension Partnership



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on Future U.S. Manufacturing Capability**

Prepared by:



Prepared for:

**Futures Group
Manufacturing Extension Partnership
National Institute of Standards and Technology
U.S. Department of Commerce**

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INTRODUCTION

International flows of goods, services and inputs have been growing in absolute and relative terms for decades and even centuries. However, continued trade liberalization and reductions in natural barriers to trade have accelerated this trend. In addition, for a variety of reasons an enormous amount of attention has been drawn to the “new” concept of globalization, which in reality represents a natural continuation of a process in place.

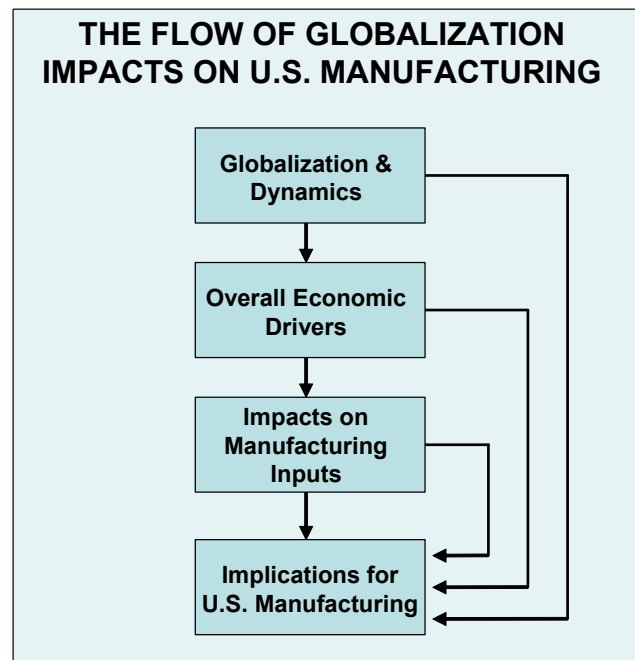
As a shorthand term used popularly to encompass the entire range of factors associated with international economic integration, globalization has become a lightning rod for both political and economic debate. Until recently, globalization was viewed positively by a broad group of constituencies in industrial nations, and was attacked primarily by a small group of vocal opponents who charged that globalization exploited certain market participants. Currently, a growing number of workers and businesses in the United States are questioning the merits of globalization on the grounds that domestic jobs are being lost due to various forms of “offshoring,” or outsourcing of goods and services to overseas companies.

This report explores the nature and impact of globalization on U.S. manufacturing competitiveness and capabilities. The analysis will focus primarily on globalization’s effects on key inputs as the link between globalization and U.S. manufacturing. However, other related trends and drivers will also be noted. This report was prepared by SRI International for the Futures Group of the Manufacturing Extension Partnership (MEP) of the National Institute of Standards and Technology (NIST) as Subproject D under Project 1, “Various comparisons and analyses of U.S. and global economic data and trends.”

The analysis was pursued according to the conceptual framework shown in the following diagram. This framework provides a logical progression of inquiry, starting with the broad course of globalization and its dynamics, then the economic effects of globalization, followed by the impacts of globalization on key manufacturing inputs. As can be seen in the chart, not only do impacts of globalization flow through different categories of factors and ultimately to U.S. manufacturing, but each category itself affects conditions facing U.S. manufacturing.

Following this analytical framework, the paper will proceed through the following course of investigation:

- Section I frames the issue by presenting in summary form a definition of globalization and its overall dynamics. It also examines the role and prospects of the institutional



and policy structure that has “enabled” globalization to proceed.

- Section II explores the overall economic drivers engendered or accelerated by globalization.
- Section III describes the effects of globalization on various categories of inputs to manufacturing.
- Section IV will combine all of the elements to identify the implications of globalization and globalization-induced input trends on U.S. manufacturing capacity and competitiveness.

I. GLOBALIZATION – SETTING THE CONTEXT

A. The Nature and Dynamics of Globalization

Globalization as a term and “phenomenon” emerged in the 1990s, and came into vogue as a means to encapsulate the overarching economic, social, cultural and political dynamics of the world system. As with any broad expression, globalization is subject to many definitions and interpretations. Early on, it was described as a general and reasonably benign trend, “The compression of the world and intensification of the consciousness of the world as a whole...”¹ Globalization was seen as “A social process in which the constraints of geography on social and cultural arrangements recede and in which people become increasingly aware that they are receding.”²

As the decade progressed, the term’s definition was sharpened to reflect a largely economic process, albeit a process that generated important social and political impacts. Thomas Friedman, in his widely popular book, *The Lexus and the Olive Tree*, crystallized this thinking by describing globalization as:

“...the inexorable integration of markets, nation-states, and technologies to a degree never witnessed before – in a way that is enabling individuals, corporations and nation-states to reach around the world farther, faster, deeper and cheaper than ever before....the spread of free-market capitalism to virtually every country in the world.”³

Globalization came to be seen as the ultimate triumph of free-market capitalism over communism, the end of a Cold War battle waged over the course of most of the 20th Century. The breakup of the Soviet bloc and the fall of all but a handful of communist regimes in the late 1980s and early 1990s signaled the defeat of central planning at the hands of market systems. As a result, instead of simply representing the natural extension of forces that have contributed to a “shrinking planet” for centuries, globalization came to take on political connotations. This, in turn, has contributed to the development of a loose “anti-globalization” coalition around the world, consisting of a constantly shifting alliance of groups opposing capitalism or its excesses. Opponents focus on such issues as loss of local control and culture, degradation of the environment, and exploitation of labor, and protests at various international meetings (WTO, IMF, economic summits, etc.) have become violent. As noted in the introduction, the coalition of anti-globalization forces is beginning to add mainstream groups of businesses and workers who see globalization as threatening their positions due to offshoring.

Stripped of its political overtones, globalization can be described as the spread of a capitalist market system throughout the world. This spread is of course not a new phenomenon. It has occurred for at least 500 years, as new transportation technologies enabled regional and international trade to grow in earnest. The modern world system of nation states emerged, and capitalism gradually replaced the static economic system of feudalism.

¹ R. Robertson, *Globalization*, 1992, p. 8.

² M. Waters, *Globalization*, 1995, p. 3.

³ T.L. Friedman, *The Lexus and the Olive Tree: Understanding Globalization*, 1999, pp. 7-8.

Over time, the new system of state-managed capitalism led to an increasing division of labor, both within and between different nations. The birth of modern economic discourse was found in efforts by Adam Smith, David Ricardo and others to advocate trade based on comparative advantage – early globalization. Capital-intensive production was reserved for core (initially European) countries, while peripheral areas provided low-skill labor and raw materials. The Industrial Revolution intensified this division, as well as tensions between center and periphery areas. Imperialist nations extended their reach through various forms of colonization, and eventually most colonies won their independence.

Through the benefits of its geography, sheer size and resource base (and some would suggest superior capitalist policy framework), in the mid-20th Century the United States gained global economic hegemony, driven largely by the enormous U.S. prowess in manufacturing. Mass production capabilities reached new heights, allowing for the satisfaction of consumer needs at high levels of efficiency and the sale of U.S. products throughout the world.

Globally, economic development spread and accelerated dramatically during the second half of the 20th Century. This was spurred by an international commitment to economic liberalization and increasing openness, initiated in the institutions designed at Bretton Woods in 1944. Successive rounds of trade liberalization were accompanied by increasing financial mobility. International agreements were also reached on investment, technology (intellectual property rights) and services. The United States championed the process of economic liberalization.

An ultimate result of this process has been the continuous emergence of new economic powers. Japan and European nations recovered from war damage, and the latter established itself as an integrated economic bloc under the European Community and current European Union. Success in Japan was mimicked initially by the so-called “Four Tigers” (Hong Kong, Singapore, South Korea and Taiwan), and later by Southeast Asian countries. All of these nations were urged by leading countries and international institutions to replace import substitution policies with export-led development strategies. Capital and technology were diffused rapidly by multinational corporations, either directly through their own investments overseas, or indirectly through outsourcing. Over the past decade, the former communist countries entered the global trading system, offering new markets, as well as sources of competition. Finally, China and to a certain extent India have become true powerhouses of manufacturing for global markets, relying heavily on their enormous amounts of low-cost labor.

In short, the world trading system now encompasses nearly all nations. Flows of physical goods are supplemented by increasing flows of inputs other than raw materials, and led by information and technology. The scale of the global distribution of resources, especially labor, generates enormous pressures for structural adjustments in production systems. Herein lies the challenge facing the U.S. manufacturing sector.

The economic outcome of globalization is reflected in the following table. Amounts are presented in current terms rather than real terms.

Selected International Economic Indicators

	1980 (\$ Bil.)	1990 (\$ Bil.)	2000 (\$ Bil.)	Average Annual Growth 1980-90 (%)	Average Annual Growth 1990-00 (%)
Global GDP	11,025	21,812	31,500	7.1%	3.7%
Global Exports	2,387	4,424	7,877	6.4%	5.9%
Global FDI (Outflows)	54	242	1,097*	16.3%	16.3%

* Due to data availability, end year is 1999 rather than 2000.

As one can see from the table, global GDP grew substantially over the two decades of 1980-2000, particularly in the 1980s. Export growth kept pace with GDP expansion in the 1980s, and grew substantially faster in the 1990s. Particularly striking is the growth of global foreign direct investment (FDI), which expanded four-fold in both decades.

B. The Role and Prospects of the Institutional and Policy Structure

As noted in the previous section, globalization was spurred or at least enabled by the post-World War II institutional framework that was designed to avoid the protectionism and downward economic spiral associated with the Great Depression, as well as to stimulate economic collaboration among nations in order to avoid political or military conflict. The Bretton Woods system of institutions included the International Monetary Fund (IMF), the General Agreement on Tariffs and Trade – GATT, the precursor to the World Trade Organization), and the International Bank for Reconstruction and Development (IBRD, or World Bank) have served the international system well, providing not only financial support to countries in need, but also a set of rules and processes for governing international transactions.

These institutions have evolved over time, and in recent years have become known as the engenders and guardians of globalization. This is in fact true. These organizations reflect the collective desire of their member nations to sustain and improve the structure for nations to achieve economic gains through their participation in a system of continuously expanding international economic transactions.

Collectively, these institutions have set forth rules and procedures that provide a strong structure of order for international economic transactions. The trading environment has been consistently liberalized over the past 50 years. Global financial institutions, notwithstanding major shocks such as the oil price shocks, the Latin American debt crisis, the Asian financial “contagion,” and others, has dealt with crises and established a major degree of financial and currency stability.

Over time, as globalization has taken root and extended into all areas of economic transactions, the institutional system has expanded to take on new roles and establish new rules – either formal or informal. Codes of conduct were established for foreign direct investment to preclude or at

least guard against excesses. The WTO expanded its scope to encompass trade in services. Significant efforts have been made to reduce piracy of intellectual property rights.

In short, rules to govern economic behavior are now an integral part of the global economic system, and sanctions have been put into place to punish those who violate international norms. While far from perfect, this legal and institutional fabric provides a commonly agreed to foundation for most forms of commercial transactions. While there is always the chance that this system could unravel in a period of severe economic strain and conflict, this is unlikely, since the stake of participants is high.

The most likely outcome for the global institutional framework is that additional rules and structures will be set forth to address issues that remain contentious, such as labor and environmental practices. These issues remain high on the list of priorities of those who actively oppose globalization. The “system” will probably respond by creating standards and regulations to govern behavior in these areas.

II. THE ECONOMIC REPERCUSSIONS OF GLOBALIZATION

Globalization has and will continue to exert a number of economic impacts. For the purpose of this analysis, which focuses on U.S. manufacturing, these will be felt in several categories of direct relevance to the manufacturing sector – markets, inputs and business models – as indicated in the following chart. The repercussions are presented in summary form in the following discussion.

GLOBALIZATION'S ECONOMIC REPERCUSSIONS

Implications for Markets

- ❑ **A Single Global Market**
- ❑ **Approaching the Perfection of Markets**
- ❑ **Enhanced Importance of Speed to Market**

Implications for Inputs

- ❑ **Increased “Commoditization” of Inputs**
- ❑ **Raised Value of Quality, Performance, Materials**

Implications for Business Models

- ❑ **Restructuring of Corporate Business Models**
- ❑ **Scale and Mass Customization**
- ❑ **Continued Redefinition of Tradable Versus Non-Tradable Products**

Markets

A Single Global Market

The simplest way to envisage the concept of globalization is to consider the global economy as a single market, rather than as several hundred separate national markets, which themselves consist of a vast network of regional and local markets. Therefore, one can simply extend one's thinking to consider economic transactions of any kind as those with someone in a nearby town or state, rather than in another country. This is the natural end result of globalization.

To be sure, buyers or suppliers at the other end of the transaction may speak other languages, may face great physical distances, or may offer different prices or quality, but they do not experience fundamental differences in policy or at least in trade barriers. Risks (currency, contractual, transportation/delivery, etc.) and hence transaction costs will be somewhat higher, but these are unlikely to matter materially in arriving at business decisions. In fact, as cross-border transactions expand and become regular, even these differences will be reduced in magnitude.

Approaching the Perfection of Markets

Globalization, in combination with technology, has been bringing markets much closer to “perfection.” Perfect market conditions form the central axiom of economic theories and relationships, even though these conditions are viewed widely as impossible to achieve. By dramatically improving information, competition, and communications, individually and more importantly collectively, globalization is wringing out many of the imperfections that shaped industries and whole economies.

Perfecting Information and Communications. At the heart of perfect markets is the availability of information – comprehensive and in real time. Information and Communications Technology, which ranges from data processing and manipulation (the work of computer hardware and software) to information transmission, is giving almost anyone access to an unlimited amount of information. The “assumption” of perfect information in economics theorems has always been the most suspect, since the availability of information has always been limited. Physical distance, the lack of effective communications systems, and the natural tendency for those holding “proprietary” information (that which gives someone an advantage) to jealously guard that information from leaking out all worked together to restrict the dissemination of knowledge.

Competitive information such as formulas, methods of production, and materials used in various products used to be guarded through sheer secrecy, and later through patents. In numerous instances, inventors operating in different places worked on the same problem in complete secrecy, thus robbing each other of the small gains made by the others. Historical examples include the development of the light bulb, the sewing machine and the airplane.

All that has changed. The global dissemination of information is accelerating at a truly explosive rate, along both temporal and spatial dimensions. In the field of “news” – terrorist attacks, natural disasters, sports scores, or stock prices – dissemination is almost instantaneous and global. The Internet, while still in its infancy, has already offered the promise of perfect information on an international basis. Once the data sources, search engines and delivery systems are all sorted out, the future holds that almost all human knowledge – all the books, reports, statistical sets and random information that have ever been created will be available to all people in all nations.

Perfecting Competition. Perfect information creates the potential for close to perfect competition. In theory, perfect competition exists when numerous producers vie for limited shares of consumer markets. Competition is so tight that producers effectively drag prices down to a point where profit margins approach zero. Access to new entrants is very easy, but survival rates are low. To a point, perfect competition clearly benefits consumers, since they are offered low prices and enhanced service packages. At its extreme, however, perfect competition can be negative to both producers and consumers, since producers’ low margins preclude investment in new process or product development.

While globalization is clearly increasing competition dramatically, the sheer size and diversity of markets allows for hundreds or thousands more manufacturers than the numbers envisioned in economists theories in most product markets. Specifications, quality, varieties and costs can vary substantially to meet producer and consumer needs.

Perfecting Capital Markets. Globalization and technology are rapidly creating perfect capital markets. Investors worldwide can now choose from a dizzying array of investment instruments, most of which would not be possible without globally available applications of advanced information technologies. Stock prices and trends anywhere in the world can be obtained instantaneously. Similarly, borrowers can obtain hundreds of quotes on a nationwide basis for loans that were once the exclusive reserve of local lending institutions.

Perfecting Labor Markets. Increasingly we are witnessing perfect labor markets. In the past, beyond land and climate, labor was the least mobile factor of production. Advanced ICT has enabled telecommuting on an international basis. Numerous labor inputs (call centers, data entry, design services, specialized software, etc.) are now routinely sourced overseas. Students and workers are also benefiting from technology-driven advances in education and training, which is being revolutionized through distance learning courses, programs and even degrees.

Perfecting Technology Markets. Technology markets themselves are reaching a “near” perfect state. While technology has become the most precious resource for many economic actors, and hence is heavily guarded through intellectual property rights, information about technology breakthroughs is ubiquitous, and exchanges of technology are the currency of modern business enterprise. Technology is a high-value input, but nevertheless one that is accumulated and traded according to increasingly accepted market rules.

Enhanced Importance of Speed to Market

The significance of bringing new products to market quickly has risen in the face of globalization. Penetrating markets rapidly is critical to branding and establishing market shares in a business environment in which competitors can easily enter markets with alternatives. The implication of this trend is that manufacturers themselves require speed in acquiring, adapting and transforming inputs to meet the ultimate market imperative.

Inputs

Increased “Commoditization” of Inputs

In the past, the term commodity was limited largely to basic raw materials such as corn, copper or crude oil. Business analysts now often describe other inputs (or even final products) as having become “commodities,” meaning that they have passed through much of the product cycle from early high profits to current marginal profits, and are now subject to mass production and heavy

competition. This term, which implies declining value, has been expanded in definition to include almost any economic factor. On the positive side, it also implies greater efficiency or consumer gains due to falling prices. A major consequence of globalization is that the available pool of almost all input factors is expanding rapidly. Hence capital and credit, labor, technology and natural resources, as well as other derived inputs, are subject to potential commoditization unless they embody unique characteristics.

The high level of attention being drawn to the “jobless recovery” of the U.S. economy is directly associated with the commoditization of certain categories of labor inputs. In the past, employment losses (or lack of growth) were confined largely to manufacturing industries which required considerable labor inputs from low-skilled or semi-skilled workers. Employment continued to expand in services and high technology sectors. More recently, advanced technologies have enabled firms to offshore inputs in these latter sectors as well, thus creating alarm that most if not all sectors are vulnerable to job losses.

Raised Value of Quality, Performance, Materials

An implication of globalization is that manufactures have the opportunity or need to serve an enormous array of differentiated markets with varying requirements in terms of cost, quality, performance, etc. In this environment, low-end products will be increasingly commoditized, yielding limited margins. Higher-end products will capture more value, similar to branded goods. In order to achieve this differentiation, manufacturers will demand inputs of all kinds which are higher in quality and performance. The primary focus of this requirement will be on labor and on the quality of materials (raw or semi-processed) that can be applied to yield premiums in demand or price.

Business Models

Restructuring of Corporate Business Models

Corporations and the way they conduct business evolve over time for a variety of reasons, including globalization. Other drivers include the increasing focus on generating revenues from intellectual property, the desire to avoid large-scale investments in plants and equipment for debt/equity reasons, etc. A direct result of these factors is a change in the structure and business models employed by major manufacturers. General Electric derives a considerable portion of its revenues from financial services. Cisco maintains almost no production sites of their own, but rather “bundles” outsourced inputs for clients. IBM has concentrated on revenues from intellectual property licensing. The old model in which corporations sought vertical integration of entire value chain production no longer holds. One implication of this is that corporations have been shifting toward a role of “impresario,” managing the recruitment and orchestration of actors, inputs and processes, but not directly taking ownership of them. This in turn reduces their corporate commitment to producing at any given site, domestically or internationally.

Scale and Mass Customization

By expanding the effective market continuously, globalization is creating increasing economies of scale for manufacturing and hence for inputs. This does not necessarily imply the concentration of specific manufacturing sites, since networks of factories spread around the world might offer a better business model. The latter might in fact be preferable in view of the need to cater to regional variations in taste. However, large multinational manufacturers will be looking for sites which provide sufficient quantities of inputs. At the same time, producers will need to address the requirement of mass customization which is important in many markets. Mass customization is the modern concept individualized craftsmanship, but extended to cover large numbers of customers. Mass customization can be applied speculatively (e.g., automobile packages, clothing styles) or individually (e.g., customized personal computers).

Continued Redefinition of Tradable Versus Non-Tradable Products

Historically, certain goods have been considered certain goods non-tradable for a variety of reasons, such as transportation costs, perishability, size, etc. These include bulky or low-value construction materials, certain categories of home furnishings, white goods, perishable foods, etc. Advanced transportation capabilities are making some products more (e.g., foodstuffs) more tradable. Another trend is for more components of products to be outsourced internationally although final goods are assembled domestically. On the other hand, time sensitivity or technological complexity has given rise to higher untradability (e.g., customized medical devices, replacement parts).

III. IMPACTS OF GLOBALIZATION ON MANUFACTURING INPUTS

The technical charge set forth for this subproject called for the examination of impacts of globalization as transmitted through various manufacturing inputs. Globalization is exerting a number of impacts on various inputs, as described below. Most of these developments are well under way, but nevertheless can be projected into the future.

Labor

Migration will be limited to low-skill and high-skill workers. In general, labor will not be able to physically migrate between countries as easily as other inputs (other than land). Exceptions to this rule will be migration (temporary or permanent) of workers to fill (1) very low skilled jobs which are deemed insufficiently attractive to native workers, and (2) high skilled jobs for which companies are willing to expend efforts to obtain visas.

Technology will increasingly enable the “virtual migration” of employment opportunities in mid-skill and high-skill labor categories. As can be seen everywhere in the media, the ability of advanced information and communications technologies to transmit audio and digital data on a real time basis anywhere in the world is creating a furor among workers and domestic suppliers, particularly in industries which were not subject to foreign competition. The offshoring of call centers, software production and even medical diagnostics is seen as a necessity by firms seeking to maintain or improve their competitiveness, and as a direct threat to those vulnerable to offshoring of their jobs or sourcing opportunities.

Skill levels will rise. Globally, labor skill areas will rise as a result of transfers of technology and capital to lower-wage countries. Rising incomes in those areas will allow for greater education and training programs, thus lifting skill levels even further. This development is already well under way in such countries as Korea, Taiwan, Malaysia and Thailand. In the very long run, rising incomes and skill levels will push up wages across the board, but this will take several decades.

Skill levels and resulting compensation will be increasingly polarized. Until the entire global pool of unskilled labor is tapped and integrated into the international trading system, wages for low skill labor will remain fairly static. Alternatively, compensation for higher-skilled workers will continue to rise. This will result in increasing disparities between the low and high skill employment categories, as has been witnessed in recent years. Middle skill categories will remain in the middle, with upward or lower pressures depending on local/domestic conditions, but the dominant trend will be to contain wages as firms seek to maintain competitiveness in the midst of rising wages for highly skilled employees.

Raw Materials

Commodity prices will continue to decline structurally. World commodity prices have encountered a broad structural decline for over a decade. The following table indicates this trend, showing that nonfuel commodities have declined in price by more than one quarter between 1995 and mid-2002. Of major commodity groupings, only fertilizer has remained stable. The

clear implication of this long-term trend is that the terms of trade of commodity producer nations, many of which are developing countries, are experiencing a declining terms of trade for their key exports. This places increasing pressure to generate foreign exchange earnings from other resources, particularly labor. Notwithstanding some changes due to resource depletion, weather variations and other factors, this trend is likely to continue. Continued improvements in mining and cultivation techniques will continue to increase supplies and reduce costs of most commodities.

PRICE CHANGES IN BASIC COMMODITIES

Commodity Grouping	Price Index: June 2002 (1995 = 100)
Total (nonfuel)	73.3
Food	79.9
Agricultural Raw Materials	71.0
Metals	74.1
Fertilizer	100.5

Oil prices will remain relatively stable in the medium term, and growing gradually over the long term. Petroleum prices are subject to severe short-term fluctuations due to political/military strife, weather, OPEC decisions, etc. However, medium and long-term rates have been remarkably stable. According to the Financial Forecast Center, international oil prices as of December 2003 were about \$29/bbl. These prices are anticipated to rise modestly in the winter months of 2004, but fall back to about \$28/bbl by May 2004. Long-term forecasts (extending 5-15 years) typically provide ranges of between \$20/bbl. And \$30/bbl. Ultimately, of course, reserves will be depleted and prices will rise considerably, but the timing of this trend has yet to be determined.

Components and Semi-Finished Goods

High-end components and semi-finished goods will receive heavy R&D investment. The importance of speed to market resulting from globalization reverberates along the supply chain from the end products to the supply of parts, components and materials needed to manufacture them. Due to the intense pressure to be the first to market with leading edge products, high-end components manufacturers in the United States, Japan, and Western Europe will continue to invest heavily in R&D. By being the first to introduce materials that are smaller and lighter, or components that provides higher efficiency, capacity, or increased functions, a supplier can capture the benefits of branding, earn early profits, and gain the next competitive edge by financing R&D for the next generation of products. This is particularly true for components used in telecommunications and information technology products.

Prices and profit margins of low-end components will continue to fall. The commoditization of components once considered high-tech or semi high-tech, such as the printed circuit boards and DRAM chips, will continue to drive their prices down. Over the next decade, intense price competition and the constant drive to find the next lowest-cost product will continue to erode

contract manufacturing production from countries such as South Korea, Malaysia, Mexico, and Singapore, and shift them to lower-cost producers in China and Thailand.

Machinery

Manufacturing production machinery will become increasingly agile, flexible, and sophisticated. This is driven primarily by two impacts of globalization: the mass customization of products, and the importance of speed to market. Machinery has to accommodate quick changeovers in design, product specification, and production quantity with ease, without the need for tools, and requiring only minimal time and labor. The rise of global contract manufacturing also necessitates that machinery become more integrated with CAD/CAM systems.

Industrialized countries will maintain global dominance in advanced production machinery. While globalization will continue to shift manufacturing to developing countries, the manufacture of production machinery, especially advanced machinery, will remain concentrated in industrialized countries, including the United States, Japan and the European Union. Production machinery is increasingly integrated with computer technology, and its design determined by advances in manufacturing and production technologies. The leaders among the manufacturers of equipment for semi-conductor and microelectronics production will maintain high profit margins and enjoy robust international sales.

There will be increasing pressure to establish international standards in production machinery. With the increased flow and homogenization of products around the world, there will be a rising need for international machinery standards in many manufacturing industries. An example is the food processing industry, where health, sanitation, and food safety standards in the importing countries must be met by the plants in producer countries. Pharmaceuticals and the manufacture of pharmaceuticals is another industry that is governed by a myriad of national regulations. As the health, environmental, safety, and other product standards converge around the world, so will standards associated with production machinery.

Design, Programming and IT Systems

Information and communications technology will expand their function and reach in manufacturing industries. As advances in ICT propel the process of globalization, globalization will further drive up manufacturing industries' demand for ICT products and services that will help them do more and perform faster, better and at lower cost. Intense global competition will force manufacturing firms to look for any pockets of operational efficiency improvement and productivity enhancement that can be achieved with better programming and communications technologies. Production machinery will be increasingly integrated with CAD/CAM technologies, and firms will rely more on the Internet and other advanced communications technology to be in constant communication with suppliers, subcontractors, offices, and customers overseas.

Design, programming and IT services will increasingly be provided by global IT clusters, some of which will be located in developing countries. As demand rises for design and ICT services, so will competition among suppliers on a global level. Prior to the collapse of the technology “bubble,” and particularly during the heavy IT activities associated with Y2K remediation, shortages of computer programmers and software engineers in the United States have given rise to increased contracting with overseas IT firms, especially in India, Ireland, and Israel. This business practice introduced U.S. firms to the potential of increasing productivity or reducing costs through offshoring. This trend will continue, and new suppliers and competitors will come onto the scene, most likely firms in China. Increasing demand for ICT services from developing countries will exert downward pressure on wages and pricing.

Technology

Technology will increasingly play the role of “differentiator” among firms and countries with regard to their economic/manufacturing performance and competitiveness. In the past, stocks and availability of capital served as the distinguishing characteristic between “core” and “periphery” nations. More recently, human capital surfaced as a key competitive variable; for example, the United States became a major exporter of certain “labor intensive” products (e.g., aircraft, machinery, medical instruments and devices) in which labor inputs were extensive but in highly skilled categories. Technology embodies both high financial capital and high human capital.

Technology will become viewed and traded as a “traditional” input. Traditionally, manufacturers considered their key inputs to be land and natural resources, labor, capital and machinery/components – things with a physical being. Technology was deemed important, but somehow lay beyond the framework of conventional inputs. The technology boom of the past two decades has lifted and transformed technology into the role of key contributor to manufacturing and all other economic activities. Technology products, rules and markets have been established. Firms formally value their portfolios of intellectual property, and actively trade patents and licenses, sometimes in lieu of conducting manufacturing themselves.

Technology “endowments” will become more concentrated. The United States dominates the global system of technology development and commercialization. Investments in basic research (university-level, national labs), the development of commercialization systems, venture capital, and general technology entrepreneurship have placed the United States well ahead of potential competitors in the technology race. While European nations and Japan urgently seek to reduce this gap, it is likely that the United States will continue to expand its technological edge over competitors, at least over the next decade and most likely well beyond. This means that U.S. manufacturers will continue to be able to develop and roll out advanced products, thus capturing the higher returns associated with early stages of the product cycle. However, as manufacturers themselves become more globalized, they may increasingly choose to locate even first-stage production in offshore production sites.

Finance

The globalization of the capital markets represents a double-edged sword to manufacturing industries. The erosion of national boundaries means that capital will move more freely among countries, chasing the highest returns around the world. On one hand, a freer capital market makes capital more accessible and cheaper to manufacturing industries that are considered good financial investments. On the other hand, financial institutions that were once confined to lending to local industries now have many more investment options: bonds, real estate, and equity in industries overseas. Manufacturing firms not only have to compete with other domestic firms and industries for capital, but also with overseas businesses and industries.

Exporters have more financial instruments at their disposal to manage risks. Another result of globalization and the advances in information and computing technologies is the development of new financial instruments, particularly futures trading. While futures and options for commodities and currencies may be considered volatile and risky for the traders, these financial instruments are useful tools at the disposal of manufacturers, especially those who import and export, to manage currency and other risks related to international trade transactions.

Other Business Services

Management consulting and associated services will increasingly disseminate information on new business models. As globalization broadens the range of opportunities and risks, success will depend increasingly on the manner in which business is conducted. Whether temporary or permanent in nature, new business models will become a key input in manufacturing and other industries. Consulting companies and purveyors of strategic information will serve as the key source of this input.

The importance of marketing will rise. Marketing has played a growing role as manufacturers seek to identify and access new markets and gain greater market shares. Globalization opens up virtually all markets, diminishing the previously natural advantages enjoyed by local manufacturers. Advanced marketing techniques can be applied to determine customer segmentation with precision, transform global brands into local brands in the minds of consumers, and develop targeted product appeal.

IV. IMPLICATIONS FOR U.S. MANUFACTURING

The U.S. manufacturing sector has clearly undergone significant changes as a result of globalization. The most visible impact has been felt through increased competition from foreign supplies of consumer goods requiring large amounts of low-skilled and semi-skilled labor inputs. For decades, the locations of manufacturing of certain categories of goods (e.g., apparel, footwear, toys, consumer electronics, etc.) purchased by U.S. consumers have migrated, first to low cost regions in the United States and later to foreign countries. More recently, attention has been drawn to a widening array of more sophisticated electronic products such as computers and communications equipment.

Before proceeding with an assessment of impacts on U.S. manufacturing, it is useful to gain a perspective on the macro-level scale of globalization's effects on the U.S. economy. The following table provides some interesting macro indicators.

SELECTED U.S. ECONOMIC INDICATORS

	1980 (\$ Bil.)	1990 (\$ Bil.)	2000 (\$ Bil.)	Ave. Annual Growth 1980-90 (%)	Ave. Annual Growth 1990-00 (%)
U.S. GDP	2,772	5,751	9,817	7.6%	5.5%
U.S. Exports (goods & services)	280	557	1,096	6.3%	6.0%
Merchandise Exports	226	394	782	5.7%	7.1%
Manufactured Exports	161	315	692	7.0%	8.2%
U.S. Imports (goods & services)	294	629	1,476	7.9%	8.9%
Merchandise Imports	294	629	1,476	7.3%	9.4%
Manufactured Imports	245	495	1,218	11.3%	10.0%
FDI Inflows	17	48	314	11.1%	19.3%
FDI Outflows	19	31	143	4.9%	21.1%
Manufactured Goods Exports/Merchandise Goods Exports (%)	71%	80%	88%		
Manufactured Goods Imports/Merchandise Imports (%)	45%	62%	83%		

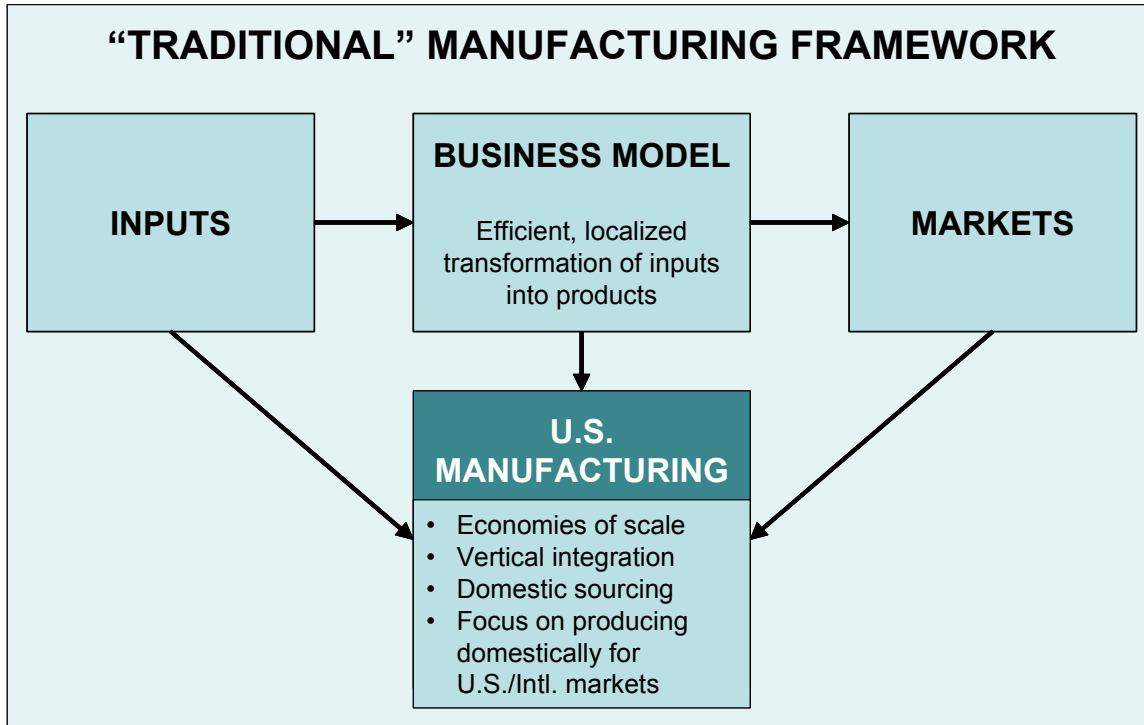
U.S. export growth lagged slightly behind the expansion of overall U.S. GDP in the 1980s, but export growth exceeded output growth in the 1990s. Throughout this period, exports of manufactured goods expanded at a faster pace than either overall merchandise exports or overall exports (including services). Thus manufactures represented the key driver behind U.S. export growth. The same phenomenon occurred in the import sector, which grew at an even faster pace. Global trade is being fueled largely by manufactures, since the share (in terms of value) of raw agricultural goods, minerals and other commodities – once the core of international trade – continues to decline.

Inflows of foreign direct investment (FDI) into the United States far exceed outflows of FDI in the 1980s. While outflows grew at a slightly faster rate in the 1990s, inflows of foreign capital in the year 2000 were more than double outflows. Globalization thus led to a considerable amount of foreign capital being invested in the United States.

Each of the developments, trends and impacts presented above affect the structure, activities, competitiveness and growth prospects of U.S. manufacturing. The following two charts provide a visualization of how the individual and aggregated impacts can be approached.

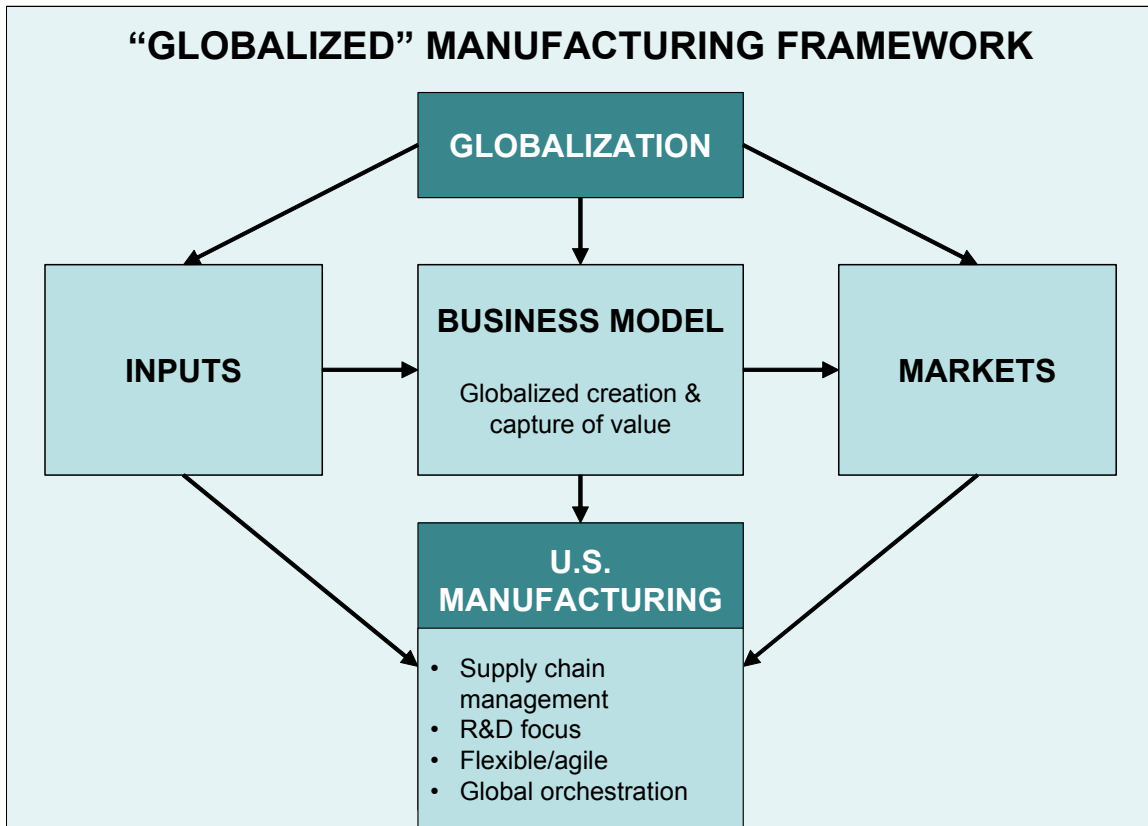
The first chart shows the traditional (pre-globalization) world in which U.S. manufacturing used to operate. The core function for manufacturers, then as now, was to employ an effective business model to link various inputs with market demand. The goal of the business model (or models) was to carry out efficient transformation – localized to the maximum extent possible – of inputs into products.

This approach, most often geared toward mass production, was characterized by economies of scale, vertical integration or domestic sourcing (to avoid the complexities of importing), and focused on producing domestically to serve largely domestic markets and to a lesser extent overseas markets through exports. At least in the United States, the pre-globalization framework was driven almost exclusively by domestic factors, since the vast majority of markets were domestic, and imported inputs consisted mainly of materials not available domestically.



The second chart indicates the manner in which globalization is altering the paradigm of U.S. manufacturing. First, globalization directly affects inputs, business models and markets as described previously in this report. While the core function of manufacturing remains the same, constantly changing business models are applied not to localized transformation but rather to the international creation and capture of value. Value is assigned by the global (rather than strictly domestic) market, and the creation and capture of value can be derived from much more than simple manufacturing transformation – value can flow from intellectual property, financing, innovative packaging of products and services, and any other item along the value chain.

In this globalized framework, producers concentrate on managing rather than owning or controlling the supply chain. Major emphasis is placed on R&D and technological innovation, and on flexibility and agility. As a result, manufacturing companies are broadening their core competencies beyond manufacturing. They are becoming orchestrators of a wide range of productive economic activities that ultimately lead to products and services sold in the market.



The following tables summarize the impacts of globalization noted previously in this report. The first indicates influences on overall systemic factors relevant to U.S. manufacturing. The second notes effects on different categories of inputs. Numbers have been assigned to each of the impacts.

SYSTEMIC IMPACTS OF GLOBALIZATION ON KEY ECONOMIC FACTORS

Category of Impact	Nature of Impact
<i>Markets</i>	1. A Single Global Market
	2. Approaching the Perfection of Competition and Markets for Information and Communications, Capital, & Labor
	3. Enhanced Importance of Speed to Market
<i>Inputs</i>	4. Increased “Commoditization” of Inputs
	5. Raised Value of Quality, Performance, Materials
<i>Business Models</i>	6. Restructuring of Corporate Business Models
	7. Scale and Mass Customization
	8. Continued Redefinition of Tradable Versus Non-Tradable Products

IMPACTS OF GLOBALIZATION ON MANUFACTURING INPUTS

Category of Impact	Nature of Impact
<i>Labor</i>	9. Migration will be limited to low and high-skill workers.
	10. Skill levels will rise.
	11. Skill levels & resulting compensation increasingly polarized.
<i>Raw Materials</i>	12. Commodity prices will continue to decline structurally.
	13. Oil prices will remain relatively stable in the medium term, and growing gradually over the long term.
<i>Components & Semi-Finished Goods</i>	14. Heavy R&D investment in high-end components & semi-finished goods.
	15. Low-end component prices & profit margins will continue to fall.
<i>Machinery</i>	16. Manufacturing production machinery will become increasingly agile, flexible, and sophisticated.
	17. Industrialized countries will maintain global dominance in advanced production machinery.
	18. There will be increasing pressure to establish international standards in production machinery.
<i>Design, Programming and IT Systems</i>	19. Information and communications technology will expand their function and reach in manufacturing industries.
	20. Global IT clusters provide design, programming & IT services.
<i>Technology</i>	21. Technology will increasingly play the role of “differentiator.”
	22. Technology will become viewed & traded as a “traditional” input.
	23. Technology “endowments” will become more concentrated.
<i>Finance</i>	24. Capital market globalization a double-edged sword to producers.
	25. More financial instruments for producers to manage risks.

Category of Impact	Nature of Impact
<i>Other Business Services</i>	26. Management consulting and associated services will increasingly disseminate information on new business models.
	27. The importance of marketing will rise.

All of these (and other) impacts combine in various ways to affect U.S. manufacturing. Some of the key implications of these dynamics are presented below. In most cases, the impacts reflect the outcomes of a group of factors rather than a single variable associated with globalization. The key impacts driving these projected outcomes are presented by number in parentheses at the end of each outcome.

The concept of manufacturing and the difference between goods and services will continue to blur. In the past, manufacturing was viewed largely as conducting and usually controlling nearly the entire process of transformation of inputs into final goods. This is changing with outsourcing. Is Dell a computer manufacturer or a packager and shipper with online logistics? In addition, goods are closely associated with allied services (or *vice versa*), which may represent a significant portion of the value of the combined product/service. Another implication of the goods/services blurring is increasing global competition in services – both “business-to-business” and “business-to-customer.” Foreign competition in many service areas was previously limited by distance and communications difficulties. Advanced IT capabilities are reducing this barrier, leading to the shifting of certain service jobs to foreign suppliers. (2, 5, 6, 8)

The nature and activities of “manufacturers” will expand beyond manufacturing. As a corollary to the implication noted above, firms that were viewed and classified as manufacturers are becoming less so. As noted previously, IBM is becoming a manager and seller of intellectual property, and General Electric is a leading financial services firm. Westinghouse has morphed into a media company. Large multinationals will encounter rising pressures to become conglomerates from the perspective of types of activities undertaken as opposed to the traditional concept of types of industries involved. (3, 5, 6, 7, 8)

The global division of manufacturing will be driven by “bundles” of inputs. The United States is highly competitive in technology, highly skilled labor, finance, design and information technology. This bundle of absolute and comparative advantages will shape the nature of U.S. manufacturing. For example, growth can be expected in leading edge technology products, complex systems (telecommunications, environmental, logistics, etc.), heavily designed goods, products with embedded IT and other electronic technologies, and so forth. (4, 5, 9-27)

Competition on the global “ladder” of manufacturing sophistication will become more pronounced. One can envision the locations of manufacturing for products of different levels of technological sophistication as falling on different rungs of a ladder. In general, the United States and several other industrial countries continuously struggle to stay at the top rungs of the ladder. The newly industrializing countries, primarily in Asia but in some cases in Central/Eastern Europe and Latin America, operate on the middle rungs. Lower-income nations occupy the lower rungs. Capabilities associated with globalization (facile transfer of technology,

telecommunications, out-sourcing, etc.) give rise to opportunities for nations on the low rungs (e.g., China, India) to move more quickly up the ladder in particular product categories. This exerts more pressure on newly industrializing countries, and so on. The location of production sites will be driven by the capabilities and costs of alternatives, which implies greater specialization. (1, 2, 4, 11, 19, 21, 23).

U.S. manufacturing will increasingly become the nucleus of innovation “spin-offs.” The concept of a spin-off is when some activity is designed and incubated in one organization, but eventually is transferred (spun off) to another entity. This process is at least initially controlled by the organization that comes up with the innovation, as opposed to the copying of new products/processes by non-affiliated firms (e.g., VCRs, PCs, etc.). U.S. companies recognize that in view of the shortening of the product cycle due to globalization and other factors, a productive strategy is to play the role of innovator and entrepreneur, yielding temporary returns as direct manufacturers and longer term profits through licensing and strategic alliance relationships as other companies assume the role of principal manufacturer. (2, 3, 6, 21, 23, 26, 27)

U.S. manufacturers will adjust their operations to maximize access to appropriate labor skills. To obtain labor inputs in middle skilled areas, companies will seek to either outsource or to establish operations in areas in which such labor is plentiful. This is the phenomenon now being experienced in China. The impact of this situation will be felt mainly on reduced employment opportunities and downward pressures on wages for semi-skilled workers. Opportunities and wages for low and high skill categories will vary on local labor supply/demand conditions. (2, 9, 10, 11)

This approach provides a conceptual framework in which globalization repercussions can be identified, assessed, debated and amended. One can argue with individual systemic or input impacts, and consequently change, add or subtract items. In addition, one could assign weights to estimate the relative importance of different drivers. Ultimately, the framework offers a means to construct a logical structure to analyze globalization drivers and their consequences for U.S. manufacturing.