Chapter 1
Overview of Transportation

1.1
What are the purposes of a transportation system in a region or a nation?

The purpose of a transportation system is to provide a mechanism for the exchange of goods, people, and information and to support economic improvements for society. Transportation provides the means to travel for many purposes such as employment, exploration, or personal fulfillment. It is a necessary condition for human activities such as commerce, recreation, or defense.

1.2
If you were asked to give a definition of transportation, what would you say? Provide three examples to illustrate your definition.

Transportation is the movement of people and goods from their place of origin to their destination. The system by which this movement occurs can be a single mode such as a highway or can involve multiple modes such as air and rail.
Examples to illustrate the definition of transportation are as follows.

- A family journeys to another country to seek a better life
- An automobile crash in a rural area requires the immediate transfer of a patient to a hospital, and
- A trainload of coal is shipped from the mine to a seaport.

1.3
How does the quality or level of service of a transportation system affect the competitive advantage of one geographic area over another (such as a city, state, or nation)? To what extent is a good transportation system sufficient to assure that the economic potential of a region will be maximized?

The quality of a transportation system affects a region's ability to utilize its existing resources, such as labor and natural resources, for trade and export. Absent the ability to transport products at a low cost, a region cannot offer goods and services at a competitive price. By providing transportation services safely, reliably, and quickly with sufficient capacity and at a relatively low cost, a region's economic base is expanded, new markets are created and skilled labor is attracted.

Transportation is a necessary but not sufficient condition to assure economic competitiveness. In addition to good transportation services, a city, state, or nation must have natural or human resources, water, power, and sewage disposal facilities, financial

capital, adequate housing, and a strong military defense. To be competitive in a global economy will also depend on the quality of multimodal linkages including maritime, rail, trucking, and air services.

1.4

What is the characteristic of countries and nations that have good national and international transportation systems? Name three countries with good transportation.

They are developed nations with a healthy economic base that have made investments in high quality transportation services. In the 18th and 19th centuries, nations with a strong maritime presence became the rulers of vast colonial empires and established international commerce with trade routes to North America, India, Africa, and the Far East**.** In the 20th century countries that became leaders in industry and commerce – such as the United States, Canada, Japan, and Germany – relied on modern networks of sea, land, and air transportation.

1.5

In addition to providing economic benefits to society, list five examples of other advantages provided by the availability of good transportation.

- Opportunity to improve present living conditions by moving elsewhere
- Because of good transportation, health care has dramatically improved
- Improvements in transportation have contributed to the worldwide decline of hunger
- Extension of life expectancy
- Enhanced opportunities for advanced education and technical training
- Increased incomes and standards of living
- Broader recreational options
- Reduction of inequality in education and employment
- Wider participation in worldwide multi-cultural experiences

1.6

Explain the statement that 'modern transportation is necessary but not sufficient to assure that a region or nation will be prosperous'.

While it is true that without competitive transportation services, the economic potential of a region is limited, a region or nation must have natural and human resources, financial capital, adequate housing, and a strong military defense if it is to succeed. When these conditions exist economic growth will be accelerated if the quality of the internal transportation system is good and there are adequate transport linkages with the rest of the world.

1.7

While it is true that good transportation provides enormous benefits to society, there is a price to be paid. What are the direct and indirect costs of transportation?

Direct costs

- Capital (design and construction)
- Operations
- Maintenance

Indirect costs

- Environmental effects
- Congestion
- Property damage
- Safety
- Noise
- Land use

1.8

List three major U.S. transportation projects that have been completed in the past 150 years.

- The transcontinental railroad
- The Panama Canal
- The Interstate Highway System
- The 'Big Dig' in Boston

1.9

Every mode of transportation has experienced a major disaster that cost many lives and property. Use internet resources to provide one example for air, ships, railroads, and highways.

- Air: TWA Flight 800
- Ships: The sinking of the Titanic
- Railroads: Collision between two Long Island commuter trains kills 79, hundreds
- Highways: Many examples resulting in over 40,000 traffic deaths per year in the U.S.

1.10
List six environmental effects of transportation.

Environmental effects of transportation include

- Noise
- Air quality
- Water pollution
- Long-term climate effects from carbon monoxide and other pollutants
- Disturbance of wetlands
- Desecration of natural beauty
- Disruption of natural habitats

1.11
Provide five examples to convince someone of the importance of transportation in U.S. society, policy, and daily life.

The following statistics related to transportation demonstrate the importance of transportation

- Transportation represents approximately 17.5% of U.S. gross domestic product
- Most of the fuel used in transportation is derived from petroleum resources
- Transportation uses over 50% of the nation's petroleum products
- Over 10% of the U.S. workforce is employed in a transportation-related activity
- The U.S. transportation system is extensive and ubiquitous. Consisting of approximately, 6.5 million kilometers of paved roadway, 175,000 kilometers of railroads, 10,000 airports, 42,000 kilometers of inland waterways, and 340,000 kilometers of pipelines.

1.12
Does transportation affect land use patterns? Buttress your answer with examples of the influence of walking/animal power, rail transit, water, highways, and air.

- Walking and horse power confined land use to dense development with activities in close proximity to each other often bounded by surrounding walls and entrance gates
- Railroads and rail mass transit created star-like land use patterns with the central city as the focal point and residences located nearby or along the radial pathways
- Water transport created seaport cities and land use development along rivers and lakes
- Highways created land use patterns that were diffuse and low density. Suburbs were created with the construction of the National System of Interstate Highways
- Air transport created ubiquitous accessibility and allowed the creation of new cities in locations that formerly were not accessible

1.13

The advances in transportation technology and service can be measured by the improvements in travel time between cities. Consider a trip of 450 kilometers between two city pairs. Contrast the travel time by stagecoach, waterways, rail, automobile, and air. Since these data are provided in the text, do a similar analysis for a 750 kilometers journey between two cities in your state.

For a 450 kilometers journey and a given city pair the values are

- Stagecoach: Twelve days
- Boat: Seven days
- Rail: Eight hours
- Automobile: Five hours
- Air: One hour

(Students to do a similar analysis for a given city pair in their state)

1.14

Define the four professional areas in transportation where employment opportunities exist: business logistics, vehicle design and manufacture, service sector, and infrastructure engineering.

- Business logistics: Deals with the management aspects of freight transportation and deals with the movement and storage of goods between the primary source of raw materials and the location of the finished product.
- Vehicle design and manufacture: Involves mechanical, electrical, systems and computer engineers, trained mechanics and production workers to design, build and maintain autos, trucks, locomotives, buses, rail transit, aircraft, ships and pipelines.
- Service industries: Furnish the ancillary support required to operate and maintain transportation systems.
- Transportation infrastructure industry is a major source of employment for professionals and deals with all aspects of infrastructure development including engineering, economics, law, ecology, archeology, and urban planning

1.15

Define transportation infrastructure engineering. Describe the five elements of this professional field.

Transportation engineering is the profession with responsibility for the planning, design, construction, operation, and maintenance of transportation infrastructure. The field includes highways, airports, runways, railroad stations and track, bridges and waterways, drainage facilities, ports and harbors, and rail or bus transit systems. The five elements are as follows.

- Transportation planning, which involves the process of developing plans and programs that improve present travel conditions.
- Transportation design, which involves the specification of features that comprise the transportation facility such that it will function efficiently and in accord with appropriate criteria and mathematical relationships.
- Transportation construction, which involves all aspects of the building process. Typically a construction firm is selected because of its experience, availability of skilled construction workers, and a competitive low bid.
- Transportation operations and management, which involves the control of vehicles in real time to ensure that they are traveling in paths that are secure from interference with other vehicles or pedestrians in the same traffic stream and operation of the infrastructure to maximize safety and efficiency.
- Transportation infrastructure maintenance, which involves the process of assuring that the nation's transportation system remains in excellent working condition.

1.16

Describe the contribution that each of the following individuals made that improved transportation in the U.S.: Dwight Eisenhower, Henry Ford, Robert Fulton, Albert Gallatin, Charles Lindbergh, Frank Sprague, Harley Staggers, James Watt, Frank Whittle Wilbur, and Orville Wright.

- Dwight Eisenhower signed the legislation authorizing the National System of Interstate and Defense Highways in 1956.
- Henry Ford developed a process to mass-produce automobiles that could be purchased at a price most Americans could afford.
- Robert Fulton demonstrated the commercial feasibility of steamboat travel.
- Albert Gallatin, who served under President Thomas Jefferson, prepared a report to Congress on the national need for transportation facilities.
- Charles Lindbergh was the first to fly from New York to Paris in 33.5 hours, a distance of more than 5750 km.
- Frank Sprague formed the Sprague Electric Railway and Motor Company and in 1888 electrified a 19-kilometer horse car line in Richmond, Virginia.
- Harley Staggers introduced the Staggers Act of 1980 that deregulated railroads and other transportation modes.
- James Watt patented a revolutionary steam engine design.
- Frank Whittle developed the first jet engine in 1938.
- Wilbur and Orville Wright, on December 17, 1903, demonstrated that a self-propelled heavier-than-air machine could be made to fly.

1.17

What were the dominant transportation modes in the 19th and 20th century? What do you think will be the dominant mode in the 21st century?

19th century

- In the 19th century, early roads were primitive and unpaved. Travel was by horseback or in animal-drawn vehicles.
- Waterway transportation developed with the introduction of steamboat travel in the U.S. in 1807.
- Canals were a dominant mode during the period 1800-1850 when approximately 6500 km of canal were built to connect waterways in the northeastern U.S.

Early 20th century

- Railroad transportation slowly emerged as a new mode during the same period that canals were being built. By the start of the 20th century railroads had become the dominant transportation mode for both passengers and freight with a vast network of rail lines that reached its peak of 418,000 km by 1915.
- The streetcar proved to be popular and reached a peak of 17.2 billion passengers annually by 1926. Cities everywhere built trolley lines, and by 1916, there were 72,500 km in operation.
- By the beginning of the 20th century, rapid transit lines were being constructed in large U.S. cities such as New York, Chicago, Philadelphia, Cleveland, and Boston.
- The bus gradually replaced streetcars as ridership steadily declined in the 1920s. By 1922 buses carried only about 400 million passengers/year compared with 13.5 billion annual streetcar passengers but by 1929 bus riders had increased dramatically to 2.6 billion passengers annually.

Mid 20th century

- Air transportation is considered to date from the historic flight of the Wright Brothers on December 17, 1903. This event heralded the beginning of a new age in air travel recognized for its military significance and as a carrier of domestic and international passengers.
- The invention of the automobile and the development of mass production techniques created a transportation revolution in the United States during the 20th century and a challenge to harness intelligent technologies into the 21st century.

1.18

When was containerization introduced? How did this development alter the movement of freight worldwide?

Containerization was introduced in 1956 when Malcom McLean modified a tanker vessel to enable the transport of 58 containers. This innovation motivated the railroad industry to become one of the principal modes for the movement of freight. With the growth in container traffic and the construction of large container ports such as Long Beach-Los Angeles, California, railroads have become a vital link for international freight transport

by moving goods between seaports and land destinations or as a land bridge serving to link the east and west coasts.

1.19

In which U.S. cities can you ride on a rail rapid transit system? Which of these systems were constructed in the second half of the 20th century?

Cities with rail-rapid transit systems constructed in the first half of the 20th century

- New York
- Chicago
- Philadelphia
- Cleveland
- Boston

Cities with rail-rapid transit constructed in the second half of the 20th century

- San Francisco
- Washington, D.C.
- Baltimore
- Miami
- Atlanta

1.20

What is meant by 'level-of-service' and how does this concept influence the likelihood of new modes being developed in the future?

The term *level of service* is used to define the user perception of transportation attributes. The traveler or shipper compares the relative level of service offered by each mode with the trip cost and makes tradeoffs among attributes in selecting a mode.