Introduction to Transportation Systems

PART I:

CONTEXT, CONCEPTS AND CHARACTERIZATION

Chapter 4:

The Customer and Level-of-Service

The Customer

- ◆ The customers of the transportation system, be it the air passenger or the coal executive who is deciding which railroad to use to service his transportation needs, is fundamental to the transportation enterprise.

- ◆ Thinking about what is important to the customer, from the perspective of what services transportation organizations provide, is fundamental.

The Customer

- ◆ Hamel and Prahalad, in "Competing for the Future", define the market opportunity as fundamental to the transportation enterprise.
- ◆ Drucker talks about *all* results being *external* to the organization, and the purpose of the business being the creation of customers.

Two Kinds of Transportation Customers

- ◆ Freight Transportation Customers
- ◆ Traveler Transportation Customers

Supply Chain Management

The transportation provider -- the railroad, for example -- becomes an integral part of the customer's logistics system, providing reliable delivery and pick-up of goods as they progress through the supply chain.

Different Kinds of Freight Requiring Different Levels-of-Service

◆ High-value manufactured goods

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◆ Bulk commodities (e.g., coal, agricultural products)

Level-of-Service Variables for Freight

- ✦ PRICE

- ✦ TRAVEL TIME

- ✦ SERVICE RELIABILITY

- ✦ AVAILABILITY OF SPECIALIZED EQUIPMENT

- ✦ PROBABILITY OF LOSS AND DAMAGE
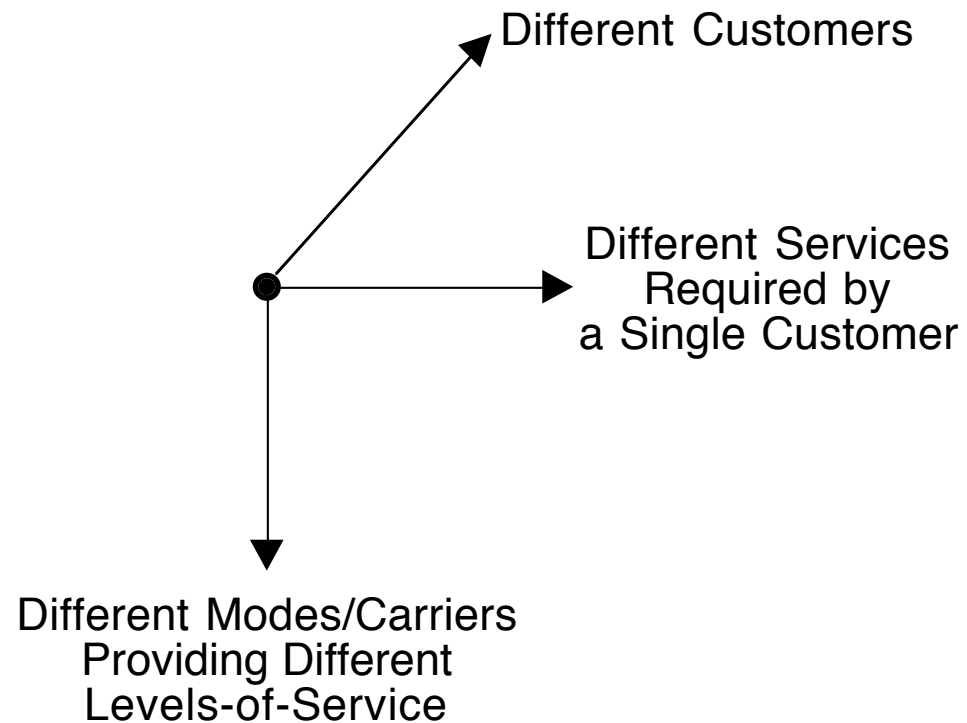
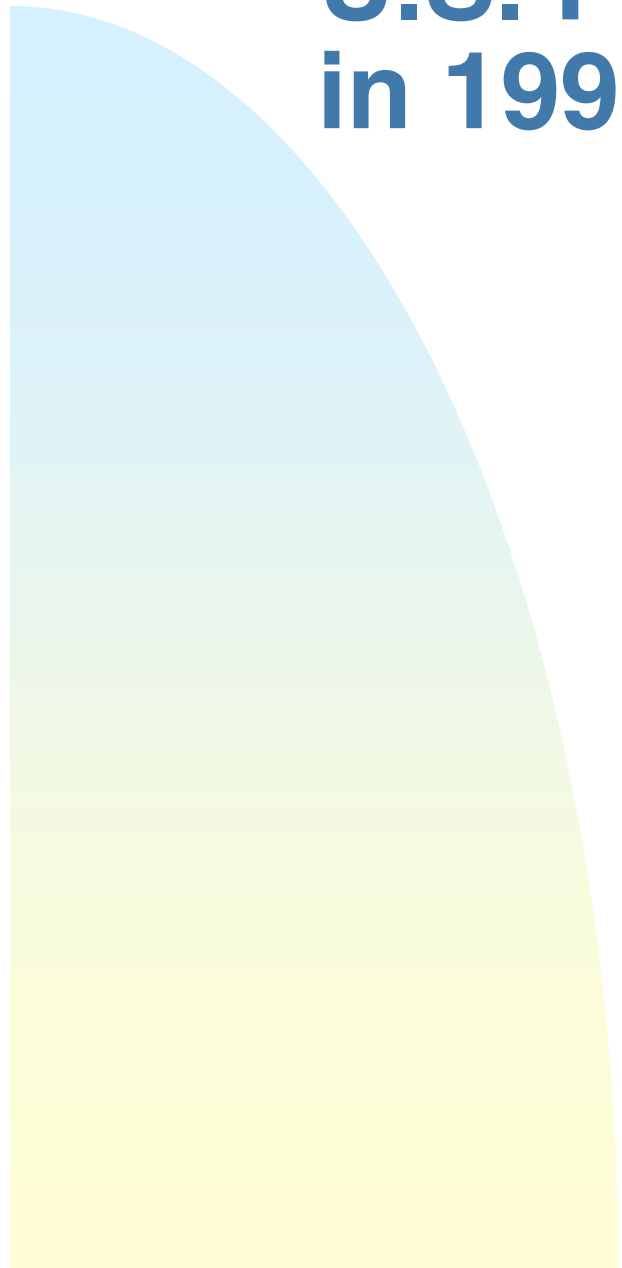Figure 4.1

Modes, Services and Customers

Different Customers

Different Services
Required by
a Single Customer

Different Modes/Carriers
Providing Different
Levels-of-Service

Figure 4.2

U.S. Freight Transportation in 1993

MODE	% of TON-MILES
RAILROAD	34.8
TRUCK	24.5
WATER	21.9
PIPELINE	18.5
AIR	0.3

But this may differ substantially from country to country.

Figure 4.3

Traveler Transportation Customers

- ◆ Urban traveler transportation
- ◆ Intercity traveler transportation
- ◆ International transportation

Trip Purposes

◆ School

◆ Job

◆ Social Activities

◆ Medical needs

Modes

◆ Automobile/Highway

◆ Bus/Highway

◆ Railroads

◆ Air

◆ Ships/Ferries

Level-of-Service Variables for Travelers

- ◆ Price
- ◆ Travel Time
- ◆ Service Frequency
- ◆ Comfort
- ◆ Reliability

Figure 4.4

Customer Choice

Customers (freight or traveler) have choices of modes.

They make these choices based on the level-of-service provided by competitors.

Level-of-service (LOS) is a complex, multidimensional concept. The transportation provider needs to understand LOS, as his/her customer perceives it.

Level-of-Service as Dynamic

The level-of-service provided by the carrier will change as a function of the volume being carried by that carrier.

But, do customers drive service decisions? We would hope so, but not always.

An old joke: "We would be better able to keep our buses on schedule if we didn't have to stop for passengers."

- Federal Express determined that people put a high value on information about their shipment.
- People want to buy the reliability and the travel time, but they also want to buy information.
- Knowing when their parcel is going to get there and knowing if it has gone astray is valuable information to the customer. (It's also valuable to Federal Express!)

Reducing Multi-Dimensional Level-of-Service to a Uni-Dimensional Variable

	variables	units
TRAVEL TIME	t_t	MINUTES
ACCESS TIME	t_a	MINUTES
WAITING TIME	t_w	MINUTES
FARE	F	$
"COMFORT"	H	"HUGS"

Figure 4.5

Utility

Let's define a variable "V", which is the "utility" of a traveler choice in "utils":

$$V = a_0 + a_1 t_t + a_2 t_a + a_3 t_w + a_4 F + a_5 H$$

Now, if high utility is superior, what is the sign of a_1, a_2, a_3, a_4 and a_5? Is each one positive or negative?

Mode Choice

Suppose we have three possible modes of travel from Boston to New York -- air, train, auto -- and you could measure each of the level-of-service variables for each mode. We could compute the utility of each mode,

$$V_{air}, \quad V_{train}, \quad V_{auto}$$

and you could assume that the mode with the highest utility is the one you would choose.

Mode Choice

However, much modern literature in utility theory uses a probabilistic approach. For example, the probability a traveler selects the air mode is as follows:

$$P(air) = \frac{V_{air}}{V_{air} + V_{train} + V_{auto}}$$

or perhaps:

$$P(air) = \frac{e^{V_{air}}}{e^{V_{air}} + e^{V_{train}} + e^{V_{auto}}}$$

Mode Choice

This probabilistic approach is intended to reflect the fact that: 1) people have different utilities, and 2) perhaps we have not captured all the level-of-service variables in our formulation.

If we know the overall size of the market, we can approximate the mode volumes by multiplying market size by the probability a particular mode is selected.

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Travel Time Reliability

This depends on the *variability* in travel time between origin and destination.
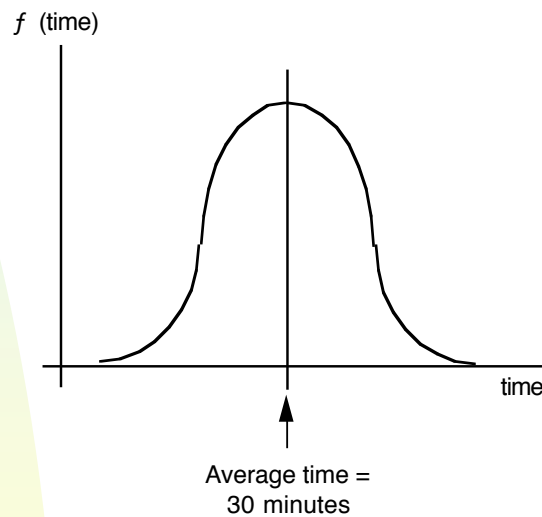
Tunnel Route

f (time)

time

Average time =
30 minutes

Figure 4.6

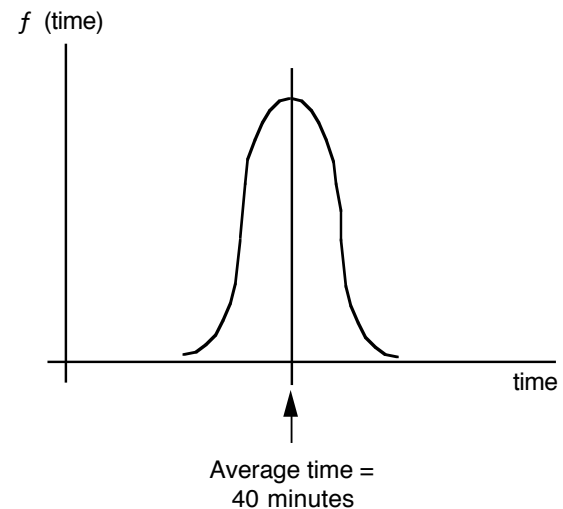Charlestown Route

f (time)

time

Average time =
40 minutes

Figure 4.7

- Now, comparing these two distributions, the average travel time going through the tunnel is lower than the average travel time avoiding the tunnel. If we were making the decision based on average travel time, we would pick the tunnel route.

- But if we had a plane to catch we might say, "If I am virtually assured of getting to that plane by taking the higher average but lower variation route, that is what I'm going to do."

- So, I chose the more "reliable" -- lower variation route -- higher average travel time route, because it virtually assures me making my air connection.

Reliability

We will call variability in travel time *service reliability*. In particular systems, service reliability in travel time can be as important as average travel time. Railroad and truck systems for moving freight differ both on a reliability dimension and on an average travel time dimension.