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Chapter 1
The Profession of Transportation

1-1
To illustrate the importance of transportation in our national life, identify a transportation-related article that appears in a local or national newspaper. Discuss the issue involved and explain why the article is newsworthy.

The fire in a rail tunnel under several blocks of Howard Street in Baltimore, on July 18, 2001, illustrates the impact of transportation on society. A 60-car train derailed inside the tunnel; hazardous materials including hydrochloric acid ignited, causing the fire that disrupted not only rail service but also power supply to much of Baltimore. Additionally, the street above the tunnel buckled in several places due to the intense heat below.

The article from the July 23, 2001 edition of the Washington Post, entitled "NTSB Wonders If Flooding Caused Baltimore Train Wreck," indicates that a break in a water main that runs adjacent to the tunnel may have caused the train derailment. The National Transportation Safety Board, in its investigation of the derailment, is examining city records to determine when the break occurred and whether the water main break caused the derailment, or if heat from the fire after the derailment caused the break. The impact of a failure in the aging infrastructure of two modes of transportation (rail and pipeline) demonstrates the role that transportation can play in daily life.

1-2
Arrange an interview with a transportation professional in your city or state (that is, someone working for a consulting firm, city, county or state transportation department, transit or rail agency). Inquire about the job he or she performs, why he or she entered the profession and what he or she sees as the future challenges in the field.

Background: Bachelor of Science degree in Civil Engineering. During undergraduate study, worked part-time for the Traffic Engineering Division of the Department of Public Works. Earned a Master of Science in Civil Engineering degree with a major in transportation. Currently employed by a consulting firm, conducting research in multimodal and intermodal transportation systems. Envisions the transportation industry becoming cohesive in that modes will connect with one another at strategic points to allow for the seamless transfer of people and goods.

Note: This is a brief transcript of an interview with a transportation professional.

1-3

Keep a diary of all trips you make for a period of three to five days. Record the purpose of the trip, how you traveled, the approximate distance traveled and the trip time. What conclusions can you draw from the data?

The table shown on the next page provides a list of all trips made by a student during a five-day period. The following conclusions can be reached about the student's travel behavior.

- 24 trips were made (an average a 5.4 trips per day)
  - 8 trips by bus
  - 9 trips by car
  - 7 trips by walking

- 248 minutes were spent traveling (an average of 49.6 minutes per day)
  - 77 minutes of travel by bus (31% of total travel time)
  - 90 minutes of travel by car (36% of total travel time)
  - 81 minutes of travel by walking (33% of total travel time)

- About an equal amount of time was spent riding buses, walking, and driving a car.

Date	Mode	Purpose	Time (minutes)
Friday, Jan. 22	Bus	Home to class	10
	Walk	Class to class	7
	Bus	Class to fraternity house	10
	Walk	Fraternity house to class	15
	Bus	Class to home	10
	Car	Home to store and back	10
	Car	Home to fraternity house and	10
Saturday, Jan 23	Car	Home to store and back	10
	Car	To store, library, and home	20
	Car	To library and back	10
Sunday, Jan 24	Car	To library and back	10
	Car	To sister's place and back	5
Monday, Jan 25	Bus	Home to Class	10
	Walk	Class to Class	7
	Walk	Class halfway home	7
	Bus	Rest of way to fraternity house	7
	Bus	Fraternity house to class	10
	Walk	Class to home	15
Tuesday, Jan 26	Bus	Home to class	10
	Walk	Class to fraternity house	15
	Walk	Fraternity house to class	15
	Bus	Class to home	10
	Car	Home to fraternity house and	10
	Car	Home to gym and back	5
TOTAL			**248**

1-4
Identify one significant transportation event that occurred in your city or state. Discuss the significance of this event.

An important event in transportation in Charlottesville, Virginia occurred in 1970, when the University of Virginia began its own bus service. The significance of this event is that the bus service, in a sense, enlarged the University. That is, students could reside off grounds and still be able to commute to classes. This opened the door to develop student housing projects off grounds. In addition, the University now could add new facilities further from central grounds and still have them accessible to students.

1-5
Describe how transportation influenced the initial settlement and subsequent development of your home city or state.

Norfolk, Virginia was one of the early settlements in this state due to its proximity to water and near the Jamestown Settlement. Its transportation evolution began mainly as water transportation due to its accessibility to the Elizabeth River. Downtown Norfolk grew around the river, which became a harbor for the cities of Norfolk and Portsmouth, Virginia. As Norfolk's population grew, there became a need for more living area and people began to settle further away from the harbor area. As a result of this migration, horse drawn vehicles became the choice mode when people traveled to and from the river. Eventually the mode of transportation that originated Norfolk and Portsmouth, water, became its main industry for employment. The Norfolk Naval Shipyard, located in Portsmouth, is a major employer for the area which services and repairs ships used for the transportation of military goods and service personnel.

1-6
Describe your state's transportation infrastructure. Include both passenger and freight transportation.

Virginia's transportation infrastructure is vast. The highway system, as of 1999, according to data from the Federal Highway Administration, includes 70,325 miles of public roads. Of these 70,325 miles, 57,737 miles are state-maintained, with the remainder maintained by cities, towns, and counties. Virginia's rail network, excluding yards and sidings, totals 3,295 miles. In addition, two of the nation's largest railroads, the CSX Corporation and the Norfolk Southern Corporation, are headquartered within the state. Intercity rail passenger service is provided by AMTRAK, which operates eight trains with scheduled stops in Virginia. Rapid rail transit is provided by Metrorail to commuters in the Virginia suburbs of Washington, D.C. A new component to the

commuter rail network is the Virginia Rail Express (VRE), which operates from Fredericksburg and Manassas to Washington, D.C. Virginia is also served by 13 airports with commercial service to over 600 worldwide destinations. Another 64 airports are licensed for public use, and the majority of these can accommodate multi-engine aircraft. Virginia also has one of the finest natural ports in the world as well as three inland ports. The port of Hampton Roads is served by an ice-free 50-ft. deepwater channel capable of handling large volumes of cargo. Virginia also maintains the Virginia Inland Port, located in Front Royal, which serves the Ohio Valley and beyond.

1-7

What is the total number of miles in your state's highway system? What percent of the highway system is comprised of Interstate highways?

Of Virginia's 57,737 state-maintained miles of highways in 1999, 1,118 miles are Interstate highways, 1.936% of the state-maintained total. With 70,325 miles of public roads, Interstate highways comprise 1.590% of the total public road mileage in Virginia.

Note: These data are available from the Internet site of FHWA's Office of Highway Policy Information at "http://www.fhwa.dot.gov/ohim/ohimstat.html"

1-8

Estimate the number of personal motor vehicles in your city or state. What is the total number of miles driven each year? How much revenue is raised per vehicle per year for each 1 cent/gallon tax? Assume that the average vehicle achieves 25 mpg.

In Virginia, as of 1999, there were 6,083,902 registered motor vehicles. An estimated 80,197,000,000 vehicle-miles were traveled. Assume the average vehicle has a gasoline consumption rate of 25 miles per gallon (mpg). Thus the total amount of gasoline (T_G)consumed in one year is:

T_G = (miles driven/year)/(mpg)
T_G = (80,197,000,000)/25
T_G = 3,207,880,000 gallons

The total revenue (T_R) raised by the 1 cent/gallon tax would be:

T_R = ($0.01/gallon) * T_G
T_R = 0.01 * 3,207,880,000
T_R = $32,078,800

1-9

How many railroad trains pass through your city each week? What percentage of these are passenger trains?

In Charlottesville, Virginia, an average of 63 freight trains pass through the city weekly (14 of these stop while 49 pass through). 20 Amtrak trains pass through weekly.

Percentage passenger trains = (20/(20+63))*100 = 24%

1-10

Review the classified section of the telephone directory and identify ten different jobs or industries that are related to transportation.

1. Airlines
2. Automobile-Dealers
3. Government - Department of Motor Vehicles
   Department of Transportation
4. Insurance - Automobile
5. Moving Corporations
6. Paving Contractors
7. Railroads
8. Service Stations
9. Tire - Dealers
10. Travel Agencies

1-11

Estimate the proportion of your monthly budget that is spent on transportation.

CATEGORY	**AVERAGE SPENDING (dollars)**	**PERCENTAGE**
Housing (rent and utilities)	$525	47.5%
Food	$350	31.7%
Clothing	$130	11.8%
Transportation (gas, parking, bus, repairs, etc...)	$100	9.0%
TOTAL	**$1105**	**100%**

Approximately 9 percent of the monthly budget is dedicated to transportation.

1-12
Identify an ITS project or application that is underway in your home state. Describe the project, its purpose, and the way it is operated.

The Virginia Department of Transportation is implementing a traffic management system in the Richmond region. This system includes the installation on Interstates 64, 95, and 295, of permanent changeable message signs installed prior to major interchanges, video detection equipment at critical congestion locations, and highway advisory radio throughout the region. This system is intended to monitor traffic and ultimately ease congestion associated with major reconstruction projects on the region's Interstate highways. The Richmond Smart Traffic Center is located adjacent to an interchange on Interstate 95 and houses the control and communications systems for the traffic management system.

1-13
Most Departments of Transportation incorporate at least five major transportation engineering subspecialties within their organization. List and briefly indicate at least three tasks falling under each specialty.

Most state departments of transportation have at least five major transportation engineering sub-classes. Five of these subspecialties in the Virginia Department of Transportation are the *planning* division, *location and design* division, *maintenance* division, *traffic engineering* division, and a *construction* division. The *planning division* is primarily concerned developing long-range transportation plans. This is accomplished by first defining transportation needs, gathering and analyzing data, and then evaluating alternatives.

The *location and design division* is primarily concerned with designing the transportation system. Usually with the design of highways, this division is responsible for the selection of dimensions for all geometric features, which include the longitudinal profiles, vertical curves and elevations, and the right-of-way.

The *maintenance division* is responsible for maintaining the transportation system to ensure it is in proper working order. This includes repairing damaged roadway sections and the scheduling of maintenance operations.

The *traffic engineering division* is responsible for the integration of the vehicles, drivers, and pedestrians into the transportation system in a manner that improves the safety and capacity of streets and highways. This includes analyzing traffic accidents, design of parking areas, and the design of roadway traffic signing plans.

The *construction division* is another subspecialty. This division is responsible for the building of the facilities designed by the location and design division. The primary tasks of this division include the development of contracts for highway construction, inspection of highway construction projects as performed by contractors, and publishing of manuals such as road and bridge specifications.

1-14
List four major detrimental effects that are directly related to the construction and use of our highway transportation system.

There are many benefits that have come from the highway system; however, these benefits have not come without significant costs. The most obvious cost is that of safety, highway accidents claim approximately 40,000 lives each year. The transportation system also creates air, water, and even noise pollution. It also spoils and changes forever the natural beauty of an area, and consumes vast quantities of precious energy resources.

1-15
Cite four statistics that demonstrate the importance of transportation in the United States.

The following statistics illustrate the importance of the transportation sector in the U.S. (data are as of 1997).

- 16.3 % of the United States' Gross National Product (GNP) is accounted for expenses related to transportation.
- Approximately 11% of the U.S. workforce is employed by transportation industries.
- Of all the petroleum used in the U.S., almost 70% is for transportation.
- Expenditures on transportation totaled $1.32 trillion.

1-16
A state has a population of 17 million people and an average ownership of 1.5 cars per person, each driven an average of 10,000 mi/year, at 20 mi/gal of gasoline (mpg). Officials estimate that an additional $75 million per year in revenue will be required to improve the state's highway system, and they have proposed an increase in the gasoline tax to meet this need. Determine the required tax in cents per gallon.

First, determine the number of vehicles in the state.
17,000,000 people * 1.5 cars/person = 25,500,000 vehicles in this state.
Next, determine the number of miles driven each year.
25,500,000 cars * 10,000 miles/year/car = $2.55 * 10^{11}$ miles driven per year
Now determine the number of gallons consumed each year.

$(2.55 * 10^{11}$ miles/year)/20 mpg = 12,750,000,000 gallons/year

Finally, determine the required tax increase.
$(1.275 * 10^{10}$ gallons / year) * TAXINCREASE = $75,000,000 / year
TAXINCREASE = $0.00588/gallon
TAXINCREASE = 0.588 cents per gallon

Therefore, impose a 0.6 cents per gallon tax to raise the required revenue.

1-17

Select a single event in Table 1-1 and explain why this is a significant achievement in the history of transportation.

In my opinion, the completion of the first transcontinental railroad in 1869 was the most significant transportation event in U.S. history. This is because the completion of the railroad meant that goods and people could now be transported with relative ease to the western part of the country. This also meant that the development of the west would become more intense. The completion of the railroad spawned the development of the remainder of the U.S., which facilitated trade on both coasts.

1-18

Name and describe the first successful turnpike effort in the newly independent United States of America.

The Philadelphia and Lancaster Turnpike Road Company was chartered by Pennsylvania in 1791 to build road between the two cities. This serves as an early example of a profitable toll road and a roadway with specified design standards.

1-19

What mode of transportation was the primary contributor to the demise of road construction in the U.S. in the early 19th century, and what advantages did the new mode offer?

Canals became popular in the early 19th century through large projects such as the Erie Canal and several smaller efforts. Recent improvements in waterway transportation, such as the successful demonstration of the steamboat in 1807, generated interest in use waterways. Waterways provided advantages over the roadways in their level profiles and relative ease of effort in moving freight when compared with roadways.

1-20

What mode of transportation succeeded the mode noted in Problem 1-19, and what advantages did it offer?

Canals were succeeded by railways as the primary mode of long-distance travel. Railroads first appeared in the U.S. around 1830. By 1840, the mileage of railways was approximately equal that of canals. Railroads continued flourish while investment in canals declined. Locations for railroads were not confined to watercourses and therefore could be built almost anywhere.

1-21

The expectations the public has for the transportation system continue to increase. What is the principal challenge faced by the transportation engineer in meeting these expectations? What fields of knowledge beyond traditional transportation engineering are needed?

The public increasingly expects an efficient, effective, long-lasting, and safe transportation system. This challenge requires a knowledge base beyond traditional transportation engineering, including an understanding of human factors, system performance, and technological advances.

