CHAPTER 11

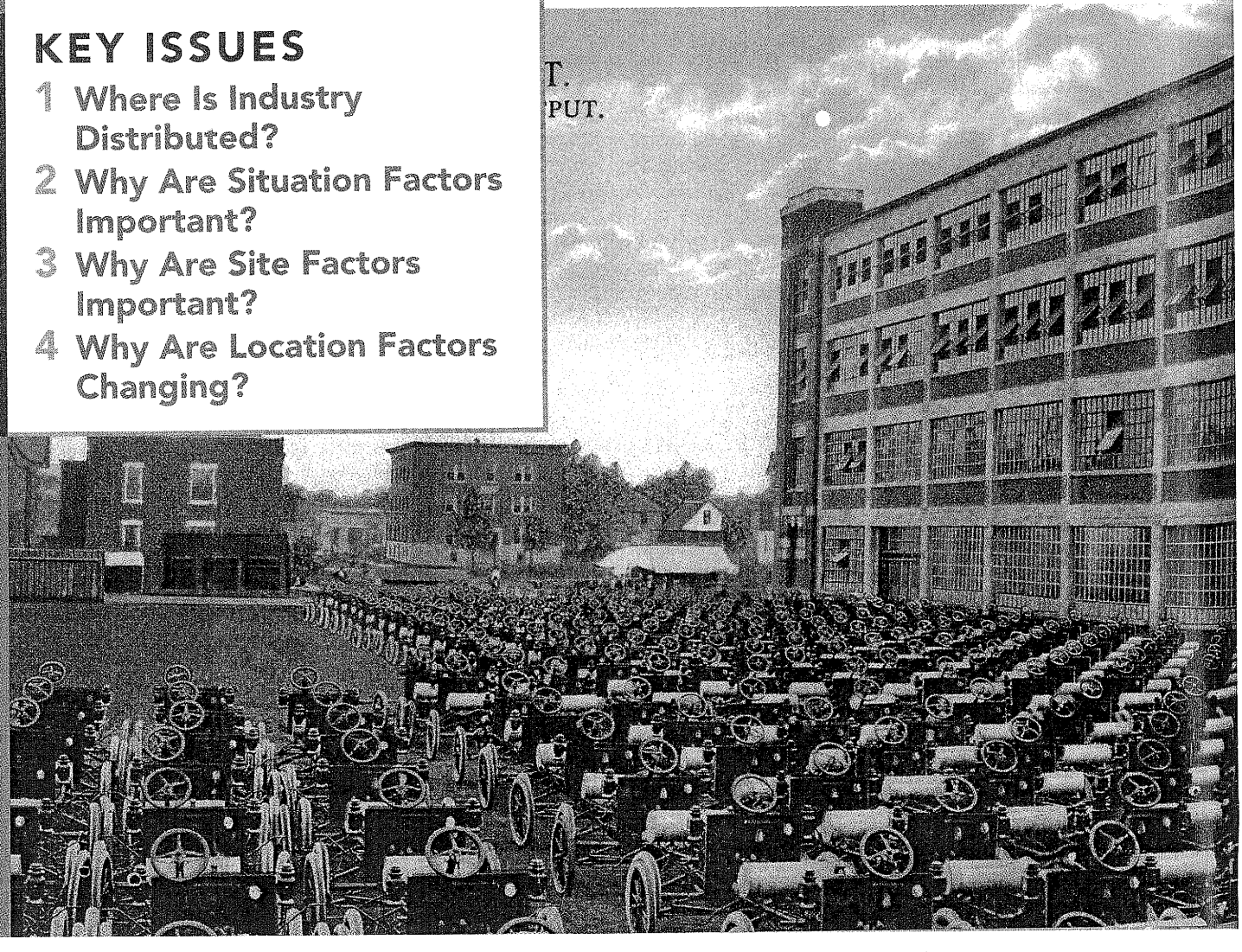
Industry

Huffy bicycles were manufactured in Ohio for more than a century, first in Dayton, where George P. Huffman founded the company's predecessor Davis Sewing Machine Co. in 1892, and beginning in 1954 at the world's largest bicycle factory in Celina. Huffy's two main U.S. competitors, Murray and Roadmaster, also manufactured bicycles in Ohio beginning in the 1930s, both in Cleveland.

In the 1950s, Murray and Roadmaster both moved bicycle production out of Ohio, Murray to Lawrenceburg, Tennessee, and then in the 1990s to Mississippi. Roadmaster moved to Little Rock, Arkansas, and then in the 1960s to Olney, Illinois. Huffy held out in Celina

KEY ISSUES

1. Where Is Industry Distributed?
2. Why Are Situation Factors Important?
3. Why Are Site Factors Important?
4. Why Are Location Factors Changing?



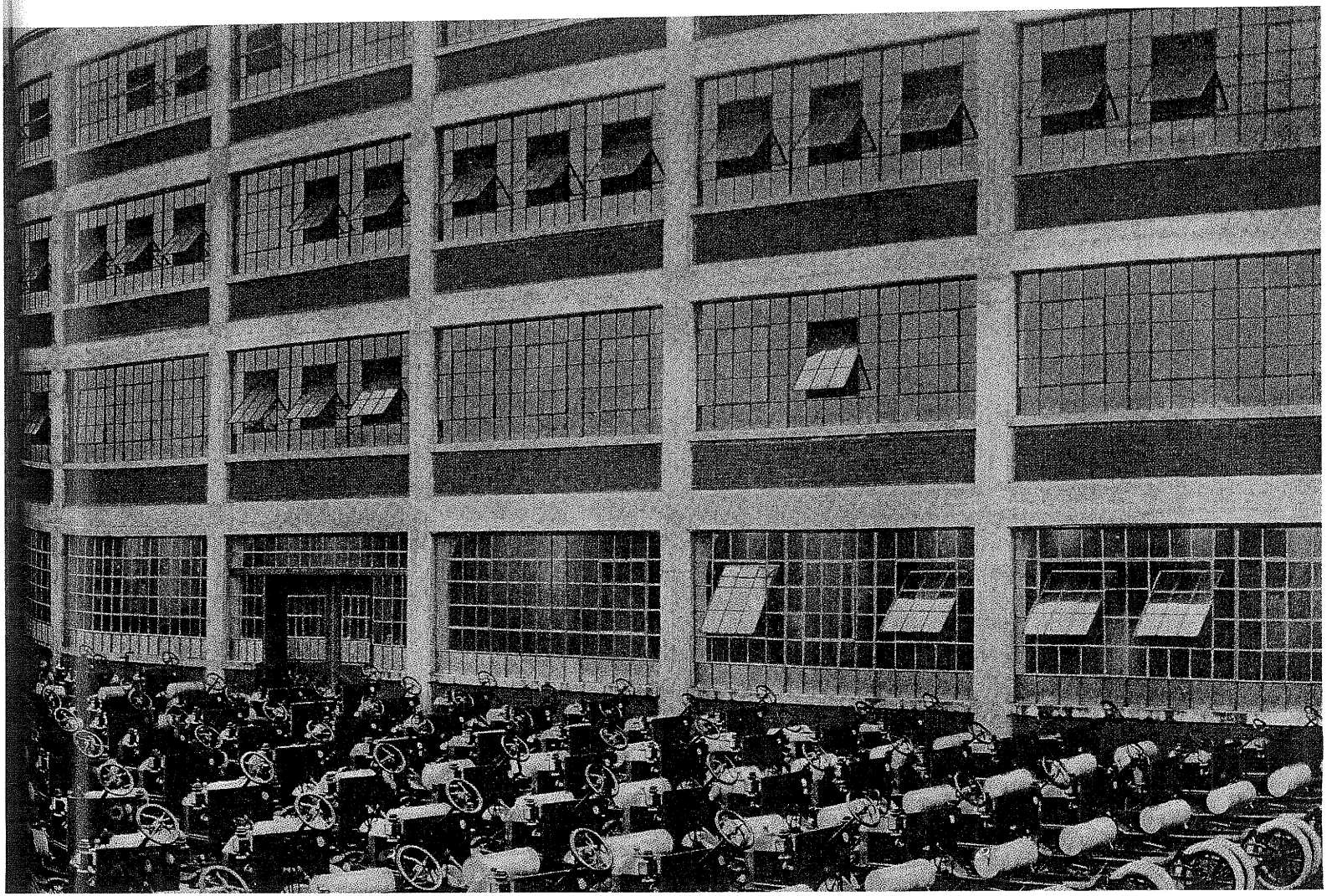
until 1998, when it moved production to Missouri for a year and then to Mexico.

In 1999, all three companies, as well as other U.S.-based bicycle manufacturers, including Schwinn, were sold to Pacific Cycle, a division of a Canadian company Dorel Industries. Pacific Cycle "designs, markets, and distributes" bicycles, according to its web site. What Pacific Cycle doesn't do is actually manufacture bicycles. All of the U.S. factories it had acquired were closed. Instead, Pacific Cycle contracts with companies in China to make the bicycles.

The bicycle story is not isolated. Ohio Art Co. moved production of its *Etch A Sketch* toy from Bryan, Ohio, to Shenzhen, China, in 2000. Maytag moved production of its refrigerators from Galesburg, Illinois, to Reynosa, Mexico, in 2002. Carrier Corp. moved production of its refrigeration units from Syracuse, New York, to Singapore in 2003. Hoover vacuum cleaners, once made in North Canton, Ohio, have been produced since 2007 by a Chinese company, Techtronic Industries Co.

Ultimately responsible for the changing geography of manufacturing is the American consumer. When Huffy bicycles were made in Celina, they sold for $80. After production was shifted overseas, the price came down to $40. For nearly all consumers, low price is much more important than place of origin.

Postcard from 1916, titled "The Ford Motor Plant [in Highland Park, Michigan] and 1,000 cars, a single day's output."



CASE STUDY / Maquiladoras in Mexico

Edi Bencomo is a factory worker in Chihuahua, Mexico. Her job is to clip together several color-coded wires for Alambrados y Circuitos Eléctricos, a factory that is owned by Delphi Automotive Systems. Bencomo migrated to Chihuahua 4 years ago, at age 16, from Madera, a village in the Sierra Madre Occidental, a mountain range 250 kilometers (150 miles) to the west. One of seven children, Bencomo saw no future for herself in remaining on her parents' corn farm. Had she remained in Madera, Bencomo probably would have been unemployed, along with 25 percent of the villagers.

In Chihuahua, Bencomo lives with her husband in a two-room shack more than an hour from the plant. They can afford to rent a somewhat better dwelling, but none are available in this rapidly growing city. She leaves home each weekday at 4 A.M. to battle hordes of workers who crowd onto buses that serve the factory area.

Bencomo earns about $4 an hour. She also receives two important benefits by working for Alambrados—a bus pass so that she can reach the plant at no cost and two meals in the cafeteria, paid for almost entirely by the company. She considers her job to be superior to that of her husband, who makes piñatas; both are paid minimum wage, but he receives no benefits.

Delphi's Chihuahua plant is known as a **maquiladora,** from the Spanish verb *maquilar*, which means to receive payment for grinding or processing corn. The term originally applied to a tax when Mexico was a Spanish colony. Under U.S. and Mexican laws, companies receive tax breaks if they ship materials from the United States, assemble components at a *maquiladora* plant in Mexico, and export the finished product back to the United States. More than 1 million Mexicans are employed at over 3,000 *maquiladoras*. Delphi has more than 50 *maquiladoras* employing 75,000 people and is one of Mexico's largest employers. ■

The title of this chapter, "Industry," refers to the manufacturing of goods in a factory. The word is appropriate because it also means persistence or diligence in creating value. A factory utilizes a large number of people, machinery, and money to turn out valuable products.

In the previous chapter, we looked at agriculture, practiced throughout the inhabited world because the need for food is universal. Industry is much more highly clustered in *space* than is agriculture. In this chapter, we look at the *regions* where factories are located and *why*. A particular *place* may be well suited or poorly suited for industry, depending on the distinctive characteristics of land, labor, and capital there.

Geographers also recognize that *connections* with the rest of the world are critical in determining whether a particular place is suitable for industry. Two connections are critical in determining the best location for a factory—*where* the markets for the product are located and where the resources needed to make the product are located.

A generation ago, industry was highly clustered in a handful of communities within a handful of MDCs, but industry has diffused to many communities in many LDCs. The United States lost one-third of its manufacturing jobs during the first decade of the twenty-first century. Americans alarmed by this loss heard "a giant sucking sound" of manufacturing jobs being "sucked" into other countries from recently closed U.S. factories. The future of manufacturing in the United States was "now in jeopardy," according to the National Association of Manufacturers, a leading industry group.

Government officials everywhere recognize the powerful role of industry in the economic health of a community. Manufacturing jobs are viewed as a special asset by communities around the world and they mourn when factories close and rejoice when they open. To attract and retain them, officials offer financial support that, when scrutinized by independent analysts, is considered excessive.

Americans' fears of manufacturing job losses were echoed elsewhere in the world. A former president of the European Union warned against the "deindustrialization of Europe." Japan's loss of manufacturing jobs to overseas locations was called a "hollowing out" by Japanese politicians. In Mexico, the loss of manufacturing jobs during the early twenty-first century led to "a wave of soul-searching."

Transnational corporations operate at a global *scale* of concern for the distribution of markets and resources. Raw materials may be collected from many places, sent to factories located in several other places for a succession of specialized manufacturing procedures, and shipped to consumers located in yet other places.

With *globalization* of competition to attract new industries—or, in many places, to retain existing ones—each place possesses distinctive location characteristics. Geographers identify the *local diversity* in assets that enable some communities to compete successfully for industries, as well as handicaps that must be overcome to retain older companies.

KEY ISSUE 1
Where Is Industry Distributed?

- Origin of Industry
- Industrial Regions

The modern concept of industry—meaning the manufacturing of goods in a factory—originated in northern England and southern Scotland during the second half of the eighteenth century. From there, industry diffused in the

nineteenth century to Europe and to North America and in the twentieth century to other regions. ■

Origin of Industry

The **Industrial Revolution** was a series of improvements in industrial technology that transformed the process of manufacturing goods. Prior to the Industrial Revolution, industry was geographically dispersed across the landscape. People made household tools and agricultural equipment in their own homes or obtained them in the local village. Home-based manufacturing was known as the **cottage industry** system.

The term *Industrial Revolution* is somewhat misleading, because the transformation was far more than industrial, and it didn't happen overnight. The Industrial Revolution resulted in new social, economic, and political inventions, not just industrial ones. The changes involved a gradual diffusion of new ideas and techniques over decades, rather than an instantaneous revolution. Nonetheless, the term is commonly used to define the process that began in the United Kingdom in the late 1700s.

The root of the Industrial Revolution was technology, involving several inventions that transformed the way in which goods were manufactured. The revolution in industrial technology created an unprecedented expansion in productivity, resulting in substantially higher standards of living. In Chapter 2, the Industrial Revolution was cited as a principal cause of population growth in stage 2 of the demographic transition.

The invention most important to the development of factories was the steam engine, patented in 1769 by James Watt (1736–1819), a maker of mathematical instruments in Glasgow, Scotland (Figure 11-1). Watt built the first useful steam engine, which could supply power far more efficiently than the watermills then in common use, let alone human or animal power. The large supply of steam power available from James Watt's steam engines induced firms to concentrate all steps in one building attached to a single power source.

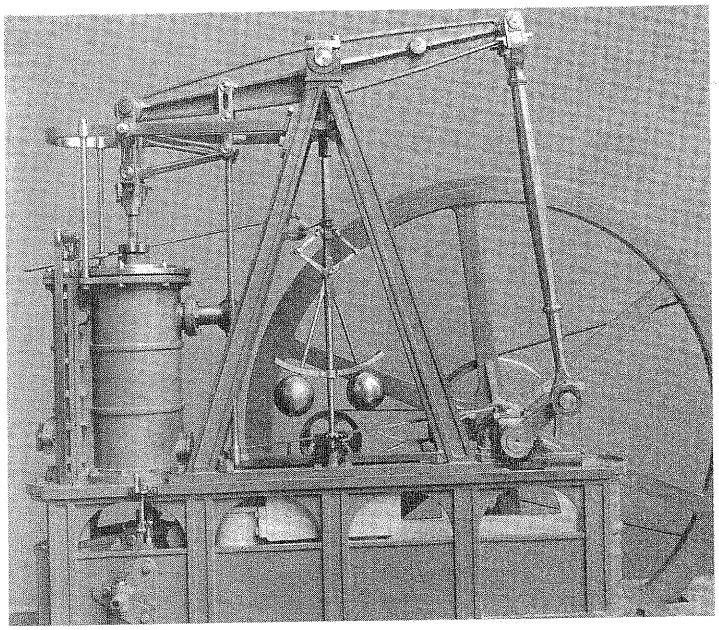


FIGURE 11-1 James Watt's steam engine. Steam injected in a cylinder (left side of engine) pushes a piston attached to a crankshaft that drives machinery (right side of engine).

Industries impacted by the Industrial Revolution included:

- **Iron:** The first industry to benefit from Watt's steam engine. The usefulness of iron had been known for centuries, but the scale of production was small. The process demanded constant heating and cooling of the iron, a time-consuming and skilled operation because energy could not be generated to keep the ovens hot for a sufficiently long period of time. The Watt steam engine provided a practical way to keep the ovens constantly heated.

  Henry Cort, a navy agent, established an iron forge near Fareham, England, to shape iron into useful objects. The combination of Watt's engine and Cort's iron purification process increased iron-manufacturing capability.
- **Coal:** The source of energy to operate the ovens and the steam engines. Iron production requires a source of heat to smelt the iron ore as well as to run the furnaces, forges, and steam engines. Wood, the main energy source prior to the Industrial Revolution, was becoming scarce in England because it was in heavy demand for construction of ships, buildings, and furniture, as well as for heat. Manufacturers turned to coal, which was then plentiful in England.

  Abraham Darby of Coalbrookdale in Shropshire, England, produced high-quality iron smelted with purified carbon made from coal, known as coke. Coke is richer in carbon and more combustible than coal, so it is a better source for the heat and gases needed to smelt iron ore.
- **Transportation:** Critical for diffusing the Industrial Revolution. First canals and then railroads enabled factories to bring in bulky raw materials such as iron ore and coal and ship finished goods to consumers (Figure 11-2).

  Europe's political problems retarded the diffusion of the railroad. Cooperation among small neighboring states was essential to build an efficient rail network and to raise money for constructing and operating the system. Because such cooperation could not be attained, railroads in some parts of Europe were delayed 50 years after their debut in Britain.
- **Textiles:** Transformed from a dispersed cottage industry to a concentrated factory system during the late eighteenth century. Prior to the Industrial Revolution, thread was spun at home on spinning wheels operated by hand and foot. People known as putters-out were hired by merchants to drop off cotton or wool at homes, where women and children sorted, cleaned, and spun it into thread. The putters-out then picked up the finished work and paid according to the number of pieces that were completed ("piece-rate").

  In 1768, Richard Arkwright, a barber and wigmaker in Preston, England, invented machines to untangle cotton prior to spinning. Too large to fit inside a cottage, spinning frames were placed inside factories near sources of rapidly flowing water, which supplied the power. Because the buildings resembled large watermills, they were known as mills.

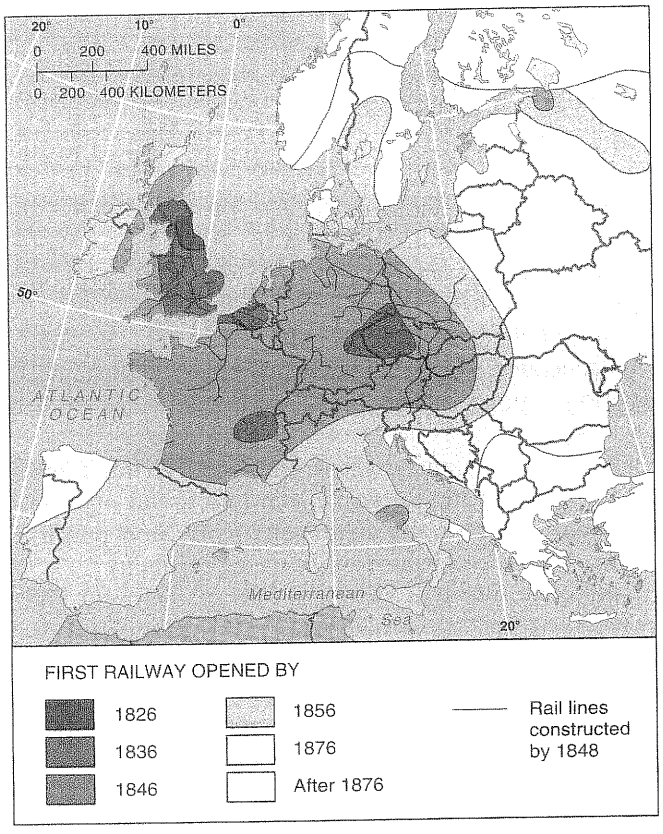


FIGURE 11-2 Diffusion of Industrial Revolution. The construction of railroads from the United Kingdom to the European continent reflects the diffusion of the Industrial Revolution. More than 50 years passed between the construction of the first railroads in Britain and the first ones in Eastern Europe.

- **Chemicals:** An industry created to bleach and dye cloth. In 1746, John Roebuck and Samuel Garbett established a factory to bleach cotton with sulfuric acid obtained from burning coal. When combined with various metals, sulfuric acid produced another acid called vitriol, useful for dying clothing. Sulfuric acid produced a blue vitriol when combined with copper, green with iron, and white with zinc.
- **Food processing:** Essential to feed the factory workers no longer living on farms. In 1810, French confectioner Nicholas Appert started canning food in glass bottles sterilized in boiling water.

Industrial Regions

Industry is concentrated in three of the nine world regions discussed in Chapter 9: Europe, North America, and East Asia (Figure 11-3). Each of the three regions accounts for roughly one-fourth of the world's total industrial output. Outside these three regions the leading industrial producers are Brazil and India. The three industrial regions are discussed in this section, beginning with the oldest.

Europe's Industrial Areas

Numerous industrial areas emerged in Europe during the nineteenth and early twentieth centuries (Figure 11-4). These include several clustered in Western Europe centered on western Germany and extending north to the United Kingdom and south to Italy and Spain, and several in Eastern Europe, primarily in the former Soviet Union.

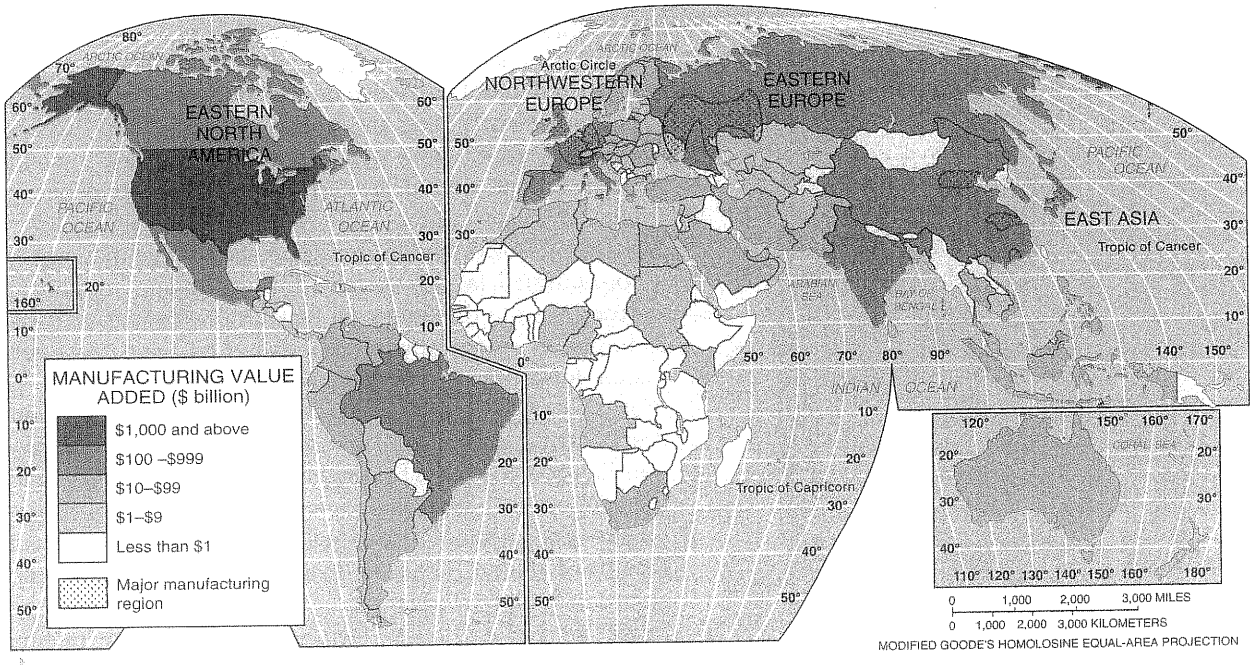


FIGURE 11-3 Manufacturing value added. Three-fourths of the world's manufacturing takes place in North America, Europe, and East Asia.

FIGURE 11-4 Industrial areas in Europe. In Western Europe, manufacturing is clustered on a north–south axis between the North Sea and the Mediterranean Sea. In Eastern Europe, industrial areas are dispersed on an east–west axis across the former Soviet Union.

- **United Kingdom:** Dominated world production of steel and textiles during the nineteenth century. As the first country to enter the Industrial Revolution, Britain was saddled in the twentieth century with what became outmoded and deteriorating factories and support services.

  Although no longer a world leader in steel, textiles, and other early Industrial Revolution industries, the United Kingdom expanded industrial production in the late twentieth century by attracting new high-tech industries that serve the European market. Japanese companies have built more factories in the United Kingdom than in any other European country. The British have done more than the other major European countries to lower taxes on businesses, reduce government regulations, convert government monopolies to private ownership, and utilize computers.
- **Rhine–Ruhr Valley:** Western Europe's most important and most centrally located industrial area. Within the area, industry is dispersed rather than concentrated in one or two cities.

  Iron and steel manufacturing concentrated in the Rhine–Ruhr Valley because of proximity to large coalfields. Access to iron and steel production stimulated other heavy-metal industries, such as railroad, machinery, and armaments, to locate in the area. Rotterdam, the world's largest port, lies at the mouth of several branches of the Rhine River as it flows into the North Sea.
- **Mid-Rhine:** Western Europe's second most important industrial area. The German portion of the Mid-Rhine area lacks abundant raw materials but lies at the center of Europe's most important consumer market. The French portion of the Mid-Rhine region—Alsace and Lorraine—contains Europe's largest iron-ore field and is the production center for two-thirds of France's steel.

  The three largest cities in the German portion are Frankfurt, Stuttgart, and Mannheim. When Germany was divided into eastern and western portions during the Cold War, Frankfurt was West Germany's most important financial and commercial center and the hub of its road, rail, and air networks. Stuttgart's industries specialize in high-value goods and require skilled labor; Mercedes-Benz and Audi automobiles are among the city's best-known products. Mannheim, an inland port along the Rhine, has a large chemical industry that manufactures synthetic fibers, dyes, and pharmaceuticals.
- **Po Basin:** Southern Europe's oldest and most important industrial area. The Po Valley contains about two-thirds of Italy's manufacturing in one-fifth of its land area.

  Modern industrial development in the Po Basin began with establishment of textile manufacturing during the nineteenth century. The area had two key assets: inexpensive hydroelectricity from the nearby Alps and a large labor supply, especially from Italy's poorer south, willing to work for relatively low wages.

- **Northeastern Spain:** Western Europe's fastest-growing industrial area in the late twentieth century. Spain's leading industrial area, Catalonia, is centered on the city of Barcelona. The area is the center of Spain's textile industry and the location of the country's largest motor-vehicle plant. Spain's motor-vehicle industry has grown into the second largest in Europe, behind only Germany's, although it is entirely foreign-owned.
- **Moscow:** Russia's oldest industrial area, centered around the country's capital and largest market. Moscow specializes in fabrics and products that require skilled labor.
- **St. Petersburg:** Eastern Europe's second largest city, specializing in shipbuilding and other industries serving Russia's navy and ports in the Baltic Sea.
- **Volga:** Russia's largest petroleum and natural gas fields. The motor-vehicle industry is concentrated in Togliatti, oil refining in Kuybyshev, chemicals in Saratov, metallurgy in Volgograd, and leather and fur in Kazan.
- **Urals:** Contains more than 1,000 types of minerals, the most varied collection found in any mining area in the world. Proximity to these inputs encouraged the Communists to locate iron and steel, chemicals, machinery, and metal fabricating in this area.
- **Kuznetsk:** Russia's most important manufacturing district east of the Ural Mountains. Soviet planners took advantage of the area's coal and iron ore to invest in iron and steel factories there.
- **Donetsk:** In Eastern Ukraine, an area of coal, iron ore, manganese, and natural gas. These assets make the area Eastern Europe's largest producer of iron and steel. Major plants are located at Krivoy Rog, near iron-ore fields, and at Donetsk, near coalfields.
- **Silesia:** Eastern Europe's leading industrial area outside the former Soviet Union. Silesia, which includes southern Poland and northern Czech Republic, is an important steel production center, near coalfields.

North America's Industrial Areas

Industry arrived a bit later in the United States than in Europe, but it grew much faster. At the time of independence in 1776, the United States was a predominantly agricultural society, dependent on the import of manufactured goods from England. The first U.S. textile mill opened in Pawtucket, Rhode Island, in 1791. The textile industry grew rapidly after 1808, when the U.S. government imposed an embargo on European trade to avoid entanglement in the Napoleonic Wars. By 1860, the United States had become a major industrial nation, second only to the United Kingdom.

Manufacturing in North America concentrated in the northeastern quadrant of the United States and in southeastern Canada (Figure 11-5). This industrial area has achieved its dominance through a combination of historical and environmental factors. As the first area of European settlement in the Western Hemisphere, the U.S. East Coast was tied to European markets and industries during the first half of the nineteenth century. The early date of settlement gave eastern cities an advantage in creating the infrastructure needed to become the country's dominant industrial center.

The Northeast also had essential raw materials, including iron and coal. Good transportation moved raw materials to factories and manufactured goods to markets. The Great Lakes and major rivers (Mississippi, Ohio, St. Lawrence) were supplemented in the 1800s by canals, railways, and highways. All helped to connect the westward-migrating frontier with manufacturing centers.

Within the North American manufacturing region, several specialized areas developed:

- **New England:** The oldest industrial area in the northeastern United States. It developed as an industrial center in the early nineteenth century, beginning with cotton textiles. Cotton was imported from southern states, where it was grown, and finished cotton products were shipped to Europe.
- **Middle Atlantic:** The largest U.S. market. It attracts industries that need proximity to a large number of consumers and that depend on foreign trade through one of this region's large ports. Other firms seek locations near the financial, communications, and entertainment industries, which are highly concentrated in New York.
- **Mohawk Valley:** A linear industrial belt in upper New York State along the Hudson River and Erie Canal. Buffalo, near the confluence of the Erie Canal and Lake Erie, was the region's most important industrial center, especially for steel and food processing. Inexpensive, abundant electricity, generated at nearby Niagara Falls, has attracted aluminum, paper, and electrochemical industries to the region.

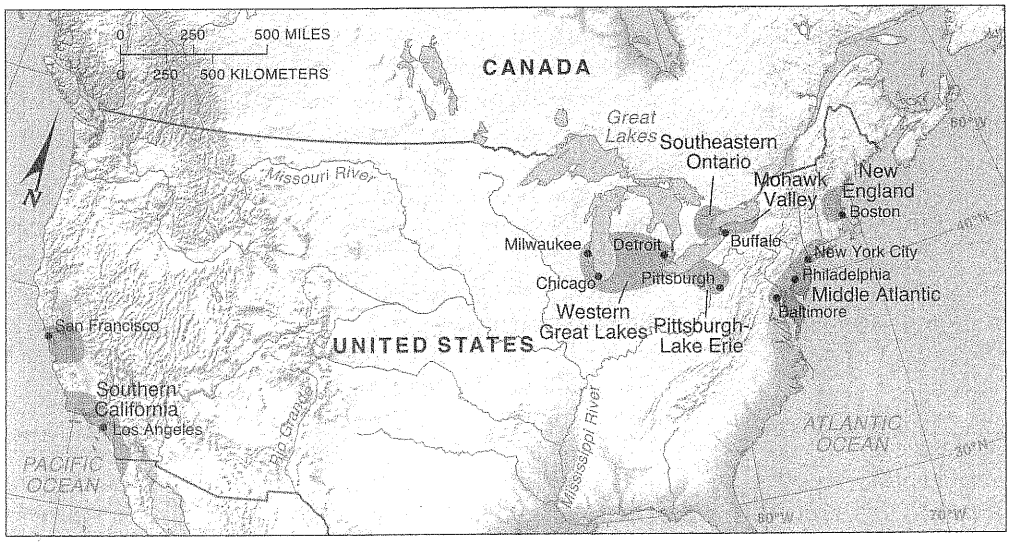


FIGURE 11-5 Industrial areas in North America. Manufacturing in North America was traditionally highly clustered in several regions within the northeastern United States and southeastern Canada.

- **Pittsburgh–Lake Erie:** The leading steel-producing area in the nineteenth century because of proximity to Appalachian coal and iron ore. Steel manufacturing originally concentrated in the area between Pittsburgh and Cleveland because of its proximity to Appalachian coal and iron ore. Proximity to steel makers attracted other manufacturers that made heavy use of steel in their own products.
- **Western Great Lakes:** Centered on Chicago, the hub of the nation's transportation network, now the center of steel production. Motor-vehicle manufacturers and other industries that have a national market locate in the western Great Lakes area to take advantage of this convergence of transportation routes. The area supplies machine tools, transportation equipment, clothing, furniture, agricultural machinery, and food products to people living in the interior of the country.
- **Southern California:** The leading industrial area outside of the Northeast. When the United States entered World War II in 1941, more than one-third of Los Angeles' manufacturing was in the aircraft industry, attracted by clear skies, light winds, and mild winters. More recently, Los Angeles has become the country's largest area of clothing and textile production, the second-largest furniture producer, and a major food-processing center. Immigrants from Latin America and Asia provide a large pool of low-wage workers.
- **Southeastern Ontario:** Canada's most important industrial area, central to the Canadian and U.S. markets and near the Great Lakes and Niagara Falls. Most of Canada's steel production is concentrated in Hamilton, Ontario, and motor-vehicle assembly in the Toronto area. Inexpensive electricity has attracted aluminum manufacturing, paper making, flour mills, textile manufacturing, and sugar refining.

East Asia's Industrial Areas

Faced with isolation from world markets and a shortage of nearly all essential resources, East Asia has taken advantage of its most abundant resource—people. The region's two leading industrial countries—Japan and China—rank second and third in manufacturing value behind only the United States (Figure 11-6).

- **Japan:** Became an industrial power in the 1950s and 1960s initially by producing goods that could be sold in large quantity at cut-rate prices to consumers in other countries. Prices were kept low, despite high shipping costs, because workers received much lower wages in Japan than in North America or Europe. The country became the world's leading manufacturer of automobiles, ships, cameras, stereos, and televisions.

  Aware that South Korea, Taiwan, and other Asian countries were building industries based on even lower-cost labor, Japan started training workers for highly skilled jobs. "Made in Japan," a phrase once synonymous with cheap, poorly made goods, now refers to high-quality motor vehicles, electronics, and precision instruments. Japan's manufacturing is concentrated in the central region between Tokyo and Nagasaki, especially in the two large urban areas of Tokyo–Yokohama and Osaka–Kobe–Kyoto.
- **China:** The world's largest supply of low-cost labor and the world's largest market for many consumer products. China is the largest manufacturer of textiles and apparel, steel, and many household products.

  Policy changes in the 1990s opened China's market and labor force to transnational corporations. Foreign-owned firms seeking low-cost labor were permitted to open factories in China to manufacture labor-intensive products such as apparel for export. Rapid economic expansion put money in the pockets of enough of China's 1.3 billion people to encourage more manufacturing for domestic consumption.

  China's manufacturers have clustered in three areas along the east coast—near Guangdong and Hong Kong, the Yangtze River valley between Shanghai and Wuhan, and along the Gulf of Bo Hai from Tianjin and Beijing to Shenyang. These three areas contain only one-fourth of China's population but one-half of its wealth, three-fourths of its foreign investment, and five-sixths of its foreign trade. The clustering of investment has produced large and increasing gaps in wealth within China.

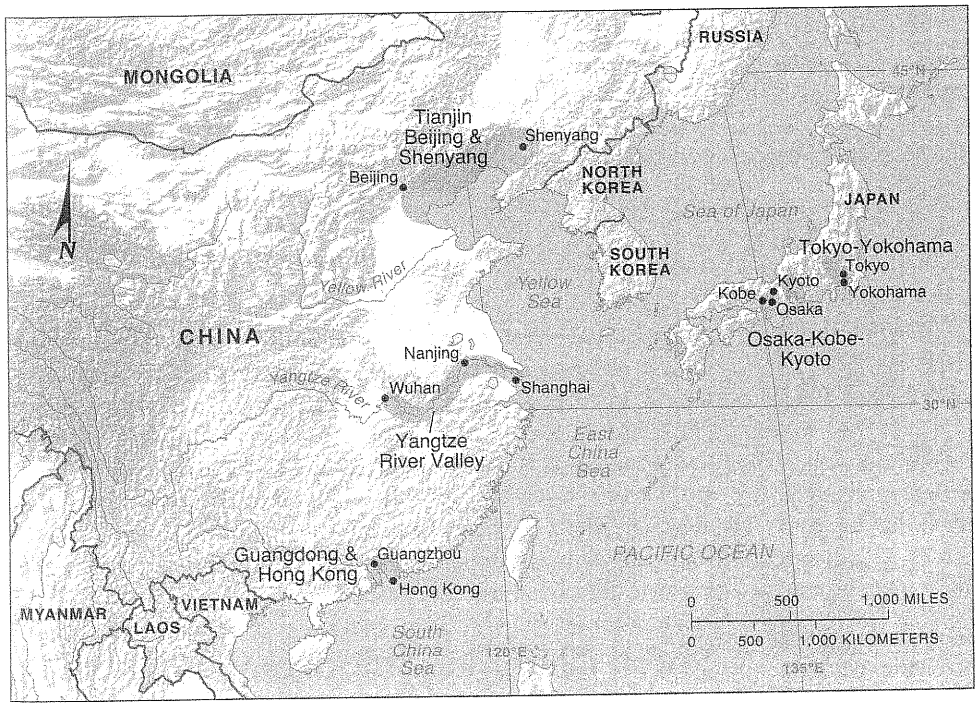


FIGURE 11-6 Industrial areas in East Asia. Within Japan, production is clustered along the southeast coast. Within China, a large percentage of industries are clustered in three centers along the east coast.

KEY ISSUE 2
Why Are Situation Factors Important?

- Proximity to Inputs
- Proximity to Markets
- Ship, Rail, Truck, or Air?

Having looked at the "where" question for industrial location, we can next consider the "why" question: Why are industries located where they are? Geographers try to explain why one location may prove more profitable for a factory than others.

A company ordinarily faces two geographical costs—situation and site. Situation factors are discussed in this section and site factors in the next section. **Situation factors** involve transporting materials to and from a factory. A firm seeks a location that minimizes the cost of transporting inputs to the factory and finished goods to consumers. ■

Proximity to Inputs

Manufacturers buy from companies and individuals who supply inputs, such as materials, energy, machinery, and supporting services. They sell to companies and individuals who purchase the product. All manufacturers try to minimize the aggregate cost of transporting inputs to their factories and transporting finished products from their plants to consumers. The farther something is transported, the higher the cost, so a manufacturer tries to locate its factory as close as possible to both buyers and sellers.

- The optimal plant location is as close as possible to inputs if the cost of transporting raw materials to the factory exceeds the cost of transporting the product to consumers.
- The optimal plant location is as close as possible to the customer if the cost of transporting the product exceeds the cost of transporting inputs.

Every industry uses some inputs. These may be resources from the physical environment (minerals, wood, or animals), or they may be parts or materials made by other companies. An industry in which the inputs weigh more than the final products is a **bulk-reducing industry**. To minimize transport costs, a bulk-reducing industry needs to locate near its sources of inputs.

Copper: A Bulk-Reducing Industry

Copper production involves several steps. The first three steps provide good examples of bulk-reducing activities that need to be located near their sources of inputs (Figure 11-7). The fourth step is not bulk-reducing, so does not need to be near inputs.

1. **Mining.** The first step in copper production is mining the copper ore. Mining in general is bulk-reducing because the heavy, bulky ore extracted from mines is mostly waste, known as *gangue*. Copper ore mined in North America is especially low-grade, less than 0.7 percent copper.

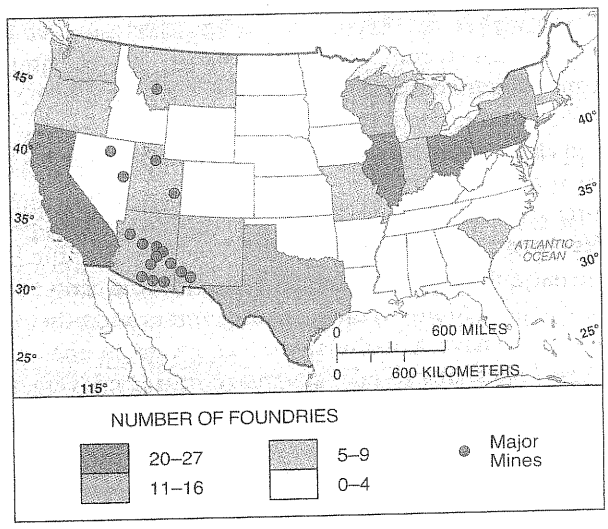


FIGURE 11-7 Bulk-reducing industries. Copper mining, concentrating, and smelting are examples of bulk-reducing industries. In the United States, most plants that concentrate, smelt, and refine copper are in or near Arizona, where most copper mines are located. In contrast, most foundries, where copper products are manufactured, are located near markets in the east and west coasts.

2. **Concentration.** Concentration mills crush and grind the ore into fine particles, mix them with water and chemicals, and filter and dry them. Copper concentrate is about 25 percent copper. Concentration mills are always near the mines because concentration transforms the heavy, bulky copper ore into a product of much higher value per weight.
3. **Smelting.** The concentrated copper becomes the input for smelters, which remove more impurities. Smelters produce copper matte (about 60 percent copper), blister copper (about 97 percent copper), and anode copper (about 99 percent copper). As another bulk-reducing industry, smelters are built near their main inputs—the concentration mills—again to minimize transportation cost.
4. **Refining.** The purified copper produced by smelters is treated at refineries to produce copper cathodes, about 99.99 percent pure copper. Little further weight loss occurs, so proximity to the mines, mills, and smelters is a less critical factor in determining the location of refineries.

Another important locational consideration is the source of energy to power these energy-demanding operations. In general, metal processors such as the copper industry also try to locate near economical electrical sources and to negotiate favorable rates from power companies.

Figure 11-7 shows the distribution of the U.S. copper industry. Two-thirds of U.S. copper is mined in Arizona, so the state also has most of the concentration mills and smelters. Most foundries, where copper is manufactured, are located near markets on the east and west coasts.

Steel: Changing Importance of Inputs

Steel is an alloy of iron that is manufactured by removing impurities in iron, such as silicon, phosphorus, sulfur, and oxygen, and adding desirable elements, such as manganese and

chromium. The two principal inputs in steel production are iron ore and coal. Steelmaking is an example of a bulk-reducing industry that has located to minimize the cost of transporting these two inputs.

Steel was a luxury item until Henry Bessemer (1813–1898) patented an efficient process for casting steel in 1855. The Bessemer process remained the most common method of manufacturing steel until the mid-twentieth century. Because of the need for large quantities of bulky, heavy iron ore and coal, steelmaking has clustered near sources of the two key raw materials.

Steelmaking demonstrates that when the source of inputs or the relative importance of inputs changes, the optimal location for the industry changes. In the United States, the distribution of steel production has changed several times because of changing inputs (Figure 11-8).

- **Mid-nineteenth century:** The U.S. steel industry concentrated around Pittsburgh in southwestern Pennsylvania, where iron ore and coal were both mined. The area no longer has steel mills, but it remains the center for research and administration.
- **Late nineteenth century:** Steel mills were built around Lake Erie, in the Ohio cities of Cleveland, Youngstown, and Toledo, and near Detroit. The locational shift was largely influenced by the discovery of rich iron ore in the Mesabi Range, a series of low mountains in northern Minnesota. This area soon became the source for virtually all iron ore used in the U.S. steel industry. The ore was transported by way of Lake Superior, Lake Huron, and Lake Erie. Coal was shipped from Appalachia by train.
- **Early twentieth century:** Most new steel mills were located near the southern end of Lake Michigan—Gary in Indiana, Chicago, and other communities. The main raw materials continued to be iron ore and coal, but changes in steelmaking required more iron ore in proportion to coal. Thus, new steel mills were built closer to the Mesabi Range to minimize transportation cost. Coal was available from nearby southern Illinois, as well as from Appalachia.
- **Mid-twentieth century:** Most new U.S. steel mills were located in communities near the East and West coasts, including Baltimore, Los Angeles, and Trenton, New Jersey. These coastal locations partly reflected further changes in transportation cost. Iron ore increasingly came from other countries, especially Canada and Venezuela, and locations near the Atlantic and Pacific oceans were more accessible to those foreign sources. Further, scrap iron and steel—widely available in the large metropolitan areas of the East and West coasts—became an important input in the steel-production process.
- **Late twentieth century:** Most steel mills in the United States closed. Most of the survivors were around southern Lake Michigan and along the East Coast.

Thus, for surviving steel mills in the United States, proximity to markets has become more important than the traditional situation factor of proximity to inputs. Coastal plants provide steel to large East Coast population centers, and southern Lake Michigan plants are centrally located to distribute their products countrywide.

The increasing importance of proximity to markets is also demonstrated by the recent growth of steel minimills, which have captured one-fourth of the U.S. steel market (Figure 11-9).

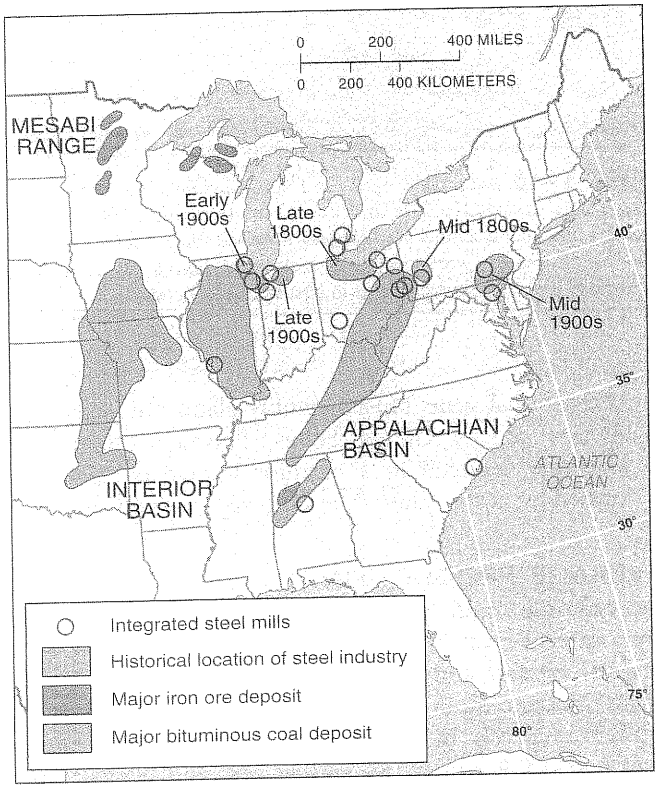


FIGURE 11-8 Impact of changing situation factors. Integrated steel mills are highly clustered near the southern Great Lakes, especially Lake Erie and Lake Michigan. Historically, the most critical factor in siting a steel mill was to minimize transportation cost for raw materials, especially heavy, bulky iron ore and coal. In recent years, many integrated steel mills have closed. Most surviving mills are in the Midwest to maximize access to consumers.

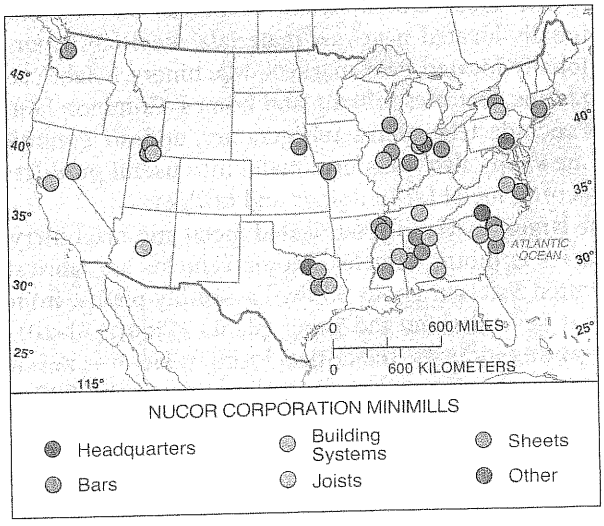


FIGURE 11-9 Minimills for steel production. Shown are the plants of Nucor, the largest minimill operator in the United States. Minimills, which produce steel from scrap metal, are more numerous than integrated steel mills, and they are distributed around the country near local markets.

Rather than iron ore and coal, the main input into minimill production is scrap metal. In the past, most steel was produced at large integrated mill complexes. They processed iron ore, converted coal into coke, converted the iron into steel, and formed the steel into sheets, beams, rods, or other shapes. Minimills, generally limited to one step in the process—steel production—are less expensive than integrated mills to build and operate, and they can locate near their markets because their main input—scrap metal—is widely available.

Proximity to Markets

For many firms, the optimal location is close to customers. Proximity to markets is a critical locational factor for three types of industries—bulk-gaining, single market, and perishable.

Bulk-Gaining Industries

A **bulk-gaining industry** makes something that gains volume or weight during production. To minimize transport costs, a bulk-gaining industry needs to locate near where the product is sold.

FABRICATED METALS. A prominent example of a bulk-gaining industry is the fabrication of parts and machinery from steel and other metals. A fabricated-metal factory brings together metals such as steel and previously manufactured parts as the main inputs and transforms them into a more complex product. Fabricators shape individual pieces of metal using such processes as bending, forging (hammering or rolling metal between two dies), stamping (pressing metal between two dies), and forming (pressing metal against one die). Separate parts are joined together through welding, bonding, and fastening with bolts and rivets.

Because fabricated and machined products typically occupy a larger volume than the sum of their individual parts and metals, the cost of shipping the final product to consumers is usually the most critical factor. Whereas steelmakers have traditionally located near raw materials, steel fabricators have traditionally located near markets. Machinery is fabricated for use in farms, factories, offices, and homes. Common fabricated goods include televisions, refrigerators, and air conditioners. Machine shops also transform metal into useful products such as structural metal for buildings and bridges.

The largest market for fabricated metal and machinery manufacturers is motor vehicles. Motor vehicles are fabricated in the United States at about 40 final assembly plants, from parts made at several thousand other plants (Figure 11-10). As a bulk-gaining industry, the critical location factor is minimizing transportation to the market, in this case the 20,000 dealers where roughly 12 million North Americans buy new vehicles each year (see Contemporary Geographic Tools box). Thus, motor-vehicle assembly involves making vehicles near where they are to be sold:

- At a global scale: Three-fourths of vehicles sold in the United States are assembled in the United States, and most of the remainder are assembled in Canada and Mexico.

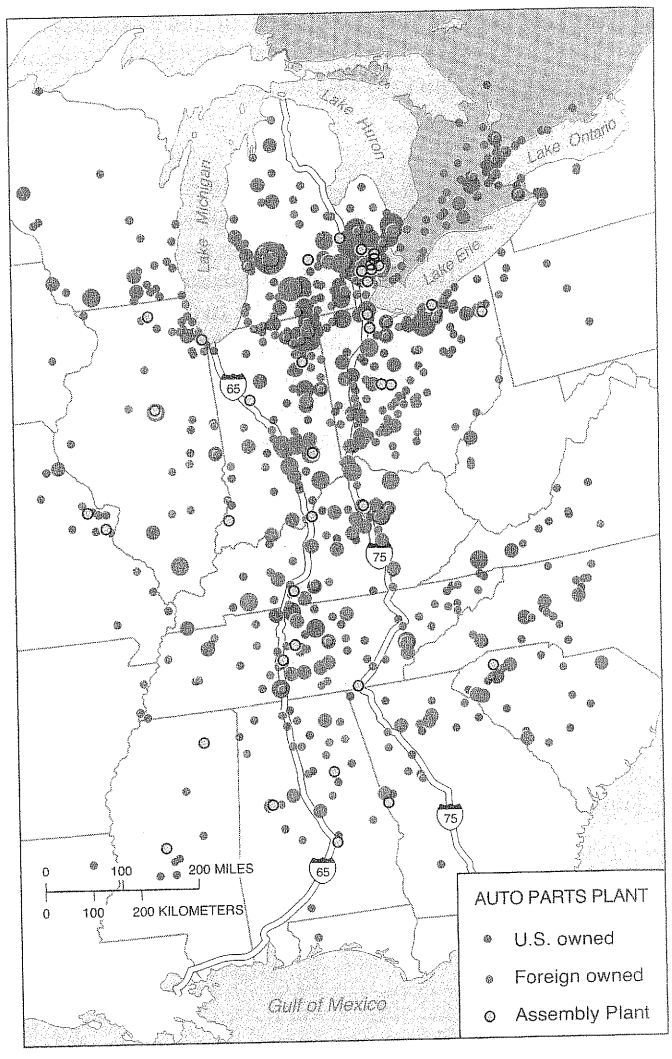


FIGURE 11-10 Auto alley. U.S.- and foreign-owned motor-vehicle parts plants. Plants are clustered in the interior of the country, near the major customers, the final assembly plants. Foreign-owned plants are more likely to be farther south, where workers are less likely to join a union. Circles are proportional to the number of plants in a particular ZIP code.

- At a national scale: Most assembly plants are located in the interior of the United States, between Michigan and Alabama, centered in a corridor known as "auto alley," formed by north–south interstate highways 65 and 75.

BEVERAGE PRODUCTION. Beverage bottling is another good example of an industry that adds bulk (Figure 11-12). Empty cans or bottles are brought to the bottler, filled with the soft drink or beer, and shipped to consumers.

The principal input placed in a beverage container is water, which is relatively bulky, heavy, and expensive to transport. Major soft-drink companies add syrups, and beer companies add barley, hops, and yeast, according to proprietary recipes. These added ingredients are much less bulky than the water and much easier to transport.

If water were only available in a few locations around the country, then bottlers might cluster near the source of such a scarce, bulky input. But because water is available where

Honda Selects a Factory Location

When Honda decided that it needed another assembly plant in the United States, it applied situation and site factors to select a location for the factory. Situation factors were considered first in the decision-making process, then site factors.

The most critical situation factor for Honda was minimizing the cost of shipping finished vehicles to its customers around North America. That led Honda to look for locations within auto alley, where its other U.S. assembly plants, as well as nearly all of its competitors, are located (Figure 11-11).

The other situation factor, minimizing the cost of shipping its inputs, was also important. Honda's most important inputs were the engine and transmission, which were to come from existing factories in western Ohio. Other parts would come from factories already shipping to Honda's two assembly plants in central Ohio. That guided Honda to the portion of auto alley encompassing Illinois, Indiana, and Ohio.

Site factors helped Honda find specific locations within auto alley. Principal site factors were land and labor, though these pointed Honda to different locations. The land site factor suggested a rural location. Honda wanted a large tract of land in order to construct a spread-out one-story factory. It needed to be near at least one interstate highway because most parts would arrive and finished vehicles would leave by truck. It also needed to be next to a rail line because some parts would come from Japan by boat and train, and finished vehicles would be shipped to the west coast by rail. An assembly plant hires several thousand workers, so Honda needed a large labor supply within a 1-hour commuting range. But it didn't want to compete for workers with existing assembly plants. That could lead to a shortage of skilled workers and push up wages. So Honda looked for areas outside the 1-hour commuting range around existing assembly plants.

Honda's short list of locations included Decatur in eastern Illinois, Greensburg in southwestern Indiana, and unnamed communities in west-central Ohio. The third site factor, capital, helped Honda make its final pick. The state governments of Illinois, Indiana, and Ohio were all willing to provide Honda with financial support for roads, utilities, and worker training. But Honda considered Indiana the safest choice: The governors of the other two states at the time were involved in financial scandals. ■

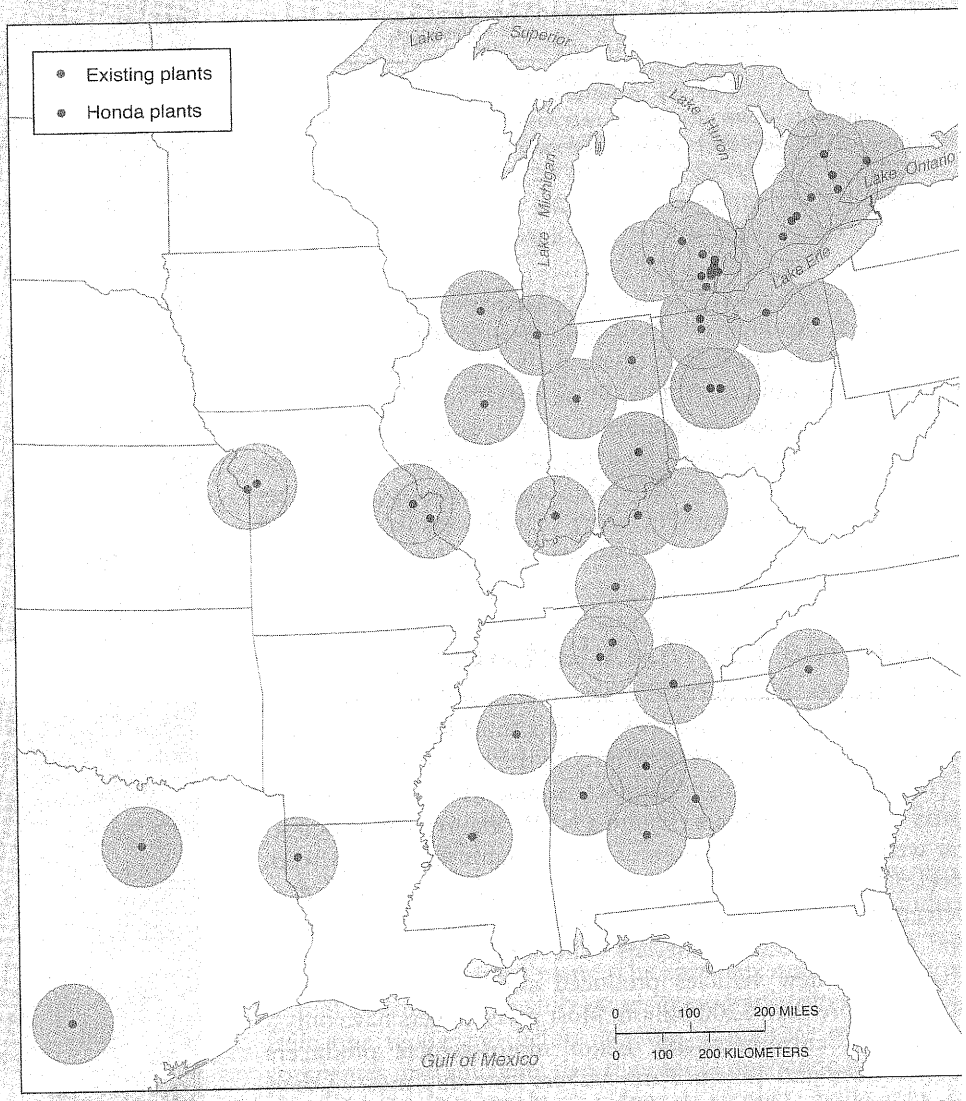


FIGURE 11-11 Labor markets around motor-vehicle assembly plants. Assembly plants draw the workforce from within a roughly 1-hour radius. New plants have been located outside the labor market area of existing plants.

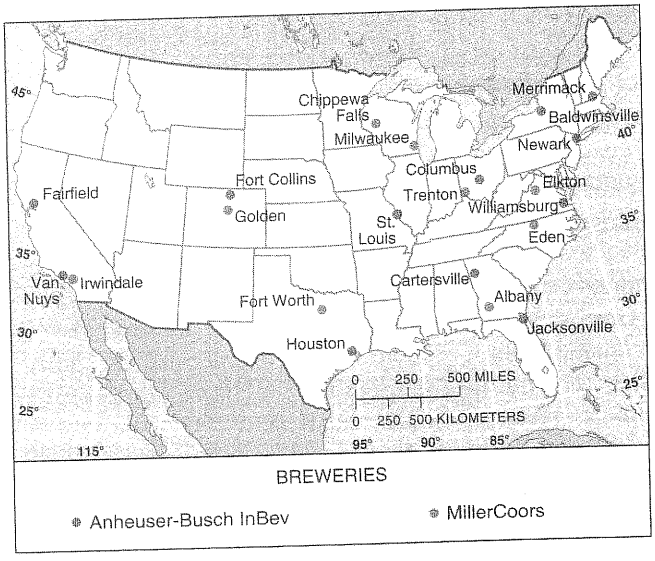


FIGURE 11-12 A bulk-gaining industry: beer-making. The two best-selling brewing companies locate their plants near major population concentrations. Most breweries are clustered in the heavily populated Northeast.

people live, bottlers can minimize costs by producing beverages near their consumers instead of shipping water (their heaviest and bulkiest input) long distances. A filled container has the same volume as an empty one, but it is much heavier. Because they are heavier, the filled containers are more expensive to ship than the empty ones, and bottlers locate near their customers rather than the manufacturers of the containers.

Single-Market Manufacturers

Single-market manufacturers are specialized manufacturers with only one or two customers. The optimal location for these factories is often in close proximity to the customer.

An example of a single-market manufacturer is a producer of parts for motor vehicles (Figure 11-13). The typical passenger car weighs about 3,300 pounds and contains about 54 percent steel, 11 percent iron, 8 percent plastic, 7 percent aluminum, 6 percent fluids and lubricants, 4 percent rubber, 3 percent glass, and 6 percent other materials. The total value of the parts attached to new vehicles produced annually in the United States is more than $200 billion. Most parts makers have only a handful of customers—the major motor-vehicle producers such as Ford and Toyota. Parts makers now ship most of their products directly to the carmaker's assembly plants clustered in "auto alley."

Proximity to the assembly plant is increasingly important for parts producers because of the diffusion of "just-in-time" delivery (see Key Issue 4). Under "just-in-time," parts are delivered to the assembly plant just in time to be used, often within minutes, rather than weeks or months in advance. For some parts makers, just-in-time delivery dictates that they build their factories as close as possible to their customers, the final assembly plants. Seats, for example, are invariably manufactured at a location within an hour of the final assembly plant. The seat is an especially large and bulky object, and carmakers do not want to waste valuable space in their assembly plants by piling up an inventory of them. Most engines, transmissions, and metal body parts are also produced at locations only a couple of hours away from an assembly plant.

On the other hand, many parts do not need to be manufactured close to the customer. For them, changing site factors are more important. Some locate in Mexico to take advantage of lower labor costs. Others come from China, where labor costs are even lower but shipping costs are higher.

Perishable Products

To deliver their products to consumers as rapidly as possible, perishable-product industries must be located near their markets. Because few people want stale bread or sour milk, food producers such as bakers and milk bottlers must locate near their customers to assure rapid delivery (Figure 11-14). Processors of fresh food into frozen, canned, and preserved products can, however, locate far from their customers. Cheese and butter, for example, are manufactured in Wisconsin because rapid delivery to the urban markets is not critical for products with a long shelf life, and the area is well suited agriculturally for raising dairy cows.

The daily newspaper is an example of a product other than food that is highly perishable, because it contains dated information. People demand their newspaper as soon after its printing as possible. Therefore, newspaper publishers must locate near markets to minimize transportation cost.

FIGURE 11-13 A single-market manufacturer: seat-making. Faurecia, a French company, makes seats for the BMW 3 Series at a factory in Leipzig, Germany, adjacent to BMW's assembly plant.

FIGURE 11-14 A perishable product: newspapers. Delivery of afternoon newspapers was once commonly handled by youths after school. Most afternoon newspapers have ceased production.

Difficulty with timely delivery is one of the main factors in the decline of newspapers. Electronic devices—computers and handheld devices—can deliver news more quickly than a newspaper. Little wonder that during the first decade of the twenty-first century, print publishing jobs declined from 1 million to 800,000 in the United States, whereas Internet publishing jobs increased from 70,000 to 80,000.

Ship, Rail, Truck, or Air?

Inputs and products are transported in one of four ways—via ship, rail, truck, or air. Firms seek the lowest-cost mode of transport, but which of the four alternatives is cheapest changes with the distance that goods are being sent.

The farther something is transported, the lower is the cost per kilometer (or mile). Longer-distance transportation is cheaper per kilometer in part because firms must pay workers to load goods on and off vehicles, whether the material travels 10 kilometers or 10,000. The cost per kilometer decreases at different rates for each of the four modes because the loading and unloading expenses differ for each mode.

- **Trucks.** Most often used for short-distance delivery, because they can be loaded and unloaded quickly and cheaply. Truck delivery is especially advantageous if the driver can reach the destination within one day, before having to stop for an extended rest.
- **Trains.** Often used to ship to destinations that take longer than one day to reach, such as between the east and west coasts of the United States. Trains take longer than trucks to load, but once underway aren't required to make daily rest stops like truck drivers.
- **Ships.** Attractive for very long distances because the cost per kilometer is very low. Slower than land-based transportation, but used when shipping cannot be done by train or truck, such as to North America from Europe or Asia.
- **Air.** Most expensive for all distances, so is usually reserved for speedy delivery of small-bulk, high-value packages.

Modes of delivery are often mixed. For example, air-freight companies pick up packages in the afternoon and transport them by truck to the nearest airport. Late at night, planes filled with packages are flown to a central hub airport in the interior of the country, such as Memphis, Tennessee, and Louisville, Kentucky. The packages are transferred to other planes, flown to airports nearest their destination, transferred to trucks, and delivered the next morning.

Containerization has facilitated transfer of packages between modes. Containers may be packed into a rail car, transferred quickly to a container ship to cross the ocean, and unloaded into trucks at the other end. Large ships have been specially built to accommodate large numbers of rectangular box-like containers.

Regardless of transportation mode, cost rises each time that inputs or products are transferred from one mode to another. For example, workers must unload goods from a truck and then reload them onto a plane. The company may need to build or rent a warehouse to store goods temporarily after unloading from one mode and before loading to another mode. Some companies may calculate that the cost of one mode is lower for some inputs and products, whereas another mode may be cheaper for other goods. Many companies that use multiple transport modes locate at a **break-of-bulk point**, which is a location where transfer among transportation modes is possible (Figure 11-15). Important break-of-bulk points include seaports and airports. For example, a steel mill near the port of Baltimore receives iron ore by ship from South America and coal by train from Appalachia.

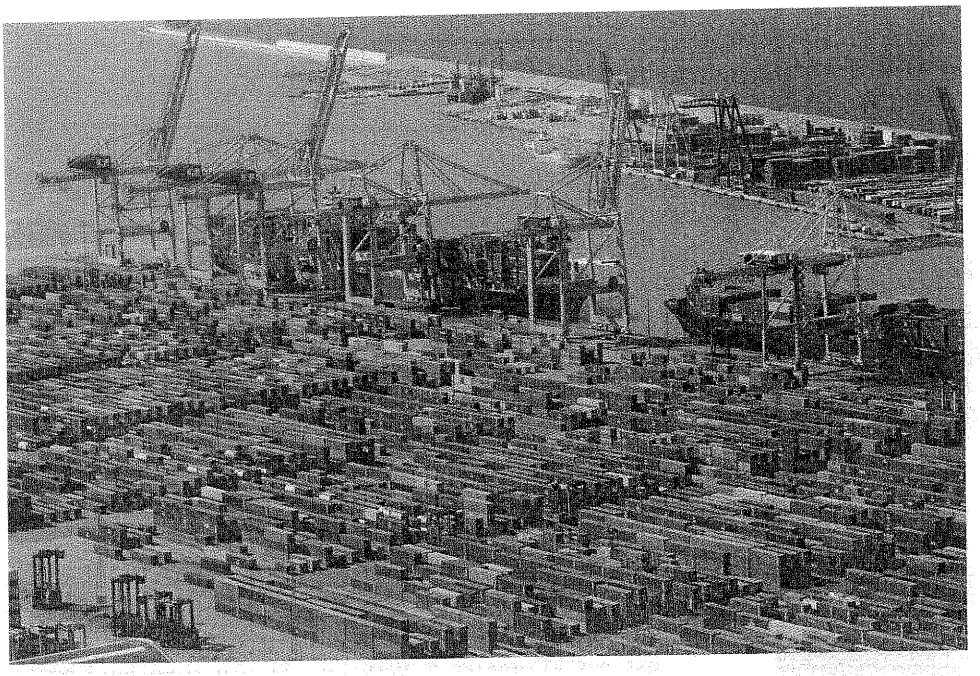


FIGURE 11-15 Break-of-bulk point: Port of Long Beach, California. Most goods shipped across the ocean are packed in uniformly sized containers, which can be quickly transferred between ships and trucks or trains.

KEY ISSUE 3
Why Are Site Factors Important?

- Labor
- Land
- Capital

Site factors result from the unique characteristics of a location. Land, labor, and capital are the three traditional production factors that may vary among locations. ■

Labor

The most important site factor at a global scale is labor. Minimizing labor costs is important for some industries, and the variation of labor costs around the world is large. Worldwide, around one-half billion workers are engaged in industry, according to the UN International Labor Organization (ILO). China has around one-fourth of the world's manufacturing workers, India around one-fifth, and all MDCs combined around one-fifth.

Labor-Intensive Industries

A **labor-intensive industry** is one in which wages and other compensation paid to employees constitute a high percentage of expenses. Labor constitutes an average of 11 percent of overall manufacturing costs in the United States, so a labor-intensive industry in the United States would have a much higher percentage than that. The reverse case, an industry with a much lower than average percentage of expenditures on labor, is considered capital-intensive.

The average wage paid to manufacturing workers exceeds $20 per hour in North America, Western Europe, and other MDCs. Health care, retirement pensions, and other benefits add substantially to the compensation. In LDCs, average wages are less than $5 per hour and include limited additional benefits. For some manufacturers—but not all—the difference between paying workers $5 and $20 per hour is critical.

A labor-intensive industry is not the same as a high-wage industry. "Labor-intensive" is measured as a percentage, whereas "high-wage" is measured in dollars or other currencies. For example, motor-vehicle workers are paid much higher hourly wages than textile workers, yet the textile industry is labor-intensive and the auto industry is not. Although auto workers earn relatively high wages, most of the value of a car is accounted for by the parts and the machinery needed to put the parts together. On the other hand, labor accounts for a large percentage of the cost of producing a towel or shirt when compared with materials and machinery.

Textiles: Labor-Intensive

Production of apparel and **textiles**, which are woven fabrics, is a prominent example of an industry that generally requires less-skilled, low-cost workers. Textile and apparel production involves three principal steps:

- Spinning of fibers and other preparatory work to make yarn from natural or human-made materials
- Weaving or knitting of yarn into fabric (as well as finishing of fabric by bleaching or dyeing)
- Cutting and sewing of fabric for assembling into clothing and other products.

The textile and apparel industry accounts for 6 percent of the dollar value of world manufacturing but a much higher 14 percent of world manufacturing employment, an indicator that it is a labor-intensive industry. The percentage of the world's women employed in this type of manufacturing is even higher.

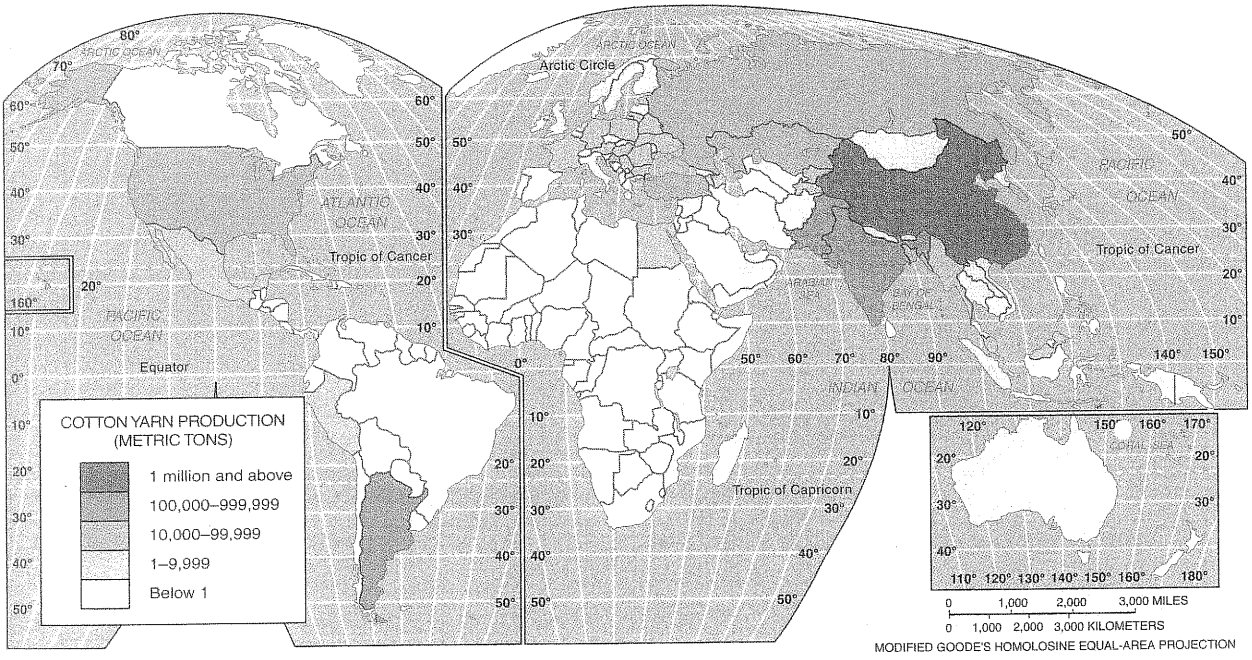
Spinning, weaving, and sewing are all labor-intensive compared to other industries, but the importance of labor varies somewhat among them. As a result, their global distributions are not identical, because the three steps are not equally labor-intensive.

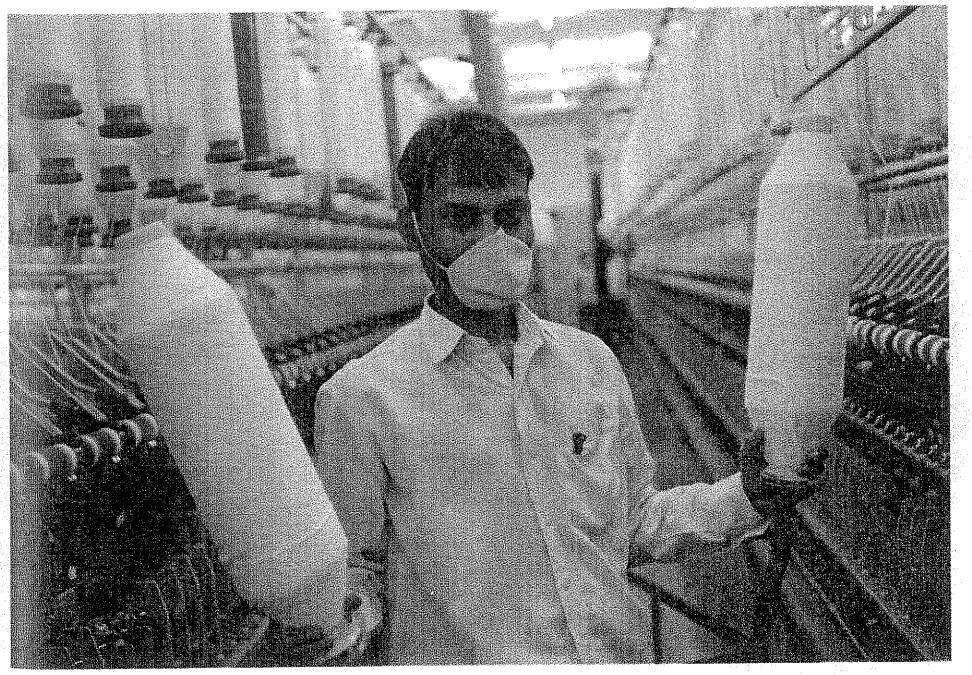
TEXTILE AND APPAREL SPINNING. Fibers can be spun from natural or synthetic elements. The principal natural fiber is cotton. Synthetics now account for three-fourths and natural fibers only one-fourth of world thread production.

Before the Industrial Revolution, spinning of cotton was a job for women, often an unmarried daughter still living at home, called a spinster, a term that came to be applied to any unmarried woman. Children usually performed carding, which involved preparing the fibers for spinning by untangling them onto rolls called cards.

Because it is still a labor-intensive industry, spinning is done primarily in low-wage countries (Figure 11-16). China produces two-thirds of the world's cotton thread.

Synthetic fibers include regenerated synthetics and true synthetics. Regenerated synthetic fibers are produced from natural raw materials modified to produce fibers suitable for weaving. The first commercially successful regenerated synthetic was rayon, made by processing the cellulose in wood pulp. True synthetic fibers are produced from substances like petrochemicals that do not naturally form fibers. The first true synthetic fiber, nylon, was developed from petroleum in 1937. Polyester is now the leading true synthetic, accounting for one-third of synthetic fiber production.





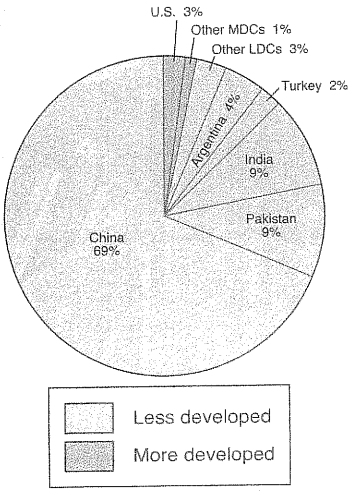
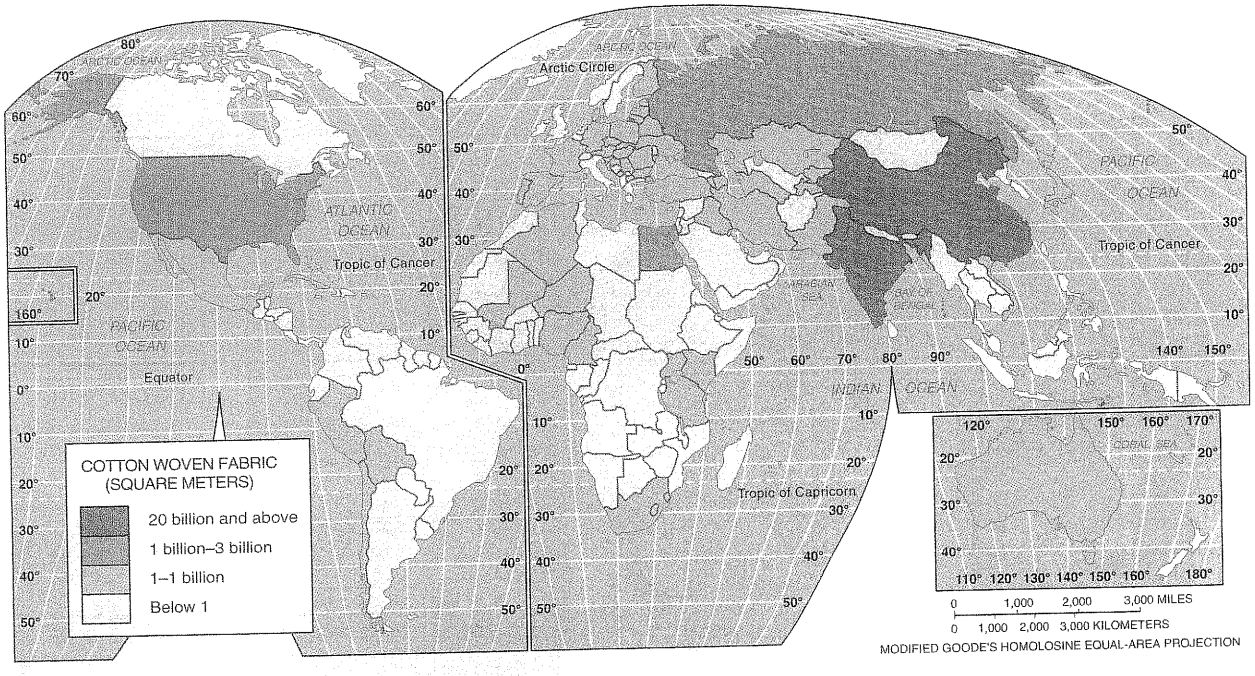
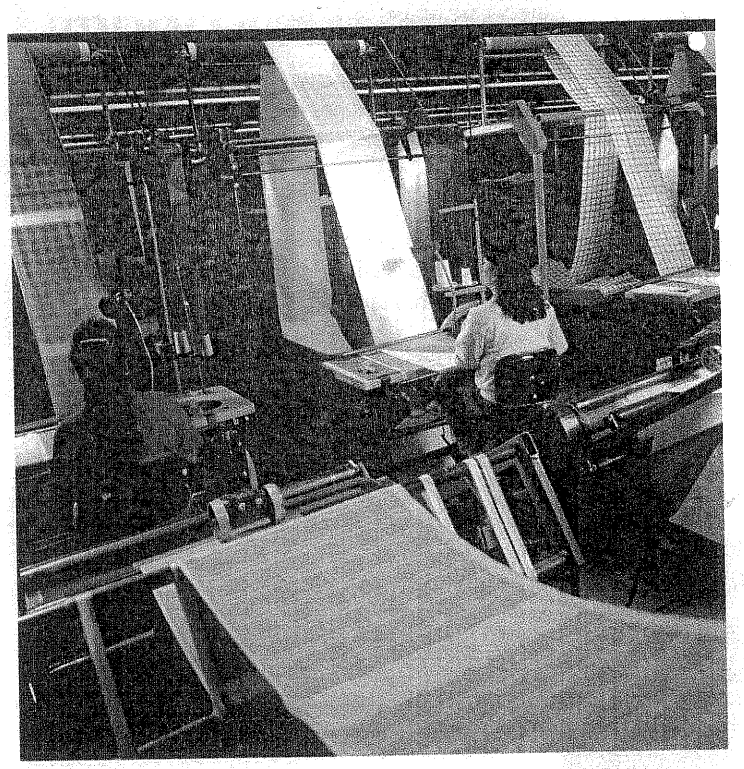


FIGURE 11-16 Cotton yarn production. Spinning of cotton fiber into yarn is clustered in a handful of less developed countries where cotton is grown. A man works with machines spinning spools of cotton at a textile mill in Indore, India.

TEXTILE AND APPAREL WEAVING. For thousands of years, fabric has been woven or laced together by hand on a loom, which is a frame on which two sets of threads are placed at right angles to each other. One set of threads, called a warp, is strung lengthwise. A second set of threads, called a weft, is carried in a shuttle that is inserted over and under the warp. As the process of weaving was physically hard work, weavers were traditionally men.

For mechanized weaving, labor constitutes a high percentage of the total production cost. Consequently, weaving especially is highly clustered in low-wage countries: 93 percent of the world's woven cotton fabric is produced in LDCs (Figure 11-17). Despite their remoteness from European and North American markets, China and India have become the dominant fabric producers because lower labor costs offset the expense of shipping inputs and products long distances. China alone accounts for





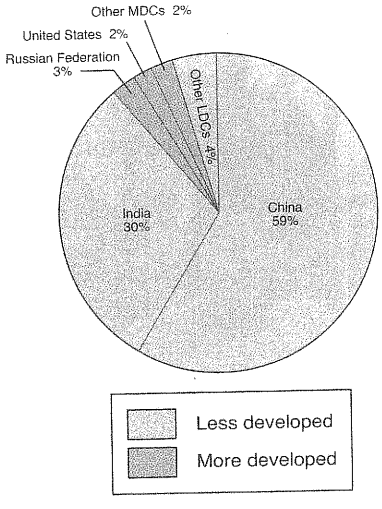


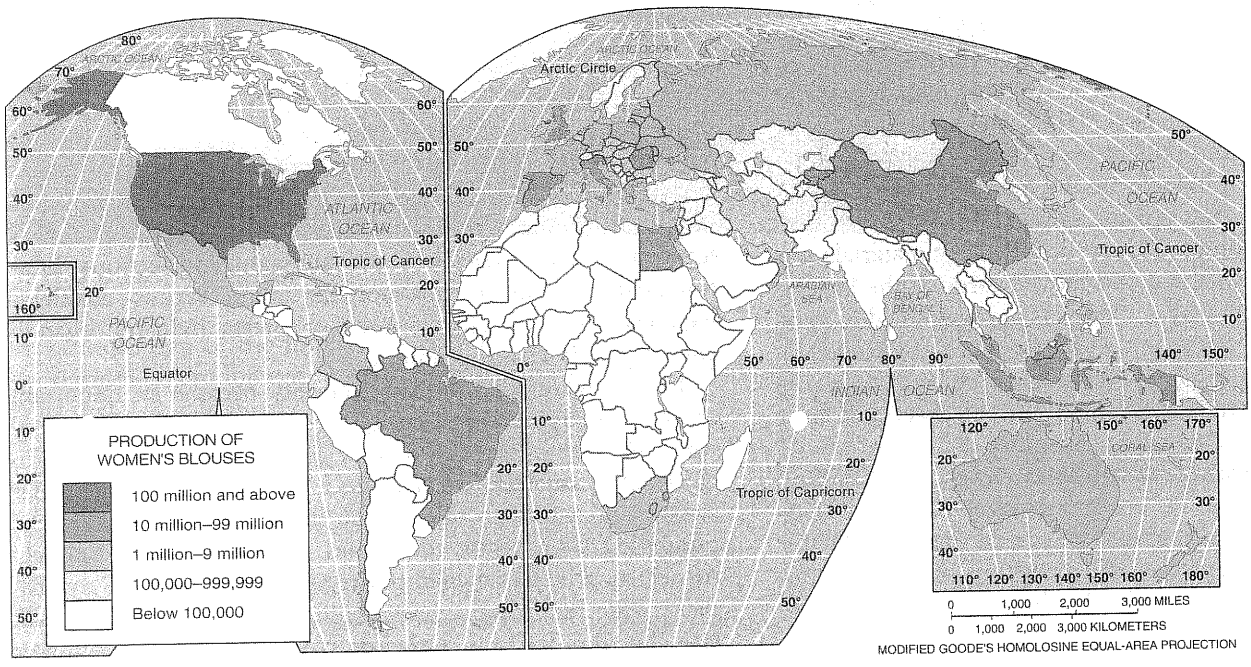
FIGURE 11-17 Woven cotton fabric production. Woven cotton fabric is likely to be produced in LDCs because the process is more labor-intensive than the other major processes in textile and clothing manufacturing. The cotton looms in the photograph are from a factory in North Carolina during the 1990s before it closed.

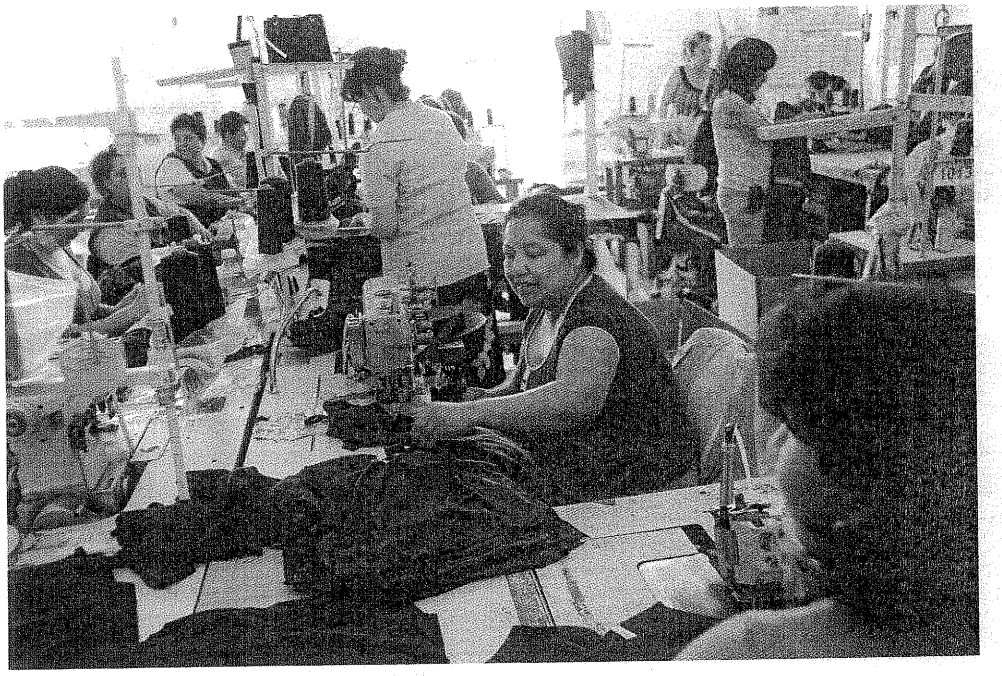
nearly 60 percent of the world's woven cotton fabric production, and India another 30 percent.

TEXTILE AND APPAREL ASSEMBLY. Sewing is probably an even older human activity than spinning and weaving. Needles made from animal horns or bones date back tens of thousands of years, and iron needles date from the fourteenth century.

The first functional sewing machine was invented by French tailor Barthelemy Thimonnier in 1830. In 1841, Thimonnier installed 80 sewing machines in a factory in St.-Etienne, France, to sew uniforms for the French army. However, Parisian tailors, fearing the machines would put them out of work, stormed the factory and destroyed the machines. Isaa Singer manufactured the first commercially successful sewin machine in the United States during the 1850s, but he was cor victed of infringing a patent filed by Elias Howe in 1846.

Textiles are assembled into four main types of products– garments, carpets, home products such as bed linens and cu tains, and industrial items such as headliners inside mot vehicles. MDCs play a larger role in assembly than in spinnin and weaving because most of the consumers of assemble products are located in MDCs. For example, two-thirds of th women's blouses sold worldwide in a year are sewn in MDC (Figure 11-18).





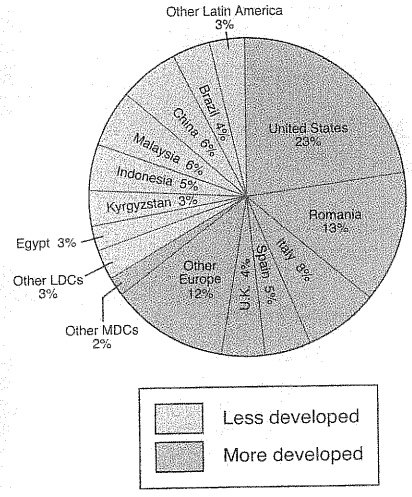


FIGURE 11-18 Production of women's blouses. Sewing of cotton fabric into blouses is more likely to take place in MDCs. Clothing producers must balance the need for low-wage workers against the need for proximity to customers. These women are sewing garments in Los Angeles.

Land

Land suitable for constructing a factory can be found in many places. If considered to encompass natural and human resources in addition to terra firma, "land" is a critical site factor.

Rural Sites

Early factories located inside cities due to a combination of situation and site factors. A city offered an attractive situation—proximity to a large local market and convenience in shipping to a national market by rail. A city also offered an attractive site—proximity to a large supply of labor as well as to sources of capital. The site factor that cities have always lacked is abundant land. To get the necessary space in cities, early factories were typically multistory buildings. Raw materials were hoisted to the upper floors to make smaller parts, which were then sent downstairs on chutes and pulleys for final assembly and shipment. Water was stored in tanks on the roof.

Contemporary factories operate more efficiently when laid out in one-story buildings (Figure 11-19). Raw materials are typically delivered at one end and moved through the factory on conveyors or forklift trucks. Products are assembled in logical order and shipped out at the other end. The land needed to build one-story factories is now more likely to be available in suburban or rural locations. Also, land is much cheaper in suburban or rural locations than near the center of a city.

In addition to providing enough space for one-story buildings, locations outside cities are also attractive because they facilitate delivery of inputs and shipment of products. In the past, when most material moved in and out of a factory by rail, a central location was attractive because rail lines converged there. With trucks now responsible for transporting most inputs and products, proximity to major highways is more important for a factory. Especially attractive is the proximity to the junction of a long-distance route and the beltway or ring road that encircles most cities. Thus, factories cluster in industrial parks located near suburban highway junctions.

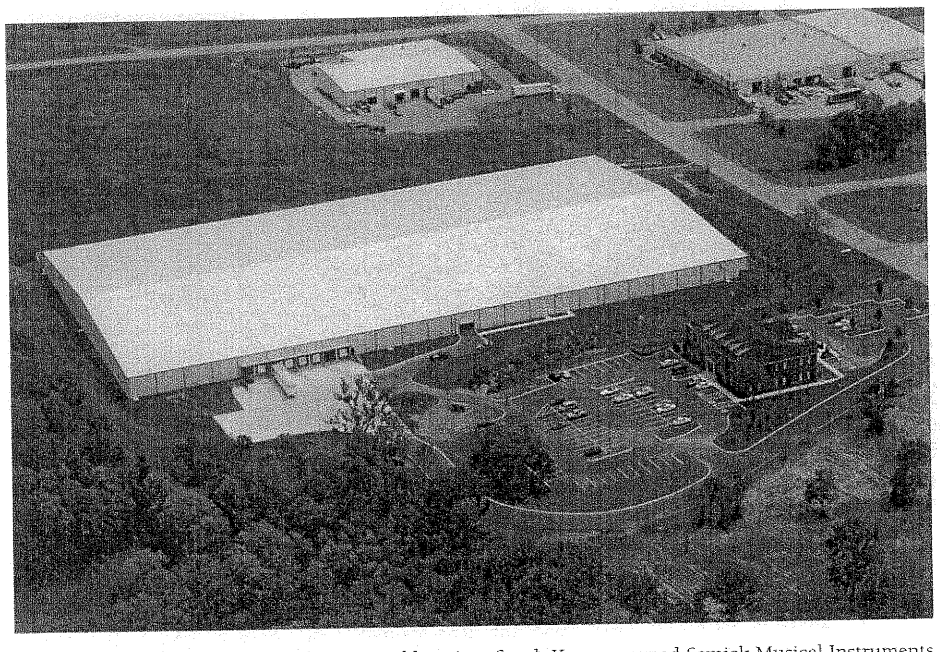


FIGURE 11-19 Land as a site factor: rural location. South Korean-owned Samick Musical Instruments Company located its piano-making factory in Gallatin, Tennessee.

Environmental Factors

Not every location has the same climate, topography, recreational opportunities, cultural facilities, and cost of living. Some executives select locations because they are attracted to the distinctive amenities of a site. Attractions could be relatively mild climates and opportunities for year-round outdoor recreation activities, or proximity to cultural facilities and major-league sports franchises. Industries may be attracted to specific parcels of land that are accessible to low-cost energy sources. Prior to the Industrial Revolution, many economic activities were located near rivers and close to forests because running water and the burning of wood were the two most important sources of energy. When coal became the dominant form of industrial energy in the late eighteenth century, location near coalfields became more important. Because coalfields were less ubiquitous than streams or forests, industry began to concentrate in fewer locations.

In the twentieth century, electricity became an important source of energy for industry. Electricity is generated in several ways, by using coal, oil, natural gas, running water (hydroelectricity), nuclear fuel, and, to a very limited degree, solar energy and wind. In the United States, electricity usually is purchased from utility companies, which are either publicly owned or privately owned but regulated by th state government. Like home consumers, industries are charged a certain rate per kilowatt hour of electricity consumed, although large industrial users usually pay a lower rate than do home consumers. Each utility company sets its own rate schedule, subject to approval by its state's regulatory agency. Industries with a particularly high demand for energy may select a location with lower electrical rates.

The aluminum industry, for example, requires a large amount of electricity to separate pure aluminum from bauxite ore (Figure 11-20). Aluminum producers locate near dams to take advantage of the large amount of cheap hydroelectric power generated there. The oldest continuously operating aluminum production and fabricating plant in the United States at Massena, New York, was established in 1902 by the Pittsburgh Reduction Co. (now Alcoa, Inc.) near a dam constructed by the St. Lawrence River Power Co. as part of a three-mile canal linking the St. Lawrence and Grasse rivers. Alcoa, the world's largest aluminum producer, also makes aluminum near other sources of inexpensive hydroelectric power.

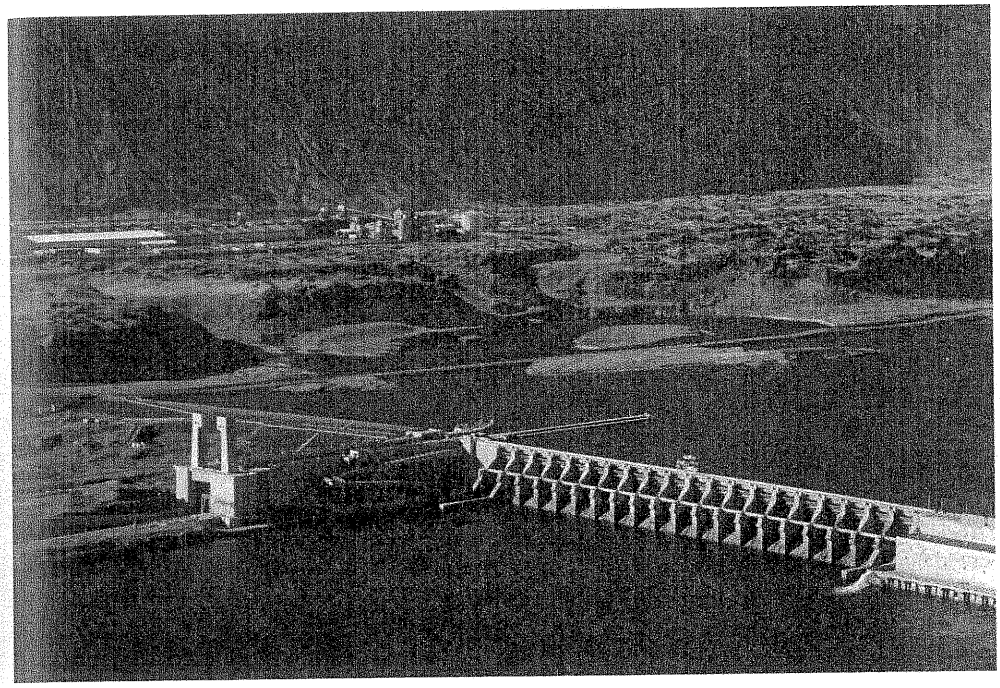


FIGURE 11-20 Land as a site factor: aluminum industry. Low-cost electricity is a critical site factor for aluminum producers. To obtain electricity, Alcoa constructed the Cheoah Dam across the Little Tennessee River in 1919.

As an indication of the importance of inexpensive electricity for aluminum production, a subsidiary of Alcoa even owns dams that generate power along the Cheoah, Little Tennessee, and Yadkin rivers in eastern Tennessee and western North Carolina.

Capital

Manufacturers typically borrow funds to establish new factories or expand existing ones. The U.S. motor-vehicle industry concentrated in Michigan early in the twentieth century largely because this region's financial institutions were more willing than eastern banks to lend money to the industry's pioneers. The most important factor in the clustering of high-tech industries in California's Silicon Valley—even more important than proximity to skilled labor—was the availability of capital. Banks in Silicon Valley have long been willing to provide money for new software and communications firms even though lenders elsewhere have hesitated. High-tech industries have been risky propositions—roughly two-thirds of them fail—but Silicon Valley financial institutions have continued to lend money to engineers with good ideas so that they can buy the software, communications, and networks they need to get started. One-fourth of all capital in the United States is spent on new industries in the Silicon Valley.

The ability to borrow money has become a critical factor in the distribution of industry in LDCs. Financial institutions in many LDCs are short of funds, so new industries must seek loans from banks in MDCs. But enterprises may not get loans if they are located in a country that is perceived to have an unstable political system, a high debt level, or ill-advised economic policies.

KEY ISSUE 4
Why Are Location Factors Changing?

- Attraction of New Industrial Regions
- Renewed Attraction of Traditional Industrial Regions

Industry is on the move around the world. Changing site factors have been especially important in stimulating industrial growth in new regions, internationally and within MDCs. At the same time, some industries remain in the traditional regions, primarily because of changing situation factors. ■

Attraction of New Industrial Regions

Labor is the site factor that is changing especially dramatically in the twenty-first century. To minimize labor costs, some manufacturers are locating in places where prevailing wage rates are lower than in traditional industrial regions.

Changing Industrial Distribution Within MDCs

Within MDCs, industry is shifting away from the traditional industrial areas of northwestern Europe and northeastern United States. In the United States, industry has shifted from the northeast toward the south and west. In Europe, government policies have encouraged relocation toward economically distressed peripheral areas.

Interregional Shift in the United States

The northeastern United States lost 6 million jobs in manufacturing between 1950 and 2009 (Figure 11-21). Especially large declines were recorded by New York State and Pennsylvania, states that once served as centers for clothing, textile, steel, and fabricated metal manufacturing. Meanwhile, 2 million manufacturing jobs were added in the South and West between 1950 and 2009. California and Texas each added one-half million manufacturing jobs.

Industrialization during the late nineteenth and early twentieth centuries largely bypassed the South, which had not recovered from losing the Civil War. The South lacked infrastructure needed for industrial development: Road and rail networks were less intensively developed in the South, and electricity was less common. As a result, the South was the poorest region of the United States. Industrial growth in the South since the 1930s has been stimulated in part by government policies to reduce historical disparities. The Tennessee Valley Authority brought electricity to much of the rural South, and roads were constructed in previously inaccessible sections of the Appalachians, Piedmont, and Ozarks. Air-conditioning made living and working in the South more tolerable during the summer.

RIGHT-TO-WORK LAWS. The principal lure for many manufacturers was enactment by Southern states of **right-to-work laws**. A right-to-work law requires a factory to maintain a so-called "open shop" and prohibits a "closed shop." In a "closed shop," a company and a union agree that everyone must join the union to work in the factory. In an "open shop," a union and a company may not negotiate a contract that requires workers to join a union as a condition of employment.

By enacting right-to-work laws, Southern states made it much more difficult for unions to organize factory workers, collect dues, and bargain with employers from a position of strength. More importantly, the region was especially attractive for companies working hard to keep out a union altogether. The right-to-work laws sent a powerful signal that antiunion attitudes would be tolerated, even actively supported. As a result, the percentage of workers who are members of a union is much lower in the South than elsewhere in the United States.

Steel, textiles, tobacco products, and furniture industries have become dispersed through smaller communities in the South, many in search of a labor force willing to work for less pay than in the North and forgo joining a union. The Gulf Coast has become an important industrial area because of access to oil and natural gas. Along the Gulf Coast are oil refining, petrochemical manufacturing, food processing, and aerospace product manufacturing.

TEXTILE PRODUCTION. The textile and apparel industry has been especially prominent in opening production in lower-wage locations while shutting down production in higher-wage locations. The U.S. textile and apparel industry was heavily concentrated in the Northeast during the early twentieth century, then shifted to the South and West.

New York's Garment District, near Pennsylvania Station at 7th Avenue and 33rd Street, once housed a large percentage of the nation's textile and apparel manufacturers. Its major attraction was a large supply of European immigrants willing to weave and sew long hours in sweatshops for low pay. Buyers from around the country arrived in New York, mostly by train, twice a year to select the clothing for sale in their stores during the next season and to place orders for making the clothes with Garment District manufacturers.

Most textile and apparel production in the United States moved from the Northeast to the Southeast during the mid-twentieth century. Favored sites were small towns of the Appalachian, Piedmont, and Ozark mountains, especially western North and South Carolina and northern Georgia and Alabama. The area is home to 99 percent of U.S. hosiery and sock producers, half of them in North Carolina (Figure 11-22).

Prevailing wage rates were much lower in the Southeast. Even more important for manufacturers, workers in the Southeast showed little interest in joining one of the unions established by

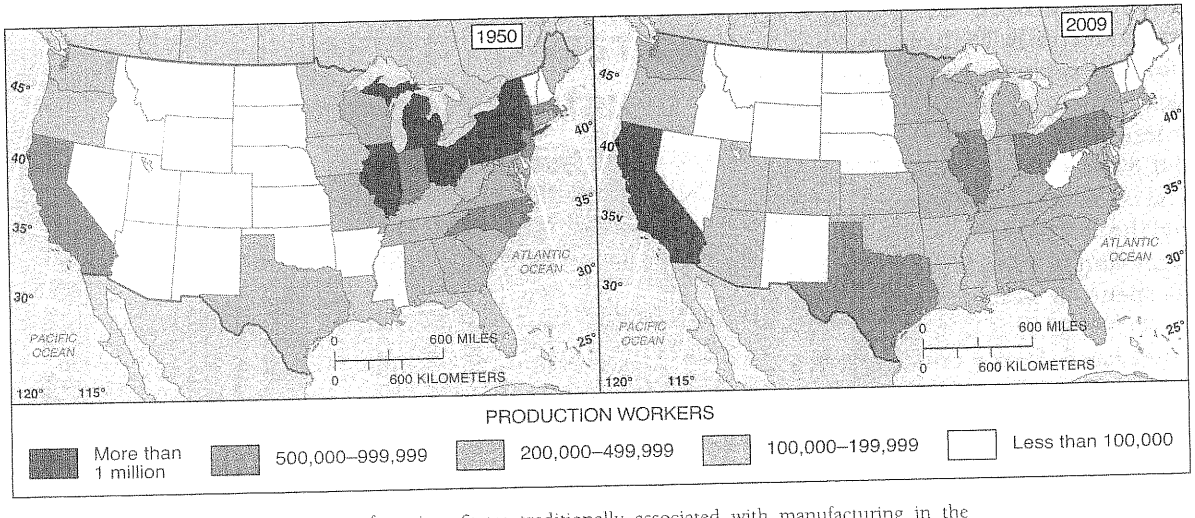


FIGURE 11-21 Changing U.S. manufacturing. States traditionally associated with manufacturing in the Northeast accounted for two-thirds of the country's manufacturing in 1950, compared to only two-fifths in 2009.

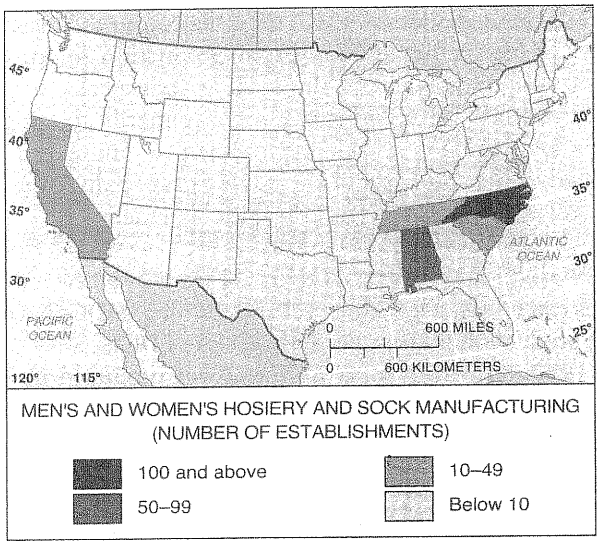


FIGURE 11-22 Men's and women's socks and hosiery manufacturers. To support their labor-intensive industry, hosiery manufacturers locate where a low-cost workforce exists. In the United States, the lowest-cost labor is concentrated in the Southeast. The U.S. Bureau of the Census classifies these manufacturers as North American Industry Classification System (NAICS) 31511.

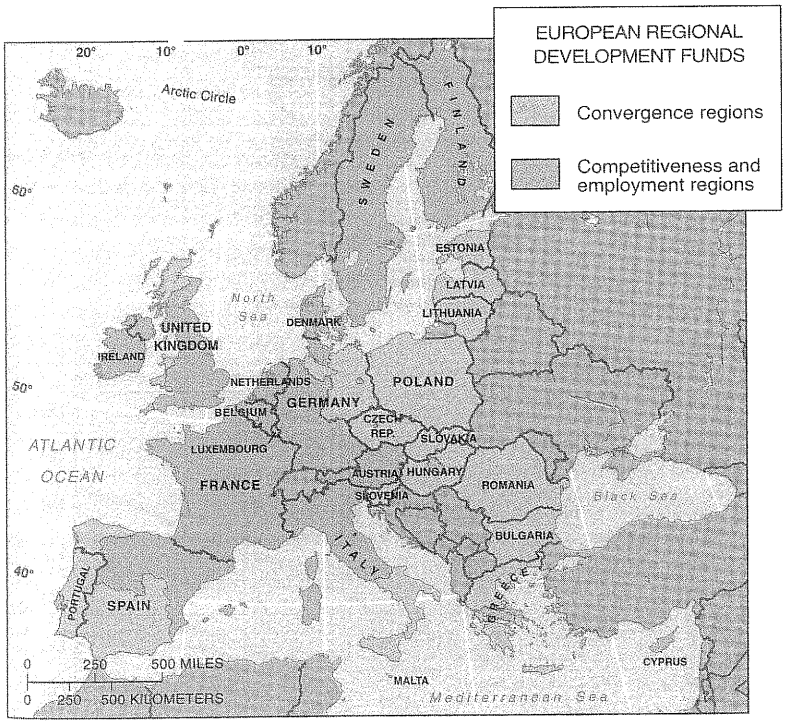


FIGURE 11-23 European Union Structural Funds. The European Union provides subsidies in regions with economic difficulties because of declining industries, as well as to regions that have lower-than-average incomes.

Northeastern textile and apparel workers to bargain for higher wages and safer working conditions. Although located farther from Northeastern population centers, Southeastern mills were able to reach markets easily after the opening of the interstate highway system beginning in the 1950s.

INTERREGIONAL SHIFTS IN EUROPE. Manufacturing has diffused from traditional industrial centers in northwestern Europe toward southern and eastern Europe. In contrast to the United States, European government policies have explicitly encouraged this industrial relocation (Figure 11-23). The European Union provides assistance to what it calls convergence regions and competitive and employment regions:

- **Convergence Regions:** Primarily Eastern and Southern Europe, where incomes lag behind Europe's average.
- **Competitive and Employment Regions:** Primarily Western Europe's traditional core industrial areas, which have experienced substantial manufacturing job losses in recent years.

The Western European country with the most rapid manufacturing growth since the late twentieth century has been Spain, especially since its admission to the European Union in 1986. Until then, Spain's manufacturing growth had been retarded by physical and political isolation. Spain's motor-vehicle industry has grown into the second largest in Europe, behind only Germany's, although it is entirely foreign-owned. Spain's leading industrial area is Catalonia, in the northeast, centered on the city of Barcelona. The region has the country's largest motor-vehicle plant and is the center of Spain's textile industry as well.

Several European countries situated east of Germany and west of Russia have become major centers of industrial investment since the fall of communism in the early 1990s. Poland, Czech Republic, and Hungary have had the most industrial development, though other countries in the region have shared in the growth. The region prefers to be called *Central Europe*, reverting to a common pre-Cold War term, to signify its more central location in Europe's changing economy. Central Europe offers manufacturers an attractive combination of two important site and situation factors—labor and market proximity. Central Europe's workers offer manufacturers good value for money—they are less skilled but much cheaper than in Western Europe, more expensive but much more skilled than in Asia and Latin America. At the same time, the region offers closer proximity to the wealthy markets of Western Europe than other emerging industrial centers.

International Shifts in Industry

In 1970, nearly one-half of world industry was in Europe and nearly one-third was in North America; now these two regions account for only one-fourth each. The share of world industry in other regions has increased from one-sixth in 1970 to one-half in 2010.

Increasingly important industrial areas outside of North America and Europe include:

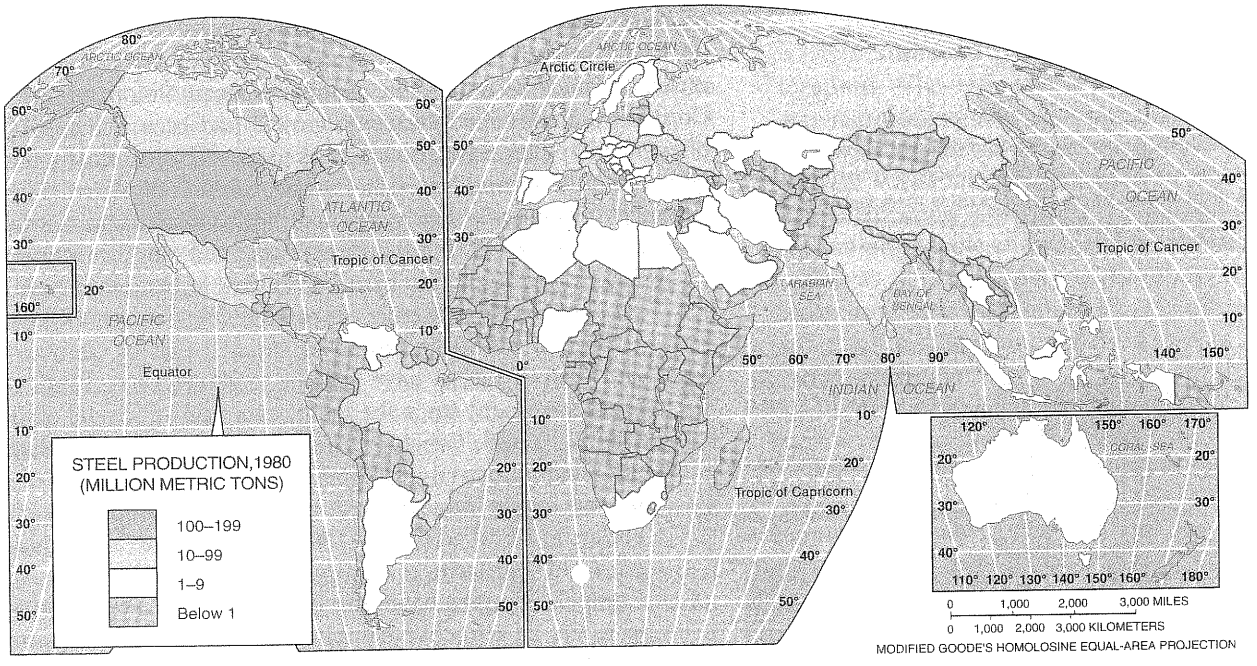
- **East Asia.** Already one of the world's three major industrial regions, as discussed in Key Issue 2. Rapid industrial growth in China means that East Asia likely will account for an increasing share of world industrial production, pulling well ahead of Europe and North America. In addition to China and Japan, East Asia also includes South Korea, which is the world's leading producer of

large container ships that play an important role in international trade. South Korea is a leading producer of steel and fabricated metal products, including motor vehicles.

- **South Asia.** Led by India, with one of the fastest-growing economies among large countries. Textiles are India's dominant industrial sector, but motor-vehicle production is growing rapidly. India is now an important center for business services, as discussed in the next chapter. India's GDP is expected to match that of the United States by 2050.
- **Latin America.** The nearest low-wage region to the United States. The cost of shipping from Mexico to the United States is lower than from other LDCs. *Maquiladora* plants have located in Mexico's far north to be as close as possible to the United States. Mexico City, the country's largest market, is the center for industrial production for domestic consumption. Brazil is the leading industrial country in Latin America. Its industries serve primarily the domestic market, which is also the region's largest. Industry is clustered in the southeast of the country, especially around the two largest cities São Paulo and Rio de Janeiro.

CHANGING DISTRIBUTIONS. The shift to new industrial regions can be seen clearly in steel and clothing. MDCs have been losing production of these key industries to LDCs.

In 1980, 80 percent of world steel was produced in MDCs and 20 percent in LDCs (Figure 11-24, top). Between 1980 and



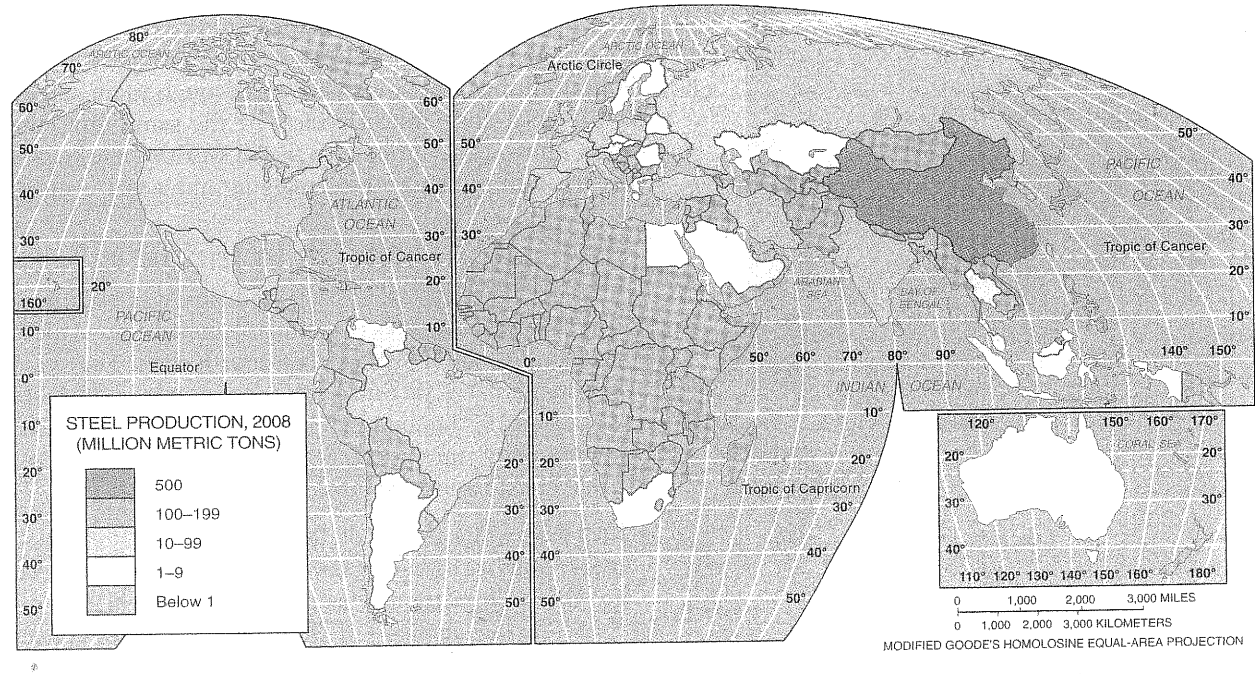


FIGURE 11-24 World steel production, 1980 and 2008. All of the world's increase in steel production has been in LDCs, especially China.

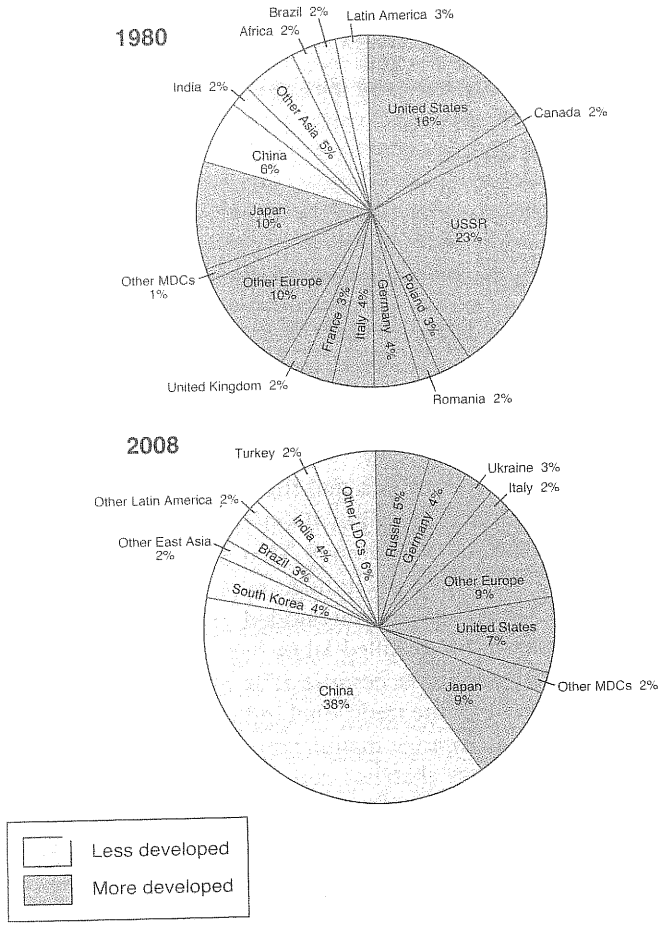


FIGURE 11-25 MDCs accounted for 80 percent of global steel production in 1980, compared to only 40 percent in 2008.

2008, the share of world steel production declined to 40 percent in MDCs and increased to 60 percent in LDCs (Figure 11-24, bottom). During this quarter-century, the share of world steel production declined from 50 percent to 23 percent in Europe and from 20 to 8 percent in North America. China, now the world's largest steel producer, accounted for 38 percent of world steel output in 2008, nearly as much as all MDCs combined (Figure 11-25). Otherwise stated, world steel production increased from around 700 million metric tons in 1980 to around 1,300 million metric tons in 2008. Production in MDCs remained about the same at around 500 million metric tons. Meanwhile, production increased during the period by around 500 million metric tons in China and by around 300 million metric tons in other LDCs.

Labor-intensive industries have been especially attracted to LDCs. The number of apparel workers in the United States declined from 900,000 in 1990 to 500,000 in 2000 and to 150,000 in 2009. During this period, most apparel sold in the United States switched from domestic-made to foreign-made (Figure 11-26). As apparel from other countries has become less expensive and less complicated to import into the United States, mills in the Southeast paying $10 to $15 per hour wages have been unable to compete with manufacturers in countries paying less than $1 per hour (Figure 11-27). European countries have been even harder hit by international competition. Compensation for manufacturing employees exceeds $30 per hour in much of Europe.

OUTSOURCING. Transnational corporations have been especially aggressive in using low-cost labor in LDCs. To remain competitive in the global economy, they carefully review their production processes to identify steps that can be performed by low-paid, low-skilled workers in LDCs. Despite greater transportation cost, transnational corporations can profitably transfer some work to LDCs, given the substantial difference in wages between MDCs and LDCs. At the same time, operations that require highly skilled workers remain in factories in MDCs. This selective transfer of some jobs to LDCs is known as the **new international division of labor**.

Transnational corporations allocate production to low-wage countries through **outsourcing**, which is turning over much of the responsibility for production to independent suppliers. Outsourcing contrasts with the approach typical of traditional mass production, called vertical integration, in which a company controls all phases of a highly complex production process. Vertical integration was traditionally regarded as a source of strength for manufacturers because it gave them the ability to do and control everything. Carmakers once made nearly all of their own parts, for example, but now most of this operation is outsourced to other companies able to make the parts cheaper and better. As a result of outsourcing, though, carmakers account for only around 30 percent of

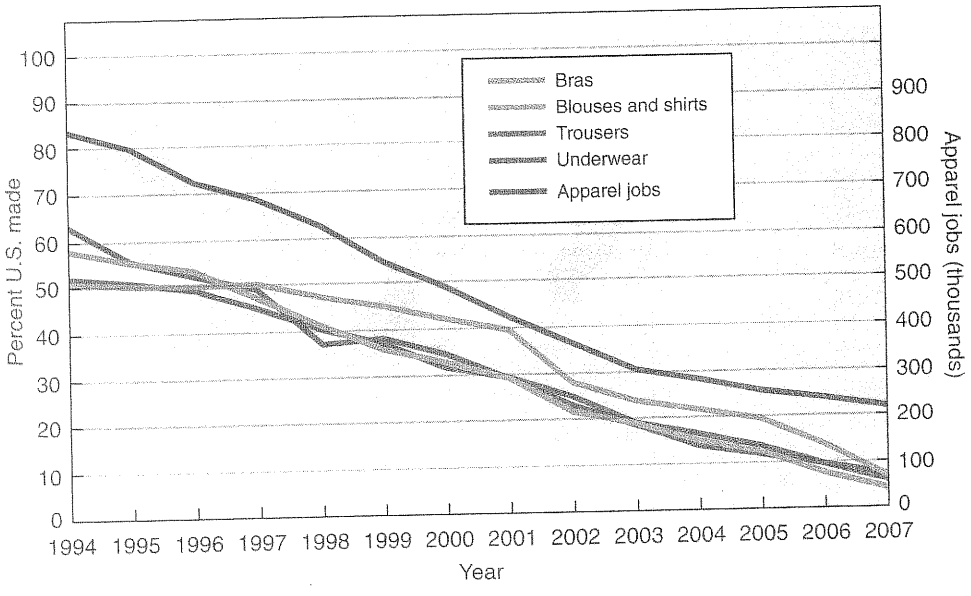


FIGURE 11-26 Apparel production and jobs in the United States. The number of jobs in the apparel industry has declined sharply in the United States since the 1990s. Not by coincidence, the percentage of everyday clothing accounted for by domestic production has decreased sharply, replaced with imports.

the value of the vehicles that bear their names. The rest of the value is tied up in the thousands of parts that go into the vehicles. The makers of these parts must also decide where to locate their factories.

Outsourcing has had a major impact on the distribution of manufacturing because each step in the production process is now scrutinized closely in order to determine the optimal location. For example, carmakers have outsourced production of seats to independent companies. The seats installed in U.S. vehicles are invariably put together in the United States, but many of the parts in the seats are made in other countries (see Global Forces, Local Impacts box).

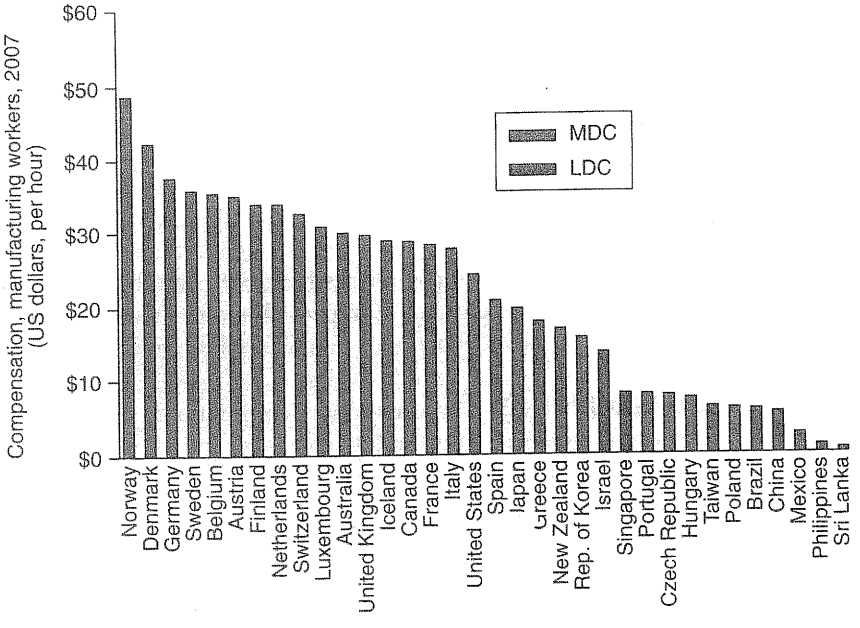


FIGURE 11-27 Manufacturing compensation. Compensation including wages and benefits is much higher in MDCs, especially in Europe, than in LDCs.

Renewed Attraction of Traditional Industrial Regions

Given the strong lure of low-cost labor in new industrial regions, why would any industry locate in one of the traditional regions, especially in the northeastern United States or northwestern Europe? Two location factors influence industries to remain in these traditional regions—availability of skilled labor and rapid delivery to market.

Proximity to Skilled Labor

Henry Ford boasted that he could take people off the street and put them to work with only a few minutes of training. That has changed for many industries, including motor vehicle assembly, which now want skilled workers instead. The search for skilled labor has important geographic implications because it is an asset found principally in the traditional industrial regions.

Computer manufacturing is an example of an industry that has concentrated in relatively high-wage, high-skilled communities of the United States, especially near universities in the Bay Area of California and at the University of Texas at Austin (Figure 11-28). Even the clothing industry has not completely abandoned the Northeast. Dresses, woolens, and other "high-end" clothing products are still made in the region. They require more skill in cutting and assembling the material, and skilled textile workers are more plentiful in the Northeast (Figure 11-29).

Traditionally, factories assigned each worker one specific task to perform repeatedly. Some

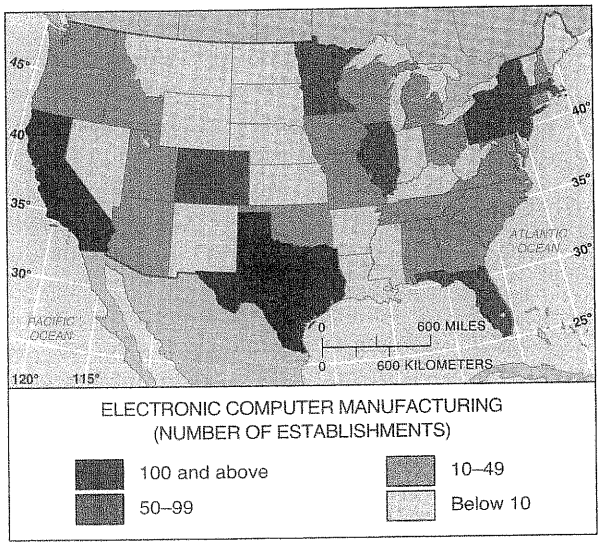


FIGURE 11-28 Electronic computing manufacturing (NAICS 3341). Manufacturers of computing equipment need access to highly skilled workers to perform precision tasks. They are willing to pay relatively high wages to attract the workers. The largest clusters of skilled workers are in the Northeast and on the West Coast.

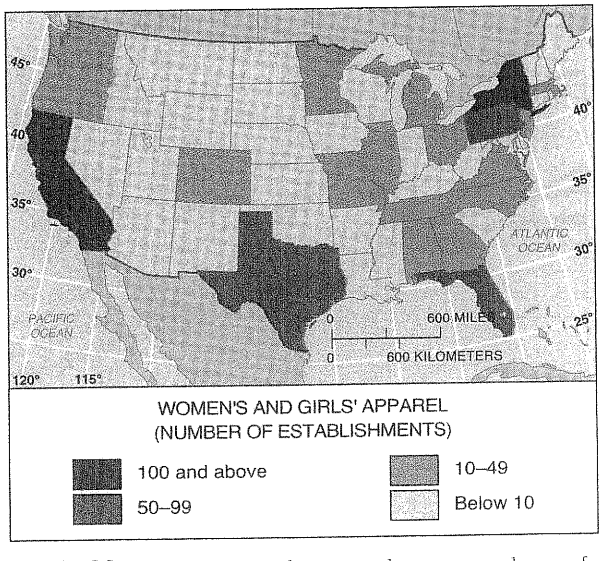


FIGURE 11-29 Women's and girls' cut and sew apparel manufacturing (NAICS 31523). Products that require more skilled workers, such as dresses and knit outerwear, are still produced primarily in or near New York City.

GLOBAL FORCES, LOCAL IMPACTS

What Is an American Car?

Distinctions between "American" and "foreign" motor vehicles have been blurred for the past three decades. Popular media have delighted in showcasing examples of "American" vehicles produced by the Detroit 3 (Chrysler, Ford, and General Motors) that have lower U.S. content than those produced by "Japanese" carmakers such as Honda and Toyota. The U.S. government distinguishes between domestic and foreign vehicles in three ways:

- For measuring fuel efficiency, the U.S. Environmental Protection Agency considers a vehicle domestic if at least 75 percent of its content comes from North America, originally defined as the United States and Canada, and, after enactment of the North American Free Trade Agreement (NAFTA), including Mexico.
- For setting import tariffs, the U.S. Department of Treasury Customs Service considers as domestic a vehicle having at least 50 percent U.S. and Canadian content.
- For informing consumers, the American Automobile Labeling Act of 1992 considers a vehicle domestic if at least 85 percent of the parts originate in the United States and Canada; a part is counted as domestic if at least 70 percent of its overall content comes from the United States and Canada.

According to data derived from Labeling Act reports, vehicles built by foreign-owned carmakers at assembly plants located in the United States had around 60 percent domestic content in 2008. Domestic content for the Detroit 3 in 2008 was 76 percent (Figure 11-30, top). The lower domestic content for foreign carmakers masks differences among individual companies. Honda and Toyota have a level of U.S. content comparable to that of the Detroit 3. German-owned carmakers such as BMW and Daimler have much lower percentages.

The gap in domestic content between the two sets of carmakers narrowed during the 1990s primarily because the foreign-owned companies bought more North American parts. After opening assembly plants in the United States during the 1980s, Japanese-owned carmakers convinced many of their Japanese-owned suppliers to build factories in the United States. During the first decade of the twenty-first century, the gap in domestic content narrowed further because the Detroit 3 bought more foreign parts. More than one-fourth of all new vehicle parts are imported. Mexico has become the leading source of imported parts, and China has been increasing its share rapidly (Figure 11-30, bottom).

In the United States, one-half of vehicle parts are made in the United States by U.S.-owned companies, one-fourth are made in the United States by foreign-owned transnational corporations, and one-fourth are made overseas and imported into the United States. As variations in situation and site costs continually shift from one country to another, these percentages are bound to change. ■

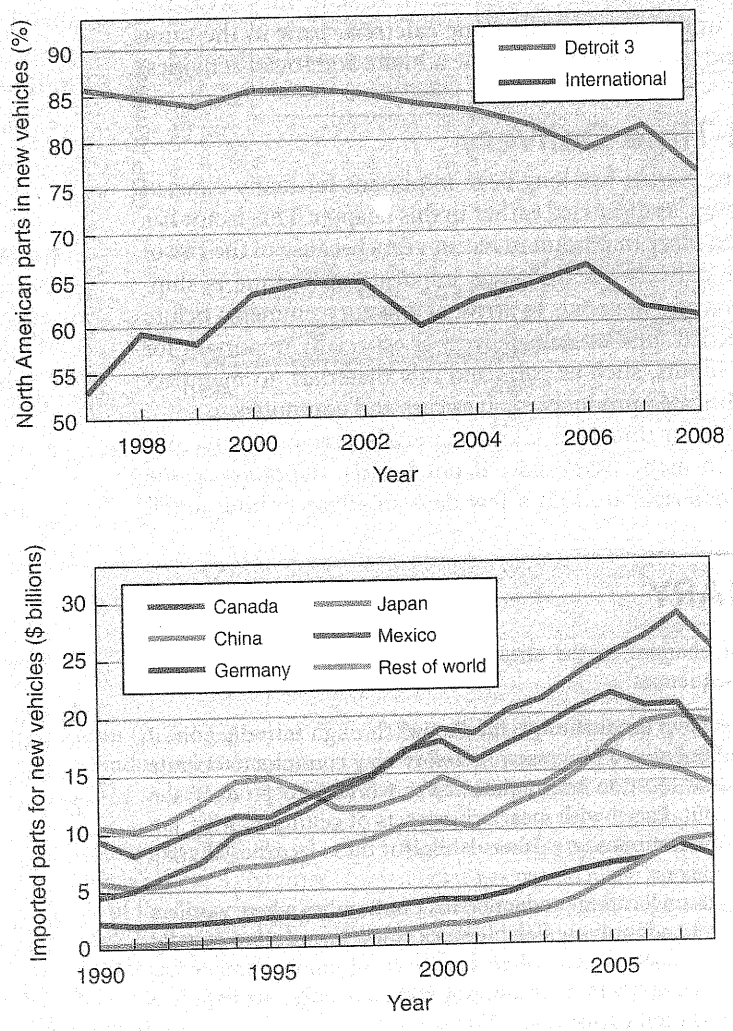


FIGURE 11-30 (top) Motor vehicles sold in the United States by the Detroit 3 contain a higher percentage of U.S.-made parts than do vehicles sold by the internationals (carmakers with headquarters in Japan, Korea, and Germany). (bottom) Mexico is the leading source of imported motor vehicle parts.

geographers call this approach **Fordist** or mass production because the Ford Motor Company was one of the first to organize its production this way early in the twentieth century. At its peak, Ford's factory complex along the River Rouge in Dearborn, Michigan, near Detroit, employed more than 100,000. Most of these workers did not need education or skills to do their jobs, and many were immigrants from Europe or the southern United States. Many industries now follow a lean or flexible production approach. The term **post-Fordist** is sometimes used to describe lean production, to contrast with Fordist production. Again, a carmaker is best known for pioneering lean production—in this case, Toyota.

Three types of work rules distinguish post-Fordist lean production:

1. **Teams.** Workers are placed in teams and told to figure out for themselves how to perform a variety of tasks.
2. **Problem solving.** A problem is addressed through consensus after consulting with all affected parties rather than through filing a complaint or grievance.
3. **Leveling.** Factory workers are treated alike and managers and veterans do not get special treatment; they wear the same uniform, eat in the same cafeteria, park in the same lot, and participate in the same athletic and social activities.

Just-in-Time Delivery

Proximity to market has long been important for many types of manufacturers, as discussed earlier in this chapter. This factor has become even more important in recent years because of the rise of just-in-time delivery. As the name implies, just-in-time is shipment of parts and materials to arrive at a factory moments before they are needed. Just-in-time delivery is especially important for delivery of inputs, such as parts and raw materials, to manufacturers of fabricated products, such as cars and computers.

Under just-in-time, parts and materials arrive at a factory frequently, in many cases daily if not hourly. Suppliers of the parts and materials are told a few days in advance how much will be needed over the next week or two, and first thing each morning they are told exactly what will be needed at precisely what time that day. To meet a tight timetable, a supplier of parts and materials must locate factories near its customers. If given only an hour or two notice, a supplier has no choice but to locate a factory within 50 miles or so of the customer.

Just-in-time delivery reduces the money that a manufacturer must tie up in wasteful inventory. In fact, the percentage of the U.S. economy tied up in inventory has been cut in half during the past quarter-century. Manufacturers also save money through just-in-time delivery by reducing the size of the factory, because space does not have to be wasted on piling up a mountain of inventory. Leading computer manufacturers have eliminated inventory altogether. They build computers only in response to customer orders placed primarily by telephone or over the Internet. In some cases, just-in-time delivery merely shifts the burden of maintaining inventory to suppliers. Wal-Mart, for example, holds low inventories but tells its suppliers to hold high inventories "just in case" a sudden surge in demand requires restocking on short notice.

Just-in-time delivery means that producers have less inventory to cushion against disruptions in the arrival of needed parts. Two kinds of disruptions can result from reliance on just-in-time delivery:

- **Labor unrest.** A strike at one supplier plant can shut down the entire production within a couple of days. A strike in the logistics industry, such as a strike by truckers or dockworkers, could also disrupt deliveries.
- **"Acts of God."** Most common are weather-related incidents, such as blizzards that close highways or floods that damage factories. A notable non-weather-related disruption followed the September 11, 2001, terrorist attacks on the United States. Suppliers in Canada and Mexico were unable to maintain just-in-time deliveries to manufacturers in the United States because the border crossings were closed. The grounding of all civilian aircraft for several days after the attacks prevented delivery of small high-value parts.

SUMMARY

Three recent changes in the structure of manufacturing have geographic consequences:

- Factories have become more productive through introduction of new machinery and processes. A factory may continue to operate at the same location but require fewer workers to produce the same output. Faced with meager prospects of getting another job in the same community, workers laid off at these factories migrate to other regions.
- Companies are locating production in communities where workers are willing to adopt more flexible work rules. Firms are especially attracted to smaller towns where low levels of union membership reduce vulnerability to work stoppages, even if wages are kept low and layoffs become necessary.
- By spreading production among many countries, or among many communities within one country, large corporations have increased their bargaining power with local governments and labor forces. Production can be allocated to locations where the local government is especially helpful and generous in subsidizing the costs of expansion, and the local residents are especially eager to work in the plant.

These, again, are the key issues in the geography of industry:

1. **Where Is Industry Distributed?** Industry is highly concentrated. Three regions where industry clustered during the twentieth century are Europe, North America, and East Asia.
2. **Why Are Situation Factors Important?** Factories try to identify a location where production cost is minimized. Critical industrial location costs include situation factors for some firms and site factors for others. Situation factors involve the cost of transporting both inputs into the factory and products from the factory to consumers.
3. **Why Are Site Factors Important?** Three site factors—land, labor, and capital—control the cost of doing business at a location.
4. **Why Are Location Factors Changing?** New industrial regions are able to attract some industries, especially because of low wage rates. For their part, traditional industrial regions have been able to offer manufacturers skilled workers and proximity to customers demanding just-in-time delivery.

CASE STUDY REVISITED / Throwing BRIC at NAFTA

NAFTA has joined the United States with its neighbors to its immediate north and south to form one of the world's three main industrial regions. Motor vehicles sold in the United States may be assembled in Canada with many Mexican parts.

Integration of North American industry has generated fear in the United States and Canada:

- Labor leaders fear that more manufacturers will relocate production to Mexico to take advantage of lower wage rates. Such labor-intensive industries as food processing and textile manufacturing may be especially attracted to a region where prevailing wage rates are lower.
- Environmentalists fear that NAFTA encourages firms to move production to Mexico because laws governing air- and water-quality standards are less stringent than in the United States and Canada. Mexico has adopted regulations to reduce air pollution in Mexico City; catalytic converters have been required on Mexican automobiles since 1991. But environmentalists charge that environmental protection laws are still not strictly enforced in Mexico.

Mexico faces its own challenges: It has lost a quarter million *maquiladora* jobs since 2000. Electronics firms are especially likely to pull out of Mexico. The reason: At $2 an hour, Mexican wages are higher than in other LDCs, although much lower than in the United States. Many firms are moving to China, where wages are only $1 an hour.

Meanwhile, some analysts believe that industry in North America, as well as in Europe, will be challenged in the coming decades by a new industrial alliance called BRIC. This is an acronym for four countries—Brazil, Russia, India, and China. The four BRIC countries together currently control one-fourth of the world's land and two-fifths of the world's population, but the four combined account for only one-sixth of world GDP (Figure 11-31). In alphabetical order, their economies rank tenth, eighth, twelfth, and third in the world.

The BRIC concept is that if the four giants work together, they will become the world's dominant industrial bloc in the twenty-first century. China and India have the two largest labor forces, whereas Russia and Brazil are especially rich in inputs critical for industry. The four BRIC countries could possess four of the six largest economies in the world by the mid-twenty-first century. However, as an industrial region, BRIC has the obvious drawback of Brazil's being on the other side of the planet from the other three. China, India, and Russia could form a contiguous region, but long-standing animosity among them has limited economic interaction so far. Still, a generation ago, few would have predicted that industry in Mexico would be highly integrated with industry in the United States and Canada. ■

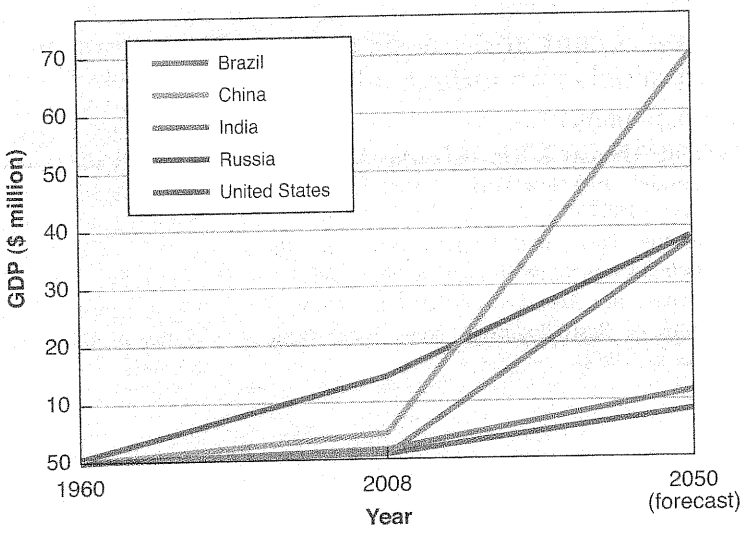


FIGURE 11-31 GDP for BRIC countries and the United States.

KEY TERMS

Break-of-bulk point (p. 355) A location where transfer is possible from one mode of transportation to another.

Bulk-gaining industry (p. 352) An industry in which the final product weighs more or comprises a greater volume than the inputs.

Bulk-reducing industry (p. 350) An industry in which the final product weighs less or comprises a lower volume than the inputs.

Cottage industry (p. 345) Manufacturing based in homes rather than in a factory, commonly found prior to the Industrial Revolution.

Fordist production (p. 368) Form of mass production in which each worker is assigned one specific task to perform repeatedly.

Industrial Revolution (p. 345) A series of improvements in industrial technology that transformed the process of manufacturing goods.

Labor-intensive industry (p. 356) An industry for which labor costs comprise a high percentage of total expenses.

Maquiladora (p. 344) Factories built by U.S. companies in Mexico near the U.S. border, to take advantage of much lower labor costs in Mexico.

New international division of labor (p. 365) Transfer of some types of jobs, especially those requiring low-paid, less skilled workers, from more developed to less developed countries.

Outsourcing (p. 365) A decision by a corporation to turn over much of the responsibility for production to independent suppliers.

Post-Fordist production (p. 368) Adoption by companies of flexible work rules, such as the allocation of workers to teams that perform a variety of tasks.

Right-to-work state (p. 362) A U.S. state that has passed a law preventing a union and company from negotiating a contract that requires workers to join a union as a condition of employment.

Site factors (p. 356) Location factors related to the costs of factors of production inside the plant, such as land, labor, and capital.

Situation factors (p. 350) Location factors related to the transportation of materials into and from a factory.

Textile (p. 356) A fabric made by weaving, used in making clothing.

THINKING GEOGRAPHICALLY

1. What have been the benefits and costs to Canada, Mexico, and the United States as a result of NAFTA?
2. To induce Kia to build its U.S. production facility in Georgia, the state spent $36 million to buy the site; $25 million to prepare the site, including grading; $30 million to provide road improvements, including an interchange off I-85; $6 million to build a rail spur; $20 million to construct a training center; $6 million to operate the center for 5 years; $6 million to develop a training course; $76 million in tax credits; $14 million in sales tax exemptions; and $41 million in training equipment. Did Georgia overpay to win the Kia factory? Explain.
3. Foreign cars account for one-fourth of the sales in the midwestern United States, compared to half in California and other West Coast states. What factors might account for this regional difference?
4. Draw a large triangle on a map of Russia, with one point near Moscow, one point in the Ural Mountains, and one point in Central Asia. What are the principal economic assets of the three regions at each side of the triangle? How do the distributions of markets, resources, and surplus labor vary within Russia?
5. What are the principal manufacturers in your community or area? How have they been affected by increasing global competition?

RESOURCES

Some recent and classic books and articles on industrial geography:

Ashton, Thomas S. *The Industrial Revolution*. London and New York: Oxford University Press, 1997.

Bluestone, Barry, and Bennett Harrison. *The Deindustrialization of America: Plant Closings, Community Abandonment, and the Dismantling of Basic Industry*. New York: Basic Books, 1982.

Dicken, Peter. "Transnational Corporations and Nation-States." *International Social Science Journal* 49 (1997): 77–90.

Essletzbichler, Jürgen. "The Geography of Job Creation and Destruction in the U.S. Manufacturing Sector, 1967–1997." *Annals of the Association of American Geographers* 94 (2004): 602–19.

Harner, John. "Place Identity and Copper Mining in Sonora, Mexico." *Annals of the Association of American Geographers* 91 (2001): 660–80.

Hogan, William T. *Minimills and Integrated Mills: A Comparison of Steelmaking in the United States*. Lexington, MA: Lexington Books, 1987.

———. "What Do They Make, Where, and Does It Matter Any More? Regional Industrial Structures in Britain Since the Great War." *Geography* 7 (1986): 289–304.

Hughes, Alex, and Suzanne Reimer, eds. *Geographies of Commodity Chains*. New York: Routledge, 2004.