**Chapter 11 Outline – Industry & Manufacturing**

Geographers are interested in studying industry because the choice of location of an industry is fundamentally about spatial relationships among raw materials, markets, and site factors.

**Key Issue 1: Where Is Industry Distributed?**

**Industrial Revolution** The **Industrial Revolution** was a series of improvements in industrial technology that transformed the process of manufacturing goods. Prior to the Industrial Revolution, 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.

Several inventions transformed the way in which goods were manufactured, beginning with the steam engine. The revolution in industrial technology created an unprecedented expansion in productivity, resulting in substantially higher standards of living. The Industrial Revolution resulted in new social, economic, and political inventions, not just traditional ones. The changes involved a gradual diffusion of new ideas and techniques over decades rather than an instantaneous revolution.

**Industrial Regions** Industry is concentrated in Europe, North America, and East Asia. European industrial areas tend to be located in regions with abundant energy, raw materials such as iron ore, and labor concentrations. North American industrial areas are located in a band from the Great Lakes to the East Coast and the California Coast. East Asia’s industrial areas are in China along the coast and in Japan.

**Key Issue 2: Why Are Situation and Site Factors Important?**

**Nonmetallic Minerals** In weight, more than 90 percent of minerals that humans use are nonmetallic, but metallic minerals are important for economic activities and carry relatively high value. Building stones, gemstones, and fertilizers are examples of nonmetallic minerals that humans commonly use.

**Metallic Minerals** Metallic minerals have properties that are especially valuable for fashioning machinery, vehicles, and other essential elements of contemporary society. Many metals are capable of combining with other metals to form alloys with distinctive properties important for industry. A **ferrous** alloy contains iron and a **nonferrous** one does not. Iron is extracted from iron ore, by far the world’s most widely used ore.

**Bulk-Gaining Industries** A **bulk-gaining industry** makes something that gains volume or weight during production. To minimize transport costs, a bulk-gaining industry needs to locate near where the product is sold. A prominent example of a bulk gaining industry is the fabrication of parts and machinery from steel and other metals. For example, steelmakers have traditionally located near raw materials; steel fabricators have traditionally located near the markets. Beverage bottlers also locate near large markets to cut down on the cost of shipping.

**Single-Market Manufacturers** Are specialized manufacturers with only one or two customers. The optimal location for these factories is often close proximity to the customers. An example of a single-market manufacturer is a producer of buttons, zippers, clips, pins, or other specialized components attached to clothing. The makers of parts for motor vehicles are another example of specialized manufacturers with only one or two customers. Proximity to the assembly plant is increasingly important for parts producers because of the diffusion of “**just-in-time**” delivery.

**Perishable Products** To deliver their products to consumers as rapidly as possible, perishable-product industries must be located near their markets. Because few people want stale bread or sour milk, food producers such as bakers and milk bottlers must locate near their customers to assure rapid delivery. The daily newspaper is an example of a product other than food that is highly perishable because it contains dated information. Newspaper publishers must locate near the markets to minimize transportation costs. People demand their newspaper as soon after it’s printing as possible.

**Ship, Rail, Truck, or Air?** Shipping costs are variable depending on the mode of transport used. Inputs and products are transported in one of four ways: via ship, rail, truck, or air. Firms seek the lowest-cost mode of transport, but which of the four alternatives is cheapest changes with the distance that goods are being sent. Long-distance shipping is the least expensive shipping option. Industries which use a number of different shipping modes tend to locate at **break-of-bulk points**,where it is easy to repackage products and change the shipping method.

Containerization has facilitated transfer of packages between modes. Containers may be packed into a rail car, transferred quickly to a container ship to cross the ocean and unloaded into trucks at the other end. Large ships have been specially built to accommodate large numbers of rectangular boxlike containers. Regardless of transportation mode, costs rises each time inputs or products are transferred from one mode to another. For example, workers must unload goods from a truck and then reload them onto a plane.

**Copper: Proximity to Inputs or Markets?** Copper production involves several steps. Mining copper ore is a **bulk reducing industry** because the heavy, bulky ore that is extracted from the mines is mostly waste. The second step in copper production is the concentration mills that grind the ore into fine particles that produce copper concentrate that is only 25 percent copper. Copper smelters then remove more impurities. As a bulk reducing industry, copper concentration mills and smelters are built near the mines to minimize transportation costs. Since so much waste has already been disposed of, proximity to the mines is a less critical factor in determining the location of the refineries.

**Steel: Changing Inputs** The two principal inputs in steel production are iron ore and coal. Because of the need for large quantities of bulky, heavy iron ore and coal, steelmaking traditionally clustered near sources of the two key raw materials. Within the United States, the distribution of steel production has changed several times because of changing inputs. Steel mills were highly clustered near the southern Great Lakes, especially Lake Erie and Lake Michigan. These areas were close to the bulky coal and iron ore to minimize transportation costs.

The increasing importance of proximity to markets is demonstrated by the recent growth of steel minimills. Rather than iron ore and coal, the main input into minimill production is scrap metal. Minimills, are less expensive to operate then traditional steel mills and they can locate near their markets because their main input—scrap metal—is widely available. World steel production is declining in developed countries and increasing in developing countries. Overall world steel production doubled between 1980 and 2010, with the biggest increase in production taking place in China.

**Motor Vehicles: Changing Markets** Carmakers manufacture vehicles at final assembly plants, using thousands of parts supplied by independent companies. Three-fourths of vehicles sold in North America are assembled in North America. Similarly, most vehicles sold in Europe are assembled in Europe, most vehicles sold in Japan are assembled in Japan, and most vehicles sold in China are manufactured in China. Carmakers’ assembly plants account for only around 30 percent of the value of the vehicles that bear their names. Independent parts makers supply the other 70 percent of the value.

Many parts makers are examples of single-market manufacturers because they ship most of their products to one or perhaps a handful of assembly plants. Motor vehicle seats, for example, are invariably manufactured within an hour of the final assembly plant. A seat is an especially large and bulky object and carmakers do not want to waste valuable space in their assembly plants by piling up an inventory of them. On the other hand, some parts do not need to be manufactured close to the customer. Some locate in countries that have relatively low labor costs.

**Labor** Minimizing labor costs is important for some industries and the variation of labor costs around the world is large. A **labor-intensive industry** is an industry in which wages and other compensation paid to employees constitutes a high percentage of expenses. The reverse case, an industry with a much lower-than-average percentage of expenditures on labor, is considered capital intensive. A labor intensive industry is not the same as a high-wage industry. Labor-intensive is measured as a percentage, whereas high-wage is measured in dollars. Motor vehicle workers are paid much higher hourly wages than textile workers, yet the textile industry is labor intensive and the auto industry is not.

**Capital** The U.S. motor-vehicle industry concentrated in Michigan early in the twentieth century largely because that region’s financial institutions were more willing than eastern banks to lend money to the industry’s pioneers. High-tech industries have been risky propositions—roughly two-thirds of them fail—but Silicon Valley financial institutions have continued to lend money to engineers who have good ideas so that they can buy the software, communications, and networks they need to get started. The ability to borrow money has become a critical factor in the distribution of industry in developing countries.

**Land** Contemporary factories operate most efficiently when laid out in one-story buildings. Raw materials are typically delivered at one end and moved through the factory in conveyors or forklift trucks. The land needed to build one-story factories is now more likely to be available in suburban and rural locations. With trucks now responsible for transporting most inputs and products, proximity to major highways is important for factories. Especially attractive is the proximity to the junction of a long-distance route and the beltway, or ring road that encircles most cities.

**Textiles and Apparel: Changing Inputs** Production of textiles (woven fabrics) and **apparel** (clothing) is a prominent example of an industry that generally requires less-skilled, low-cost workers. Spinning, weaving, and sewing are all labor intensive compared to other industries, but the importance of labor varies somewhat among them. Textile and apparel production involves three principle steps: spinning, weaving, and assembly.

**Key Issue 3: Why Does Industry Cause Pollution?**

**Global-Scale Air Pollution** Earth is warmed by sunlight that passes through the atmosphere, strikes the surface, and is converted into heat. When the heat tries to pass back through the atmosphere to space, some gets through and some gets trapped. A concentration of trace gasses in the atmosphere can block or delay the return of some of the heat leaving the surface heading for space, thereby raising Earth’s temperature. When fossil fuels are burned, one of the trace gasses, carbon dioxide, is discharged into the atmosphere. The anticipated increase in Earth’s temperature, caused by carbon dioxide trapping some of the radiation emitted by the surface, is called the **greenhouse effect**.

The stratosphere contains a concentration of **ozone** gas. The ozone layer absorbs dangerous ultraviolet rays from the Sun. Were it not for the ozone in the stratosphere, ultraviolet rays would damage plants, cause skin cancer, and disrupt food chains. Earth’s protective ozone layer is threatened by pollutants called **chlorofluorocarbons**.

**Regional-Scale Air Pollution** Air pollution may damage a region’s vegetation and water supply through acid deposition. Acid precipitation damages lakes, killing fish and plants. On land, concentrations of acid in the soil can injure plants by depriving them of nutrients and can harm worms and insects. Buildings and monuments made of marble and limestone have suffered corrosion from acid rain. Geographers are particularly interested in the effects of acid precipitation because the worst damage is not experienced at the same location as the emission of the pollutants.

**Local-Scale Air Pollution** Air pollution is especially severe in places where emission sources are concentrated, such as urban areas. The air above urban areas may be polluted because a large number of factories, motor vehicles, and other polluters emit residuals in a concentrated area. Urban air pollution has three basic components: carbon monoxide, hydrocarbons, and particulates. Progress in controlling urban air pollution has had mixed results.

**Sanitary Landfill** Using a sanitary landfill is by far the most common strategy for disposal of solid waste in the United States. Thousands of small-town “dumps” have been closed and replaced by a small number of large regional ones. Given the shortage of landfills, alternatives have been sought to dispose of solid waste. A rapidly growing alternative is incineration. Burning releases some toxins into the air and some toxins also remain in ash. Thus solving one pollution problem may increase another.

**Hazardous Waste** Disposing of hazardous waste is especially difficult. Hazardous waste includes heavy metals (including mercury, cadmium, and zinc), PCB oils from electrical equipment, cyanides, strong solvents, acids, and caustics. These may be unwanted by-products generated in manufacturing or waste to be discarded after usage. If poisonous industrial residuals are not carefully placed in protective containers, the chemicals may leach into the soil and contaminate groundwater or escape into the atmosphere.

**Water Pollution Sources** Pollution enters a body of water at a specific location is called **point-source pollution**. Point-source water pollution originates from a specific point, such as a pipe from a wastewater treatment plants. The two main point sources of pollution are manufacturers and municipal sewer systems. **Nonpoint-source pollution** comes from a large, diffuse area. Nonpoint sources usually pollute in greater quantities and are much harder to control than point sources of pollution. The principle nonpoint source is agriculture. Fertilizers and pesticides spread on fields are carried to rivers and lakes by irrigation systems and natural runoff.

**Impact of Water Pollution on Aquatic Life** Polluted water can harm aquatic life. Aquatic plants and animals consume oxygen and so does the decomposing organic waste that humans dump in the water. If too much waste is discharged into water, the water becomes oxygen starved and the fish die. Many factories and power plants use water for cooling and then discharge the warm water back into the river or lake. Fish adapted to cold water, such as salmon or trout, might not be able to survive the warmer water.

**Key Issue 4: Why Are Situation and Site Factors Changing?**

**Shifts within the United States** The northeastern United States lost 6 million jobs in manufacturing between 1950 and 2009. Industrial growth in the South since the 1930s has been stimulated in part by government policies to reduce historical disparities. The Tennessee Valley Authority brought electricity to much of the rural South, and roads were constructed in previously inaccessible sections of the Appalachians, the Piedmont, and Ozarks. Steel, textiles, tobacco products, and furniture industries have become dispersed through smaller communities in the South, many in search of a labor force willing to work for less pay than the North. The textile industry is an example of an industry that used to be concentrated in the Northeast and is now mostly found in the South.

The principle lure for many manufacturers to locate in the South has been **right-to-work laws**. A right-to-work law requires a factory to maintain a so-called “open shop” and prohibits a “closed shop”. In a “closed shop” a company and union agree that everyone must join a union to work in the factory. The percentage of workers who are union members is much lower in the South than elsewhere in the United States. More importantly, the region has been especially attractive for companies working hard to keep out the unions altogether.

**Interregional Shifts in Europe** Manufacturing has diffused from traditional industrial centers in northwestern Europe towards Southern and Eastern Europe. Several European countries situated east of Germany and west of Russia have become major centers of industrial investment since the fall of communism in the early 1990s. These countries offer manufactures an attractive combination of two important site and situation factors: labor and market proximity. The workers offer manufacturers good value for money; they are less skilled but much cheaper than in Western Europe and they are more skilled than workers in Asia and Latin America. The region is also close to the wealthy markets of Western Europe.

**Outsourcing** Transnational corporations have been especially aggressive in using low-cost labor in developing countries. Despite the greater transportation cost, transnational can profitably transfer some work to developing countries, given their substantially lower wages compared to those in developed countries. Transnational corporations allocate production to low-wage countries through **outsourcing**, which is turning over much of the responsibility for production to independent suppliers. Outsourcing contrasts with the approach typical of traditional mass production, called **vertical integration**, in which a company controls all phases of a highly complex production process.

**Mexico and NAFTA** The North American Free Trade Agreement (NAFTA), effective in 1994, eliminated barriers to moving goods among Mexico, Canada, and the United States. Because it is the nearest low-wage country to the United States, Mexico attracts labor-intensive industries that also need proximity to the U.S. market. Plants in Mexico near the U.S. border are known as **maquiladoras**, from the Spanish verb *maqullar*, which means “to receive payment for grinding or processing corn.” Under U.S. and Mexican laws, companies receive tax breaks if they ship materials from the United States, assemble the components at a maquiladora plant in Mexico, and export the finished product back to the United States.

**Bric and Brics** Much of the world’s future growth in manufacturing is expected to locate outside the principle industrial regions described earlier. The financial analysis firm Goldman Sachs coined the acronym BRIC to indicate the countries it expects to dominate global manufacturing during the twenty-first century: Brazil, Russia, India, and China. The four BRIC countries together currently control one-fourth of the world’s land area and contain 3 billion of the world’s 7 billion inhabitants. Their economies rank second (China), seventh (Brazil), ninth (Russia), and eleventh (India) in the world.

**Proximity to Skilled Labor** Traditionally, factories assigned each worker one specific task to perform repeatedly. Some geographers call this approach **Fordist** production because the Ford Motor Company was one of the first companies to organize its production this way early in the twentieth century. Most workers did not need education or skills to do their jobs. Many industries now follow a lean, or flexible, production approach. The term post-Fordist production is sometimes used to describe lean production in contrasts with Fordist production.

**Just-in-Time Delivery** As the name implies, just-in-time is shipment of parts and materials to arrive at a factory moments before they are needed. Under just-in-time, parts and materials arrive at a factory frequently, in many cases daily or even hourly. Just-in-time delivery reduces the money that a manufacturer must tie up in wasteful inventory. In fact, the percentage of the U.S. economy tied up in inventory has been cut in half during the past three decades. Manufacturers can also reduce the size of the factory because space does not have to be wasted on piling up a mountain of inventory.