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Intermodal Transportation and Vehicular Systems



Basic Concepts

- Define *intermodal transportation*.
- State the importance of intermodal transportation in our society.
- Identify the importance of containerization.
- List and discuss the advantages of intermodal transportation.
- Define passenger and cargo intermodal transportation.

Intermediate Concepts

- Describe legislation and government agencies that control intermodal transportation.

Advanced Concepts

- Plan an intermodal shipping route.

A mode of transportation is a method of moving people and goods. Modes of transportation exist in all the environments of transportation: land, air, water, and space. Each mode of transportation is responsible for the moving of people and goods to new locations. In reality, however, getting from one place to another often requires more than one mode of transportation. Imagine sending a package from your home to an international destination. The package would be picked up by a small truck or van and delivered to a sorting terminal. See **Figure 25-1**. From there, the package, along with hundreds of other packages, would be taken to an airport terminal. An airplane would be used to transport the package to the destination country. Once in the foreign country, the package may travel in several different vehicles before reaching the final destination. In the transit from the starting point to the destination point, the package was transported using several modes of transportation. This is an example of intermodal transportation. The

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The ISTEA of 1991 also addresses environmental concerns. It is meant to make energy use more efficient in intermodal transportation.

Figure 25-1. Intermodal transportation. Many packages are transported by truck from customers' homes to a sorting facility and then to an airline terminal to continue their journeys. (United Parcel Service)



prefix *inter-* comes from the Latin language and means “between.” Thus, intermodal means between several modes or involving more than one mode.

Intermodal Transportation

Intermodal transportation, or intermodalism, has been a reality in the United States since the mid-1980s. The U.S. government recognized the need for an increase in intermodalism and passed the *Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991*. The Act called for the creation of the National Commission on Intermodal Transportation (NCIT). NCIT studied the state of intermodal transportation and made suggestions to Congress through its final report in 1994. The Commission found that intermodal transportation has great benefits for the nation, including increased productivity and decreased congestion. See **Figure 25-2**. Today, the U.S. Department of Transportation’s Office of Intermodalism oversees intermodal transportation in the United States.

Intermodal systems involve less material handling, which results in less damage and loss of goods. See **Figure 25-3**. This type of transportation has cut down on shipping time and costs. Intermodal transportation also reduces energy consumption.

This mode of transportation takes time to plan and organize. It depends on each mode working on a timetable. Service can easily break down if all modes do not stay on schedule. If one mode does not pick up where the other one ends, the process is slowed down. There are delays and confusion. Both timing and planning are vital to intermodal transportation. Intermodal transportation can be broken into two categories. These categories are intermodal cargo transportation and intermodal passenger transportation.

Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991:
The act that created the National Commission on Intermodal Transportation (NCIT).

Intermodal Cargo Transportation

Intermodal cargo transportation is the movement of goods and products using two or more modes of transportation. Transporting cargo from one point to another is often done by using several different modes of transportation. For example, the shipping of grain from the United States to Russia may go something like this:

- The grain is first harvested by the farmer and brought out of the fields in trucks or wagons. See **Figure 25-4**.
- The farmer sells the grain and hauls it to a grain elevator.
- The grain is loaded into railroad cars or semitrucks and transported to a port.
- Here, the grain is loaded onto a ship that carries it across the ocean.
- Once the grain arrives in Russia, it must then be unloaded and distributed by way of land vehicles to various places of use.

There are a few different ways in which to ship cargo by intermodal transport. Since the intermodal transportation system has grown, special shipping containers and transport vehicles have been developed.

Figure 25-2. The increased use of intermodal transportation has reduced highway traffic congestion like this.

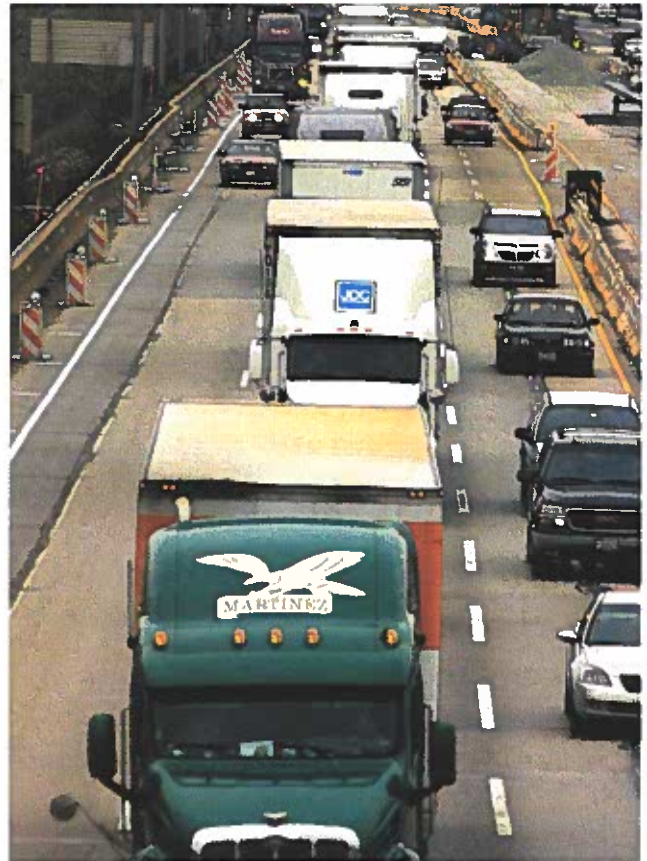


Figure 25-3. This port facility is an example of intermodal transportation. Shipping containers arriving onboard the ships are unloaded and stored before being transferred to railcars or truck chassis to continue their journey. Movement in the opposite direction also takes place. Containers arriving by rail or highway are stored and then loaded onto ships.



Intermodal cargo transportation: Transporting cargo from one point to another by using several different modes of transportation.

Figure 25-4. The first intermodal transport step following the harvest of this shelled corn is to haul it by truck to a grain elevator. The corn might travel by train, barge, and ship before it reaches its final destination.



Containerized shipping

Imagine you are traveling to a relative or friend's house across the country for a week-long vacation. Would you carry each individual piece of clothing, or would you pack all the clothes into a suitcase? Of course, the clothes would be easier to carry if they were packed together in a piece of luggage. See **Figure 25-5.** *Containerization* is a method of handling goods by packing many small packages, which are going to the same destination, in one large container. This method eliminates the handling of many small packages every time they change vehicles. It is easier and requires less time and people to move one container, rather than many small packages.



Technology Link

Agriculture: Intermodal Delivery of Crops

It may not surprise you that agriculture uses transportation throughout many of its processes. Tractors, grain trucks, and harvesters are commonly associated with agriculture. You may not realize, however, that in order for crops to be delivered to the market or food plant, most products are shipped through intermodal transportation. This occurs with food products, including grain, milk, and tropical produce.

When wheat is harvested, it is collected using a harvester, or combine. The combine separates the wheat into the grain and straw. The straw is sent out the back, and the grain is stored in the combine and later unloaded into an open-topped grain truck. The grain is driven to a grain elevator or silo for sale or storage. At the elevator or silo, augers and conveyors transport the grain. From the grain elevators, the grain is often loaded onto either barges or railroad cars. The grain is then transported to another elevator across the nation or world and unloaded into hoppers that feed back into an elevator. From there, it is transported by truck to the final destination.

Milk is also transported by several modes of transportation. As you may imagine, tanker trucks from the farms that milk the cows transport it to the dairy that processes the milk. It is also transported, however, within the dairy farm and dairy processing plant by pipelines. Pipes and tubes are used to connect milking machines, storage tanks, heat-treating machines, and bottling machines.

Imagine the intermodal processes that bananas, mangos, and coffee beans harvested in the tropical regions of the world must travel through to reach our supermarkets. The crops are harvested and transported using farm equipment, transported using tractor-trailers, and then shipped to the United States on ships, finally arriving at the supermarket on trucks. Without efficient intermodal transportation it would be impossible to have fresh produce in many parts of the United States year-round.

Figure 25-5. Containerized shipping is similar to using a suitcase, since it is easier to pack a number of items into one container than to transport them individually.



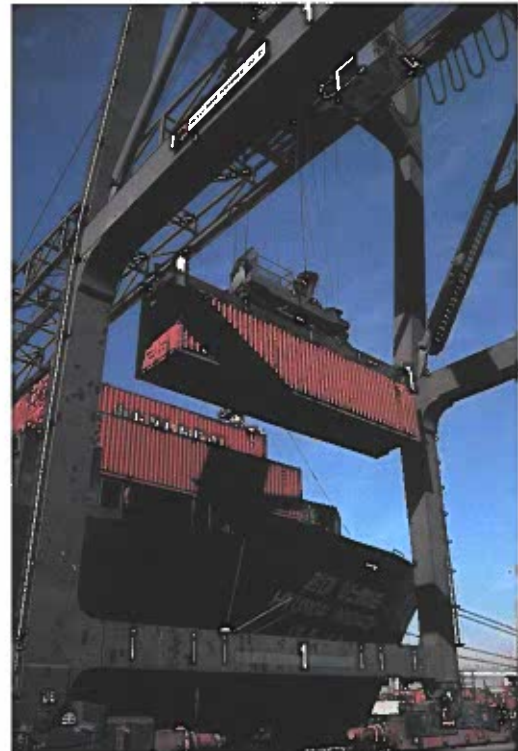
Containerization: A method of handling goods by packing many small packages, which are going to the same destination, in one large container.

Dry cargo container: A fully enclosed shipping container resembling a large metal box with doors either on the side or end.

The less the individual packages are handled, the less likely it is that they will be accidentally damaged or stolen. This method of packing makes intermodal transportation safer and more efficient than other modes of transportation.

Containerized shipping is an efficient method of transporting goods. The *dry cargo container* is the most frequently used and most commonly recognized. See **Figure 25-6**. This container is fully enclosed, resembling a large metal box with doors either on the sides or ends. Products requiring circulating air are shipped in *ventilated containers*. These containers have openings in the sidewalls allowing air to flow around the cargo. Open top and flat rack containers are used for large equipment and bulk goods. The open top containers have removable or retractable roofs, and the flat rack containers do not have sides or a top. *Thermal containers* are used to transport perishable food products. They can be insulated, refrigerated, heated, or both refrigerated and heated. The standard container size is 8' wide, 8' 6" high, and 40' long. The inside volume of a standard container is about 2385 ft³. Planners organize the products to be shipped in the best possible configuration to minimize wasted space.

Figure 25-6. Dry goods containers, such as the one shown here being unloaded by crane, are the most common type. Several more specialized containers are also used. (Port of Long Beach)



Ventilated container: A container that has openings in the sidewalls allowing air to flow around the cargo.

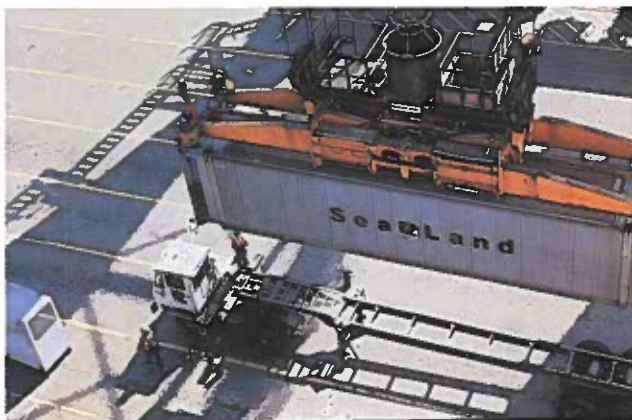
Thermal container: A container used to transport perishable food products. It can be insulated, refrigerated, heated, or both refrigerated and heated.

When transported by water, the containers can be swiftly loaded onto ships with the aid of cranes. See **Figure 25-7**. Containers filled with products to be sent to the same place are transported by rail or highway. Those that have contents to be sent several different places are moved to a central distributing point. There, they are opened, and the contents are sent on to their final destinations. When using a highway mode, the container is lifted onto a frame with eight wheels. See **Figure 25-8**. A truck tractor can then pull the container. Railroad flatcars can also carry the containers. The containers can be lifted directly onto the flatcar and transported to their destination by way of rails. See **Figure 25-9**. Once they arrive at their destination terminal, the containers are unloaded onto a truck trailer and transported across the land. A container transported on a railroad flatcar is referred to as a *Container on Flat Car (COFC)*. Transporting the containers across the ocean on barges and ships is done quite often. The ships are designed to carry these standard containers. They are referred to as *containerships*. See **Figure 25-10**. Another way to ship goods is transporting containers by air.

Figure 25-7. Containerized shipping. Large metal containers filled with goods are loaded onto flat railcars to be transported. (CSX Creative Services)



Figure 25-8. Often, containers are loaded onto a trailer frame and hauled away by a tractor. (CSX Creative Services)



Trailers on Flat Cars (TOFCs)

Trailer on Flat Car (TOFC) is another method of intermodal transportation. It involves trailers full of cargo carried on a rail flatcar. See **Figure 25-11**. This method of intermodal transportation is called *piggybacking*.

Other forms of intermodal cargo transportation

Liquids and mined materials are also transported by using intermodal methods. Oil, milk, inks, chemicals, and other liquids are transported through pipelines. For instance, oil is transported to a terminal through pipelines and then pumped into a tank truck and hauled to its destination. See **Figure 25-12**. Mined materials, such as coal, ore, and various stones, are first transported by way of conveyor out of the ground. From the stationary conveyor, they are loaded into trucks or hopper railroad cars. The railroad car or truck hauls the materials to their final destination.

Intermodal Passenger Transportation

People also use intermodal transportation. Often, we use it several times a day without realizing it. If you ride your bike to your friend's house, and then you both ride to school in a car, you have just experienced intermodal transportation. Let us say you have

Figure 25-9. Containers are often loaded on flatcars for long-distance land transportation. These container flats are shown in a rail yard along with a number of other specialized freight cars.

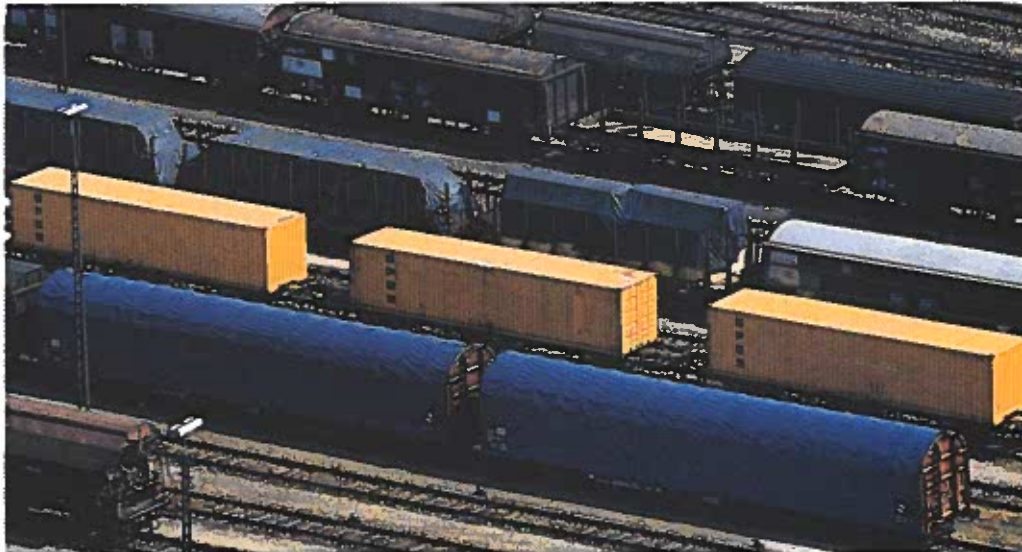


Figure 25-10. Containerships are designed to carry the maximum number of containers, both in their holds and stacked on deck.



Container on Flat Car (COFC): A container transported on a railroad flatcar.

Containership: A ship designed to carry standard containers.

Trailer on Flat Car (TOFC): A method of intermodal transportation involving trailers full of cargo carried on a rail flatcar.

Piggyback: To carry a trailer or container on wheels on a flat railroad car.

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Because of the savings found in using railroad transportation for cargo rather than trucks, there has been a trend developing from the government about using freight trains more often.

Figure 25-11. Trailer on Flat Car (TOFC) is a widely used form of intermodal transportation. Loaded trailers are placed on flatcars for long-distance transportation and then hauled to their final destination as a tractor-trailer unit.



just won a trip to Maui, one of the Hawaiian islands. You live in Boston, Massachusetts. You would probably get to the airport by way of a bus or car. You would catch a plane to San Francisco, California. See **Figure 25-13**. Once you are in California, you have to change planes. You get on the moving sidewalk that goes through the airport, and you board the next plane. You then fly to Honolulu, Hawaii. Once you are there, you take a taxi to board a ferry, which will take you to the island of Maui.

Intermodal passenger transportation: Transporting passengers from one point to another by using several different modes of transportation.

Intermodal passenger transportation is the movement of people using two or more modes of transportation. In the previous example, you experienced intermodal passenger transportation by using a combination of land, air, and water transportation.

These modes of transportation, however, are not as streamlined as cargo intermodal transportation. You have to purchase separate tickets for the bus, airplane, and ferry, and you may even have to walk a distance

from the bus stop to the airport. Passenger transportation companies are beginning to see the importance of seamless intermodal travel and are fixing this problem. Due to partnerships and alliances between companies, in some places, you can buy a ticket from one company that will include all the bus, plane, light-rail, and shuttle tickets you will need to get from the starting point to the destination point. Companies are also building terminals alongside or within other transportation stations. In many cities, the intercity bus station and train station are in the same building or terminal. See **Figure 25-14**. Another common example is the placement of rental car companies and shuttle bus pickups inside or

Figure 25-12. Some tractor-trailers, called tankers, haul liquid cargo. (Freightliner Corporation)



Career Connection

Pipelayers, Pipefitters, and Steamfitters

The use of pipelines requires the work of pipelayers, pipefitters, and steamfitters. These construction professionals lay, install, and fit the pipes needed to move materials within buildings and across cities. Pipelayers lay city utilities, such as water mains and sewer systems, as well as oil and gas lines. Pipefitters and steamfitters install piping used in power production and manufacturing plants.

Pipelayers, pipefitters, and steamfitters typically work 40-hour workweeks, with overtime pay if extra work is required. The nature of the work is, at times, physically demanding and, often, outdoors. Entry requirements into the profession are a high school diploma or the equivalent and being 18 years old. Training is provided through apprenticeship programs. The apprenticeship program through the United Association of Journeymen and Apprentices of the Plumbing, Pipefitting, Sprinkler Fitting Industry of the United States and Canada (UA), which is the largest pipefitting union, lasts 5 years. Each year of the apprenticeship consists of 1700–2000 hours of on-the-job training and 216 hours of classroom instruction. The classroom instruction covers topics such as drafting, mathematics, safety, and local codes. The average pipelayer makes over \$15 per hour, while the highest paid makes over \$25 per hour.



next to airport terminals. Intermodal transportation should be efficient and save passengers time. The closer these facilities are to each other, the more time can be saved.

Figure 25-13. Airplanes are often part of an intermodal transportation system for both freight and passengers. This aircraft is being guided to an airport gate, where the jet way will be connected to allow passengers to unload and new passengers to board.



Figure 25-14. Urban mass transit systems are examples of intermodal passenger transportation. A—This suburban transit station outside of Washington, D.C., allows travelers arriving by car or bus to continue their journey by subway. B—Passengers arriving at the station by subway can then transfer to buses or cars parked in adjacent lots.



Vehicular Systems of Intermodal Transportation

Land, water, air, and space transportation all have vehicles and vehicular systems that are unique to their environments. Intermodal transportation is different, however, in that it uses vehicles in multiple environments to transport people and goods. The vehicles selected and used determine the vehicular systems used in intermodal transportation. There are really only two vehicular systems intermodal transportation impacts—structure and support.

Structural Systems

The structures of the vehicles used in cargo intermodal transportation must be able to carry the container being transported. In land transportation, special trailers and rolling stock have been designed to carry the containers. Trailers used in highway transportation to move intermodal containers are known as chassis. A chassis is a frame that connects to the tractor, or semi, in the front and has wheels in the rear. A chassis is very similar to the underside of a typical semitrailer. The containers are placed on top of the chassis and secured in each of the four corners. Because the sizes of the containers are fairly standard, most chassis are made in standard lengths. The structure of the chassis, however, can also be made to be shortened or extended to fit various sizes of containers.

Railcar structures are also designed differently for intermodal transportation. Flatcars are standard railcars without walls. These are typically used for hauling trailers, as previously described. *Well cars* are designed so the containers actually sit near or below the height of the axles. See **Figure 25-15**. This allows two containers to be stacked on top of one another, without worrying about the height of tunnels and other obstructions along the railroad. Well cars are often linked with other well cars and share the same bogies. These cars can fit various sizes of containers.

Lastly, the structures of ships must also be designed to carry containers. Most often, containerships and barges carry intermodal

Well car: A railcar designed so the containers actually sit near or below the height of the axles, allowing two containers to be stacked on top of one another.

containers. Containerships are large ocean-going vessels that can carry hundreds of containers. Barges are smaller and travel in inland waterways. Containers in these ships can be stacked as many as eight high. This makes the shipping of containers more cost-efficient.

Support Systems

Like the other four transportation systems, intermodal transportation also requires support systems. For example, ports and harbors are needed to load and unload ships. Unlike a port used for only one mode of transportation, however, intermodal ports must also have facilities for the loading and unloading of semitrucks and trains. Intermodal terminals must have facilities for all the modes of transportation they serve. This often makes intermodal stations very expensive to construct. The money saved from the efficiency of intermodal transportation, however, often makes up for the costs of the facilities.

Figure 25-15. Rail transport. These containers have been stacked into well-type cars to be transported partway to their final destination. (Norfolk Southern Corporation)



Curricular Connection

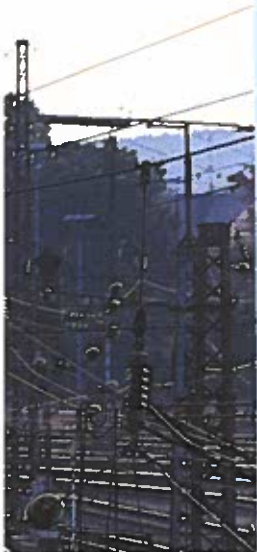
Language Arts: Formal Writing

There are two different types of writing: formal and informal. Formal writing is used when at school or in the workplace, while informal writing is only appropriate in personal correspondence such as e-mails, blogs, and text messages. Preparing work e-mails, memos, and reports in a formal style highlights your professionalism. Effective written communication is dependent upon an ability to write formally.

When writing formal pieces, always use proper spelling, punctuation, grammar, and complete sentences. Do not address the audience directly (*you*) or refer to oneself in the first person (*I* or *me*). Doing so gives the piece a conversational, subjective tone, which is inappropriate when writing formally.

Do not use contractions in your formal writing—instead, spell out each word. For example, rather than using *can't*, *cannot* would be a more appropriate choice. Along the same lines, spell out single-digit whole numbers as well as the word *and*, instead of substituting the ampersand (&). Additionally, it is best to avoid using colloquial language—informal, everyday speech—such as *yeah*, *cool*, or *gonna*. Slang abbreviations such as *jk* or *lol* should also be reserved for informal writing such as instant messaging, e-mailing, or texting.

When communicating with coworkers, clients, or customers, formal writing techniques are required. Writing formally presents a professional tone that most employers expect of their employees. Effective and proper professional communication is dependent upon the mastery of formal writing techniques.



At intermodal ports and docks, large cranes are used to pick the containers off the ships and place them into a storage area. See **Figure 25-16**. From there, other cranes or specialized pieces of equipment are used to place the containers onto trucks or railcars. At railroad intermodal facilities, loading equipment is used to transfer the containers from the railcars to the truck chassis and vice versa. These facilities also employ people to monitor the transfer of the containers and make sure the containers are sent to the correct places on the correct mode of transportation.

Figure 25-16. Giant cranes are used at intermodal ports to load containers on ships, unload them for storage, or transfer them to other means of transportation.



Career Skills

Safety

Safety on the job is everyone's responsibility. Many workplace accidents occur because of careless behavior. Practicing good safety habits is essential for preventing accidents and injuries on the job. Knowing how to use machines and tools properly is the responsibility of both the employer and employees. Wearing protective clothing and using safety equipment correctly helps keep workers safe.

The government agency that promotes safety in the workplace is the Occupational Safety and Health Administration (OSHA). You will be required to follow the specific OSHA regulations that apply to your workplace.

Summary

Intermodal transportation is a system that uses a combination of several modes of transportation to get from one place to another. It is an efficient system of cargo transportation. Containerization is a very popular method of effective intermodal transportation because it cuts back on material handling, and it also saves on labor costs. Containers can be loaded onto ships, flat railroad cars, and airplanes. Carrying a trailer or container on wheels on a flat railroad car is referred to as piggybacking. Passengers also use intermodal transportation.

Key Words

All the following words have been used in this chapter. Do you know their meanings?

containerization	intermodal passenger	Trailer on Flat Car (TOFC)
Container on Flat Car (COFC)	transportation	ventilated container
containership	Intermodal Surface	well car
dry cargo container	Transportation Efficiency	
intermodal cargo	Act (ISTEA) of 1991	
transportation	piggyback	
	thermal container	

Test Your Knowledge

Please do not write in this text. Place your answers on a separate sheet.

1. Write the definition of *intermodal transportation*.
2. *True or False?* The federal government has made no effort to recognize the need for intermodal transportation.
3. What is the importance of intermodal transportation in our society?
4. List the two categories of intermodal transportation.
5. List vehicles that may be used to move freight from Tokyo, Japan to St. Louis, Missouri.
6. Why is containerization useful?
7. Name at least two advantages of intermodal transportation.
8. *True or False?* Containerization is an efficient method of handling cargo.
9. Describe two types of containers.
10. What does *TOFC* stand for?

11. Carrying truck trailers on the back of railroad cars is known as:
 - A. hauling.
 - B. containerization.
 - C. piggybacking.
 - D. intermodal passenger transportation.
12. *True or False?* Travelers hardly ever use intermodal transportation systems.
13. Describe how you have used intermodal transportation in the past.
14. *True or False?* Intermodal harbors and ports are the same as those used for only one mode of transportation.



STEM Activities

1. Design and build a scale model of a transportation system with two modes.
2. As a class project, develop a proposal for an intermodal transportation system to relieve traffic congestion in a major city with a population of 2 million people.