CASE STUDY / Maquiladoras in Mexico

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

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

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

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

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

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

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

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

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

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

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

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

KEY ISSUE 1
Where Is Industry Distributed?

- Origin of Industry
- Industrial Regions

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

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

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

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

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

Industries impacted by the Industrial Revolution included:

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

  Henry Cort, a navy agent, established an iron forge near Fareham, England, to shape iron into useful objects. The combination of Watt’s engine and Cort’s iron purification process increased iron-manufacturing capability.

- **Coal**: The source of energy to operate the ovens and the steam engines. Iron production requires a source of heat to smelt the iron ore as well as to run the furnaces, forges, and steam engines. Wood, the main energy source prior to the Industrial Revolution, was becoming scarce in England because it was in heavy demand for construction of ships, buildings, and furniture, as well as for heat. Manufacturers turned to coal, which was then plentiful in England.

  Abraham Darby of Coalbrookdale in Shropshire, England, produced high-quality iron smelted with purified carbon made from coal, known as coke. Coke is richer in carbon and more combustible than coal, so it is a better source for the heat and gases needed to smelt iron ore.

- **Transportation**: Critical for diffusing the Industrial Revolution. First canals and then railroads enabled factories to bring in bulky raw materials such as iron ore and coal and ship finished goods to consumers (Figure 11-2).

  Europe’s political problems retarded the diffusion of the railroad. Cooperation among small neighboring states was essential to build an efficient rail network and to raise money for constructing and operating the system. Because such cooperation could not be attained, railroads in some parts of Europe were delayed 50 years after their debut in Britain.

- **Textiles**: Transformed from a dispersed cottage industry to a concentrated factory system during the late eighteenth century. Prior to the Industrial Revolution, thread was spun at home on spinning wheels operated by hand and foot. People known as putters-out were hired by merchants to drop off cotton or wool at homes, where women and children sorted, cleaned, and spun it into thread. The putters-out then picked up the finished work and paid according to the number of pieces that were completed (“piece-rate”).

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

**FIGURE 11-1** James Watt’s steam engine. Steam injected in a cylinder (left side of engine) pushes a piston attached to a crankshaft that drives machinery (right side of engine).
• **Chemicals:** An industry created to bleach and dye cloth. In 1746, John Roebuck and Samuel Garbett established a factory to bleach cotton with sulfuric acid obtained from burning coal. When combined with various metals, sulfuric acid produced another acid called vitriol, useful for dying clothing. Sulfuric acid produced a blue vitriol when combined with copper, green with iron, and white with zinc.

• **Food processing:** Essential to feed the factory workers no longer living on farms. In 1810, French confectioner Nicholas Appert started canning food in glass bottles sterilized in boiling water.

### Industrial Regions

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

#### Europe’s Industrial Areas

Numerous industrial areas emerged in Europe during the nineteenth and early twentieth centuries (Figure 11-4). These include several clustered in Western Europe centered on western Germany and extending north to the United Kingdom and south to Italy and Spain, and several in Eastern Europe, primarily in the former Soviet Union.
• **United Kingdom**: Dominated world production of steel and textiles during the nineteenth century. As the first country to enter the Industrial Revolution, Britain was saddled in the twentieth century with what became outmoded and deteriorating factories and support services. Although no longer a world leader in steel, textiles, and other early Industrial Revolution industries, the United Kingdom expanded industrial production in the late twentieth century by attracting new high-tech industries that serve the European market. Japanese companies have built more factories in the United Kingdom than in any other European country. The British have done more than the other major European countries to lower taxes on businesses, reduce government regulations, convert government monopolies to private ownership, and utilize computers.

• **Rhine–Ruhr Valley**: Western Europe’s most important and most centrally located industrial area. Within the area, industry is dispersed rather than concentrated in one or two cities.

  Iron and steel manufacturing concentrated in the Rhine–Ruhr Valley because of proximity to large coalfields. Access to iron and steel production stimulated other heavy-metal industries, such as railroad, machinery, and armaments, to locate in the area. Rotterdam, the world’s largest port, lies at the mouth of several branches of the Rhine River as it flows into the North Sea.

• **Mid-Rhine**: Western Europe’s second most important industrial area. The German portion of the Mid-Rhine area lacks abundant raw materials but lies at the center of Europe’s most important consumer market. The French portion of the Mid-Rhine region—Alsace and Lorraine—contains Europe’s largest iron-ore field and is the production center for two-thirds of France’s steel.

  The three largest cities in the German portion are Frankfurt, Stuttgart, and Mannheim. When Germany was divided into eastern and western portions during the Cold War, Frankfurt was West Germany’s most important financial and commercial center and the hub of its road, rail, and air networks. Stuttgart’s industries specialize in high-value goods and require skilled labor; Mercedes-Benz and Audi automobiles are among the city’s best-known products. Mannheim, an inland port along the Rhine, has a large chemical industry that manufactures synthetic fibers, dyes, and pharmaceuticals.

• **Po Basin**: Southern Europe’s oldest and most important industrial area. The Po Valley contains about two-thirds of Italy’s manufacturing in one-fifth of its land area.

  Modern industrial development in the Po Basin began with establishment of textile manufacturing during the nineteenth century. The area had two key assets: inexpensive hydroelectricity from the nearby Alps and a large labor supply, especially from Italy’s poorer south, willing to work for relatively low wages.
• **Northeastern Spain**: Western Europe’s fastest-growing industrial area in the late twentieth century. Spain’s leading industrial area, Catalonia, is centered on the city of Barcelona. The area is the center of Spain’s textile industry and the location of the country’s largest motor-vehicle plant. Spain’s motor-vehicle industry has grown into the second largest in Europe, behind only Germany’s, although it is entirely foreign-owned.

• **Moscow**: Russia’s oldest industrial area, centered around the country’s capital and largest market. Moscow specializes in fabrics and products that require skilled labor.

• **St. Petersburg**: Eastern Europe’s second largest city, specializing in shipbuilding and other industries serving Russia’s navy and ports in the Baltic Sea.

• **Volga**: Russia’s largest petroleum and natural gas fields. The motor-vehicle industry is concentrated in Togliatti, oil refining in Kuybyshev, chemicals in Saratov, metallurgy in Volgograd, and leather and fur in Kazan.

• **Urals**: Contains more than 1,000 types of minerals, the most varied collection found in any mining area in the world. Proximity to these inputs encouraged the Communists to locate iron and steel, chemicals, machinery, and metal fabricating in this area.

• **Kuznetsk**: Russia’s most important manufacturing district east of the Ural Mountains. Soviet planners took advantage of the area’s coal and iron ore to invest in iron and steel factories there.

• **Donetsk**: In Eastern Ukraine, an area of coal, iron ore, manganese, and natural gas. These assets make the area Eastern Europe’s largest producer of iron and steel. Major plants are located at Krivoy Rog, near iron-ore fields, and at Donetsk, near coalfields.

• **Silesia**: Eastern Europe’s leading industrial area outside the former Soviet Union. Silesia, which includes southern Poland and northern Czech Republic, is an important steel production center, near coalfields.

### North America’s Industrial Areas

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

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

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

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

• **New England**: The oldest industrial area in the northeastern United States. It developed as an industrial center in the early nineteenth century, beginning with cotton textiles. Cotton was imported from southern states, where it was grown, and finished cotton products were shipped to Europe.

• **Middle Atlantic**: The largest U.S. market. It attracts industries that need proximity to a large number of consumers and that depend on foreign trade through one of this region’s large ports. Other firms seek locations near the financial, communications, and entertainment industries, which are highly concentrated in New York.

• **Mohawk Valley**: A linear industrial belt in upper New York State along the Hudson River and Erie Canal. Buffalo, near the confluence of the Erie Canal and Lake Erie, was the region’s most important industrial center, especially for steel and food processing. Inexpensive, abundant electricity, generated at nearby Niagara Falls, has attracted aluminum, paper, and electrochemical industries to the region.
- **Pittsburgh–Lake Erie**: The leading steel-producing area in the nineteenth century because of proximity to Appalachian coal and iron ore. Steel manufacturing originally concentrated in the area between Pittsburgh and Cleveland because of its proximity to Appalachian coal and iron ore. Proximity to steel makers attracted other manufacturers that made heavy use of steel in their own products.

- **Western Great Lakes**: Centered on Chicago, the hub of the nation’s transportation network, now the center of steel production. Motor-vehicle manufacturers and other industries that have a national market locate in the western Great Lakes area to take advantage of this convergence of transportation routes. The area supplies machine tools, transportation equipment, clothing, furniture, agricultural machinery, and food products to people living in the interior of the country.

- **Southern California**: The leading industrial area outside of the Northeast. When the United States entered World War II in 1941, more than one-third of Los Angeles’ manufacturing was in the aircraft industry, attracted by clear skies, light winds, and mild winters. More recently, Los Angeles has become the country’s largest area of clothing and textile production, the second-largest furniture producer, and a major food-processing center. Immigrants from Latin America and Asia provide a large pool of low-wage workers.

- **Southeastern Ontario**: Canada’s most important industrial area, central to the Canadian and U.S. markets and near the Great Lakes and Niagara Falls. Most of Canada’s steel production is concentrated in Hamilton, Ontario, and motor-vehicle assembly in the Toronto area. Inexpensive electricity has attracted aluminum manufacturing, paper making, flour mills, textile manufacturing, and sugar refining.

### East Asia’s Industrial Areas

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

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

  Aware that South Korea, Taiwan, and other Asian countries were building industries based on even lower-cost labor, Japan started training workers for highly skilled jobs. “Made in Japan,” a phrase once synonymous with cheap, poorly made goods, now refers to high-quality motor vehicles, electronics, and precision instruments. Japan’s manufacturing is concentrated in the central region between Tokyo and Nagasaki, especially in the two large urban areas of Tokyo–Yokohama and Osaka–Kobe–Kyoto.

- **China**: The world’s largest supply of low-cost labor and the world’s largest market for many consumer products. China is the largest manufacturer of textiles and apparel, steel, and many household products.

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

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