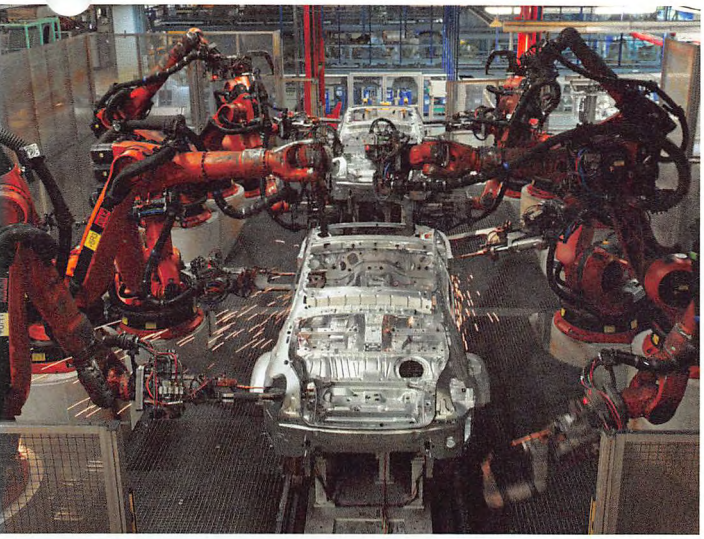
CHAPTER 12

Industry and Services



Guenter Schiffmann/Bloomberg/Getty Images

FIGURE 12.1 Regensburg, Germany. Robots work on the chassis of Bayerische Motoren Werke AG (BMW) automobiles.

Entering the main part of the BMW automobile plant near Regensburg, Germany, I felt like I was stepping onto the set of a science fiction movie. I saw rows of giant orange-colored machines making jerky motions as they assembled the parts of engines that would be placed into car bodies (**Fig. 12.1**). A few people walked the factory floor, but not many—and they were not working on the cars themselves; instead, they were maintaining the machines and making sure everything ran smoothly.

Decades ago, an automobile plant such as this would have employed thousands of workers—many engaged in low-skill tasks. Now, the workforce at most plants of this sort is dramatically smaller, and much of the work is highly skilled, requiring advanced training in electrical engineering, computer programming, and the like. What I was witnessing was one example of a massive economic transformation of the last few decades, one that raises fundamental questions about the changing nature of manufacturing and the future of work.

There is no simple answer to such questions because what is happening in the manufacturing and employment sectors differs greatly from place to place. A few months earlier, I had visited a garment factory in Pacific Asia where I saw people cutting cloth by hand and sewing it with traditional sewing machines (see Fig. 12.15). The contrasts with the German automobile plant show why any attempt to make sense of the evolving character of the industrial and service sectors must take geographical circumstances into account.

In this chapter, we begin by looking at the origin and diffusion of industrial production. Next, we explore how industrialization has changed in recent decades. We examine concepts including flexible production and the global division of labor. Then, we consider how the expanding service economy is altering employment and shaping economic geography.

CHAPTER OUTLINE

12.1 Describe the Hearth and Diffusion of the Industrial Revolution.

Manufacturing began long before the Industrial Revolution. In **cottage industries**, families in a community worked together out of their homes, each creating a component of a finished good or making the good itself. For example, in a small town in England, a few families would receive a shipment of wool from a merchant and then prepare the wool and pass it on to families who would spin the wool into yarn. Those families then passed the yarn to weavers who made blankets and other wool products. Typically, this work was done over the winter, after harvest and before planting the next year's crop. In the spring before planting, the merchants returned to pick up the finished products and pay for the production. Merchants then shipped the goods around the world.

In the 1700s, as global trade grew and faster ships came into use, iron, gold, silver, and brass goods produced in cottage industries in India were in demand wherever they could be bought. India's textiles, made on individual spinning wheels and hand looms, were considered the best in the world. They were so finely made that British textile makers rioted in 1721, demanding legislative protection against imports from India. China and Japan also possessed substantial cottage industries long before the Industrial Revolution.

The transition from cottage industries to the Industrial Revolution happened as Europeans sought to generate greater profit by producing larger quantities of the goods in high demand. They looked for ways to take advantage of **economies of scale**—increasing the quantity of goods produced to decrease the average cost of production for each item.

European manufacturing operations, from the textile makers of Flanders and Britain to the iron smelters of Thüringen, grew during the 1700s. However, Europe's products could not match the price or quality of those in other parts of the world. European companies worked to gain control of overseas industries. For example, the Dutch and British East India Companies targeted local industries in Indonesia and India, respectively, in the 1700s and 1800s.

Both the Dutch and British companies were privately owned and operated companies. Each company recruited and established battalions of soldiers to help them take control of production in Southeast and South Asia. Their presence created political chaos, which they took advantage of by pitting local factions against one another. British merchants exported tons of raw fiber from India to expand textile industries in northern England, including Liverpool and Manchester.

The Industrial Revolution

The wealth brought into the Netherlands and England through trade (**Fig. 12.2**) funded technological innovations in manufacturing that enabled European factories to produce more products at lower prices. The resulting **Industrial Revolution** gave rise to the mass production of goods using machines, not just human labor. Europe flooded global markets with inexpensive products, burying cottage industries at home and abroad. Colonies were no longer merely sites of valuable cottage production; they became providers of essential raw materials and generators of revenue that fueled rapid industrial expansion in Europe.

The first steps in industrialization occurred in the mid-1700s in northern England, where cotton from America and India was shipped to the port of Liverpool. Textile factories in the British Midlands, south of Manchester, took advantage of rivers flowing downhill from the Pennines (a range of mountains and hills in north-central England) to power cotton spinning machines.

Wealth brought to Europe through trade funded improvements such as the spinning jenny and the steam engine. James Watt improved the steam engine by creating a separate chamber to house the steam and by perfecting the pistons that are driven by steam pressure. The invention did not happen overnight. A series of attempts over a few decades finally worked when Watt partnered with toymaker and metalworker Matthew Boulton, who inherited great wealth from his wife (her father had amassed wealth as a global cloth trader). Boulton paid for the final trials and errors that made the Boulton & Watt steam engine work. Coal powered the steam engine, which came to be used in water pumps, trains, looms, and eventually ships.

A pre-Industrial Revolution in iron working enabled iron to be used in many inventions of the Industrial Revolution. In Coalbrookdale, England, in 1709, ironworker Abraham Darby found a way to *smelt* iron. He found that by burning coal in a vacuum-like environment, he could remove impurities, leaving behind coke, the high-carbon portion of coal that burns at a high temperature. Darby put iron ore and coke in a blast furnace and then pushed air into the furnace. Smelting iron ore with coke made it possible for ironworkers to melt the ore and pour it into molds (instead of shaping it by hammering against anvils). The use of molds allowed inventors to make the same product over and over again, thus increasing production. As the **toponym** indicates, the residents of Ironbridge, a town near Coalbrookdale, still take pride in their town's bridge, the first to be constructed entirely from cast iron in 1779 (**Fig. 12.3**).

During the early Industrial Revolution, before the railroad connected industrial sites and reduced the transportation costs of coal, manufacturing had to be located close to coal fields. In Britain, densely populated and heavily urbanized industrial regions developed near coal fields (**Fig. 12.4**). The two largest centers of British industry were an ironworking region in the Midlands, where Birmingham is located, and a textile production region in the Northwest, where Liverpool and Manchester developed as important cities.

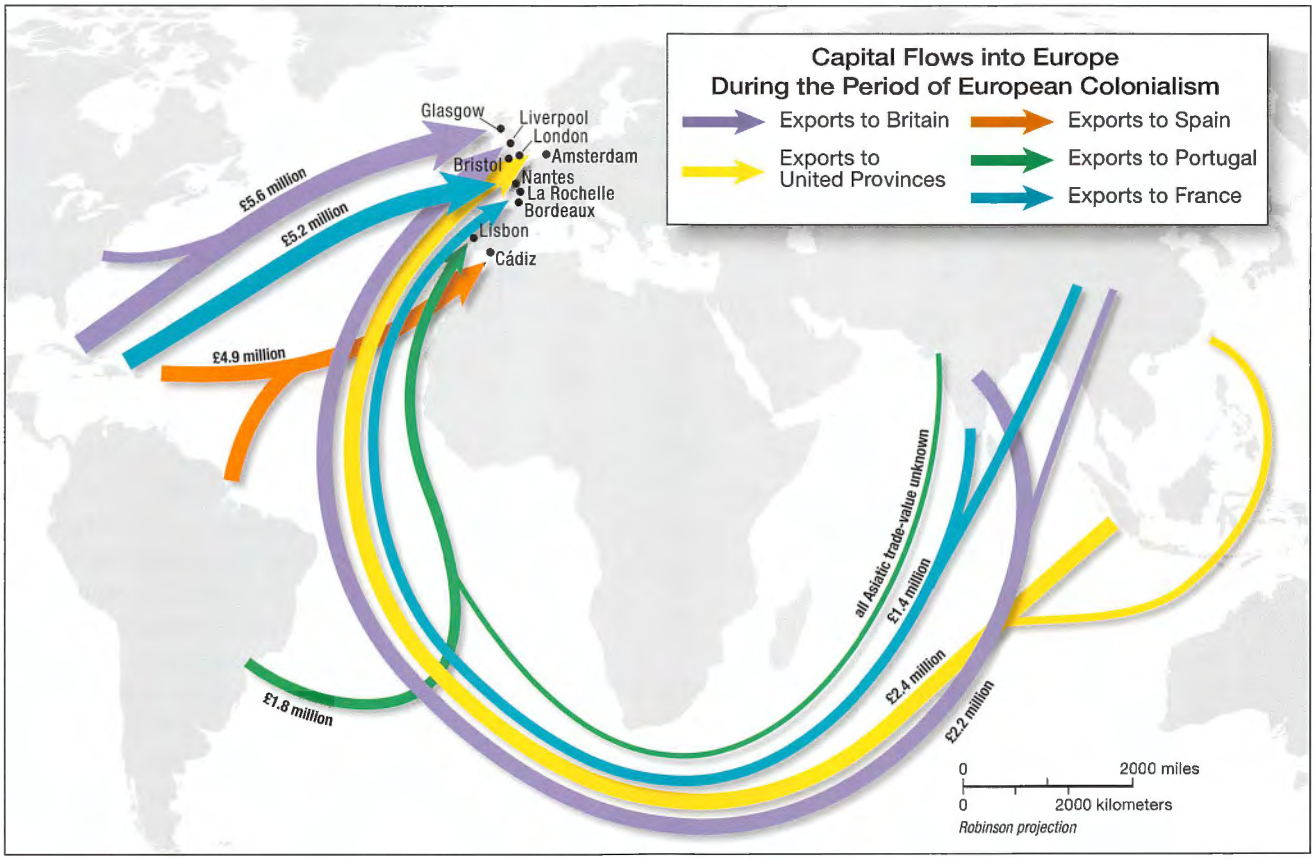


FIGURE 12.2 Capital Flows into Europe During the Period of European Colonialism. This map shows the major flows of capital into Europe from Europe's colonies. The capital helped fuel Europe's Industrial Revolution at the end of the 1700s and into the 1800s.

Manufacturing plants also needed to be connected to ports, where raw materials could arrive and finished products could depart. In the first decades of the Industrial Revolution, manufacturers used boats and barges traveling down canals and rivers to move raw materials to industrial zones and finished products to ports.

The steam engine helped concentrate even more industrial production in the British Midlands and Northwest. Industrialists used the steam engine to pump water out of coal mines, making it possible for coal workers to reach deeper coal seams. In the textile industry, the steam engine powered spinning wheels that spun over 100 spools of thread at a time and powered dozens of looms in a factory all at once. Steam engines also fueled the newest modes of transportation: locomotives on railroads and steamships on the oceans.

The first commercial railway connected Manchester, a center of textile manufacturing, along 35 miles of track to the port of Liverpool in 1830. Sited where the River Mersey flows into the Irish Sea, Liverpool faced west—toward the Atlantic Ocean and British colonies in North America. Cotton and tobacco from the colonies arrived in Liverpool and was transported by rail or canal to factories in Manchester. Coal from Leeds, northeast of Manchester, was transported to Manchester to fuel steam engines. The coal, cotton, and textile factories were located close to each other, helping the area become the hearth of textile manufacturing in the Industrial Revolution.

The rail network expanded as thousands of miles of iron and then steel track were laid. Railroads made it possible to move larger quantities of products faster over land. The steam engine also made its mark on ocean transportation. The first

John Robertson/Alamy Stock Photo

FIGURE 12.3 Ironbridge, England. The world's first bridge made entirely of cast iron was constructed in the late eighteenth century near Coalbrookdale, England, reflecting the resources, technology, and available skills in this area at the time.

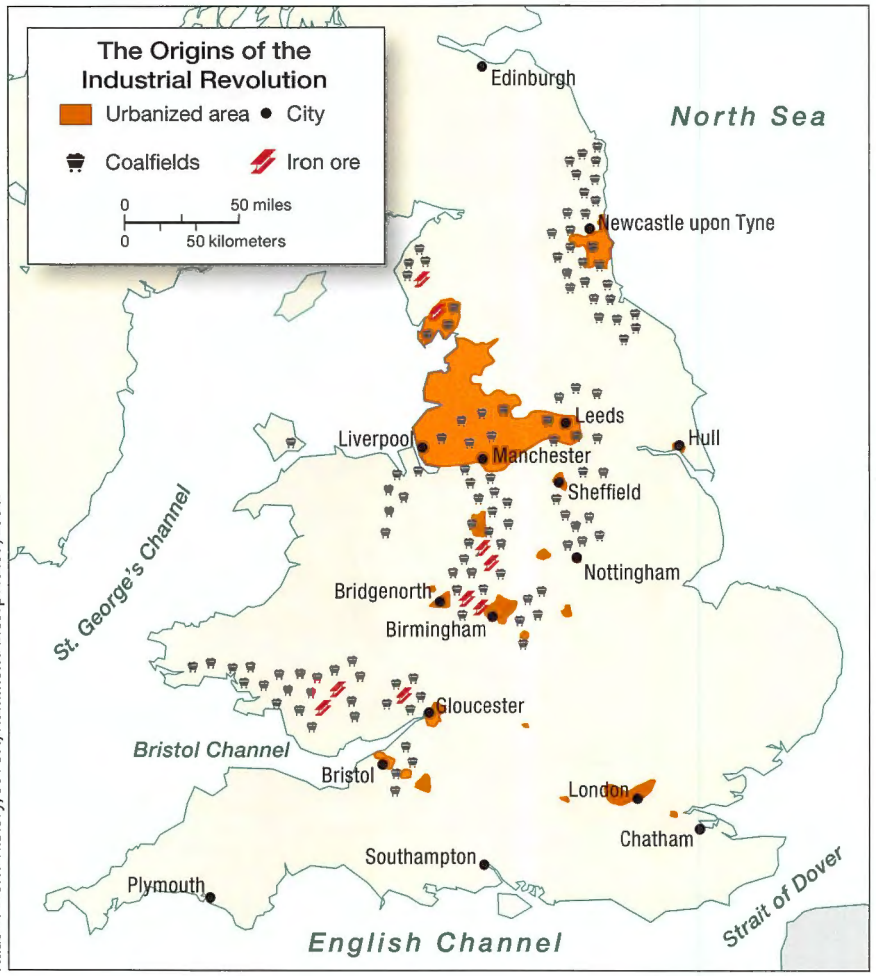


FIGURE 12.4 The Hearth of the Industrial Revolution. The areas of Great Britain that industrialized earliest were those closest to the resources needed for industrialization: coal, iron ore, and capital. Large areas of urbanization grew near industrial zones and in the port cities where materials came in and from which industrialized products went out.

steam-powered ship crossed the Atlantic Ocean in 1819, shrinking the time it took sailing ships to travel across seas. Soon after, shipbuilders designed larger steamships that could transport more goods (**Fig. 12.5**).

With the development of the railroad and steamship, Great Britain expanded its economic advantages over the rest of the world. British investors and business leaders held a near-monopoly over many products. The British perfected coal smelting, cast iron, the steam engine, and the steam locomotive. The systems Britain set during the Industrial Revolution became institutionalized and helped entrench British economic power. For example, the railroad pioneer George Stephenson, who led the building of the railway between Manchester and Liverpool, set the standard gauge (the distance between the two railroad tracks) that is still used for 60 percent of the world's railroads today. The Industrial Revolution increased Britain's global influence. The British capitalized on their manufacturing monopolies, resources in their colonies, and wealth generated through colonialism and trade to become the world's dominant economic and political power in both the eighteenth and nineteenth centuries.

Diffusion of the Industrial Revolution to Mainland Europe

In the early 1800s, the innovations of Britain's Industrial Revolution diffused into mainland Europe. Once there, the same set of locational criteria for industrial zones applied. Sites needed to be close to resources and connected to ports by water. Coal and iron ore were heavy, and transportation of both resources was costly. The first manufacturing belts in continental Europe were therefore located close to coal fields. They were also connected by water to a port so that raw materials could be imported from the Americas and Asia and finished products could be exported.

A belt of major coal fields extends from west to east through mainland Europe, across northern France and southern Belgium, the Netherlands, the German Rühr Valley, western Bohemia in Czechia, and Silesia in Poland. Colonial empires gave access to the necessary capital and raw materials to fuel industrialization, benefiting France, Britain, Belgium, the Netherlands, and eventually Germany. Iron ore is found along a similar belt. The map outlining the diffusion of the Industrial Revolution into Europe shows that industrial production was concentrated along the coal and iron ore belt through the middle of mainland Europe (**Fig. 12.6**).

When industries developed in one area, economic growth had a spillover effect on the port cities to which they were linked by river, canal, or rail. One of the largest industrial centers in continental Europe was the Rühr area of present-day Germany (Germany did not become a single country until the 1870s). The Rühr is connected to the port of Rotterdam, the Netherlands, by the Rhine River. Each port has a **hinterland**, or an area from which goods can be produced, delivered to the port, and then exported. A port also serves its hinterland by importing the raw materials that are delivered to manufacturing sites for production. In other words, Rotterdam is the port, and its hinterland includes the region along the Rhine, including the Rühr in Germany.

Rotterdam grew to be the most important port in Europe. Over the last 200 years, the Dutch have radically altered the port, expanding it from the mouth of the Rhine delta west to the coast of the North Sea. As production and transportation innovations took hold, Rotterdam built new facilities to accommodate them. For example, in the 1950s, Rotterdam Municipal Port Management recognized the growth in the use of oil and built the Europoort. They extended pipelines to the port and

dug a deep canal to enable oil imports. Rotterdam became the distributor for oil throughout the port's hinterland.

In the 1980s, Rotterdam saw an opportunity to connect the port with the interior of continental Europe by railroad. It extended the port further west and built the Betuweroute rail line, which connects Rotterdam with Emmerich, Germany. Rotterdam is both the starting and end point for goods along the corridor. It continues to expand to meet the changing **situation** of the global economy. In the process, it has solidified its position as one of the most important hubs of global commerce.

Once railroads were well established in Great Britain and continental Europe, companies could locate manufacturing plants away from coal and iron ore and in (or close to) major cities such as London and Paris. Cities could import raw materials, produce goods drawing from their large labor supply, and sell the goods to the many consumers living in cities. Until the railway expanded throughout Great Britain, industrialization was slow to reach London because it lacked easy access to coal and iron ore. But when the railroad arrived, London became a particularly attractive site for industry. Its port location on the Thames River was an advantage. More importantly, it was the nerve center of the British Empire. By choosing a **site** in London, a manufacturing company could put itself at the heart of Britain's global **network** of influence.

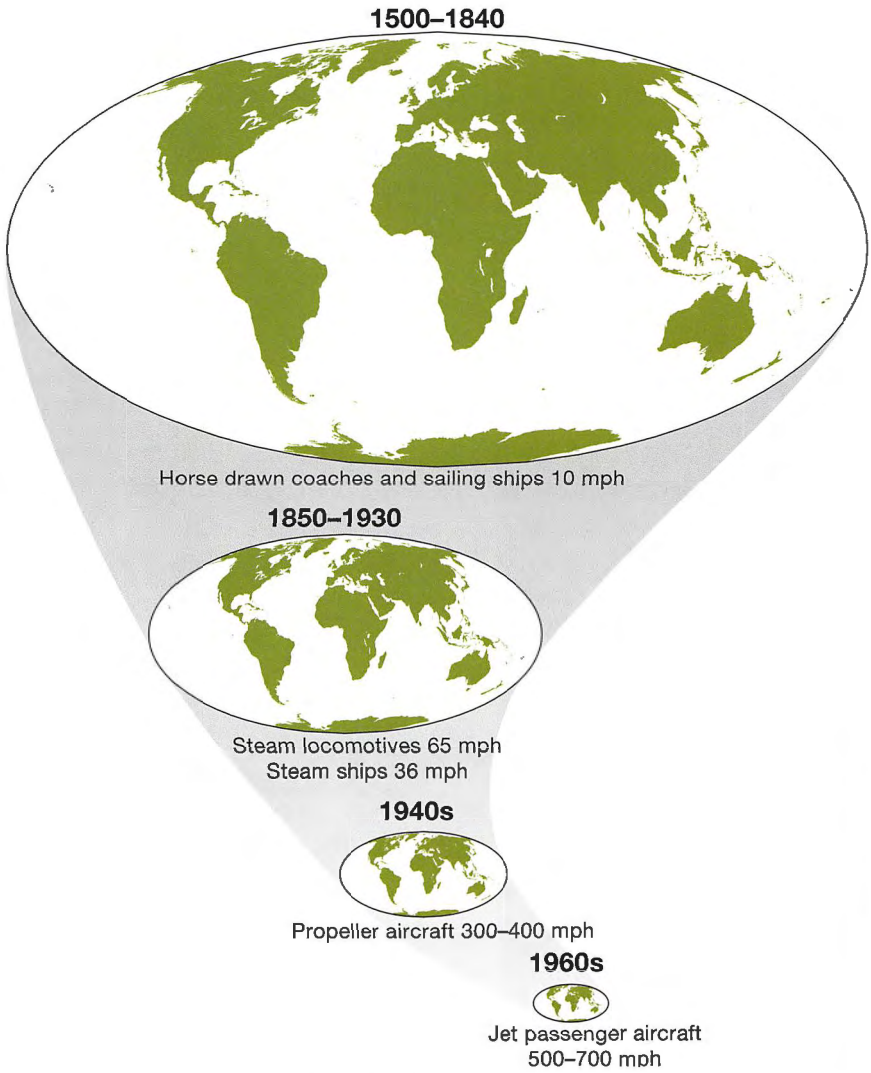


Figure courtesy of: Peter Dicken, Global Shift.

FIGURE 12.5 The World Shrinks Through Transportation Innovations. This diagram helpfully illuminates how much more quickly goods and people could move over land and sea after 1960 compared to 1850. The maps are slightly misleading, though, because new transportation technologies do not connect every single place on Earth. Places close to airports and seaports are more connected to each other than places away from transportation nodes. Time–space compression tells us the world is shrinking, but unevenly, as some places are closer and some are as far or farther away than they have ever been.

Paris was already continental Europe's greatest city, but like London, it did not have coal or iron deposits in its immediate vicinity. However, when a railroad system was added to the existing network of road and waterway connections to Paris, the city became the largest local market for manufactured products for hundreds of miles around and attracted major industries. The city had long been a center for the manufacture of luxury items, including jewelry, perfumes, and fashions, and it now experienced substantial growth in metallurgy and chemical manufacturing. Paris had a ready labor force, the presence of governmental agencies, a nearby ocean port (Le Havre), and France's largest domestic market.

London and Paris became, and remain, important industrial centers because of their commercial and political connections with the rest of the world (**Fig. 12.7**). Germany still ranks among the world's leading producers of both coal and steel, and remains Europe's most important industrial power. By the early twentieth century, industry began to diffuse far from the original European hearth to northern Italy (now one of Europe's major industrial regions), Catalonia (anchored by Barcelona) and northern Spain, southern Sweden, and southern Finland.

Diffusion of the Industrial Revolution Beyond Europe

Western Europe's early industrialization gave it an enormous economic head start, known as a **first mover advantage**. The region was positioned at the center of a quickly growing

FIGURE 12.6 Diffusion of the Industrial Revolution. The eastward diffusion of the Industrial Revolution occurred during the second half of the nineteenth century.

world economy in the nineteenth century, when industrialization began to diffuse from Europe to the Americas and Asia. **Secondary hearths** of industrialization developed in eastern North America, western Russia and Ukraine, and East Asia. The primary industrial regions established by the 1950s were close to coal, the major energy source, and were connected by water or railroad to ports (**Fig. 12.8**). These regions were targets of heavy investment, bringing prosperity to the regions and great wealth to the investors.

North America

By the beginning of the twentieth century, there was only one serious rival to Europe. It was a territory settled predominantly by Europeans and with particularly close links to Britain, which provided links to the capital and innovations that fueled industrialization there: North America. Manufacturing in North America began in New England during the colonial period. Although the northeastern states were not especially rich in mineral resources, American companies could acquire needed raw materials from overseas sources.

Industries developed along the Great Lakes, where goods could be moved in and out of industrial centers by canals, rivers, and lakes. A ready supply of coal fueled industrialization, and there was never any threat of a coal shortage. U.S. coal reserves are among the world's largest and are widely distributed, from Appalachian Pennsylvania to the northwestern Great Plains (**Fig. 12.9**).

Author Field Note Viewing Industrial History in Paris, France

"When the Eiffel Tower was built in 1887, it served as a symbol of the Industrial Age. Viewing it against the backdrop of the sprawling metropolitan area of Paris (photo taken from the top of the only skyscraper in Paris proper, Montparnasse) reminds me that the Paris basin is the industrial as well as agricultural heart of France. The city and region are served by the Seine River, along which lies a string of ports from Le Havre at the mouth to Rouen at the fall line. A district of high-rise buildings has sprung up just outside Paris proper (behind the Eiffel Tower in this photo), and nearby lies a major industrial complex including power plants, petrochemical plants, and oil installations."

– A. B. Murphy

FIGURE 12.7 **Paris, France.**

Russia and Ukraine

The St. Petersburg region is one of Russia's oldest manufacturing centers. Tsar Peter the Great planned and built the city to serve both as Russia's capital and as the country's industrial core. He encouraged western European artisans with skills and specializations to migrate to the region and imported high-quality machine-building equipment to help fuel industrialization. St. Petersburg developed manufacturing based on shipbuilding, chemical production, food processing, and textile making.

After World War I, the newly formed Soviet Union annexed Ukraine and took control of its agricultural lands, rich resources, and industrial potential, especially the coal-rich

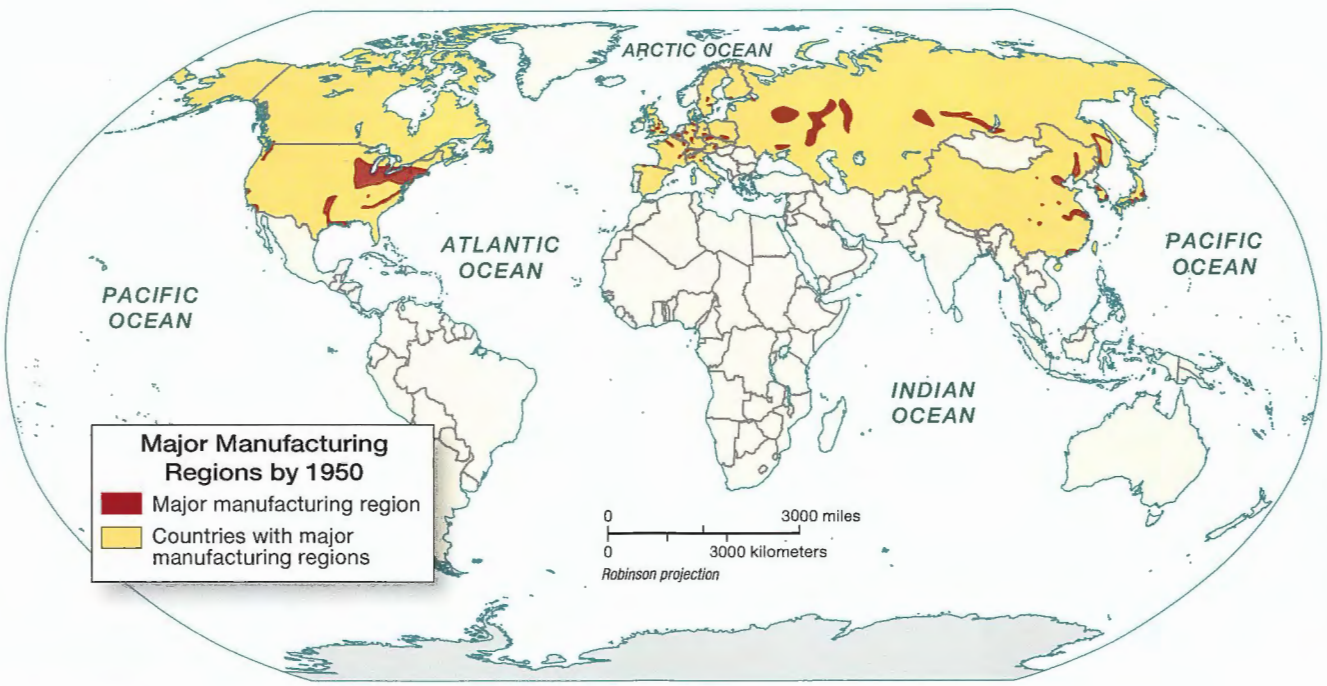


FIGURE 12.8 **Major Industrial Regions of the World in 1950.** This map shows the major industrial districts of Europe, North America, Russia, and East Asia in approximately 1950.

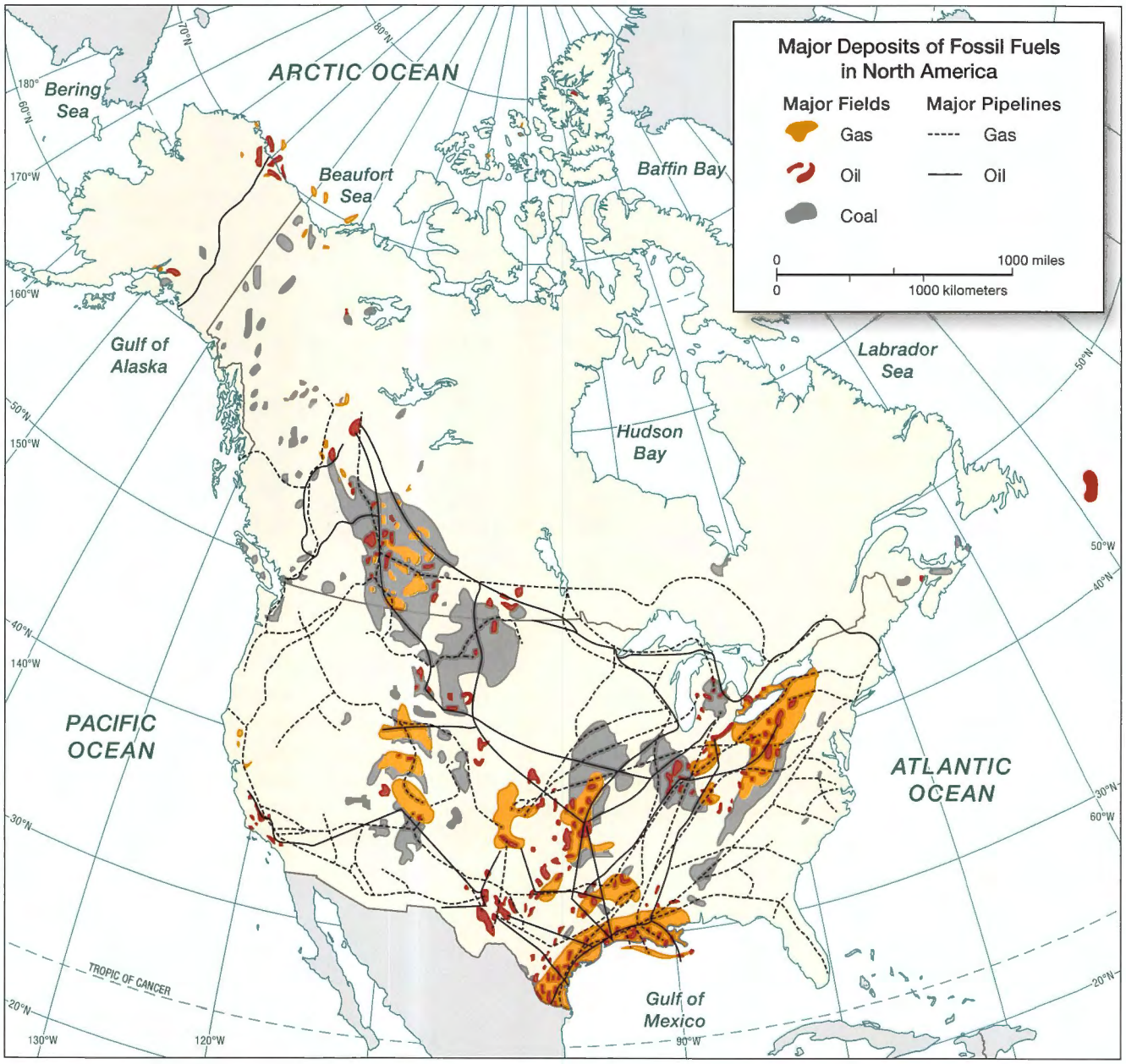


FIGURE 12.9 Major Deposits of Fossil Fuels in North America. North America is one of the world's largest energy consumers, and the continent is also endowed with substantial energy sources.

Donbas region. The Soviet Union was resource rich, as is Russia today. Soviet leaders tapped into resources in Ukraine and also directed an economic plan to industrialize areas closer to Moscow to develop a large industrial belt. They developed industries in Nizhni Novgorod, a river port located at the confluence of the Volga and Oka rivers, 270 miles southeast of Moscow. Following the Volga River, goods can be imported or exported from Nizhni Novgorod to the Black Sea or the Caspian Sea.

East Asia During the 1700s and much of the 1800s, Japan's government chose to be economically isolated from most of the world economy. Japan opened its economy through a change in government policy in 1868. Soon after, the Industrial Revolution diffused to Japan. Japan encouraged young men to study sciences in universities abroad so they could take their knowledge back to Japan and create industries. With limited natural resources, Japan depended on raw materials imported from other parts of the world for manufacturing.

Early Japanese industrialization focused heavily on the military sector. In the late 1800s and early 1900s, Japan used its modernized military to colonize Korea, Taiwan, and portions of mainland China. These places provided resources for Japan's further industrialization and imperial expansion. Japan's dominant region of industrialization and

urbanization is the Kanto Plain (see Fig. 12.8), which contains about one-third of the nation's population and includes the Tokyo–Yokohama–Kawasaki metropolitan area. Japan's second largest industrial complex extends from the eastern end of the Seto Inland Sea to the Nagoya area and includes the Kobe–Kyoto–Osaka triangle.

TC Thinking Geographically

Compare and contrast the **site** and **situation** of industrial production early on in the Industrial Revolution and today. Consider the chapter opener about the BMW plant in Germany. What resources does a manufacturing company now need to produce goods, and how does the situation of the current world economy influence the sites companies choose for manufacturing?

12.2 Explain How and Why the Geography of Industrial Production Has Changed.

So far, globalization has helped us understand many human geographic developments, including local and popular cultures, identities, language loss, colonialism, political disputes, and of development. We turn now to globalization's impact on the geography of manufacturing and service industries since World War II.

Globalization includes the processes that are increasing interactions, deepening relationships, and heightening interdependence across country borders. It is also the outcomes of these processes, which are unevenly distributed and look different from place to place. Globalization could not have happened without improvements in transportation and communication technologies. Improved sailing ships and navigation methods helped establish global trade routes and the first wave of colonialism. The invention of the steamship, the diffusion of railroads, and the diffusion of the telegraph and then the telephone quickened global trade and created the context for the second wave of colonialism. Major technological developments that expanded or were invented after World War II, including jet airplanes, container ships, telephones, and the Internet, furthered globalization.

Fordist Production

The manufacturing boom of the twentieth century began with early innovations in the production process. Perhaps the most significant was the mass-production assembly line pioneered by Henry Ford, which allowed the inexpensive production of consumer goods at a single site on a previously unknown scale. Ford's idea was so important that the dominant mode of mass production came to be known as **Fordist**.

Fordist production also gave rise to political-economic and financial arrangements that supported mass production by corporations. Global manufacturing operated under Bretton Woods financial order, a series of agreements made at a 1944 conference in Bretton Woods, New Hampshire. Countries who signed the Bretton Woods accords agreed to peg the value of their currency to the U.S. dollar, which was pegged to gold (the U.S. later stopped pegging its currency to gold in 1971). In the uncertainty after WWII, Bretton Woods created the stability in international exchange that was needed to encourage the mass production of goods on a global scale.

The 1900s were marked by a surge in both production and consumption. Workers found employment on assembly lines. Ford paid his workers a good wage, and droves of job seekers migrated to the Detroit area to work in the automobile industry. Ford's goal was to mass-produce goods at a price point where his workers could afford to purchase them.

Ford's River Rouge plant in Dearborn, Michigan (**Fig. 12.10**), used the **vertical integration** of production common during the Fordist period. Ford imported coal, rubber, and steel from

Everett Collection Inc/Alamy Stock Photo

FIGURE 12.10 Dearborn, Michigan. The industrial complex of the Ford River Rouge plant as it stood in the 1940s. The corporation imported raw materials, bringing them by barge and rail to the plant. The complex included a power plant and facilities for producing steel and the component parts of automobiles. Nearly everything Ford needed to produce an automobile was brought together at the factory complex, where up to 100,000 employees (at its peak in the 1930s) manufactured components and assembled automobiles.

around the world and brought them to his River Rouge plant in Dearborn, just west of Detroit. The massive Ford River Rouge was an industrial complex of 93 buildings with over 120 miles of conveyor belts that covered an area 1 × 1.5 miles. The Henry Ford Foundation states that "Henry Ford's ultimate goal was to achieve total self-sufficiency by owning, operating and coordinating all the resources needed to produce complete automobiles." The Rouge complex included a power plant, boat docks, and a railroad. Up to 100,000 people worked there. It even included a fire station and a police department, prompting the Henry Ford Museum to describe it as "a city without residents."

Following the Fordist example, industries moved toward sites with available labor, resources, developed infrastructure, and proximity to consumers. Furniture manufacturing shifted from Boston in 1875 to Cincinnati by 1890 and then to Grand Rapids, Michigan, by 1910. It also took off in High Point, North Carolina, where entrepreneurs built manufacturing plants in the early 1900s to take advantage of the "abundance of lumber, low-cost labor combined with Reconstruction era wood-working skills and attitudes" (Walcott 2011). Furniture manufacturers were also drawn to High Point for the presence of infrastructure, proximity to customers, and a humid climate, which kept wood from cracking. High Point and other furniture centers agglomerated, or clustered together, to take advantage of nearby forests and available services and infrastructure.

Classical Location Theory

The North Carolina furniture example illustrates some of the locational influences on industry. Efforts to develop generalizations about locational influences gave rise to classical **location theory**, often credited to British economist Alfred Marshall (1842–1924). Marshall argued that similar industries tend to cluster in an area. He called this process localization, and later theorists called it **agglomeration**. Marshall held that clustered industries could attract workers with industry-specific skills, share information, and attract support services specific to the industry.

Whereas Marshall explained *why* industries would cluster together, German economic geographer Alfred Weber (1868–1958) explained *where* industries would cluster. In *Theory of the Location of Industries* (1909), Weber examined the factors that pull industry to specific locations. His **least cost theory** focused on a factory owner's desire to minimize three categories of costs. The first and most important (at the time) was transportation. Weber suggested that it is least expensive to bring raw materials to the point of production and to distribute finished products where transportation costs are lowest. The **friction of distance** is the increase in time and cost that comes with increased distance over which commodities must travel. If a heavy raw material is shipped thousands of miles to a factory, the friction of distance increases. Friction of distance long prompted manufacturers to locate their plants close to raw materials—particularly if needed raw materials, such as coal and iron ore, were heavy.

The second cost was labor. Higher labor costs tend to reduce the margin of profit, so a factory farther away from raw materials and markets can do better if cheap labor compensates for the added transport costs.

The third factor in Weber's model was similar to Marshall's theory of localization in that Weber described the advantages of agglomeration. When many companies that produce the same or similar goods cluster in one area, as with furniture manufacturing in North Carolina, they can share talents, services, and facilities. For example, all furniture companies need access to lumber, textiles, ports, and skilled employees. By clustering together in the High Point region, the furniture manufacturers can also share infrastructure improvements. Moreover, they all have access to the accountants and lawyers in the area who specialize in contracts and trade. In 2012, local governments in the High Point region invested in a system of wireless Internet access. Now the 75,000 furniture buyers who go to High Point twice a year can use the wireless system on their iPads and tablets as they seal deals. Finally, agglomeration can make a location more attractive by potentially overcoming higher transportation or labor costs.

Considering these three factors together—transportation, labor, and localization (agglomeration)—Weber determined that the least cost location for a manufacturing plant could be determined by a location triangle (**Fig. 12.11**). Economic geographer Jean-Paul Rodrigue (2014) explains that "solving Weber's location model often implies three stages; finding the least transport cost location, and adjusting this location to consider labor costs and agglomeration economies." Weber reasoned that industry will be located close to raw materials to lower transportation costs, but that labor availability (either skilled or cheap) and agglomeration of industry can "pull" industries toward sites where these other two factors are advantageous.

The Impact of Transportation Innovations

Weber's theory of location was written over a century ago, when the cost of transportation accounted for over 50 percent of the final price of a good traveling over significant distances. Hence, he emphasized transport costs as the most important variable in industrial location. But transportation now accounts for 5 percent or less of the cost of most goods. In an era of vastly improved infrastructure, relatively cheap oil, and container ships, widely dispersed production systems can be cost effective.

Efficient transportation systems enable manufacturers to buy raw materials from distant sources and distribute finished products to consumers in distant locations. Since World War II, major developments in transportation have improved **intermodal** connections, places where two or more modes of transportation meet (including air, road, rail, barge, and ship), in order to ease the flow of goods and reduce the costs of transportation. Manufacturers also look to develop alternative

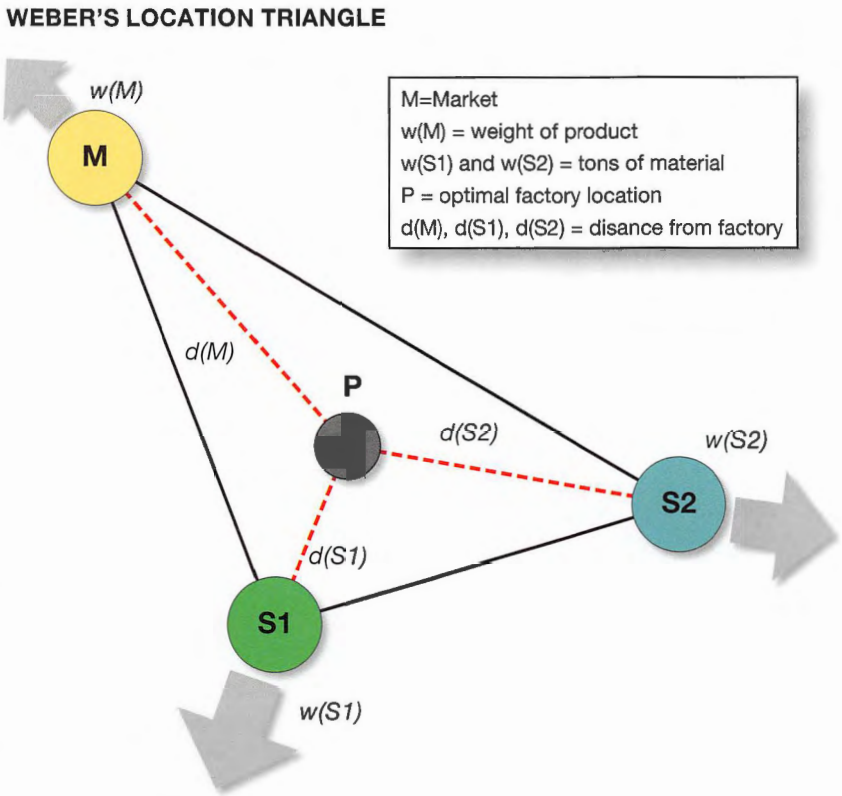


FIGURE 12.11 Weber's Location Triangle. Weber assumed that the cost of transporting goods was the same in all directions and increased at an equal rate in all directions. He also assumed that water was available everywhere, but that labor was available only in certain population centers.

transportation options in the event of emergencies (e.g., truck routes when rail service is interrupted).

The high volume of resources and goods shipped around the globe over the past few decades could not have happened without the invention of the container system. Goods are now packed in standard-sized containers that are picked up by special mechanized cranes at an intermodal connection and placed on ships. At the next destination, they are moved to semitrailer trucks, barges, or railroad cars (**Fig. 12.12**). The container system has lowered costs and increased flexibility, permitting many manufacturers to pay less attention to transportation costs in their location decisions. Refrigerated containers also ease the shipment of perishable goods around the globe (see Chapter 13).

The container ship has dramatically changed the economic geography of the world economy since the first one sailed in 1956. Before containers, a ship would arrive at port with various, odd-sized crates and boxes. Hundreds of longshoremen would flock to the dock to unload goods by hand. With containerization, ports now have relatively few employees, who operate high-tech cranes, moving standard-sized containers from ship to dock or dock to ship with precision. A massive container ship can be unloaded within 24 hours of reaching a port.

Nearly 90 percent of long-distance cargo is now shipped in containers. With a volume in excess of 2250 cubic feet (more than 65 m^3), a standard container can accommodate goods worth millions of dollars. Steel containers are structurally sound and can be stacked and moved from truck to rail to ship without worrying about how fragile the contents of the containers are (Fig. 12.12).

The largest of today's container ships are enormous—more than four American football fields long and over 60 yards wide. Most container ships are designed to fit through the Suez Canal and the Panama Canal, the latter of which was widened in 2016 to accommodate all but the largest of the new container ships.

Containerization has even changed the map of major port cities. Ports have become intermodal hubs, and port authorities and managers are constantly expanding and improving their infrastructure and systems to attract more cargo. Ports do not solely attract cargo, as the cruise ship in the background of Figure 12.12 demonstrates.

Container ships have changed the layout and size of many ports. Ports such as San Francisco have declined because their piers are not well suited to loading and unloading containers. Others have boomed. Nearby Oakland has capitalized on a container-friendly port retrofit that made it one of the more important shipping centers along the west coast. The growth in global consumption of goods has helped small ports located near consumers, such as Busan, South Korea, to expand dramatically. And previously nonexistent ports such as Tanjun Pelepas, Malaysia, have emerged as significant port cities because containerization has made it economical to produce goods in Southeast Asia that are sold as far away as New York, London, and Buenos Aires.

Belgian geographer Jacques Charlier has studied how containerization has increased trade in the Benelux (Belgium, the Netherlands, and Luxembourg) seaport system. He explains the locational advantage of Rotterdam is that it is no more than six hours by rail or truck from 85 percent of the population of western Europe. The container system and the growth in shipping at Rotterdam and other Benelux ports have combined to foster the development of other industries, helping to make the region, in Charlier's words, a "warehouse for Europe." The Netherlands is now home to more than 1800 U.S. firms, including call centers, distribution centers, and production centers, especially for food. Over 50 percent of all goods entering the European Union pass through Rotterdam or Amsterdam (also in the Netherlands).

Flexible Production and Product Life Cycle

Fordist production was based on both mass production and mass consumption. Money flowed through the world economy as consumers bought goods manufactured in

FIGURE 12.12 Copenhagen, Denmark. Cranes and container ships are found at every major port around the world. Unlike railroad gauges that are not standard globally, containers are a standard size. Container ships keep getting larger, though, and ports change their design and infrastructure to keep pace.

large-scale complexes. As the global economy became more integrated and transportation costs decreased, the advantages of concentrating production in large-scale complexes declined. As a result, in the latter third of the twentieth century, many enterprises began moving toward a post-Fordist, flexible production model.

In the post-Fordist model, production processes are driven by customer demand, and the components of goods are made in different places around the globe and then brought together for assembly. The term **flexible production** is used because firms can pick and choose among many suppliers and production strategies allover the world. Then they can quickly shift where they manufacture or assemble their products in response to adjustments in production costs or consumer demand. These systems respond to consumers who want the newest, best, or greatest offering, and enable manufacturers to lower the cost of production by moving around the world.

Capitalism persists as an economic system not only because people consume, but also because producers create and respond to consumer demand. Companies adapt to changing consumer preferences. Through the process of **commodification**, goods that were not previously bought, sold, and traded gain a monetary value and are bought, sold, and traded on the market. A new good, such as a virtual assistant (e.g., Alexa or Echo), starts at a high price and becomes somewhat of a status symbol because of its high cost. The longer the virtual assistant is on the market and the greater the number of firms producing virtual assistants, the lower the price drops. To compete, companies eventually move the production of virtual assistants to lower the cost of production.

The production of a good changes over time. For example, the production of televisions moved through four stages: introduction, growth, maturity, and decline. Commercial production of television sets began after World War II. A variety of small and medium-sized firms in Europe, Asia, and North America were involved in production during this stage. Firms in the United States, including Zenith, were the dominant producers until the 1970s. The cost of manufacturing televisions was high in the introductory stage because the company had invested a great deal in developing the technology, but had not sold enough units to lower the cost.

During the 1970s and 1980s, television production hit the growth stage, when a dramatic shift occurred. A small number of large Asian producers—particularly in Japan—seized a much larger percentage of the market and a few European firms increased their position as well. The increased sales and profits during this stage encouraged companies to produce and sell large numbers of televisions.

During the 1970s, major firms moved the manufacture of components and the assembly of televisions out of their home countries. U.S. firms moved these functions to the maquiladoras of Mexico (discussed in Chapter 10) and the special economic zones of China (described in Chapter 9). Japanese firms moved component manufacturing and assembly to Taiwan, Singapore,

Malaysia, and South Korea. The assembly stage was the most labor intensive, so television manufacturers tapped into the global labor market and located assembly plants not just in Mexico, China, and Southeast Asia, but also in India and Brazil.

In the maturity stage, a few manufacturers continued to make small changes to the product and invested in marketing to secure their market share. Manufacturing of televisions became more mechanized. More technology lowered wage costs, and companies moved production closer to consumers. By 1990, 10 large firms were responsible for 80 percent of the world's color television sets. Of those 10, eight were Japanese and two were European. Only one firm in the United States, Zenith, remained, and its share of the global market was relatively small.

In the decline stage, fewer consumers were demanding the product. In response, manufacturers began shifting to research and development of new goods or production of other, higher-demand goods. In the twenty-first century, electronics companies like Samsung and Panasonic have invested in research and development of high-definition and plasma televisions, and these high-end televisions are now produced in Japan—and more recently China and South Korea. These investments began a new product development cycle for high-definition electronics.

The Globalization of Production

The various innovations described above have led to an increasingly globalized landscape of production. Tracing the production of conventional television sets throughout the world over time helps us see how this happened and how it has given rise to a **global division of labor** (also called the new international division of labor), which refers to the late-twentieth-century tendency for production facilities to be concentrated in the global economic periphery and semiperiphery to take advantage of lower labor costs. Then research and development operations can continue to be located in the core. The global division of labor is still with us. However, the recent trend toward flexible production has meant that production can and does move to take advantage of infrastructure, skilled labor, and accessible markets as products and methods of assembly change.

Geographically, the term **time–space compression**, coined by geographer David Harvey, captures the dramatic changes taking place in the contemporary global economy. This is the idea that developments in communication and transportation technologies have accelerated the speed at which things happen so that the distance between places has become less significant (see Chapter 4). Harvey argues that modern capitalism has so accelerated the pace of life and the relationship between places that "the world seems to collapse inwards upon us." Fluctuations in the Tokyo stock market affect New York minutes later. Overnight, marketing campaigns can turn a product innovation into a fad around the world. Kiwis picked in New Zealand yesterday can be in the lunch boxes of children in Canada tomorrow. And decisions made in London can make or break a fast-developing deal over a transport link between Kenya and Tanzania.

Time–space compression shapes the global division of labor. When the world was less interconnected, most goods were produced not just close to raw materials, but also close to consumers. Thus, the major industrial belt in the United States was in the Northeast, both because there was readily available coal and other raw materials and because most of the population was there. This has changed with **just-in-time delivery**. Rather than keeping a large inventory of components or products, companies keep just what they need for short-term production and new parts are shipped to them quickly when needed.

Advances in information technologies and shipping coupled with the global division of labor make it possible for companies to move production from one site to another. The movements are based on the "new place-based cost advantages." David Harvey has called this decision process a **spatial fix**. In choosing a production site, location is only one consideration. "Distance is neither determinate nor insignificant as a factor in production location decisions" today (Walcott 2011).

Major global economic players take advantage of low transportation costs, favorable governmental regulations, and expanding information technology to construct vast economic networks in which different parts of the production process are carried out in different places to benefit from the advantages of specific locations. Examples of companies that have created such networks include General Motors, Philips, Union Carbide, and Exxon.

One way to grow profits is to cut costs, and labor (wages, benefits, insurance) makes up a sizable proportion of production costs. Most multinational corporations have moved labor-intensive manufacturing to peripheral countries that have low cost labor, few regulations, and low tax rates. The manufacturing that remains in the core is usually highly mechanized. Technologically sophisticated manufacturing also tends to be sited in the core or semiperiphery because the expertise, infrastructure, and research and development are there.

Nike We can use Weber's location theory to consider the site for a factory producing lightweight consumer goods, including textiles and shoes, during the first half of the twentieth century. In the triangle of factors, the most important for lightweight consumer goods is a ready supply of low-cost labor. Being close to the raw materials is less of a concern because shipping lightweight components is relatively inexpensive. Agglomeration is also a draw, so producers of component parts locate nearby and serve more than one company.

In the shoe business, companies that made shoelaces used to locate close to shoe manufacturers. In the 1920s, towns near Boston, Massachusetts—great "shoe towns" such as Haverhill, Brockton, and Lynn—were home to factories specializing in both men's and women's shoes. About 300 shoe factories had sales offices "within a few blocks of each other in Boston" (Smith 1925), and in a leather district close to the city, tanneries prepared hides imported from around the world.

Economic geographer J. Russell Smith (1925) described the economic landscape of the shoe factory town of Lynn:

> Walking the streets of Lynn one realizes what concentration an industry can have; the signs upon the places of business read—heels, welts, insoles, uppers, eyelets, thread, etc., etc. It is an astonishing proof of the degree to which even a simple commodity like a shoe, so long made by one man, can be subdivided and become the work of scores of industries and thousands of people.

Shoe salespeople periodically went to shoe company headquarters in Boston to learn about the company's newest offerings. Then they would fill their suitcases with samples to show their clients as they made the rounds of their sales territories.

With flexible production systems and container ships, lightweight consumer goods still need to be located close to low-cost labor, but connectedness to an intermodal port is vital as well. Not surprisingly, the production of shoes is no longer concentrated in a handful of shoe towns on the east coast. Nike demonstrates how selecting manufacturing sites for components and products has changed with just-in-time production and the globalization of production.

The transformation from making shoes in a few shoe towns to having them pass through an elaborate global network of international manufacturing and sales did not happen overnight. University of Oregon track coach Bill Bowerman and one of his former runners, Phil Knight, founded Nike in 1961. Knight designed a trademark waffle sole that would create more traction for runners, and Nike sold $8000 in footwear in its first year. The company established headquarters in Beaverton, Oregon, a suburb of Portland.

Nike began production in the 1960s by contracting with an Asian firm to manufacture its shoes. In 1974, Nike set up its first domestic shoe manufacturing plant in the small town of Exeter, New Hampshire, just 46 miles from Lynn, Massachusetts. By the end of that year, Nike's workforce was still modest in number. Nike employees in Oregon concentrated on running the company and expanding sales, while employees who worked directly for Nike in New Hampshire and Asia produced shoes.

Nike grew to become the world's leading manufacturer of athletic shoes, with global sales of over $36 billion in fiscal year 2018 and a worldwide labor force of over 70,000 people in 44 countries (**Fig. 12.13**). As its sales skyrocketed, Nike established new manufacturing plants in Asia and beyond. Although several thousand people work today for Nike in Beaverton, not a single individual in Oregon is directly involved in putting a shoe together. Employees at Nike headquarters are designers, planners, financial administrators, marketing and sales specialists, information technology directors, computer technicians, lawyers, and support personnel. They work to orchestrate the production and sale of Nike products through

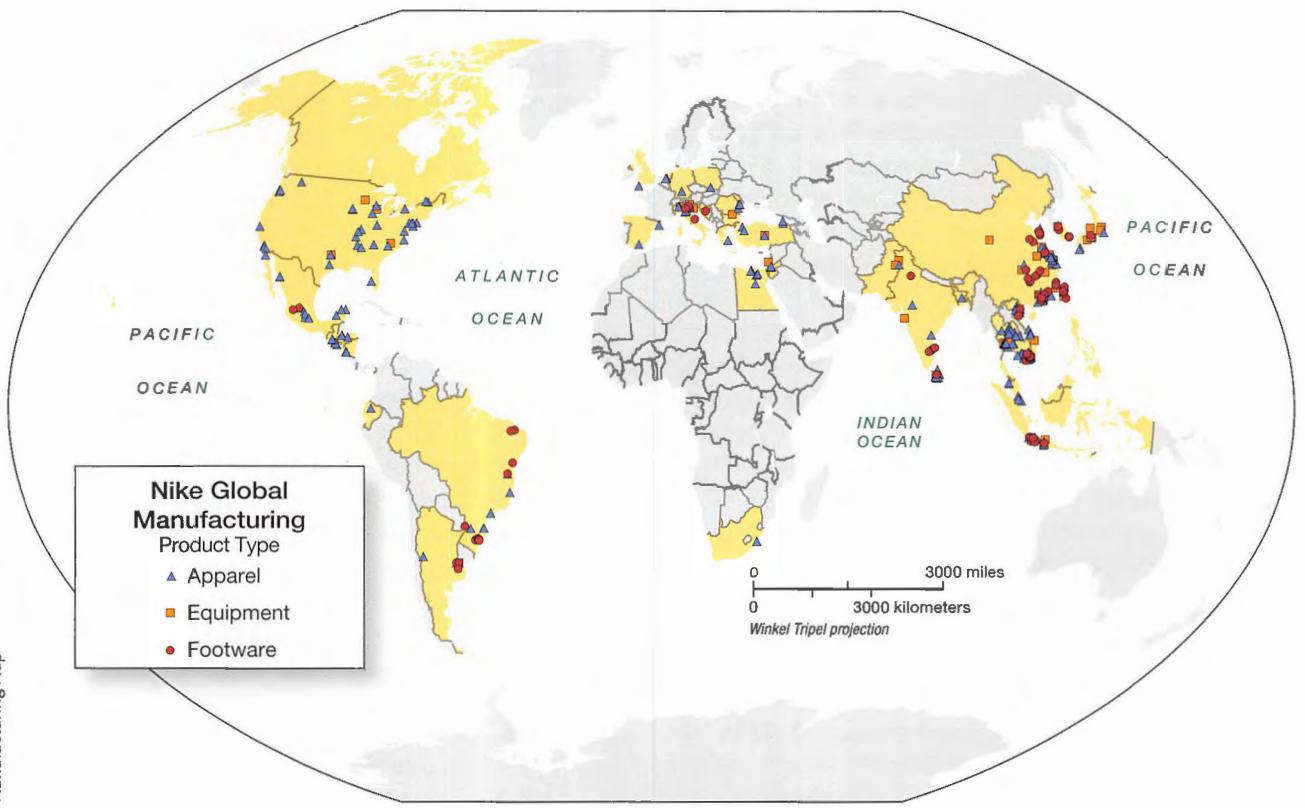


FIGURE 12.13 Nike Production Facilities and Contract Factories. Nike uses flexible production to manufacture shoes and apparel in hundreds of contract factories around the world. It plans short- and long-range contracts with factories, constantly assessing the best possible places to manufacture shoes, apparel, and equipment.

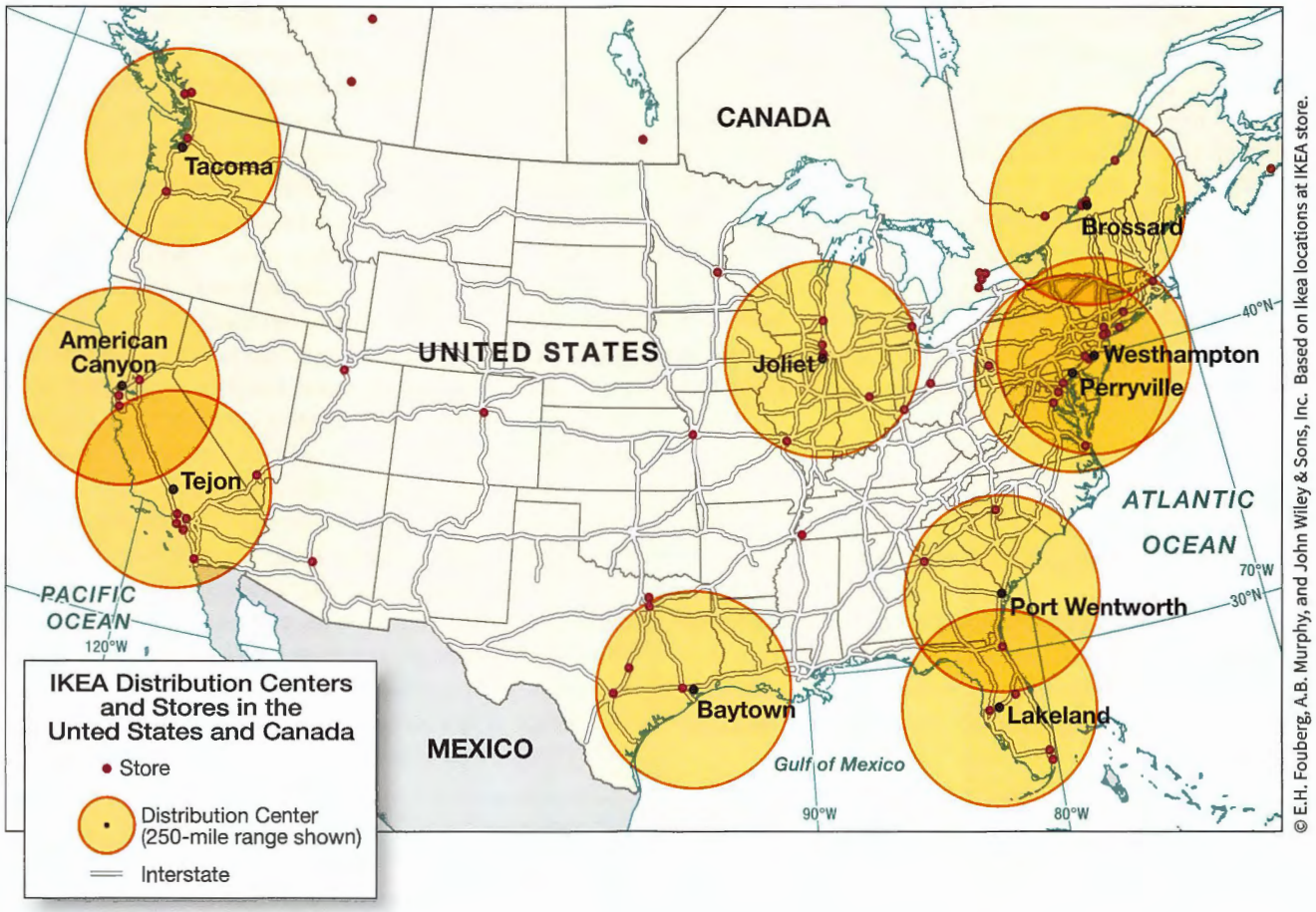


FIGURE 12.14 Ikea Distribution Center and Store Map. Ikea recently opened the Lakeland, Florida distribution center, designed specifically to deliver Internet orders in Florida and the southeastern states.

a **network** in which each **node**, or connection point, makes some contribution. Then it, in turn, is influenced by the niche it occupies in the network. Nike's Beaverton employees do this from a place that bears little resemblance to what one might have found in a town housing an important shoe company in the early twentieth century.

Ikea The largest producer, distributor, and seller of furniture in the world today is based in Sweden. Ingvar Kamprad founded the company in 1943 at the age of 17. Kamprad, a born entrepreneur, first sold matches from door to door in his neighborhood in Sweden. He expanded his offerings to pens, Christmas decorations, and greeting cards during his teenage years. Pens were one of the main offerings in Ikea when he founded the company in 1943. Kamprad first produced and sold furniture in 1948, using wood from Sweden's sizable forests. The company has expanded in product offerings and locations since, focusing on producing modern and classic furniture at an affordable price point.

Ikea has created its own **commodity chain**. It designs the furniture, but draws on nearly 1000 suppliers located in 50 countries (Krewson 2010). The company's volume of production and sales is so high that it chooses the sites for its distribution centers with an eye on where stores are and where store expansion will occur.

Ikea has ten distribution centers scattered around the United States (**Fig. 12.14**). Opening a distribution center in Savannah, Georgia (Port Wentworth), allowed it to reduce the transportation time and cost of distribution to its stores in Orlando, Tampa, and Atlanta. The Savannah distribution center also enabled Ikea to open more locations in Florida and elsewhere in the southeast. Growth in the demand for Ikea products in the southeast led to the company opening its most recent distribution center in Lakeland, Florida. Ikea's newest distribution centers are models of efficiency. Computerized robotic cranes move products into the distribution center and then pull goods out for distribution to stores. The crane is never empty-handed; the same crane that loads goods into the distribution center from a ship also finds and loads goods onto trucks and railroad cars for transport to stores.

Developing and controlling a large proportion of its commodity chain allows Ikea to operate at incredibly high volume with low prices, generating small profits for the company along each step in the commodity chain, but large profits overall. Ikea invests in distribution infrastructure to keep transportation costs as low as possible. The company has reorganized its distribution center structure so that low-flow products (products that do not turn over in stores quickly) are stored in central distribution centers, and high-flow products are stored closer to stores so they can quickly replenish supply.

The system is efficient, but there are environmental costs to building multiple facilities and transporting items across significant distances. Ikea is aware of these costs and so has embraced green technologies. For example, the company has moved aggressively to adopt renewable energy sources for the heating and cooling of its buildings. It has also worked with the United Nations High Commissioner on Refugees (UNHCR) to create new, more durable, housing units for refugees, including a solar panel that generates enough energy to power one light and a USB charging port. These environmental and social initiatives are examples of the ways some transnational corporations seek to demonstrate their responsibility to a sometimes-skeptical public.

Multinational Corporations, Outsourcing, and Global Production Networks

A large part of business decision making today focuses on outsourcing and global sourcing—on where to extend contracts to complete projects and where to have component parts produced and assembled. Economic geographers originally used the term **outsourcing** to describe a company in a core country moving production or services abroad (**Fig.12.15**). In the 1990s and into the twenty-first century, outsourcing implied taking work that would normally be done in the global economic core and moving it to the semiperiphery or periphery. Media coverage often focused on the outsourcing of manufacturing jobs to China and the outsourcing of call centers to India.

But *outsourcing* suggests a one-way movement of economic activities—from core to periphery—that is overly simplistic in today's globalized economy. Growing **connectivity** and the rise of major Chinese and Indian companies have deepened globalization. *Outsourcing* has thus become an umbrella term for the use of global production networks to manufacture goods and provide services globally.

Outsourcing has been driven in part by the growth of Indian companies that specialize in completing projects and fulfilling contracts by becoming experts in outsourcing themselves. Imagine that a global company, headquartered in the United States, produces and sells accounting software. A major regulatory change in the United States might require the company to reprogram the software to account for the

Author Field Note Sewing Textiles in the Pearl River Delta, China

"Humen is one of the Pearl River Delta cities that has been transformed by outsourcing to China. The small textile factory I visited provided insights into the opportunities and challenges that are confronting China today. The 40 or so employees were mostly young, but there were a few older folks. They were making women's clothes for the French market. Most of them made the clothes from start to finish. Into each of the items of clothing was sewn a label with a fancy-sounding Italian name. The clothes were sold in Humen for the equivalent of $1.50–$2.50 each, but most of them were destined for France, where they would be sold for 20 times that amount.

The employees work under a contract that stipulates a nine-hour day and a base wage of about $275/month plus basic room and board. They can work more hours, however, and are compensated based on how much they produce during the extra hours. Apparently, almost all employees choose to work extra hours—typically seven days a week, with breaks only on Sunday evenings and one day at the beginning of each month. If they work that hard, they can earn the equivalent of close to $500/month. The main workroom has decent lighting and ventilation. The manager told me there had been significant upward pressure on the wages of employees in the last few years, making it harder for him to earn much of a profit. He worried about factories relocating to lower-wage countries. In addition, he said that he was having an increasingly hard time recruiting employees. He also noted with some mixture of amusement and annoyance that the people who had made out the best in his part of the city were the former farmers, who either had received substantial compensation (in the form of apartments) for being displaced or were getting some share of rent for buildings constructed on the land they used to farm."

– A. B. Murphy

Photo by A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 12.15 **Humen, China.**

complexities of the new regulation. The company can hire an Indian company like Tata or Infosys or Wipro that specializes in what is called business process outsourcing (BPO). The ball is then in the Indian company's court. It has to produce a finished product by a contractually agreed-upon date to get paid, and it can do whatever it sees fit to get the job done. In many cases, the Indian company outsources the work itself, keeping tabs on and testing the product before delivering it to the company in the United States. BPO also happens when certain business functions (call centers, human resources, accounting, software engineering, and the like) are turned over to an Indian firm to manage.

As the BPO software example suggests, maximizing profits when producing goods is no longer as simple as moving from core to periphery to take advantage of lower labor costs. Indeed, China has capitalized on the desire of companies to produce goods globally by becoming the world leader in **global sourcing**. Say you are daydreaming and you think of a great new product, like sunglasses with windshield wipers on them. You no longer need to figure out where to make your product. You can mock up a prototype and take it to a global sourcing fair in Las Vegas, Mexico City, Johannesburg, or São Paulo, and meet with dozens of Chinese global sourcing firms. They will give you a bid on what it will cost to produce your awesome new product, and they will tell you when it can be done. You sign a contract, and you receive shipment of your product without ever having set foot in China.

The Chinese global sourcing firm you have signed up with likely has connections to manufacturers throughout Asia, Africa, and the Americas. Your windshield wiper sunglasses may be stickered "Made in Mexico" when you receive them. If your product flies off the shelf and you order another shipment, your Chinese global sourcing company may ship the next order with stickers saying "Made in China." The global sourcing firm is connected and nimble, so you do not have to be. It controls a larger part of the commodity chain and can generate more wealth for itself by making the lowest-cost production decisions.

BPO and global sourcing both fall under the umbrella of outsourcing. Both move a segment of the commodity chain to another country, and place full responsibility for that segment in the contracted company's hands. BPO typically involves tertiary, quaternary, and quinary economic activities (i.e., service activities). Global sourcing, by contrast, typically concerns the secondary, or manufacturing, sector of the economy. However, global sourcing also includes quite a bit of service work, because the Chinese sourcing company develops the relations with the manufacturers, uses its knowledge of trade regulations, and manages a large sector of the product's commodity chain.

Given the complex geographically dispersed networks that now are part of the creation of many goods and services, economic geographers increasingly argue that the commodity chain model is too simplistic. Instead, we should be thinking about **global production networks**—networks that encompass the wide variety of activities, arrangements, and transactions that are involved in the production, distribution, and consumption of goods and services. The concept draws attention to the wide variety of arrangements and relationships that knit together people and places and define the world economy today.

Made in America or Designed in America?

ABC World News features a segment called "Made in America," In one season of episodes, journalists knocked on doors and challenged homeowners to look at every item in their home for the "made in" sticker. The news crew then helped families move all goods not "Made in America" onto the street so the family could get a sense of how much of what is in their home is manufactured in the United States and how much is manufactured elsewhere in the world. The ABC World News crew then, according to their website, "took on the challenge of trying to fill three rooms in a home entirely with 100 percent American-made products."

Would an iPhone or AirPods get to stay in the house redesigned by ABC World News? When you open a box with an Apple product, the typed words "designed by Apple in California" greet you. Analyzing the commodity chain of an iPhone shows the product is made in several countries, including Italy, Taiwan, Germany, Japan, South Korea, and the United States (**Fig. 12.16**). The iPhone is not made solely in the U.S., but few products, especially technology products, are produced solely within one country.

Does the fact that the entire iPhone is not produced in the U.S. mean the iPhone does not benefit the U.S. economy? The research and development that went into the iPhone and other innovative components took place in the United States, and great benefits flow to U.S.-based Apple, which employs many Americans and whose stockholders have benefited from the product. Apple also captures much of the financial benefit from the sale of iPhones around the world, and the invention of the iPhone has led to the development of related products and services, many of which are based in the United States and contribute to the country's economy.

When considering how American a "Made in America" product is, it is also important to think about the social and environment impacts of its creation and use. For any product or service that is tied to a global production network—and most higher-value products are—the impacts do not stay within individual countries. What happens during the production process gets most of the attention, but consumption matters as well.

Consumption, while an end point of a global production network, is the beginning of a product's afterlife—and the afterlife impacts of a product created and designed by an American firm can extend far beyond a country's boundaries. What happens when people discard their old iPhones? Corporations such as Apple work to reduce consumer waste by recycling iPhones and computers, and by offering discounts to consumers who recycle their old iPhones. Nonetheless, there is a growing problem with the electronic waste that comes

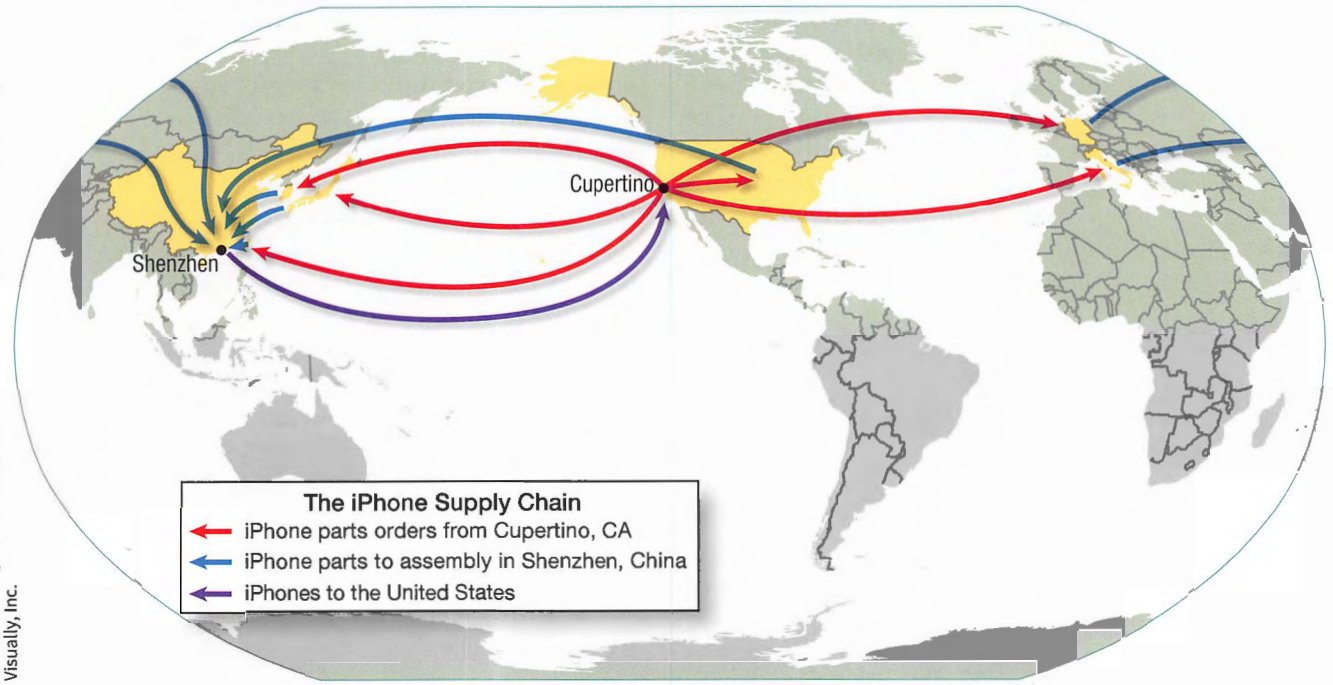


FIGURE 12.16 **Inside an iPhone.** The countries that produce the component parts of the iPhone are mapped along with the major companies involved in production.

from discarded iPhones and other computer products. Much of the waste ends up in hazardous dumps. In many global cities in the periphery, adults and children work with toxic materials to recover valuable copper wire and other components of computers and related electronic devices made by Apple and its competitors.

The jobs created by industry in one place can cause environmental damage and social effects in another. Consumption, or purchasing an item, is the end point in a global production network that affects places in different ways. Studying the geography of these networks sheds light on the origins and life cycles of products and helps explain how production and consumption affect places and peoples that are part of the network.

TC Thinking Geographically

Think about a cutting-edge, high-technology product that was recently commodified and is still quite expensive to purchase, and not yet broadly used (perhaps something you have read about, but not even seen). Using the Internet, determine where this product is manufactured and assess why the product is manufactured there. Hypothesize why this location is the **site** of production and how the **situation** for the product in the larger world economy has to change to shift production in the future. Think about how long it might take for production costs (and the price of the product) to decrease substantially if the location of production changes.

12.3 Explain Global Patterns of Industrial Production.

Industrial production encompasses a broad range of manufacturing activities, not just the steel mills and chemical plants that we tend to associate with the word *industry*. The world map of industrial production today (**Fig. 12.17**) is more complicated than its 1950s predecessor (Fig. 12.8). Some older centers of industrial production have declined or shifted to different kinds of production, and many new centers have sprung up. These changes are tied to the forces we have examined in this chapter: transportation innovations, the global division of labor, flexible production, and increasingly complex global production networks.

Outside of a narrow range of products that rely on heavy raw materials, Weber's location theory no longer works to explain the spatial organization of industrial production. In an increasingly integrated network of global cities, industrial location is influenced not just by labor costs, transportation, and market access (as Weber suggested). Now it is also driven by the regulatory environment, the changing energy picture, and access to skilled labor.

The Regulatory Environment

Governments regularly enter into agreements with one another that affect production and imports. Over the past 70 years, production has also been affected by the proliferation of regional

trade associations and related agreements, including the Association of Southeast Asian Nations (ASEAN), the United States-Mexico-Canada Agreement (USMCA), the European Union (EU), and many more. Regional trade agreements are similar to bilateral agreements between two countries, but they involve more than two countries. They can result in the movement of production within a region and can diminish (or remove) trade quotas and tariffs among member countries to promote trade.

Most state governments (164 as of 2019) are also members of the World Trade Organization (WTO), which develops rules of trade among the member states. The WTO generally seeks to promote freer trade by encouraging member states to sign agreements. It also works against import quota systems and discourages protection by a country of its domestically produced goods. It is, in short, an organization that promotes globalization and has advanced the diffusion of industrial production.

Agreements negotiated under the auspices of the WTO often come into force in stages in order to avoid major economic shocks. In 2001, when Europe and the United States agreed to allow China to become a member of the WTO, they also agreed to remove the quota system that restricts the import of Chinese goods into Europe and the United States. Soon after these quotas were eliminated, both the United States and the European Union issued "safeguard quotas" against certain Chinese imports to buffer the impact of Chinese goods on domestic producers.

The buffering helped for a while, but the rapid expansion of Chinese exports over the last two decades has been a source of tension. The United States and Europe argue that Chinese subsidies give their industries an unfair advantage and that China imposes unfair requirements on foreign companies doing business there. China rejects these claims. It argues that it has the right to control certain aspects of its economy, given that it is still a relative newcomer to the global economic game. Additionally, China claims that under any circumstances, its exports boost North American and European economies. The resulting tug-of-war is behind the prolonged negotiations and battles over tariffs that have plagued relations between China and Western countries—particularly the United States.

Regulations at the state and local scales also matter. Environmental regulations, safety requirements, minimum wage laws, and much more affect the cost of production. These make the cost of production higher—sometimes prompting companies to move to different locations with weaker regulatory requirements. That can boost the company's profit, but it can also have negative implications for both the place being abandoned and the new place of business. The former has to deal with job loss, whereas the latter may face environmental challenges and a job market dominated by businesses that offer limited benefits for locals.

Regulations at the state and local levels can also be used to attract businesses. Governments often seek to recruit manufacturers through incentives that include tax breaks, subsidies, and other forms of support. Export processing zones such as the maquiladoras, discussed in Chapter 10, provide a case in point. Many hundreds of such zones around the world are now shaping the global geography of industry.

The Energy Picture

Earlier in the chapter, we explained that at the start of the Industrial Revolution, manufacturing plants were established on or near coal fields. During the mid-twentieth century, the use of coal as an energy source in industry increasingly gave

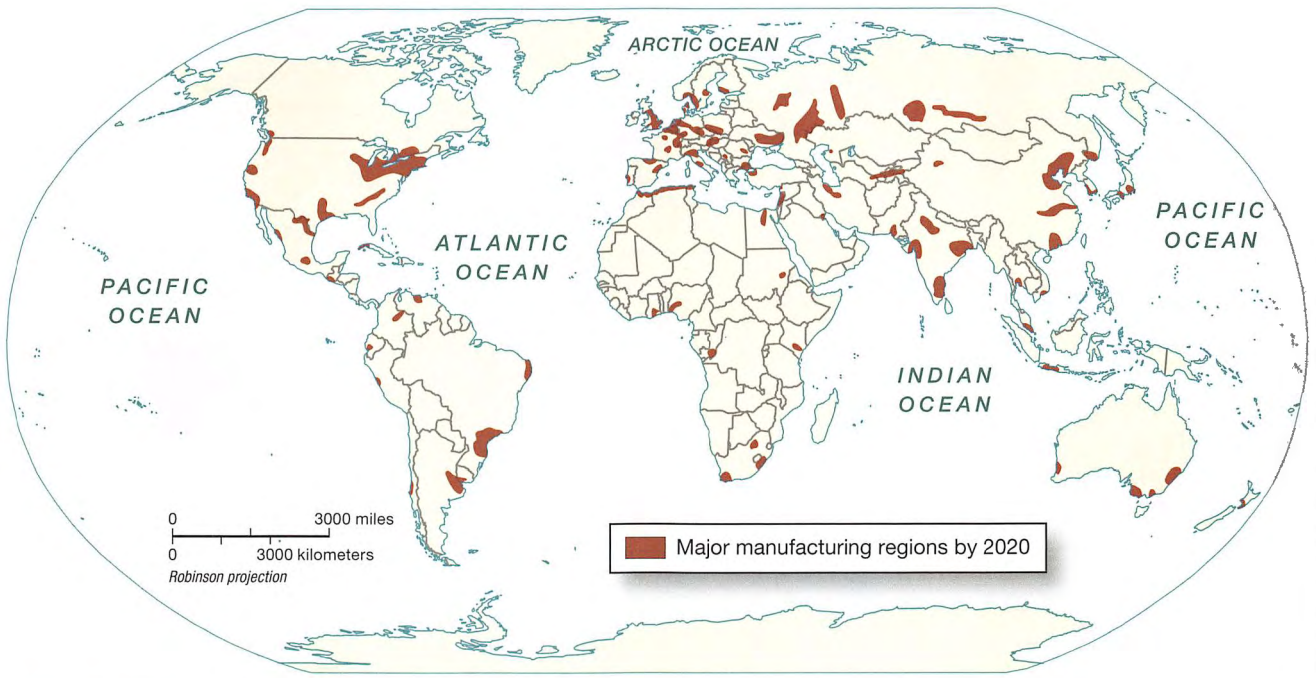


FIGURE 12.17 Major Concentrations of Industrial Production Today. Manufacturing is global, and production networks make it possible for components of goods to be produced in many places.

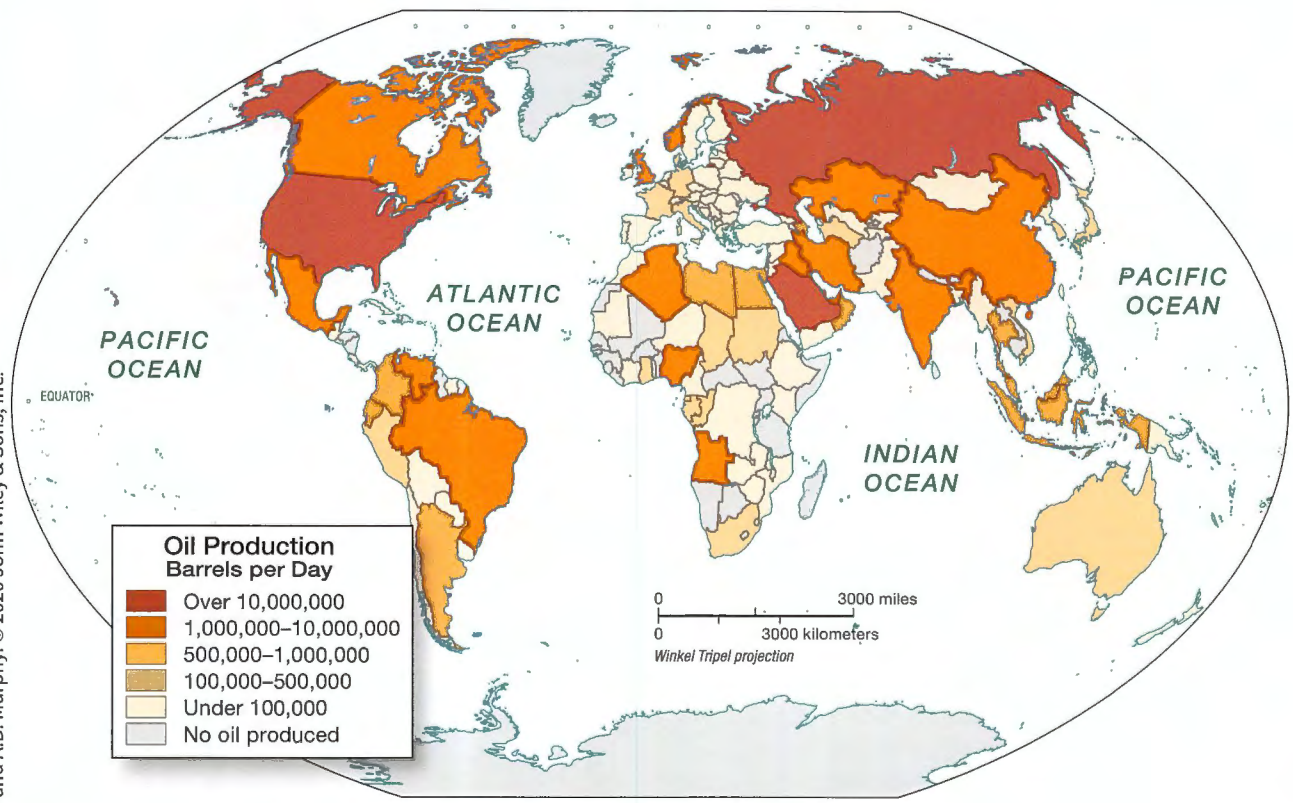
way to oil and gas. Today, energy-intensive major industrial complexes are not confined to areas near oil fields. Instead, a huge system of pipelines and tankers delivers oil and natural gas to manufacturing regions throughout the world.

Even though energy supply has become a less significant factor in industrial location, having a secure energy supply is a priority for states—in part to ensure that the state's industrial potential is not threatened. This is certainly true in the United States. U.S. consumption of petroleum and natural gas today is about 20 percent of the annual world total. The United States requires around 20.5 million barrels of petroleum per day to keep its power plants, machinery, vehicles, aircraft, ships, buildings, and homes functioning. More so than many countries, the United States taps the oil that it has (**Fig. 12.18**).

Even with this level of production, the United States remains somewhat dependent on foreign oil supplies. Concerns over that state of affairs are behind the push for the United States to expand offshore oil drilling. Besides drilling for oil, the United States also undertakes large-scale fracking of oil and natural gas shale (the high-pressure injection of fluid into well bores to release petroleum and natural gas). Opposition to these activities has grown. Opponents of offshore drilling point to the risks of oil spills, as happened on a large scale in the Gulf of Mexico in 2010 (the BP oil spill). As for fracking, opponents argue that it causes air and water pollution and can trigger earthquakes. Nonetheless, contesting these projects is difficults given the combination of state interest in promoting energy security and corporate interest in enhancing profits. Such projects can, however, be slowed when they are no longer very profitable due to declining oil and natural gas prices, as happened in the second half of the 2010s.

The expanding use of natural gas since World War II has also weakened the link between where energy resources are found and where industrial production takes place. That's because the development of natural gas has led to the construction of vast numbers of pipelines that carry natural gas across enormous distances. In the United States alone, 2.4 million miles (over 4 million km) of pipelines had been constructed by 2018, 2.1 million miles of which are dedicated to distributing natural gas.

The long-standing reliance on oil and gas in industrial production throughout much of the world has had a profound impact on countries with extensive oil and gas reserves: Saudi Arabia, Kuwait, Iraq, Russia, and others (**Table 12.1**). None of these countries except Russia is a major industrial power, but they all played a key role in the industrial boom of the twentieth century. While oil brought great wealth to some in these countries, it has also ensured that outside powers, including the United States and Great Britain, were anxious to ensure that they would not lose access to their energy resources. This set of circumstances put these countries in the geopolitical spotlight (Chapter 8). It also left them vulnerable to global fluctuations in the price of oil and gas—a continuing issue today. Looking forward, states dependent on oil and gas production are facing questions about what happens when the oil and



Data from: United States Central Intelligence Agency, World Factbook, 2017. E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 12.18 Oil Production by Country, 2017. Saudi Arabia, the United States, and Russia each produce more than 10 million barrels of oil per day.

TABLE 12.1 World's Largest Oil Producers

Top Oil Producers (Barrels per Day)			
1. United States	17,886,000	**12.** Nigeria	2,057,000
2. Saudi Arabia	12,419,000	**13.** Kazakhstan	1,959,000
3. Russia	11,401,000	**14.** Qatar	1,943,000
4. Canada	5,295,000	**15.** Norway	1,864,000
5. China	4,816,000	**16.** Angola	1,655,000
6. Iraq	4,616,000	**17.** Algeria	1,577,000
7. Iran	4,468,000	**18.** Venezuela	1,527,000
8. United Arab Emirates	3,791,000	**19.** United Kingdom	1,163,000
9. Brazil	3,428,000	**20.** Libya	1,074,000
10. Kuwait	2,870,000	**21.** India	1,012,000
11. Mexico	2,084,000	**22.** Oman	988,000

gas runs out, or when the growth in alternative energy sources weakens the oil and gas market.

New sources of energy have been developed over the past 70 years to supplement oil and gas, furthering the spatial decoupling of industrial production from natural resource reserves. The use of nuclear power expanded rapidly in the 1960s and 1970s, with many plants coming on line in widely dispersed locations. More recently, the combination of several high-profile accidents (e.g., Chernobyl, Three Mile Island, and Fukushima) and concerns over the disposal of nuclear waste have prompted some countries to turn away from nuclear power. Nonetheless, nuclear power still accounts for some 14 percent of global energy production (over 50 percent in some countries, with France leading the way at 75 percent). And the geographic dispersal of these plants makes it possible for manufacturing facilities to locate in a wide range of places.

The growing use of renewable alternative energy sources represents another recent energy-related development that has facilitated the spatial diffusion of manufacturing. Even earlier in the industrial era, hydropower was a renewable source of energy that allowed some industries to move away from coal-producing regions. For example, it takes enormous amounts of energy to turn copper into usable products, prompting manufacturers to locate their plants near electricity-producing dams that provided relatively cheap energy.

The newer story, though, is the growth in alternative energy. Plants producing solar and wind energy have sprung up far from the traditional places where coal is found—taking advantage of abundant sunshine in some places and steady winds in others. Although alternative energy still represents only a fraction of the total energy used in manufacturing, and will likely remain that way for many years, its contribution is growing (Chapter 13). Many believe that alternative energy technologies will serve as major catalysts of future economic growth. Europe and East Asia in particular are investing heavily in these technologies, and as they become more widespread, industrial locational flexibility will grow.

The Growing Role of Skilled Labor

Over the past half-century, mechanization has revolutionized the industrial production of many goods. Factories that once employed thousands of people now operate with only a few hundred employees who maintain the machines that do much of the work once done by human hands. Moreover, the complex global production networks that are part of the life cycle of many products demand a workforce that is more focused on business management than on mechanical tasks. And the increasingly complex regulatory environment surrounding industrial production in many places requires individuals who know how to navigate that environment.

These developments make it important for a growing number of industries to locate in places with access to skilled labor. To be sure, many industries still employ substantial numbers of people performing lower-skilled jobs. However, the balance between those jobs and the ones requiring more advanced computer, business, and human resource skills has shifted. The result is that places with substantial pools of high-skilled individuals can help attract certain types of manufacturing. Examples are capital cities and cities with universities and research institutes. That helps to explain why Figure 12.17 shows industrial agglomerations located close to major urban centers in a variety of world regions.

Contemporary Centers of Industrial Activity

As a result of various forces that have altered the nature of industrial production over the past half-century, many older manufacturing regions have experienced deindustrialization. Companies move industrial jobs to other regions, leaving the newly deindustrialized region to work through a period of high unemployment. If possible, these regions switch to a service economy (see the last major section of this chapter). Nonetheless, most of them still show up on the modern map of industrial production (Fig. 12.17), either because some older industries have held on or (more likely) because new types of manufacturing have sprung up. The newer manufacturing operations may be located a modest distance away from the older industrial concerns, but at the scale of a world map, those moves are not very visible.

Take the case of the central part of Germany—one of the most important centers of heavy industrial production in the early twentieth century. Much of the former industrial base is gone, and individual places suffered greatly. But not too far away (when viewed at the global scale), newer highly mechanized factories have sprung up, making a variety of sophisticated machines. As a result, the central part of Germany

continues to show up on Figure 12.17 as a place of significant industrial production.

The same can be said of many other centers of industrial production that were already on the 1950 map (Fig. 12.8). The biggest change from that map is the emergence of a much more geographically dispersed pattern of industrial production. We have seen the basic ingredients that gave rise to that pattern: the declining cost of transportation, the draw of low-cost labor, flexible production, and changes associated with the regulatory environment, the changing energy picture, and the growing need for high-skilled labor.

The pattern also reflects developments that unfolded in particular world regions that have changed the world economy. In particular, East Asia has become an important new region of industrialization. The islands, countries, provinces, and cities fronting the Pacific Ocean have made the geographic term *Pacific Rim* synonymous with manufacturing.

The Rise of East Asia

Throughout most of the twentieth century, Japan was the only global economic power in East Asia, and its regional dominance seemed beyond doubt. Other nodes of manufacturing existed, but these were no threat, and certainly no match, for Japan's industrial might. In the 1960s and 1970s, the picture began to change with the rise of the so-called Four Tigers of East and Southeast Asia: South Korea, Taiwan, Hong Kong, and Singapore. The benefits were threefold: Labor-intensive industries shifted to areas with lower labor costs, government made efforts to protect developing industry, and governments invested in education and training. From these benefits, the tigers emerged as **newly industrializing countries (NICs)**.

South Korea developed significant manufacturing districts exporting products ranging from automobiles and grand pianos to calculators and computers. One of these districts is centered on the capital, Seoul. The city can boast some 10 million inhabitants in the city proper and over 25 million in the metropolitan area. The two other districts lie at the southern end of the peninsula, anchored by Pusan and Kwangju. Taiwan's economic planners promoted high-technology industries such as personal computers, telecommunications equipment, precision electronic instruments, and other high-tech products. More recently, the South Koreans have moved in a similar direction.

Photo by A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 12.19 Hong Kong. The urban skyline of Hong Kong today is one of the most dramatic on the planet.

Just a trading colony seven decades ago, Hong Kong started producing textiles and light manufactures in the 1950s. The success of these industries was based on plentiful, cheap labor. Next came expanded production of electrical equipment, appliances, and other household products. Hong Kong's geographical situation contributed enormously to its economic fortunes. The colony became mainland China's gateway to the world, a bustling port, financial center, and **break-of-bulk point**, where goods are transferred from one mode of transport to another (**Fig. 12.19**).

In 1997, China took over the government of Hong Kong from the British. Consequently, a showplace of capitalism came under nominal control of the quasi-communist Chinese central government. However, there was a guarantee that it could maintain much of its autonomy for 50 years. Hong Kong is a special administrative region (SAR) of China under the principle of one country, two systems.

The industrial growth of Singapore also was influenced by its geographical setting and the changing global economic division of labor. Strategically located at the tip of the Malay Peninsula, Singapore is a small island inhabited by a little over 4 million people, mostly ethnic Chinese, but with Malay and Indian minorities. Fifty years ago, Singapore was mainly an entrepôt (transshipment point) for such products as rubber, timber, and oil. Today, the bulk of its foreign revenues comes from exports of manufactured goods and, increasingly, high-technology products. Singapore is also a center for quaternary industries, selling services and expertise to a global market.

Rapid economic growth brings with it risks. In 1997, risky lending practices and government investment decisions caused Thailand's currency to collapse. Its stock market then followed; banks closed and bankruptcies were filed. Soon Malaysia and Indonesia were affected. By early 1998, one of the Four Tigers, South Korea, required a massive infusion of dollars (provided by the International Monetary Fund, an international financial institution), to prevent economic chaos. However, the reforms that allowed the region to overcome these economic troubles served to strengthen East and Southeast Asia's economies. The Four Tigers continue to exert a powerful regional—and international—economic role.

The Chinese Juggernaut

China's major industrial expansion took place during the communist period. Some industrial growth occurred during the period of European colonial influence and later during the Japanese occupation. But when communists took over in 1949, one of their leading priorities was to develop China's resources and industries as rapidly as possible.

China is a vast country with a substantial resource base. The quality of some of its coal is good, the quantity enormous, and many of the deposits are near the surface and easily

extracted. China's iron ores are not as productive and are generally of lower grade, but new finds are regularly being made.

Until the early 1960s, Soviet planners helped promote China's industrial development. China was constrained by the low level of development before the 1949 communist takeover. At the time, China had a poorly developed transport network. Moreover, its major resource deposits lay far from the areas where most people lived. Like their Soviet allies, China's rulers were determined to speed up the industrialization of the economy, and their decisions led to the creation of several major and lesser industrial districts.

Under state planning rules, the Northeast district (formerly called Manchuria and now Dongbei) became China's industrial heartland. The region's coal and iron deposits located in the basin of the Liao River supported the development of a heavy industry complex. Shenyang became the "Chinese Pittsburgh," with metallurgical, machine making, engineering, and other large industries. Anshan, to the south, emerged as China's leading iron and steel-producing center. Harbin to the north (China's northern-most large city, with more than 5 million inhabitants) produced textiles, farm equipment, and light manufactures of many kinds.

The second largest industrial region in China, the Shanghai and the Chang Jiang district, developed in and around the country's biggest city, Shanghai. The Chang Jiang district contains both Shanghai and Wuhan. It rose to prominence and, by some measures, eventually exceeded the Northeast as a contributor to the national economy. Another industrial complex that developed farther upstream, along the Chang Jiang River, focused on the city of Chongqing.

Political and economic reforms starting in the 1980s led to a tremendous surge in the Chinese economy. The state embraced aspects of capitalism and opened itself to foreign investment, while retaining strong state overall control. For many years thereafter, China had the fastest-growing economy in the world. In traditional industrial sectors, the Chang Jiang district became a pacesetter for Chinese industrial growth—both in terms of iron and steel production, and also in terms of its diversified production. Railroad cars, ships, books, foods, chemicals—an endless variety of products—come from the Chang Jiang district. China also moved aggressively into high-tech manufacturing. Then the making of new consumer products led to a diffusion of manufacturing to a wide variety of cities. Those within striking distance of Hong Kong benefited the most.

In Chinese cities, bulldozers are sweeping away the vestiges of the old China; cottages with porches and tile roofs on the outskirts of the expanding cities make way for new buildings. Decaying remnants of the old cities stand amid the glass-encased towers that symbolize the new economic order (**Fig. 12.20**). Modern skyscrapers now dominate the skyline of the cities at the top of the Chinese urban-economic and administrative hierarchy—including Beijing, Shanghai, and cities in special economic zones (SEZs). China's major cities now play host to gleaming new airports, daring architecture, spectacular public projects, and the termini of efficient high-speed railroads (**Fig. 12.21**).

FIGURE 12.20 Shanghai, China. Remnants of the old city remain, but they are rapidly losing ground to high-rise apartment and office buildings.

At the same time, the Northeast has become China's "Rust Belt." Many of its state-run factories have been sold or closed, or are operating below capacity. Eventually, the Northeast is likely to recover because of its resources and its favorable

FIGURE 12.21 Shenzhen, China. Shenzhen was not even incorporated as a city until 1979, but today it is a city of some 12 million people. The futuristic landscape of the central city reflects its role as a technology and trading hub.

FIGURE 12.22 Mumbai, India. Cotton products made in factories in the Mumbai metropolitan area are readily available in the city's markets. The cotton industry has been a major part of Mumbai's economy since the first cotton mill in India was built there in 1854.

geographic site. But under the state's new economic policies, the dynamic eastern and southern provinces have grown into major manufacturing belts and have changed the map of this part of the Pacific Rim.

Today, the Chinese government is pushing industrialization into the country's interior. New investment is flowing into poorer parts of the central and western portions of the country. China is also looking to take advantage of its proximity to South and Southeast Asia through efforts to deepen transnational economic cooperation. From a global perspective, what is particularly striking is the magnitude and influence of the Chinese economic juggernaut. On August 15, 2010, China officially surpassed Japan as the world's second largest economy. China has become the world's largest exporter, and its energy and raw material demands are now affecting the global supply of key resources. More passenger vehicles are purchased in China each year than in the United States, and China invests more domestically than any other country in the world (see the discussion of the Belt and Road Initiative in Chapters 8 and 10).

Nonetheless, China's economy still depends heavily on exports and foreign investment. China's gross national income (GNI) per capita, while on the rise, is three times smaller than Japan's and almost four times smaller than that of the United States. Moreover, there are potentially destabilizing social and environmental costs to China's rapid rise. With labor costs growing in China relative to Southeast Asia, China's economic growth is slowing. China may well find itself facing some of the very forces that gave it an advantage over other places not long ago.

The Wider World Other newly industrializing countries have become increasingly significant global nodes of production. Over the past decade, manufacturing has surged in world cities of South and Southeast Asia, in South Africa, and in parts of Central and South America. Brazil, Russia, India, China, and South Africa are sometimes grouped under the acronym BRICS (each letter standing for one of these countries), because these countries demonstrate a shift in global economic power away from the traditional economic core. India has become the world's sixth largest economy. Although industrial production in India is modest when compared to the country's huge size and enormous population, major industrial complexes have developed around Kolkata (the Eastern district, with engineering, chemical, cotton, and jute industries, plus iron and steel based on the Chota Nagpur reserves), Mumbai (the Western district, where cheap electricity helps the cotton and chemical industries), and Chennai (the Southern district, with an emphasis on light engineering and textiles) (**Fig. 12.22**).

India has no major oil reserves, so it spends heavily on oil energy. But the country has a great deal of hydroelectric potential and access to ample coal. Its Bihar and Karnataka iron ore reserves may be among the largest in the world. With a large labor force, a growing middle class, and a location midway between Europe and the Pacific Rim, India's economic influence is on the rise.

Do Places Still Matter?

The diffusion of manufacturing activity to the semiperiphery and periphery, coupled with time–space compression, has led some commentators to suggest that we are entering an era characterized by the "end of geography." By this they mean an era characterized by so much fast, easy connectivity that where something happens does not matter much. Alvin Toffler first suggested this idea in his *Future Shock* (1970). More recently, Richard O'Brien advanced a similar idea in *Global Financial Integration: The End of Geography* (1992), and Thomas Friedman suggested something similar in *The World Is Flat* (2005). Each author argues that technological changes and developments in the global economy have reduced the significance of location and made place differences increasingly insignificant.

Geographers who study industrial production recognize that the nature and meaning of location and place have changed greatly in recent times. However, they also note that these changes do not create a geographically undifferentiated world. Local influences continue to matter a great deal; they just matter in different ways than they did in the past. So it is important to understand how places have changed as a result of new production methods, new corporate structures, and new patterns of industry. Then it is necessary to cultivate an awareness of how the relationship between global processes and local places creates opportunities and constraints for different parts of the planet.

TC Thinking Geographically

What steps have been taken by your community to attract new business? Tax breaks? Promises to provide infrastructure? Research what debates have developed over promises to attract new business in your community. What assumptions about **development** and **globalization** are made by those arguing for and against those promises?

12.4 Determine How Deindustrialization and the Rise of Service Industries Have Changed the Economic Geography of Trade.

Service industries—tertiary, quaternary, and quinary sectors—produce ideas, advice, innovations, and assistance to businesses and individuals. Tertiary services involve a broad range of actions that aid people and businesses, including personal services such as cutting hair and giving massages, as well as entertainment, transportation, and retail. Quaternary industries are those involved with the collection, processing, and manipulation of information and capital. These include the realms of finance, administration, insurance, legal services, and computer services. Quinary industries aid complex decision making and the advancement of human capacities. Think of scientific research, higher education, and high-level management when considering quinary industries.

Distinguishing among types of services is useful, given the growth in the size and complexity of the service sector. In the global economic core, service industries employ more workers than the primary and secondary industries combined. Yet these service industries range from small-scale retailing to tourism services to research on the causes of cancer. Placing all of these activities in a single category is not very helpful.

Distinguishing among different types of service industries is also useful in highlighting particular phases in the development of the service sector. Early in the twentieth century, the domestic and quasi-domestic tertiary industries experienced rapid growth in the industrialized world. With the approach of World War II, the quaternary sector began expanding rapidly, and this expansion continued after the war. During the last three decades, both the quaternary and quinary sectors have experienced very rapid growth, giving greater meaning to the term *postindustrial*.

The expanding service sector in the core economies is only one aspect of the changing global economy. Accompanying, and in some cases driving, this expansion are several other developments that have already been mentioned: the increasing mechanization of production, particularly in manufacturing enterprises operating in the core; the growth of large multinational corporations; and the scattering of the production process across geographic space.

Not all services contribute equally to an economy. You can pay $20 for a haircut and $20,000 for a surgery, but both are part of the service industry. You can also think about services in terms of *low cost, low benefit* versus *high cost, high benefit*. When you pay $20 for a haircut, the money goes to the person who cuts your hair, and the stylist in turn uses some of the money to pay rent to the salon owner and some of the money to buy groceries. The impact of the fraction devoted to rent multiplies, as the owner devotes a portion of it to the utility companies that serve the salon and the beauty companies that supply the salon with the products it uses.

With the $20,000 surgery, you are paying part of the incomes of the surgeon, the anesthesiologist, and the nurses. You are also paying the hospital, which in turn purchases utilities and all kinds of medical products. For each service you purchase, think about the persons being paid as having a wake (like that caused by a boat) behind them. The stylist can pay for only a small part of the rent and a couple of groceries from your $20—low cost, low benefit to the economy. The surgeon can pay part of a child's private school tuition, part of a vacation, and an entire month's worth of groceries—high cost, high benefit to the economy.

Geographical Dimensions of the Service Economy

Deindustrialization and the growth of the service economy unfolded in a world economy already characterized by wide socioeconomic disparities. Only areas that had industry could deindustrialize. At the global scale, the wealthier industrial regions were the most successful in establishing a postindustrial service economy. Deindustrialization did little to change the basic disparities between core and periphery that have long characterized the global economy. Even in the manufacturing realm, a few key resources were necessary to allow the core industrial regions to retain their dominance. Such resources included the availability of capital, access to technology and infrastructure, and innovative production strategies. Today, eastern Asia, western Russia and Ukraine, western Europe, and North America still account for well over 75 percent of the world's total output of manufactured goods.

Despite its continued dominance in the manufacturing arena, the core has experienced wrenching changes associated with the economic shifts of the past 70 years. Anyone who has spent time in Detroit, Michigan, the British Midlands, or Silesia (southern Poland and northeastern Czech Republic) knows there are pockets of significant hardship in relatively prosperous countries. These are the result of large-scale deindustrialization.

In the United Kingdom, the major industrial zones of Newcastle, Liverpool, and Manchester lost much of their industrial base during the 1960s and 1970s. The industrial zone of the northeastern United States (around the Great Lakes) did too, with steel manufacturing jobs moving to areas of the world

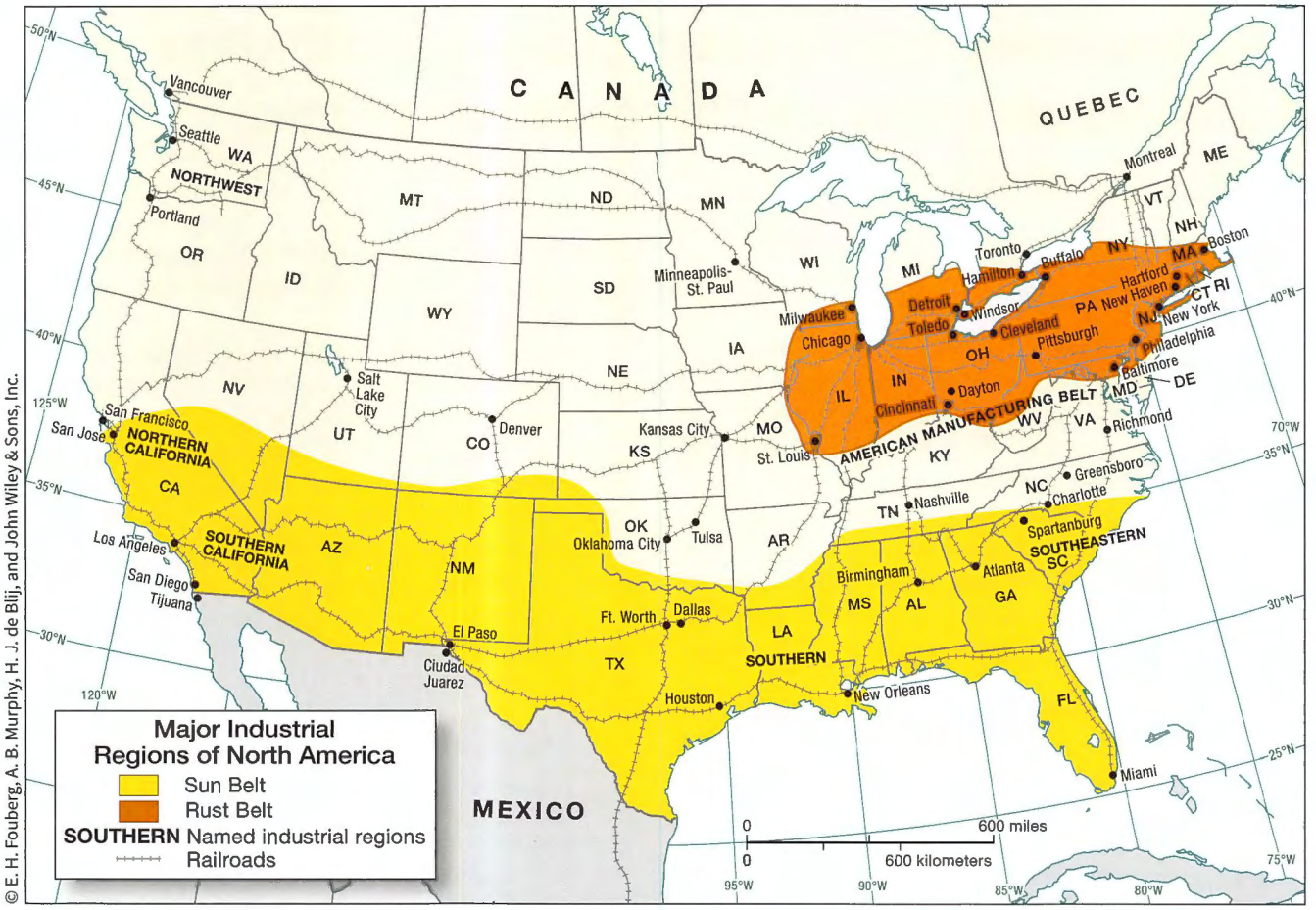


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FIGURE 12.23 Major Manufacturing Regions of North America. North American manufacturing has dispersed to the Sun Belt, and deindustrialization has taken hold in parts of the American Manufacturing Belt, now known as the Rust Belt. But new industries have sprung up there as well.

with lower wages. This region of the United States, which used to be called the Manufacturing Belt, came to be called the **Rust Belt**, evoking the image of long-abandoned, rusted-out steel factories (**Fig. 12.23**). Then the global economic downturn that began in 2008 resulted in job losses in communities dependent on both secondary and tertiary industries. These examples remind us that not all deindustrialized regions find their niche easily in the new service economy. It also posits that a tertiary economy, once established, does not necessarily buffer places from recessionary trends.

Nonetheless, some parts of the Rust Belt have revived significantly in recent years. Moreover, a number of secondary industrial regions have transitioned to a viable service economy fairly successfully. The **Sun Belt** is found in the southern part of the United States, stretching through the Southeast to the Southwest (Fig. 12.23). Both the population and economy of this region have grown over the last few decades. Service-sector businesses have chosen to locate in places such as Atlanta and Dallas, where the climate is warm and local laws favor business interests. The eastern part of the Sun Belt served as an early industrial region. Birmingham developed an iron and steel economy and Atlanta an industrial economy around cotton, tobacco, and furniture. In recent decades, high-tech and financial industries have changed the economy and landscape of the Sun Belt, as can be seen in the names of its sports stadiums: TIAA Bank Field in Jacksonville, Florida; Bank of America Stadium in Charlotte, North Carolina; and the AT&T Stadium in Arlington, Texas.

New Patterns of Economic Activity

Most service industries are not tied to raw materials and do not need large amounts of energy. Market accessibility is more relevant, but advances in telecommunications have rendered even that factor less important for some types of service industries.

To understand the influences that shape the location of services, it is useful to review the distinction among tertiary, quaternary, and quinary industries. Tertiary services related to transportation and communication are closely tied to population patterns and to the location of primary and secondary industries. Other tertiary services, such as food service and retail, are influenced mainly by market considerations. If they are located far from their consumers, they are unlikely to succeed.

Geographers can use technologies like GIS to model the best locations for new businesses, office complexes, government centers, and transportation connections. Major retailers do not just shape the landscapes of the places where they choose to put stores. They also change the economic prospects and physical landscapes of the places where their headquarters are located.

Walmart's headquarters in Bentonville, Arkansas, provide a particularly striking example. If producers of consumer products want to sell their goods in Walmart stores, they must travel to Bentonville to negotiate deals with Walmart. In order to provide low prices to consumers, Walmart negotiates low prices with major producers. To create lower-priced products, companies have moved production abroad, and to create good relationships with the world's number one retailer (with sales of over $500 billion in fiscal year 2019), a variety of companies have moved into Arkansas (**Fig. 12.24**). Those companies, along with an array of other businesses supporting their activities (hotels, restaurants, copy centers, delivery services), have fundamentally transformed the state.

The locational influences on quaternary services are more diverse. These are high-level services aimed at the collection, processing, and manipulation of information and capital. Some are strongly tied to particular locations. Retail banking and various types of administrative services require a high level of personal contact, so those services tend to be located near the businesses they are serving.

Other types of quaternary services can operate almost anywhere as long as they have access to digital processing equipment and telecommunications. When you send in your credit card bill, it is unlikely to go to the city where the headquarters of the issuing bank is located. Instead, it will go to North Dakota, South Dakota, Nebraska, or Colorado. Similarly, many "back-office" tasks related to insurance are performed in places such as Des Moines, Iowa, not Chicago or Hartford.

Many quaternary service activities are spread across the globe. If you go in for an MRI at a North American hospital late in the day, the image that is produced may well be evaluated in India (when it is night in the United States, it is daytime in India). Many of the call centers for technical help for computers and related industries (software, hardware) are located in India and the Philippines. Given the relatively high levels of college education and the large numbers of English speakers in these places, as well as the ease of routing phones through the Internet, "help desks" need not be located down the hall or even down the street. These locational curiosities occur because technological advances in the telecommunications sector have allowed all sorts of quaternary industries to be located far away from either producers or consumers. What matters most is infrastructure, a workforce that is sufficiently skilled but not too expensive, and favorable tax rates.

Those who work in the quinary sector can be widely dispersed. However, many concentrate close to seats of government, universities, and corporate headquarters. Corporate headquarters tend to be located in large metropolitan areas, whereas seats of government and universities can be found in places that were chosen long ago as appropriate sites for administrative or educational activities based on cultural values or political compromises. The American ideal of the "university town" (which originated in Germany) led to the establishment of many universities in modest-sized towns

Guest Field Note Watching Walmart Grow in Fayetteville, Arkansas

Fiona M. Davidson
University of Arkansas

For most geographers, the simple act of daily observation of the world around them becomes a profoundly satisfying habit. The rapidly changing urban/economic landscape of northwest Arkansas is one of the fastest growing metropolitan areas in the United States. Walmart originated in Bentonville, Arkansas, and as it became increasingly successful, it remained committed to its home in this affordable, rural corner of the mid-South. By the early 1990s, the company's growth had fueled the growth of other service industries and had contributed to the retention of several other major corporations. A decision to require Walmart suppliers to locate offices in the region similarly boosted growth in the area. Procter & Gamble put its office in Fayetteville, only 25 miles from Walmart's home in Bentonville. Dozens of other major corporations have a presence in the region as well. The results have been both positive and negative. Property prices have risen, with rising tax revenues and better public service provision, and the corporations have proven to be generous philanthropists. However, sprawl, congestion, overcrowded schools, and serious waste disposal issues also followed, This once-rural corner of America has become a metropolitan growth pole, complete with national coffee shops, rush hour congestion, and sprawling golf course subdivisions of 6000-square-foot "European" mansions.

Fiona M. Davidson

FIGURE 12.24 **Fayetteville, Arkansas**

such as Champaign-Urbana, Illinois; Norman, Oklahoma; and Eugene, Oregon, rather than in major commercial centers. Political compromises led to the establishment of major seats of government in small towns. Ottawa, Canada, and Canberra, Australia, are examples. The point is that historical location decisions influence the geography of the quinary sector. It is not just university professors and government officials who are affected. All sorts of high-level research and development activities are located on the fringes of universities, and a host of specialized consultants tend to concentrate around governmental centers. These then become major nodes of quinary activity.

High-Technology Corridors

A **high-technology corridor** is an area designated by local or state government to benefit from lower taxes and high-technology infrastructure. These areas provide high-technology jobs to the local population and attract designers of computers, semiconductors, telecommunication infrastructure, sophisticated medical equipment, and the like.

California's Silicon Valley is a well-known example of a high-technology corridor. Several decades ago, a number of innovative technology companies located their research and development activities near the University of California, Berkeley, and Stanford University. Both universities are near San Francisco. These companies were attracted by the prospect of developing links with existing research communities and the availability of a highly educated workforce. Once some high-technology businesses located in the Silicon Valley, others were drawn to the area as well, creating what geographers call a *growth pole* that spurred economic development in the surrounding area.

Today, Silicon Valley is home to dozens of computer companies (such as Cisco Systems, Adobe, Hewlett-Packard, Intel, and IBM). Manuel Castells, Peter Hall, and John Hutriyk call such a concentration a *technopole*, an area where agglomeration is based on a synergy among technological companies. A similar sort of technopole developed outside Boston near Harvard University, the Massachusetts Institute of Technology, and many other universities, creating the "Route 128 high-technology corridor." This corridor has been largely supported by the federal government rather than the local government, which supports many other technopoles.

Technopoles can be found in western Europe, East Asia, North America, and Australia. Few are on the scale of Silicon Valley, but they are visible elements of the economic landscape. Many have sprung up on the edges of good-sized cities, particularly near airports. In Brussels (Belgium), for example, the route into the city from the airport passes buildings occupied by computer, communication, and electronics firms. In Washington, D.C., the route from Dulles International Airport (located in the Virginia suburbs) to the city passes the headquarters of companies such as AOL, MCI, and Orbital Sciences (the Dulles Corridor). In the Telecom Corridor of Plano-Richardson (just outside of Dallas, Texas), telecom companies such as Nortel and Ericsson have taken root, but so too have numerous high-technology companies that are not telecom related (**Fig. 12.25**). In each of these technopoles, major multinational companies attract other startup companies hoping to become major companies, to provide services to major companies, or to be acquired by major companies.

Many of the technology firms are multinationals. Like their counterparts in other countries, they function in a globalized information environment and market their products all over the world. Being near raw materials or even a particular market is unimportant. What matters is being close to major transportation and communication networks.

High-technology industries have become such an important symbol of the postindustrial world that local, regional, and national governments often pursue aggressive policies to attract firms in this sector. Bidding wars sometimes develop between localities seeking to attract such industries. Although high-technology industries often bring economic benefits, they have some drawbacks. Communities that have attracted production facilities find that the manufacture of computer chips, semiconductors, and the like requires toxic chemicals and large quantities of water. And even more research-oriented establishments sometimes have negative environmental impacts in that land must be cleared and buildings constructed to house them.

Michael Vi/Alamy Stock Photo

FIGURE 12.25 Plano-Richardson, Texas. The Plano-Richardson Telecom Corridor is located just north of Dallas and is home to Diodes, a semi-conductor company with its Headquarters in Plano, Texas and offices in Silicon Valley, Shanghai, Taipei, Shenzhen, Tokyo, Seoul, and Munich.

But the high-technology sector is clearly here to stay, and areas that can tap into it usually are in an advantageous economic position.

Tourism Services Every service industry has its own locational characteristics. However, tourism is almost in a class by itself due to its geographical extent and economic significance. Once a relatively small activity confined to selected locations, tourism is now the world's largest service-sector industry.

Tourism grew dramatically in the global economic core during the second half of the twentieth century, when incomes and leisure time increased for many people. Over the past three decades, the number of East and Southeast Asian tourists has risen much faster than the global average, reflecting the economic boom in many Pacific Rim countries. A weakening global economy and concerns over political stability caused a noticeable dip in travel around 2010, but absent a major economic or geopolitical crisis, tourism is likely to continue to expand.

FIGURE 12.26 Duisburg, Germany. The old industrial canal corridor has been converted to a pedestrian district to attract businesses, shops, and restaurants.

In Chapter 10, we looked at the social and cultural impacts of tourism, but tourism is a major service industry as well. Communities all over the world have worked hard to promote tourism, and many economies now rely on tourist receipts. The tourist industry has transformed downtowns, ports, hinterlands, parks, and waterfronts. High-rise, ultra-modern hotels dominate urban skylines from Boston to Brisbane. The Port of Miami and Fort Lauderdale's Port Everglades have been reconstructed to serve the cruise industry. Many ports from Tokyo to Tampa have added cruise terminals complete with shopping malls and restaurants. Theme parks such as Disney's establishments near Orlando, Paris, Tokyo, Hong Kong, Shanghai, and Los Angeles draw millions of visitors and directly or indirectly employ thousands of workers. Dubai has constructed an indoor ski run in the Mall of the Emirates to attract more visitors. Once-remote wildlife parks and nature reserves in East Africa and South Asia currently receive thousands of visitors. They now require expanded facilities, and the increase in visitors can cause ecological damage. Many formerly isolated beaches are now lined by high-rise hotels and resorts. In the Caribbean and the Pacific, some entire islands have been taken over by tour operators.

The economic impacts of tourist-related development are far reaching. The monetary value of goods and services associated with tourism now exceeds $8 trillion. If spillover effects are considered, the figure is even larger. With a growing middle class in China and India, and with increases in average life expectancy, that figure is likely to continue to grow. That growth will then affect places all over the world.

Place Vulnerabilities in a Service Economy

Places are subject to vulnerabilities in any type of economy. In the early stages of industrialization, the economic fortunes of places were tied to their manufacturing operations. As a result, such places were vulnerable when demand shifted for the goods produced by local manufacturers. They were also threatened by the changing costs of transportation, or decisions by business owners to downscale or shift production elsewhere. Many older industrial areas in the United States and Europe experienced such adjustments, and their best hope for rebuilding often lay in the service economy. For example, in Duisburg—a city at the heart of Germany's Ruhr Valley—abandoned steel mills were turned into tourist attractions and warehouses were converted into retail establishments, restaurants, and offices (**Fig. 12.26**).

Service economies create their own vulnerabilities. Tourism can fall off in the face of economic downturns or natural hazards, and office work can be outsourced to distant places. We usually think of manufacturing jobs being affected by mechanization, but service jobs are vulnerable as well. In recent decades, countless jobs in the travel planning industry have been lost to the Internet. Similarly, scanning machines in supermarkets have reduced the need for employees, and automated answering services have taken the place of live voices in many businesses. Such changes can create the same sorts of hardships and pressures for economic readjustment faced by communities that rely on secondary industries.

In our globalized world, a disruption in a city or region with which a service-oriented place is linked can have serious consequences for that place that are beyond the control of anyone there. When the Arab Spring broke out in Cairo, the economy of Luxor (some 400 miles south of Cairo) took a major hit because international tourism stopped.

Some globalized economic developments can also negatively affect local places. For example, the financial service industry expanded rapidly over the past few decades because of increasingly innovative products and arrangements. Some people made spectacular amounts of money, but some financial instruments and procedures were based on unrealistic assumptions. Banks made loans they should not have made, and mortgages were issued to people who were unlikely to meet their payments. These practices contributed to the dramatic economic downturn of 2008, when a housing slump led to many defaults on so-called subprime mortgages. A banking crisis followed that rippled throughout the economy and, in our interconnected world, affected the fortunes of places near and far.

The 2008 crisis reminds us of the continuing vulnerabilities of places in a service economy, even if there is no direct challenge to the specific service industries on which the local economy is based. It also raises a key question with a geographical foundation: What are the consequences of divorcing the development of wealth in a knowledge economy from the fate of individual places, regions, or countries?

TC Thinking Geographically

How do the service industries in a country change in response to changes in **population pyramids**? When a country like Japan has an aging population, how can it use technological innovation or **migration** of workers to help provide health-care services to older residents? Using reputable news sources and working to find sources from multiple countries, determine how Japan is addressing the shortage of workers in the health care service industry.

Summary

12.1 Describe the Hearth and Diffusion of the Industrial Revolution.

1. The transition from cottage industries to the Industrial Revolution happened as Europeans sought to generate greater profit by producing more of the goods in high demand. To do this, they looked for ways to take advantage of economies of scale—increasing the quantity of goods being produced in an effort to decrease the average cost of producing each item.
2. The Industrial Revolution began in northern England in the mid-eighteenth century. It was characterized by the mechanization of production and the use of hydropower and coal as sources of energy. Because of the high cost of moving heavy raw materials, factories initially concentrated close to the location of energy resources. With the invention of the railroad in the late eighteenth century, production facilities could start moving closer to where consumers lived.
3. Industrialization diffused to continental Europe starting in the early 1800s. The first manufacturing belts in continental Europe were located close to coal fields in northern France, southern Belgium, and northwestern Germany. Early industrialization led to the growth of port cities, notably Rotterdam. Rotterdam is still Europe's most important port city.
4. By the mid-nineteenth century, industrialization diffused outside western Europe—principally to North America and parts of eastern Europe. Japan also began to industrialize in the late nineteenth century after the country opened up to the outside world after a change in government in 1868.

12.2 Examine How and Why the Geography of Industrial Production Has Changed.

1. In the early twentieth century, larger-scale industrial concerns adopted Fordist production techniques, especially mass-production assembly lines. The Fordist period was marked by a surge in both production and consumption. Fordist production led to changes in the location of industry toward sites with good access to available labor, resources, infrastructure, and consumers.
2. Efforts to develop generalizations about the influences on industrial location gave rise to classical location theory. The most influential classical location theory was Weber's least cost theory, which focused on the importance of three factors: transportation costs, labor costs, and the advantages that come with industrial clustering or agglomeration.
3. The costs associated with Weber's three factors have shifted over time. Transportation innovations such as containerization have greatly reduced the cost. Labor costs have increased, particularly in the global economic core. These shifts have altered the spatial organization of production. They have also ushered in an era of flexible production, in which the components of goods are made in different places around the globe and then brought together for assembly in response to customer demand.
4. Flexible production and the growth in labor costs in the global economic core gave to a global division of labor. Production facilities making everyday goods came to be increasingly concentrated in the global economic periphery and semiperiphery, while research and development operations remained in the

core. Developments in communication and transportation technologies accelerated the speed with which things happened and made the distance between places less significant. The term *time–space compression* describes this situation.

5. Industrial production in the contemporary world is dominated by multinational corporations. These corporations obtain component parts for the goods they produce from around the world (global sourcing), and many of them acquire the businesses they deal with (vertical integration). Large-scale industrial production today takes place in what are called global production networks, which encompass the activities, arrangements, and transactions involved in the production, distribution, and consumption of goods and service.

12.3 Explain Global Patterns of Industrial Production.

1. Industrial location today is influenced not just by labor costs, transportation, and market access, but also by regulatory constraints, the changing energy picture, and access to skilled labor. Government regulation can attract or discourage business. The shift from coal to oil, and more recently to nuclear power and alternative energy sources, makes it easier for industrial production to be more spatially disaggregated. The emergence of centers of education and research in major cities around the world have furthered this trend.
2. Centers of industrial production are now found all over the world. Many older industrial zones have experienced deindustrialization, but most still show up on the modern map of industrial production either because some older industries have held on or because new types of manufacturing have sprung up near older industrial sites. East Asia has emerged as the greatest new center of industrialization over the past 50 years, with China taking the lead after political and economic reforms were instituted in 1989.
3. Recently industrializing countries have become increasingly significant global nodes of production. Over the past decade, manufacturing has surged in the urban cores of South and Southeast Asia, in South Africa, and in parts of Central and South America.
4. Despite the diffusion of industrial production and the shrinking of the world through time–space compression, local influences still matter. A plan to develop an industrial operation in two different places will play out differently because those places are not alike.

12.4 Determine How Deindustrialization and the Rise of Service Industries Have Changed the Economic Geography of Trade.

1. In the global economic core, service industries employ more workers than primary and secondary industries combined. The growth of the service sector reflects the changing nature of the world economy, the increasing mechanization of production in manufacturing enterprises operating in the core, the growth of large multinational corporations, and the scattering of the production process across geographic space.
2. Deindustrialization in the global economic core has led to wrenching changes in some places. The so-called Rust Belt in the United States was hard hit, as were parts of northern England in the United Kingdom and the early-to-industrialize regions in continental Europe.
3. Factors affecting the location of service industries include access to markets and the availability of skilled labor. The latter has a particular influence on high-level services (quaternary and quinary sectors of the economy). A combination of skilled labor, tax incentives, and infrastructure has led to the development of high-technology corridors, which are now centers of wealth and are influential economic nodes.
4. Tourism has emerged as a major service industry. It has brought considerable wealth to some areas, but it can also leave places vulnerable to larger economic shifts or events that discourage people from traveling. Vulnerabilities exist in places dependent on other service industries as well.

Self-Test

12.1 Describe the hearth and diffusion of the Industrial Revolution.

1. The Industrial Revolution began in the mid-eighteenth century:
   a. in the London metropolitan area where major banks were located.
   b. in northern England near accessible coalfields.
   c. in the Paris metropolitan area where migrants had congregated.
   d. in parts of China where cottage industries were strong.

2. In the wake of the Industrial Revolution, _____ grew to be the most important port in Europe.
   a. London
   b. Paris
   c. Rotterdam
   d. Rome

3. Which of the following inventions helps to explain the emergence of London and Paris as major industrial centers in the nineteenth century?
   a. The railroad
   b. The water wheel
   c. The steamship
   d. The automobile

4. By the first half of the twentieth century, major industrial complexes had sprung up in each of the following regions except:
   a. the Kanto region around Tokyo, Japan.
   b. the Great Lakes region of the United States.
   c. the Rühr River Valley of Germany.
   d. the Ganges River Valley of northern India.

12.2 Examine how and why the geography of industrial production has changed.

5. Fordist production is characterized by:
   a. assembly-line production.
   b. just-in-time delivery systems.
   c. flexible production.
   d. containerization.

6. Which of the following was not taken into consideration in Weber's least cost theory of industrial location?
   a. transportation costs
   b. labor costs
   c. the skill of the labor force
   d. agglomeration

7. The fact that kiwis picked in New Zealand yesterday can be in the lunch boxes of children in Canada tomorrow is an example of:
   a. the global division of labor.
   b. outsourcing.
   c. flexible production.
   d. time–space compression.

8. True or False: Global outsourcing is common in the secondary sector, but not in the tertiary sector.

12.3 Explain global patterns of industrial production.

9. Which of the following has had a significant influence on industrial location in recent decades?
   a. government regulation
   b. the geography of agricultural production
   c. access to capital at places where an industrial operation might be built
   d. the location of oil fields

10. The expansion of alternative energy will likely:
   a. eclipse traditional energy sources in a few years.
   b. lead to greater flexibility in industrial location.
   c. advantage North America over Europe and East Asia.
   d. slow the turn toward the mechanization of industrial production.

11. True or False: Industrial production is more spatially concentrated today than it was in the 1950s.

12. Which of the following countries was one of East/Southeast Asia's newly industrializing countries (one of the region's "Four Tigers") in the 1960s and 1970s?
   a. China
   b. Japan
   c. Korea
   d. Vietnam

12.4 Determine how deindustrialization and the rise of service industries have changed the economic geography of trade.

13. The provision of legal services is an example of a:
   a. secondary economic activity.
   b. tertiary economic activity.
   c. quaternary economic activity.
   d. quinary economic activity.

14. Areas that have experienced deindustrialization over the past few decades are primarily concentrated in:
   a. the global economic core.
   b. the global economic semiperiphery.
   c. the global economic periphery.
   d. no one of the foregoing more than another.

15. Technopoles tend to emerge:
   a. in and around industrial manufacturing zones.
   b. in small towns where environmental regulations are weak.
   c. close to ports served by large container ships.
   d. close to research universities.

16. True or False: Tourism is the world's largest service-sector business.