

# Introduction to Transportation Systems

---

**PART I:**

**CONTEXT,  
CONCEPTS AND  
CHARACTERIZATION**

# **Chapter 6:**

## **Transportation Systems: Key Points 1-10**

# The Elevator Example

- ◆ Elevators are simple compared to some of the more complex transportation systems, but they can be instructive and illustrative.
- ◆ With this simple example we can gain insight into overall system behavior that we can apply to more complex systems.

# Elevator System

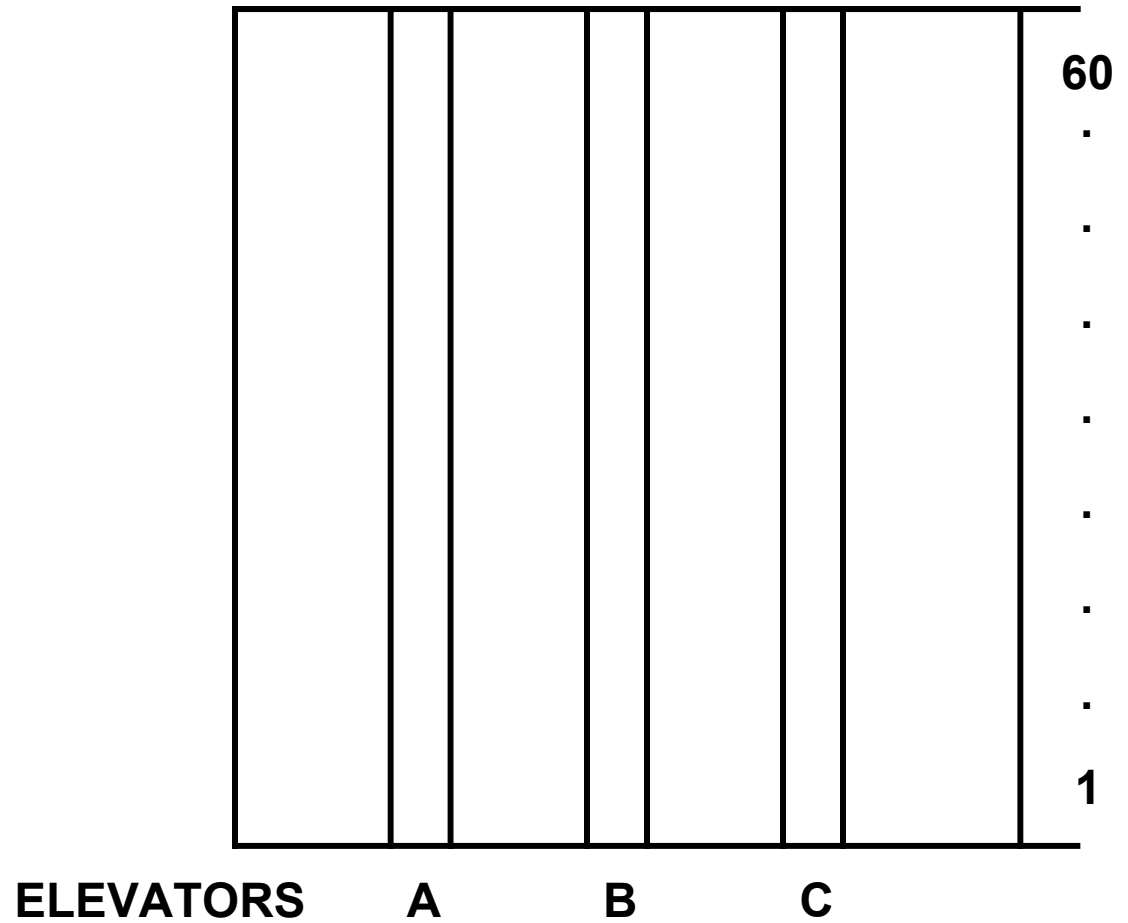


Figure 6.1

# Key Points

We argue the following key points are relevant and fundamental to understanding transportation systems.

# Key Point 1: Behavior

People and organizations alter behavior based on transportation service expectations.

# Key Point 2: Transportation as Part of a Broader System

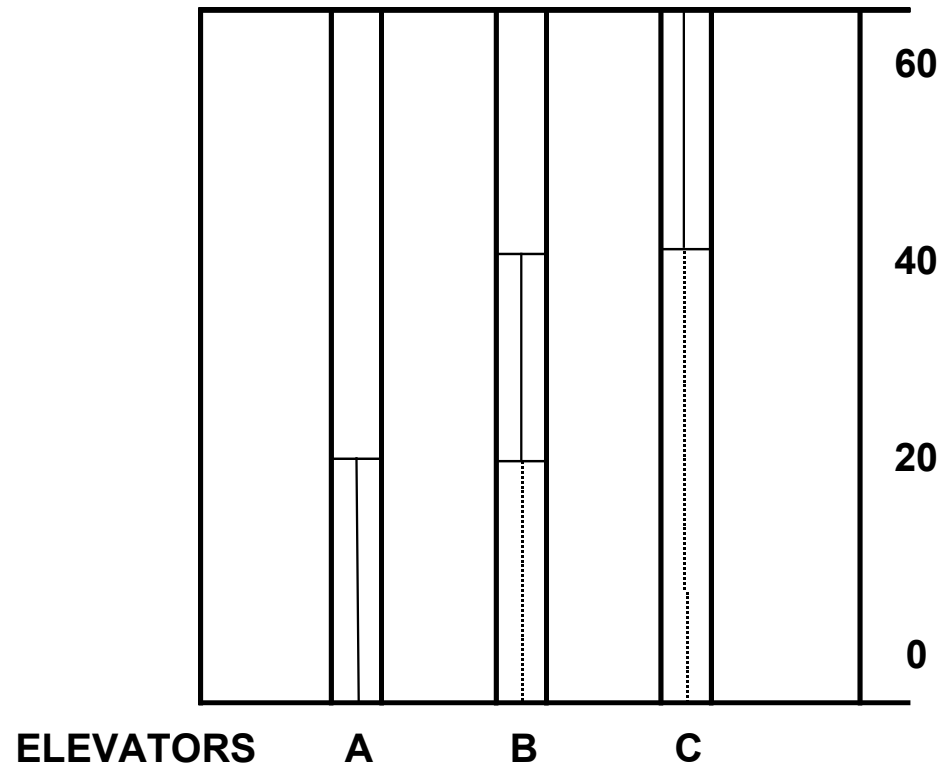
Transportation service is part of a broader system -- economic, social and political in nature.



# Key Point 3: Competition

Competition (or its absence) for customers by operators is a critical determinant of the availability of quality transportation service.

# Elevators with “Banks”



**Concept: Redundant Paths**

Figure 6.2

# Key Point 4: The Vehicle Cycle

Analyzing the flow of vehicles on transportation networks, and defining and measuring their cycle, is a basic element of transportation systems analysis.

- ◆ All vehicles, be they elevators, freight cars, airplanes, buses or ships are a fundamental, and often expensive, part of a transportation system.
- ◆ Keeping that *asset productive* is key to success.

# Key Point 5: Queuing and Storage

Queuing for service and for customers and storage for vehicles/freight/travelers, etc., are fundamental elements of transportation systems.

# Key Point 6: Transfers

Intermodal and intramodal transfers are key determinants of service quality and cost.

Transfers between elements of the transportation system are often inefficient. In the elevator example, a transfer from the walk-mode as one comes into the building, to the elevator-mode, implies some waiting and, hence, some inefficiency.

# Key Point 7: Operating Policy

Operating policy affects level-of-service.

## CLASS DISCUSSION

Example of Operating Policy for the Elevator System?

# Key Point 8: Capacity

“Capacity” is a complex, multi-dimensional system characteristic affected by:

- ➡ infrastructure
- ➡ vehicles
- ➡ technology
- ➡ labor
- ➡ institutional factors
- ➡ operating policy
- ➡ external factors (e.g., “clean air”, safety, regulation)



# Key Point 8: Capacity (continued)

In the elevator example,

- ◆ We could increase the number of elevators.
- ◆ We can also change vehicle technology. For example, we could have larger or faster elevators.
- ◆ We could have capacity improvements as a result of control technologies and smarter algorithms for dispatching.

# Key Point 9: Supply

Level-of-service =  $f$  (volume);  
*Transportation Supply*. As volume approaches capacity, level-of-service deteriorates dramatically -- the “hockey stick” phenomenon.

## LOS vs. Volume: The Hockey Stick

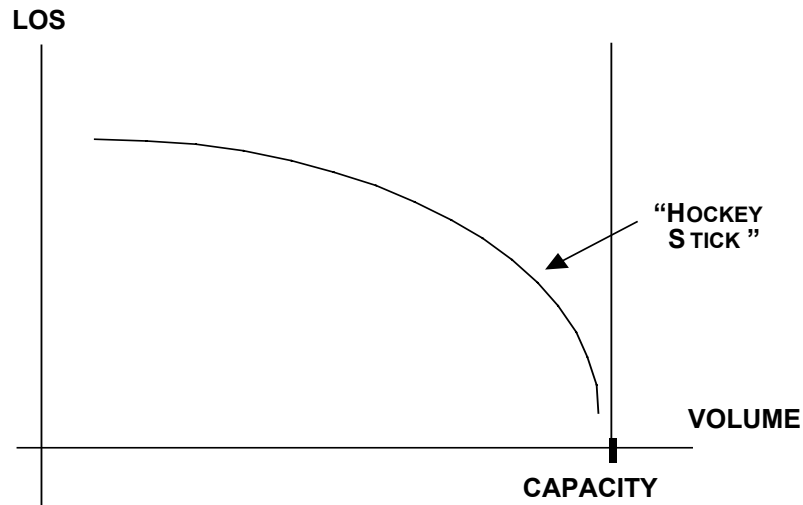


Figure 6.3

# Key Point 10: Availability of Information

The availability of *information* (or the lack) drives system operations and investment and customer choices.

The idea is, that with more information, the elevator system could be run more efficiently and effectively.

# Key Point 10: Availability of Information (continued)

The field of intelligent transportation systems (ITS) is based upon having real-time information about vehicles on highways and making network control and individual routing decisions based on that information.

Can we make effective use of the information?

- ◆ Can we use the information to improve network control strategies and hence performance?
- ◆ Are there algorithms that we can utilize to make the network run more effectively?
- ◆ Can we perform those algorithms in the appropriate time frame -- i.e., real time?