1.221J/11.527J/ESD.201J *Transportation Systems*

Fall 2004

LECTURE 11 (and forward):

TRAVELER TRANSPORTATION

DISPLAYS

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MIT

Traveler Transportation Outline

- Differences between Traveler and Freight Transportation
- A Brief History of Metropolitan Areas
- Some Transportation History
- Automobile Transportation
- Urban Public Transportation
- Intercity Traveler Transportation
  - Air Transportation
  - Rail Transportation
- Mexico City
- Intelligent Transportation Systems (ITS)

Differences between Traveler and Freight Transportation

- The Transportation Process
- Safety and Security
- Level-of-Service Variables
- Groups
- Motivation for Travel
- Travel as Discretionary
- Success in the Marketplace

CLASS DISCUSSION

Substitutability of Communications and Transportation

- Two opposing perspectives:
  - Communications will greatly reduce the need for transportation because of the telecommuting option; people will not have to actually physically be at the office to make a contribution.
  - On the other hand, while telecommuting may occur, the economic interactions that will occur as a result of enhanced communication may generate *more* travel than is saved by the telecommuting option.

Core and Garden Cities
(after Lay)

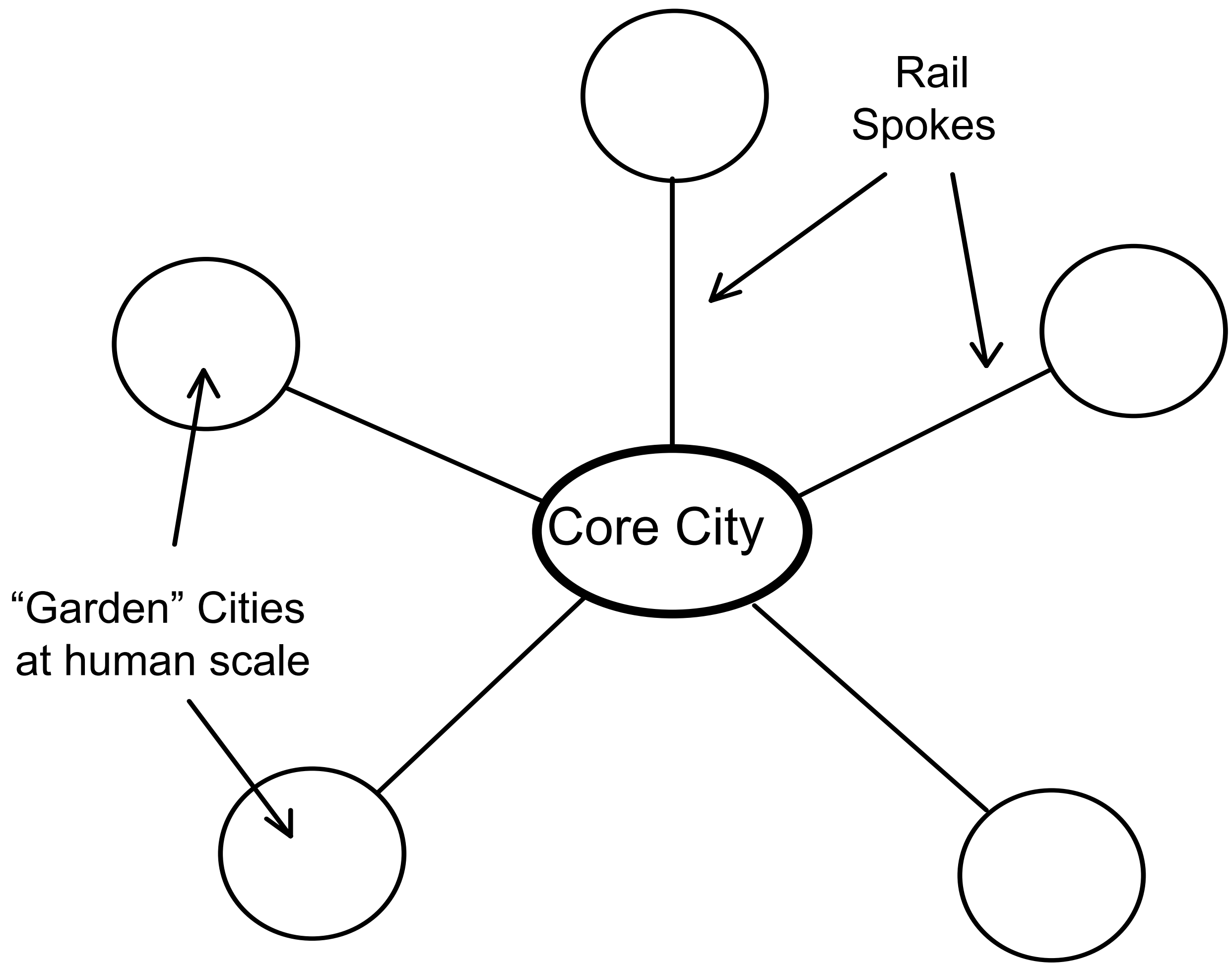


Figure 21.2

The U.S. Model

“Infill” between the “Spokes” (after Lay)

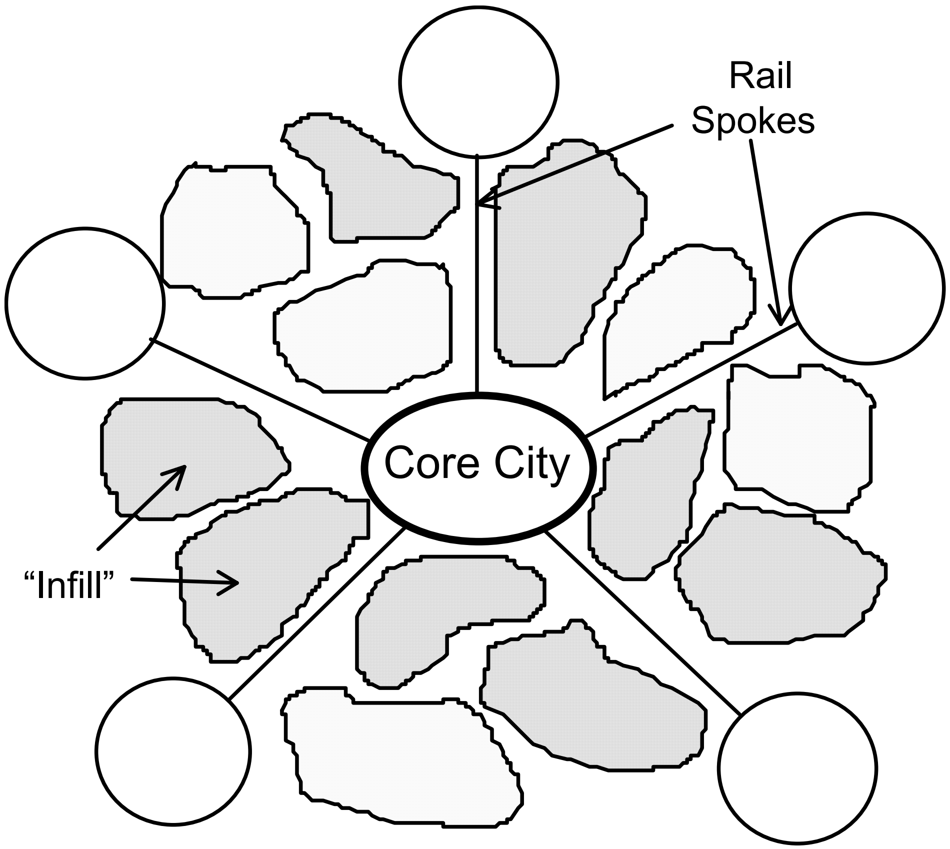


Figure 21.3

Other Urban Questions

- Suburbanization
- Mega-Cities
- Ring-Roads
- “Edge Cities”

Land Use and Public Transportation

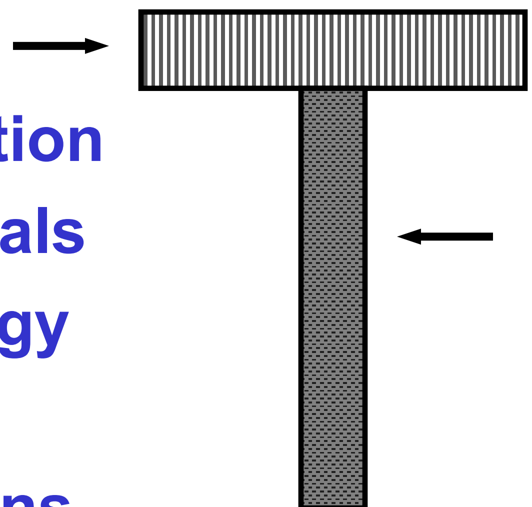
- You cannot separate transportation policy from the way in which land is used: for residences, for shopping, for jobs. Land use and transportation are hand-in-glove.
- Low-density development patterns make providing public transportation services extremely difficult.
- Experts from the fields of *urban policy, real estate development, regional economics, municipal finance, landscape ecology, transportation, urban air quality, public health and civil engineering* are needed.

The T-Shaped "New Transportation Professional"

Breadth in:

Transportation Fundamentals

- **technology**
- **systems**
- **institutions**



In-depth knowledge within a transportation specialty

Sussman, Joseph M., "Educating the 'New Transportation Professional'",
ITS Quarterly, Summer 1995.

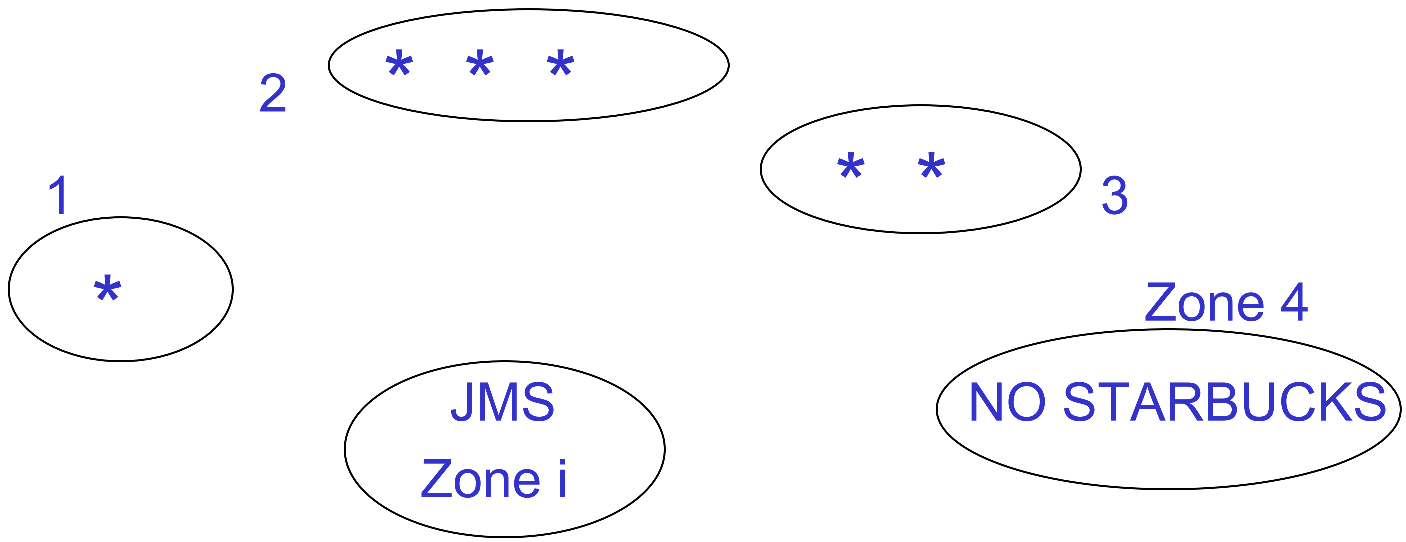
Figure 21.4

MOBILITY VS. ACCESSIBILITY

Mobility – The ability to move people and freight freely

Accessibility – The ability to reach attractive destinations

THE STARBUCKS MODEL



* = Starbucks

How can I improve my accessibility to Starbucks?

- I could move closer to one
- Starbucks could build one near me
- The transportation system could improve

THE STARBUCKS MODEL
(CONTINUED)

Accessibility from Zone i to Starbucks

$$A_i = \sum_{j=1,4} \frac{\text{\# of Starbucks in Zone } j}{t_{ij}}$$

If there is no Starbucks in Zone 4, the mobility between Zone i and Zone 4 is irrelevant. Even if I can get to Zone 4 very fast, it doesn't matter (with respect to that trip purpose).

Some Transportation History

Lay begins with carts, coaches and stage coaches, and the use of horses for transportation.

Lay, Max G., *Ways of the World: A History of the World's Roads and of the Vehicles that Used Them*, Rutgers University Press, New Brunswick, NJ, 1992.

As Lay mentions, the cost of a round-trip from Paddington Station to another station in London in 1800 by horse-drawn vehicle was about 1% of the annual wage of a typical worker, where the comparable trip today would be about .02% of the annual wage of that same worker.

System safety was several orders of magnitude poorer in antiquity than they are now. 40,000 people a year die on U.S. highways. But if one looks at the safety of transportation systems in these more primitive times, they were several orders of magnitude less safe than today.

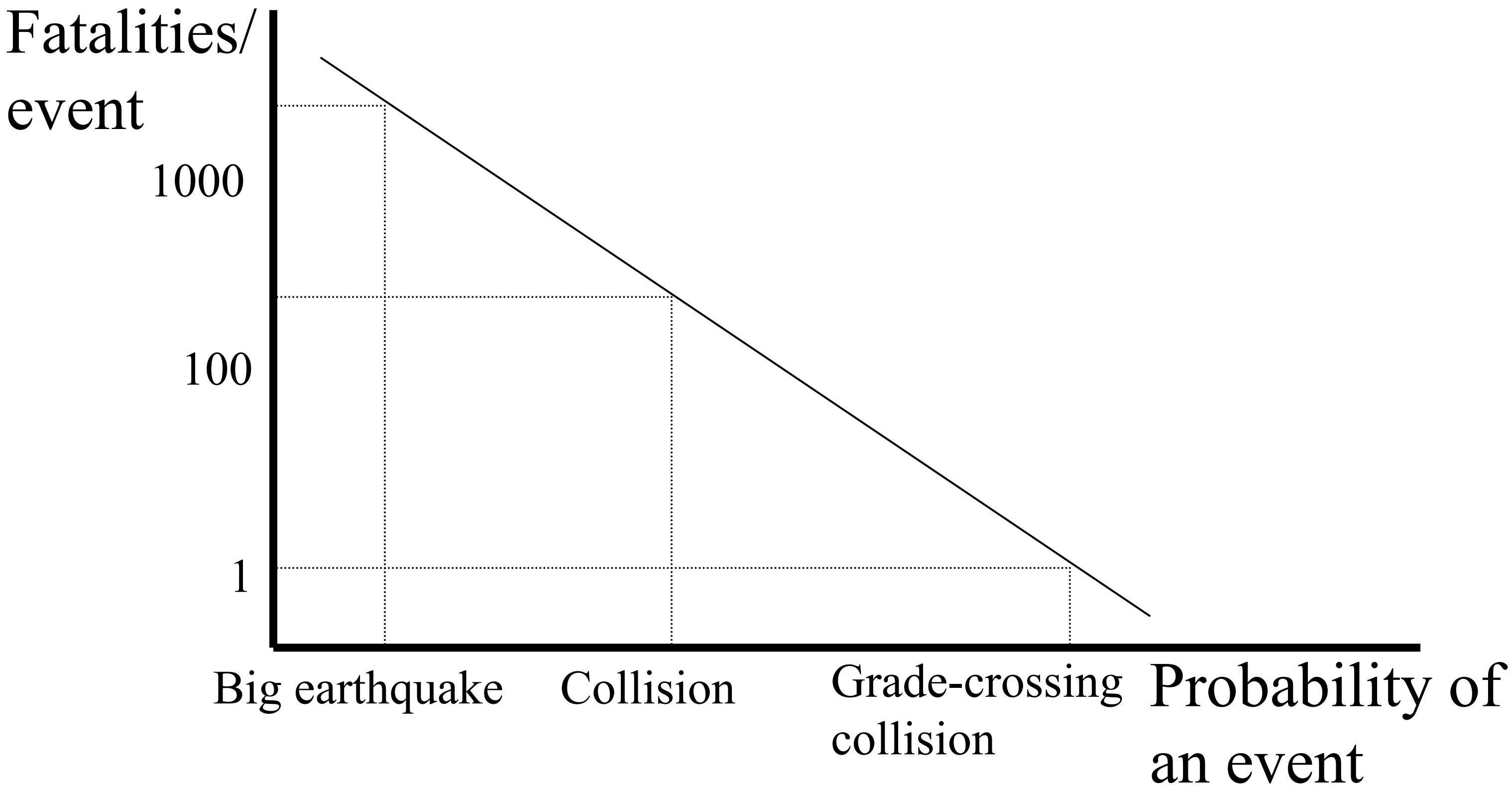
SAFETY OF HIGH SPEED RAIL

STUDY OF JR EAST

- There has never been a fatality on the Japanese HSR system, which began operations in 1964.
- JR East is arguably the safest railroad in the world.
- They want to stay that way!

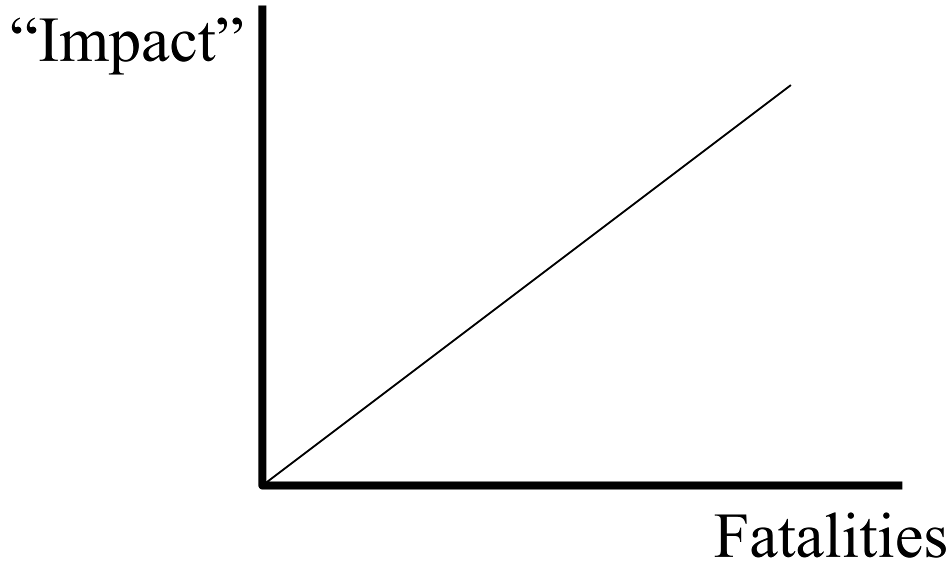
THE QUESTION:

- How best to invest in improving safety?

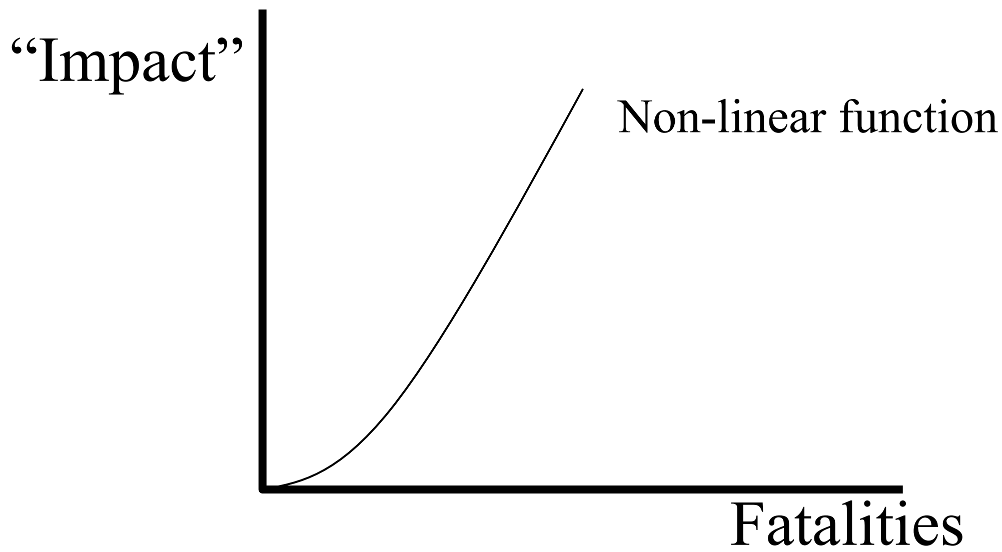


- Average number of fatalities dominated by grade-crossing accidents

HOW TO THINK ABOUT THIS QUESTION



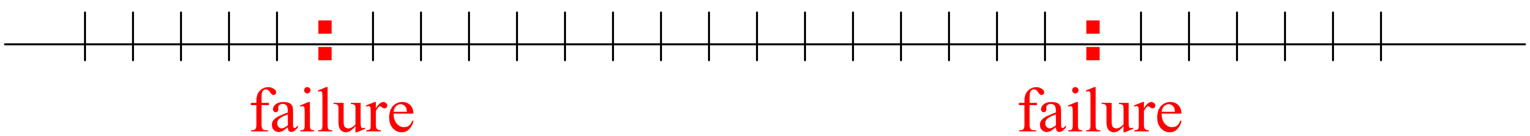
- Double the fatilities→ double the impact



- 1 accident with 10 fatalities is much worse than 10 accidents with 1 fatality each
- 1 accident with 100 fatalities is much, much worse than 100 accidents with 1 fatality each
- 1 accident with 1000 fatalities—off the charts!

INVESTING IN LOWERING FATALITIES DUE TO EARTHQUAKES

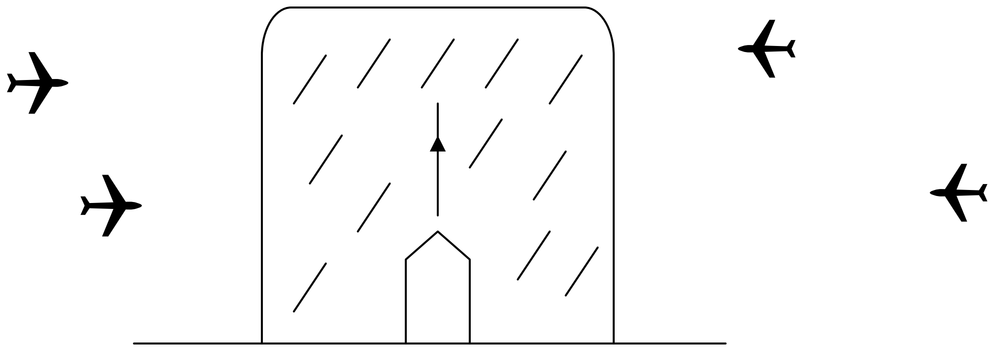
The idea: Infrastructure fails and trains derail



- What can we do?
  - Strengthen infrastructure
  - Better breaking systems
  - Early warning systems (e.g., offshore sensors)
  - Lower speeds
- These strategies have different costs and benefits and interact

Safety vs. Performance

Space and Air Transportation



To avoid collision, there is a Special Use Area (SUA) in SPACE and in TIME

- e.g., 100-mile radius
- ± 3 hours around the launch

- This causes diversions and delays for air transportation.

Safety vs. Performance
(CONTINUED)

- Why is the relationship among radius of SUA and time window and costs to airline industry?
- Why not shoot off the spacecraft and "take our chances"?
- What is the trade-off?
  - LOS and costs for the air industry
  - Safety -- no collisions
- How would you decide on the radius and the time window?
- Is the problem likely to grow in the future? Why?

What Enabled Transportation to Advance?

- Technological Developments
- Automobile Dominance
- The Gas Tax
- Construction Jobs

Environmental Concerns

- Emissions - Air Quality - Clean Air Acts
- Emissions - Global Climate Change
- Land Use - Sprawl
- Fragile Ecosystems (Endangered Species Act)
- Others

Traveler LOS

We first discuss the dominant traveler mode, automobiles, and then generalize to LOS variables for travelers.

Why People Like Cars

- We like the flexibility
- The automobile network is universal
- It often (but not always) is the fastest mode, depending on levels of congestion, time of day and the available alternatives
- Privacy
- Automobiles suggest that you are at a higher level of society
- People simply enjoy the sensation of driving

Land Use Patterns

- Given the way our land-use patterns have developed, particularly in the United States, cars are virtually a necessity. There are areas where taking at least part of your trip without an automobile is virtually impossible.
- Land-use densities are so low that public transportation is not viable. The automobile is fundamental and a necessity of life, not a luxury, depending upon land-use choices that society makes.

A Final Set of Reasons We Love Cars

- It is very often a good transportation buy. It is a good value for your transportation dollar.
- You get this high-quality transportation service which is a good buy, because *somebody else* is paying a lot of the costs for the infrastructure and cleaning up the environment.
- This choice is economically rational. Highway transportation may well be cheap, or at least cheap relative to the level-of-service that is being provided to you, because of the way in which the costs of the highway infrastructure are paid for.

Traveler LOS Considerations

- Average Trip Time
- Reliability of Trip Time
- “Value-of-Time”
- Aggregating Small Time Savings over Many People

Other LOS Variables

- Cost
- Service Frequency
- Waiting Time
- Comfort
- Safety and Security
- “Intangibles”

LOS variables determine mode choice. The importance of LOS will vary among people and by trip purpose.

Modal Options

- Private automobile
- Taxi
- Bus
- Train
- Boat
- Various intermodal combinations
- Bicycle
- Walking

In an urban context one can subdivide auto into single occupancy, carpools, van pools, etc.

For intercity, one adds airlines, train, bus, as well as private auto.

Hierarchical Decision-Making

- Long-Range Choices: employment -- where am I going to work; residence
  -- where am I going to live relative to where I work.
- Medium-Range Choices: automobile ownership and mode choice to work.
- Short-Range Choices: people decide about route choice on a particular day; non-work travel -- judgments about travel to shopping and other ad hoc activities other than the traditional journey to work.

- The fundamental insight is that people do not make a single instantaneous judgment about trip-making and mode choice; rather one has to model transportation demand by thinking hierarchically about how long-, medium- and short-range decisions lead to decisions about individual trips.

URBAN PUBLIC TRANSPORTATION

LOS Variables for Urban Travelers

Let us review our level-of-service variables for travelers.

- Travel time
- Reliability
- Cost
- Waiting time
- Comfort
- Safety
- Security

are all examples of level-of-service variables that are relevant to any traveler transportation mode.

How Public Transportation Measures Up

- Comfort in a crowded rush-hour subway car is not high
- One has to wait for service depending on the service frequency of the mode one is considering
- Travel time may be greater or less than that of an automobile, depending on the circumstances
- How about self-image?

CLASS DISCUSSION

Some Other LOS Variables

- Security
- Availability of service
- Safety
- Accessibility to service

Types of Urban Public Transportation Service

- Conventional Bus
- Para-Transit
- Demand-Responsive Service
- Rail Systems
- Subways
- Commuter Rail
- Intermodal Services

The Vehicle Cycle

The basic equation for sizing a fleet is as follows:

$$NVEH = \frac{VC}{HEADWAY}$$

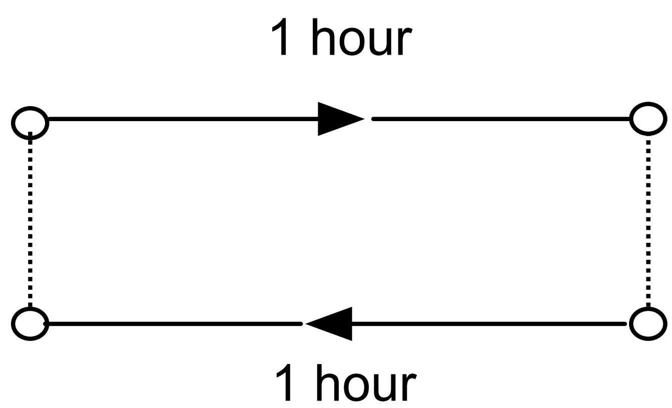
where NVEH is number of vehicles in the fleet; VC is the vehicle cycle on this route -- the time it takes the vehicle to traverse the entire route; and HEADWAY is the scheduled time between consecutive vehicles.

Alternatively,

$$NVEH = FREQUENCY \; VC$$

where *FREQUENCY* is the number of vehicles per unit of time passing a point on the route.

Vehicle Cycle



Suppose we want a service frequency of four vehicles per hour.

- How many vehicles do we need?
- How would you reduce the number of vehicles needed?

CLASS DISCUSSION

Figure 28.8

ITS -- Public Transportation Applications

- The ITS concept, described in Chapter 24, can be applied to public transportation. These applications, known collectively as Advanced Public Transportation Systems (APTS), include such technologies as automatic vehicle location and automatic passenger counters, which can provide the basis for more efficient fleet management systems, both in fixed rail and bus systems.

Traveler Information through ITS

Intermodal Transfers

There are operating strategies that would allow transit systems to operate more effectively. These strategies are *information-driven* and ITS technologies can be a boon to the transit industry both in improving operations and service and in providing timely information to travelers. The latter in and of itself could be an important market initiative for the public transportation industry.

Fares, Ridership and Finance

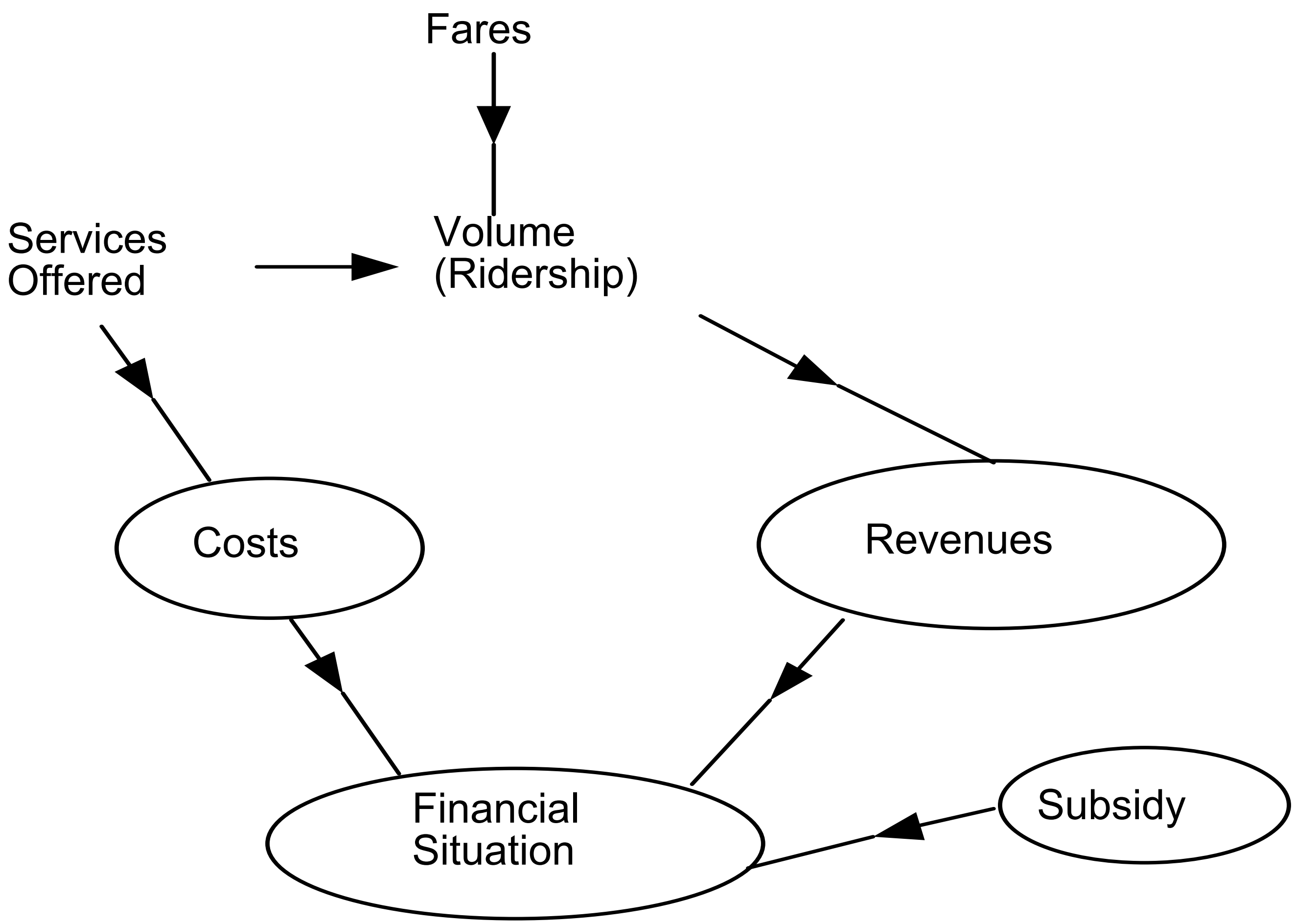
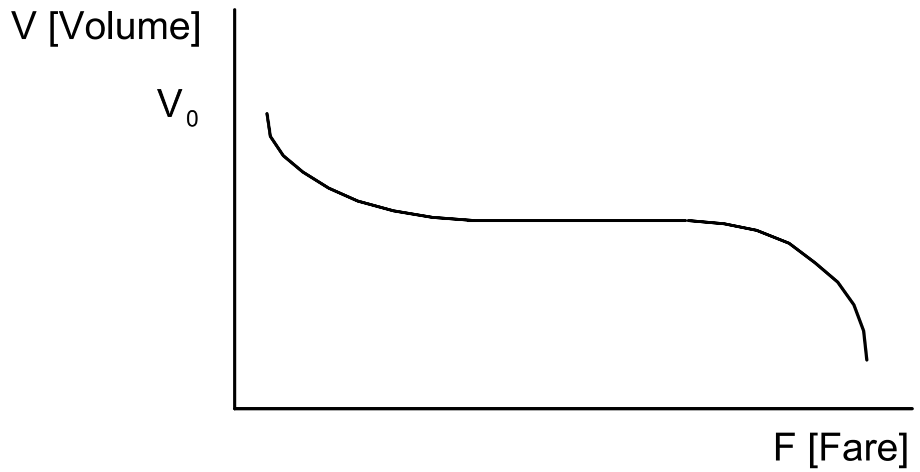


Figure 28.12

“Inelastic” Demand Function



The horizontal line would reflect little or no change in demand (inelastic demand) as a function of fare for some range of fares. So why not simply raise fares and hence revenue?

- Equity
- Air Quality
- Congestion on Highways

Figure 28.15

INTERCITY TRAVELER TRANSPORTATION: AIR

Reasons for Air Industry Financial Problems

- *Competition* is the critical element. There are those that would argue that the industry has more capacity than it needs for the demands it serves.
- Earnings in the airline industry are very sensitive to the ratio of filled seats to total seats. Once a seat flies empty, the revenue from that seat is gone forever. And airlines, recognizing that fact, have gone through some *destructive pricing battles*.
- The airline industry finds it difficult to quickly adjust its fleet size and hence its capacity. The time between ordering new aircraft from the manufacturer and delivery to the airline can be several years.

A Trend: Strategic Alliances

Air Traveler Transportation and the 30 "Key Points"

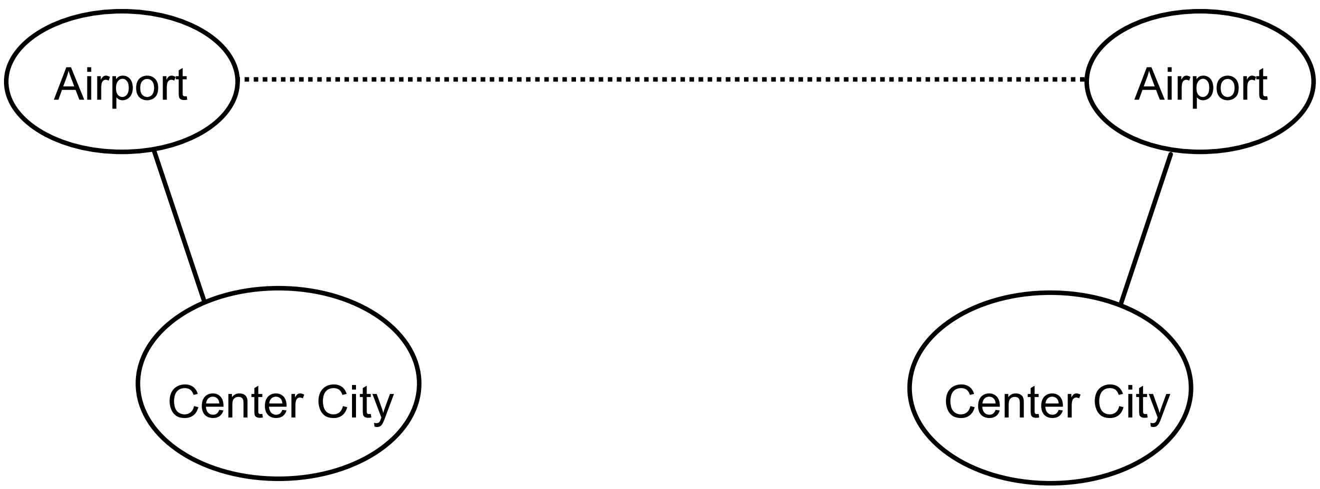
- Stochasticity
- Peaking in Demand
- Selecting Capacity
- Network Behavior

Other Key Points?

Land-Side Issues

- Airport Access

Airport Location



It is door-to-door travel time that matters.

Figure 29.1

Aircraft Technology

- Aircraft Size
- Short Take-Off and Landing Aircraft
- Hypersonic Flight
- The “Space Plane”
- Engine and Materials Technology

Air Transportation as an Example of Subsidies

- Subsidies
  - Between long-distance and short-distance passengers. Cost functions look different for long-distance and short-distance passengers, so there may be cross-subsidies.
  - Between business and non-business travelers. Business travelers require flexibility to make plans on very short notice and change their plans very quickly. The airline industry charges them a premium for this service.
  - Among various origin-destination pairs. Customers on the non-competitive routes subsidize those on competitive routes.

Flows of Funds in Air Transportation

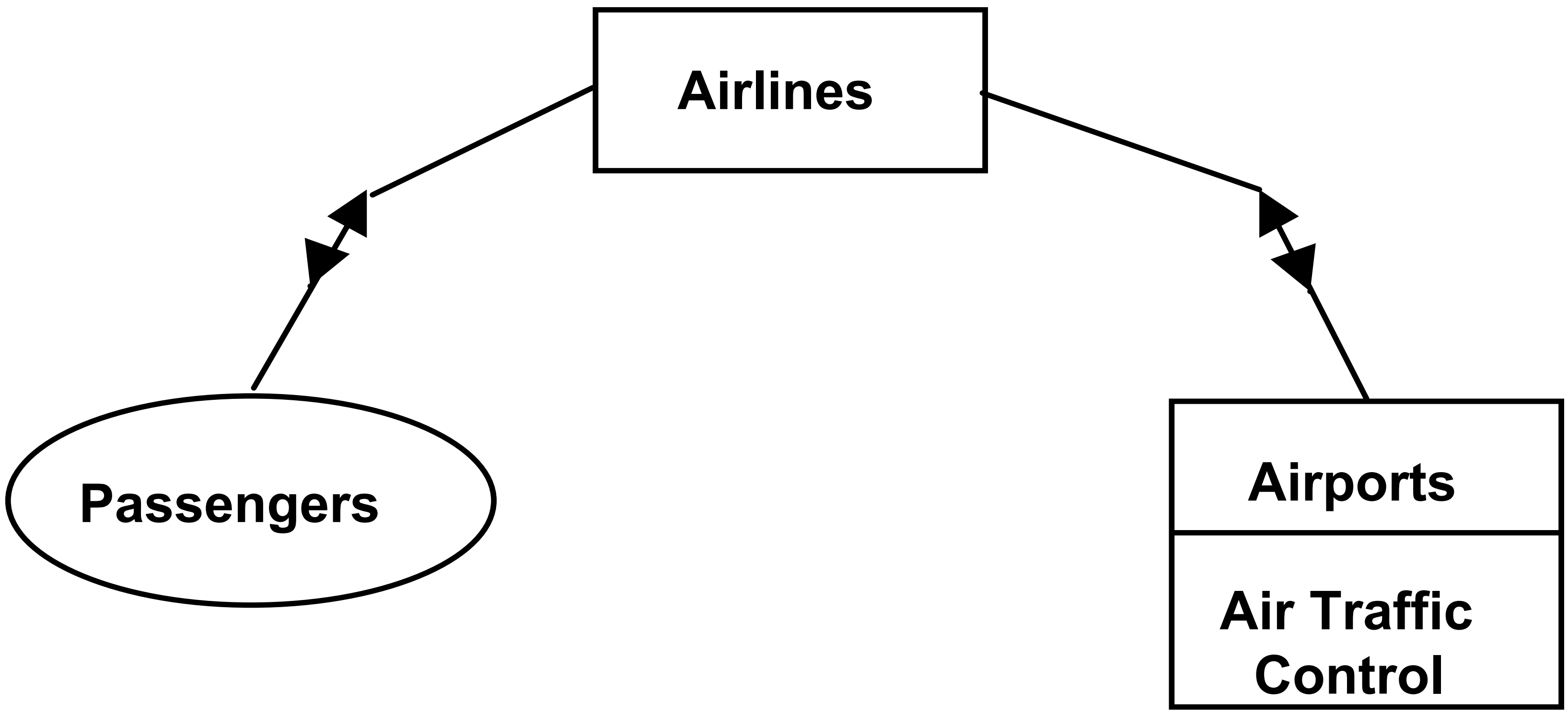


Figure 29.4

Subsidies in Air Transportation

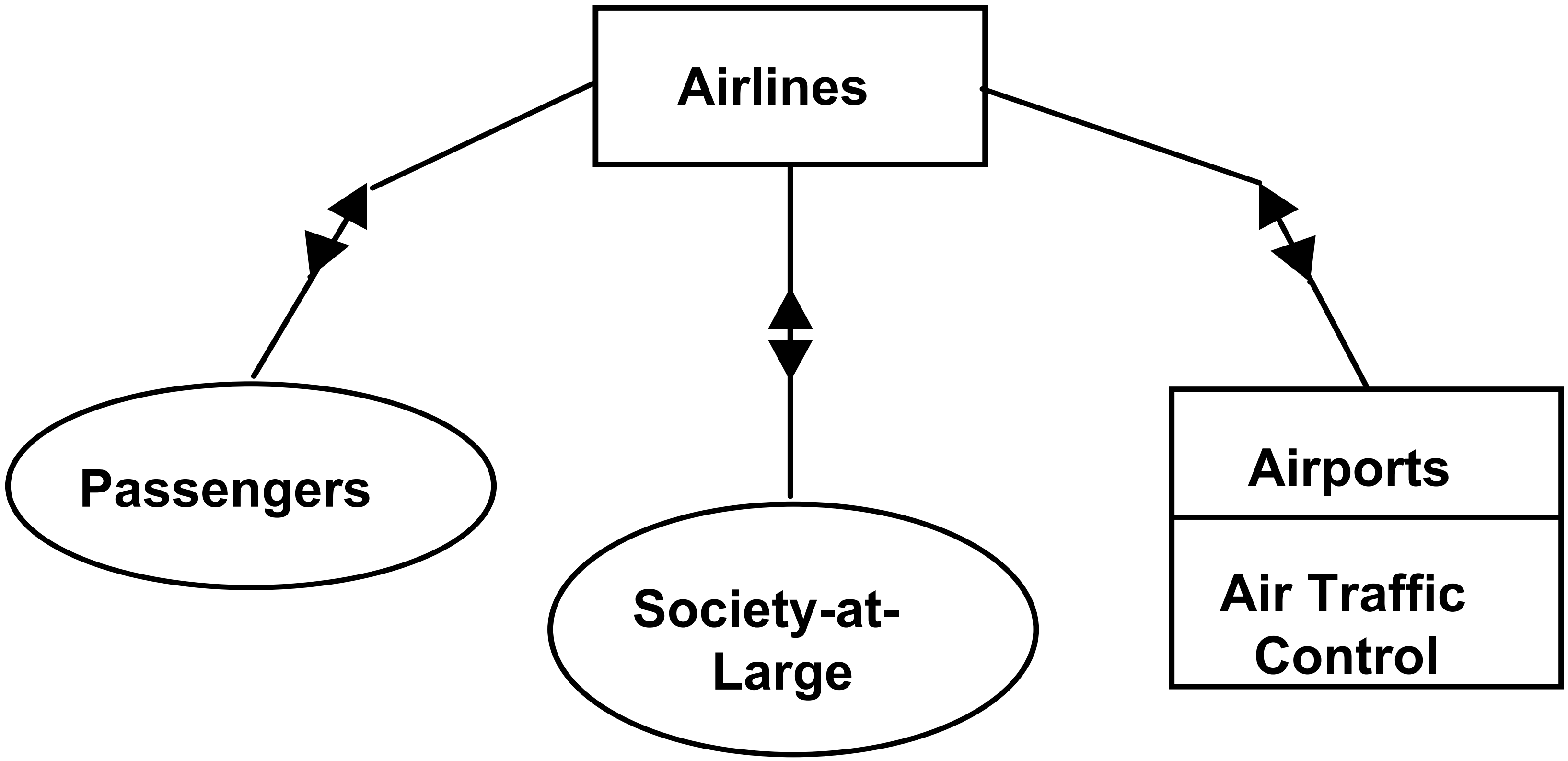


Figure 29.5

- Does Society-at-Large Benefit Enough to Warrant the Subsidy to Air Transportation?

CLASS DISCUSSION

INTERCITY RAIL TRANSPORTATION

RAIL STATION VS. AIRPORT LOCATION

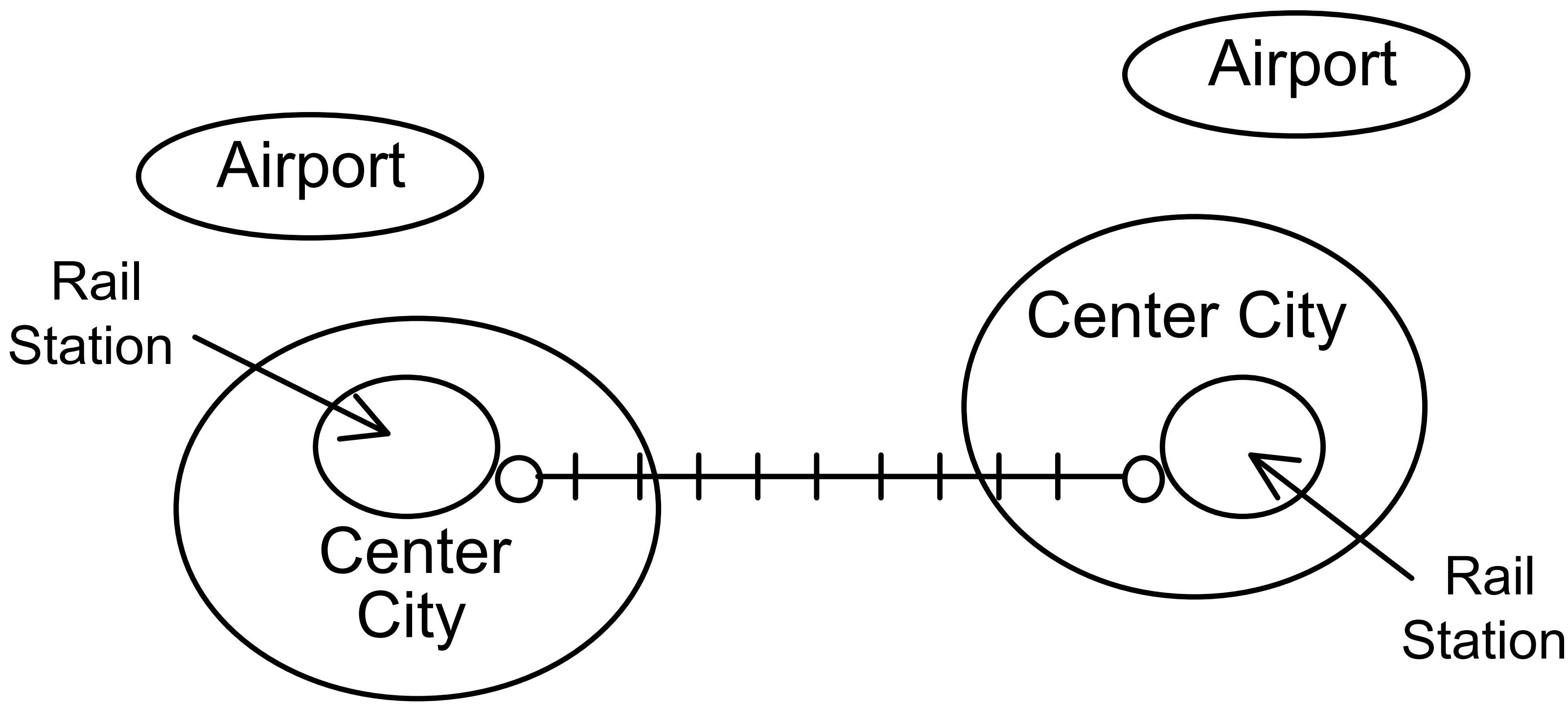


Figure 30.1

MAINTENANCE COST VS. SPEED

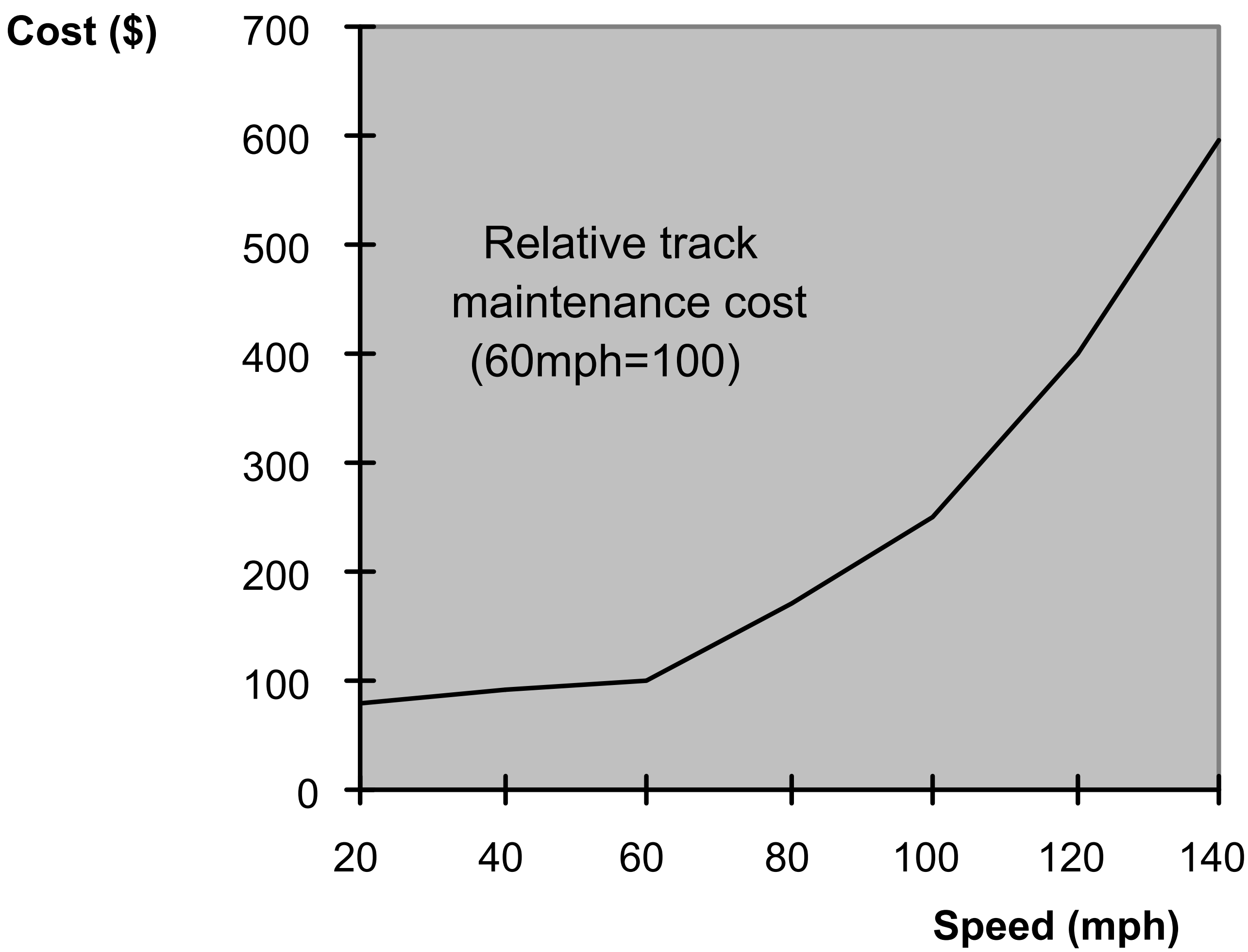
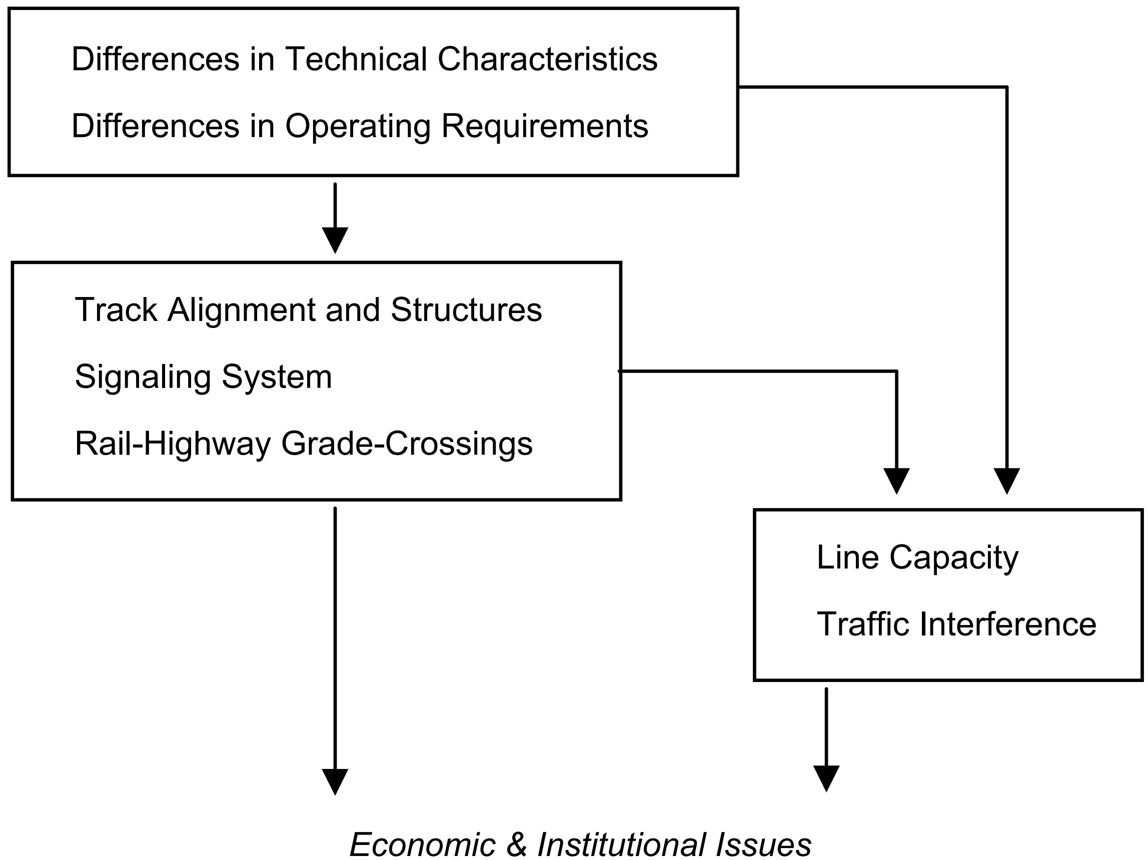


Figure 30.3

SHARING R.O.W. BETWEEN PASSENGER AND FREIGHT TRAINS



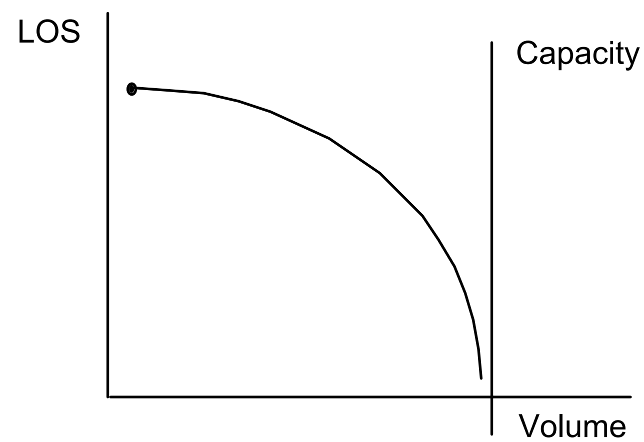
Source: Roth, Daniel, "Incremental High Speed Rail in the U.S.: Economic and Institutional Issues", Thesis for Master of Science in Transportation, Department of Civil and Environmental Engineering, MIT, July 1994.

Figure 30.5

PERSPECTIVES OF FREIGHT RAILROADS ON PASSENGER SERVICE

- Capacity

  LOS Degrades as Volume Approaches Capacity



- Liability
  - The risk profile changes when a railroad has passenger operations, because of the increased probability of injuries and deaths.
- Cost-Sharing and Cost-Allocation
  - Right-of-way is being shared by freight and passenger; how do you decide who pays what for the use of that right-of-way?

Figure 30.6

HSR, INCREMENTAL HSR AND MAG-LEV

H S R

dedicated service
very high speed
150-200 m.p.h.
(Europe and Japan)

Less Technology

- Incremental HSR
- Shared ROW (with freight)
- Speed: 125-150 m.p.h.
- Capacity Issues
- Safety Issue (grade-crossing)

More Technology

- MAG LEV
- Dedicated ROW
- Speed: 300 m.p.h.
- “High Tech”
- Very expensive (comparatively)
- As yet unproven technology (commercially)

Figure 30.7

SOME AMTRAK BUSINESS MODELS

- Ownership
  - Infrastructure Company
  - Operating Companies
- Rail/Air Intermodal
- Regionally-Scaled Systems

SOME AMTRAK-RELATED PUBLIC POLICY ISSUES

- Environment
- Congestion
- Urban Form
- Who benefits and who pays
  - TRUST FUND
- Modal Diversity
- Equity

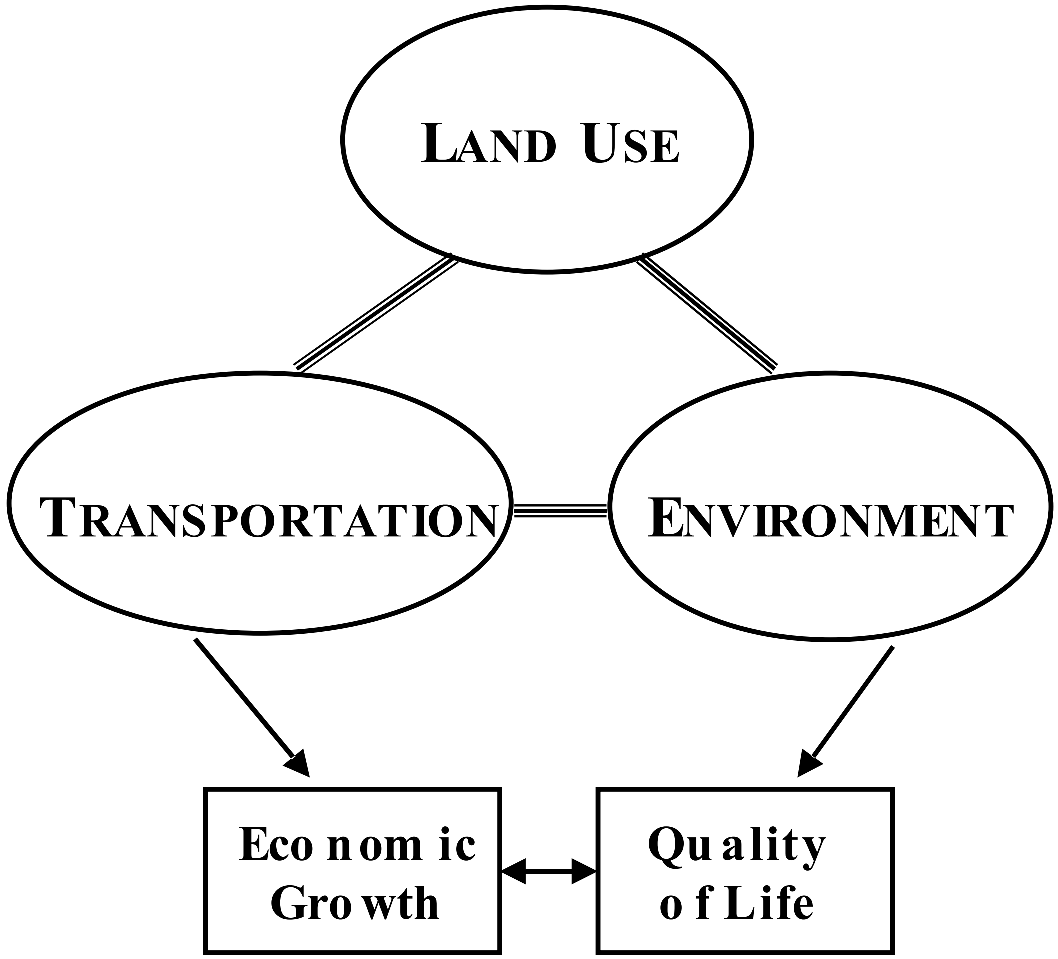
MEXICO CITY -- A MEGACITY IN THE DEVELOPING WORLD

Molina and Molina, *Air Quality in the Mexico Megacity*

MEXICO CITY

- Population ~ around 20 million
- Spans three political jurisdictions (Federal District (DF), State of Mexico (EM), Hidalgo)
- Spread-out land use patterns
- The economic engine of Mexico
- Extraordinary air quality issues
- Extraordinary congestion
- One of the largest metros in the world
- Informal transportation (colectivos) important
- With some wealth, growth in automobile ownership

KEY INTERRELATIONSHIPS



POLICY AREAS: TRANSPORTATION

- Fleet composition and operations/inspection and maintenance
  - Trucks
  - Buses
  - Colectivos
  - Taxis
  - Private cars
- Fuels -- blend, price
- Fleet composition -- age, technology

POLICY AREAS: TRANSPORTATION
(CONTINUED)

- Public transportation
  - Bus
  - Metro
  - Colectivo
  - Intermodalism

POLICY AREAS: TRANSPORTATION
(CONTINUED)

- Infrastructure/technology
  - Truck bypass
  - Metro expansion
  - Dedicated bus lanes
  - Intelligent transportation systems (ITS) pricing

POLICY AREAS: TRANSPORTATION
(CONTINUED)

- Regional perspective on land use
- Transit-oriented development
- Redensification
- Institutions
- Linkages between DF and EM
- Transportation and environmental planning

Transportation Options

- Gas tax tied to conformity and funds for roads and public transportation
  - reduce private car use
  - forces integration of transport investments
  - maintains roads and promotes public transit
- Higher registration fees for *older* vehicles
  - fleet turnover
- Limit vehicle types through permits
  - improve fleet fuel efficiency
  - reduce SUV growth

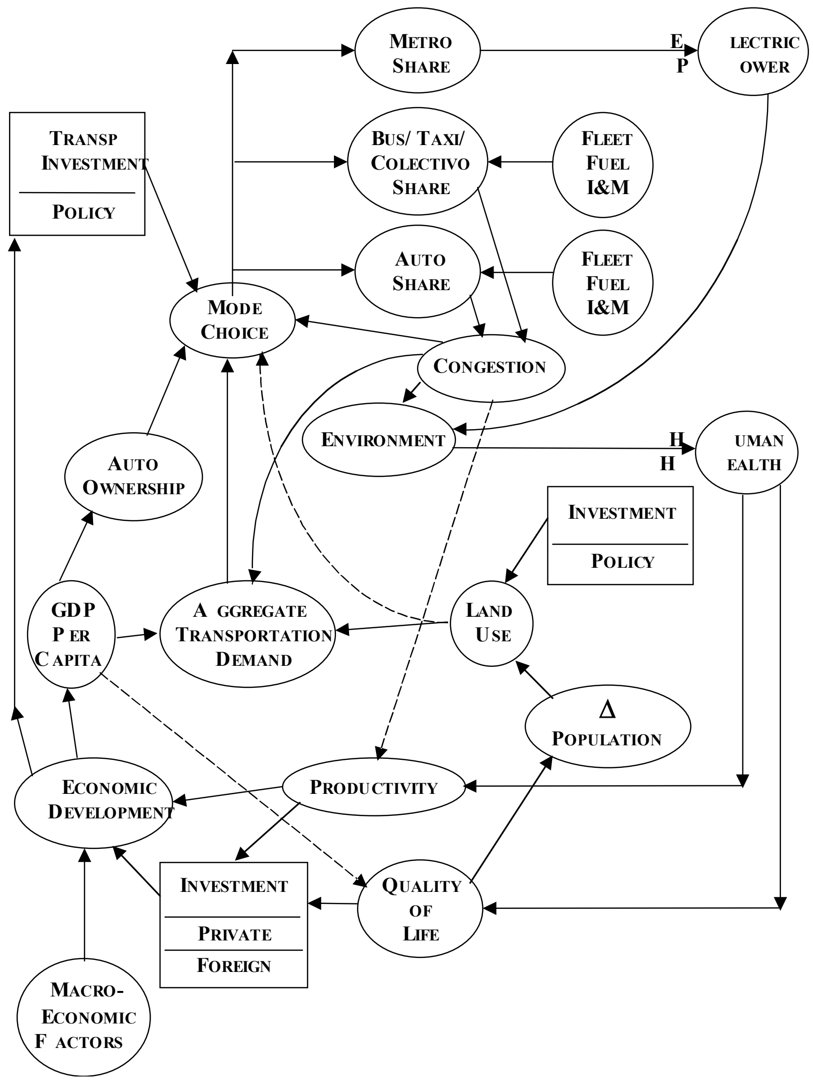
Transportation Options

- Integrate Fare System (SmartCard)
  - increase ridership on public transport
  - reduce commuting time
- Coupling better transit access with higher auto parking costs and restrictions on congested areas
  - reduced congestion by promoting modal shifts
- Improve security on public transit
  - mode shift to public transit

Transportation Options

- Integration of metro bus routes
  - increase ridership on public transport
  - reduce commuting time
- Coupling urban-development and metro stations
  - power passenger-km-traveled on “dirty” modes
  - Improved metro ridership
- Metro expansion (including to EM)
  - increased ridership

THE MEXICO CITY CLIOS DIAGRAM
TRAVELER TRANSPORTATION



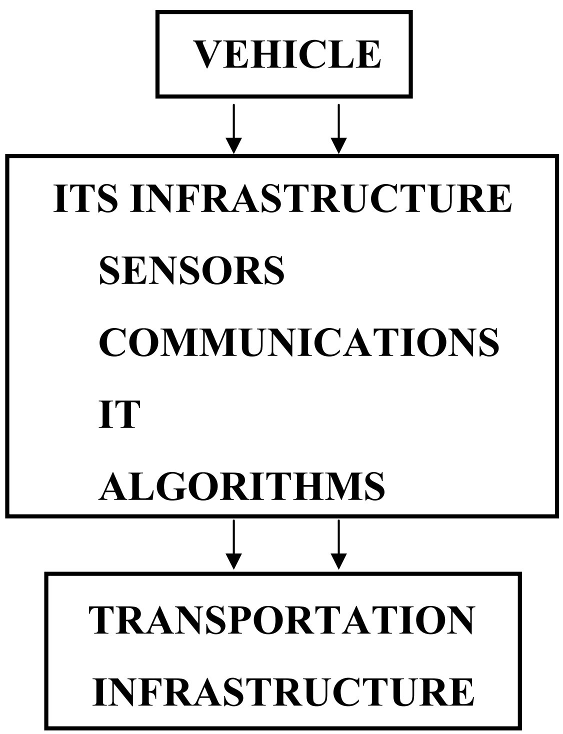
Intelligent Transportation Systems (ITS)

Definition of ITS

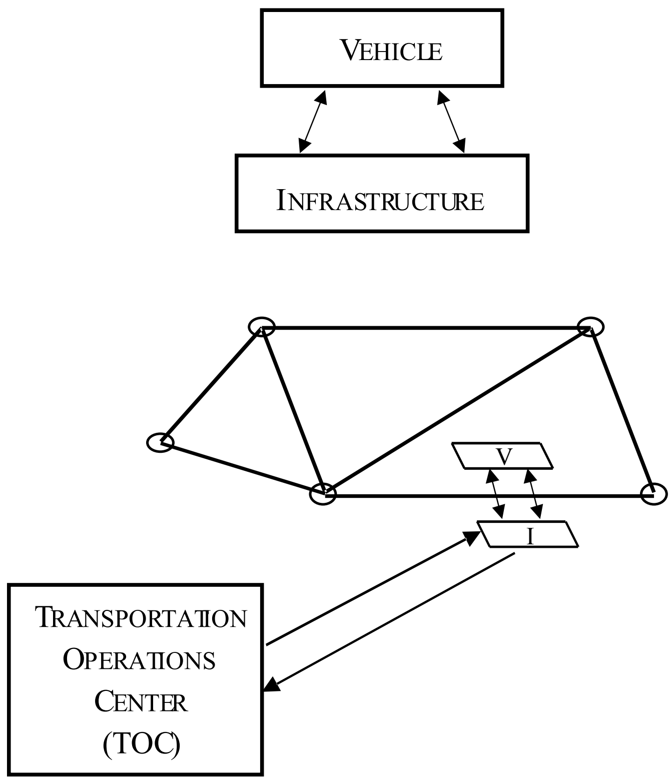
- Intelligent Transportation Systems (ITS) apply well-established technologies of communications, control, electronics and computer hardware and software to the surface transportation system.

The Fundamental ITS Insight

- Linkage of vehicle and transportation infrastructure through ITS infrastructure.



Fundamental ATMS/ATIS Systems



ATMS - - ADVANCED TRANSPORTATION MANAGEMENT SYSTEM
(OPERATOR)

ATIS - - ADVANCED TRAVELER INFORMATION SYSTEM
(CUSTOMER)

The ITS-4 Technologies

- The ability to *sense* the presence and identity of vehicles or shipments in real-time on the infrastructure through roadside devices or Global Positioning Systems (GPS);
- The ability to *communicate* (i.e., transmit) large amounts of information cheaper and more reliably;
- The ability to *process* large amounts of information through advanced information technology; and
- The ability to *use* this information properly and in real-time in order to achieve better transportation network operations. We use *algorithms* and *mathematical methods* to develop strategies for network control and optimization.

Some Functions

- Manage and monitor the network traffic flows
- Provide information on the state of the network
- Fleet management (vehicle location)
  - Trucks
  - Buses
- Monitoring vehicle condition and status
  - Trucks
  - Buses
- Autonomous systems
  - Vehicle status
  - Intelligent cruise control
  - Obstacle detection

Introduction

- ITS combines high technology and improvements in information systems, communication, sensors, and advanced mathematical methods with the conventional world of surface transportation infrastructure.
- In addition to technological and systems issues, there are a variety of institutional issues that must be carefully addressed.
- Substantial leadership will be required to implement ITS as an integrator of transportation, communications and intermodalism on a regional scale.

The Vision for ITS in the U.S.

- A national system that operates consistently and efficiently across the U.S. to promote the safe, orderly and expeditious movement of people and freight. Here, recognition of the need to think intermodally and about the needs for *both* personal and freight mobility was explicit.
- An efficient public transportation system that interacts smoothly with improved highway operations. The concept that ITS had to do more than simply improve single occupancy vehicle level-of-service on highways is captured here.
- A vigorous U.S. ITS industry supplying both domestic and international needs.

Advanced Transportation Management Systems (ATMS)

- ATMS will integrate management of various roadway functions. It will predict traffic congestion and provide alternative routing instructions to vehicles over regional areas to improve the efficiency of the highway network and maintain priorities for high-occupancy vehicles.
- Real-time data will be collected, utilized, and disseminated by ATMS systems and will further alert transit operators of alternative routes to improve transit operations.
- Dynamic traffic control systems will respond in real-time to changing conditions across different jurisdictions (for example, by routing drivers around accidents).

Incident Management

- We are interested in reducing non-recurring congestion; that is, incident- or accident-based congestion rather than rush hour congestion.
- One can identify and locate those incidents and remove them quickly, and reduce congestion-based delay substantially.
- With the technology on the network to measure velocities in real-time everywhere in the network, one can think about being able to identify and locate incidents by various velocity signatures.

Electronic Toll and Traffic Management (ETTM)

- The basic idea here is that one can detect and identify individual vehicles with road-side readers
- These readers can debit an account by sensing the transponder carried on your windshield; you pay your toll electronically rather than having to stop and pay.
- That, in and of itself, reduces congestion.
- Enables congestion pricing.

Advanced Traveler Information Systems (ATIS)

- ATIS will provide data to travelers in their vehicles, in their homes or at their places of work.
- Information will include: location of incidents, weather problems, road conditions, optimal routings, lane restrictions and in-vehicle signing.
- Information can be provided both to drivers and to transit users and even to people before a trip to help them decide what mode they should use.
- “May-Day” calls for help from a disabled vehicle are included here as well.

Advanced Vehicle Control Systems (AVCS)

- In the near term, intelligent cruise control, which automatically adjusts the speed of the vehicle to that of the vehicle immediately ahead, is an example of AVCS.
- More generally, collision warning systems would alert the driver to a possible imminent collision, say, with a roadside obstacle.
- In more advanced systems, the vehicle would automatically brake or steer away from a collision.
- These systems are autonomous to the vehicle and can provide substantial benefits by improving safety and reducing accident-induced congestion.

Automated Highway Systems (AHS)

"Hands-off, feet-off, brain-off" driving.

Does this make sense?

What are the barriers to deployment?

"The Devil and
the Governor of Massachusetts"

Commercial Vehicle Operations (CVO)

- In CVO, the private operators of trucks, vans and taxis are using ITS technologies to improve the productivity of their fleets and the efficiency of their operations.
- Such concepts as weigh-in-motion (WIM), pre-clearance of trucks across state boundaries, automatic vehicle location for fleet management, on-board safety monitoring devices, are included here.

Advanced Public Transportation Systems (APTS)

- APTS can use ITS technologies to greatly enhance the accessibility to information for users of public transportation.
- Also, ITS can improve fare collecting, scheduling of public transportation vehicles, intramodal and intermodal connections, and the utilization of bus fleets.

Advanced Rural Transportation Systems (ARTS)

- How ITS technologies can be applied on relatively low-density roads is a challenge that is being undertaken by many rural states.
- Safety rather than congestion is the main motivation for ARTS. Single vehicle run-off-the-road accidents are a target here.
- "May-Day" devices are of particular interest in this environment.

		Characteristics
ATMS	Advanced Transportation Management Systems	Network management, including incident management, traffic light control, electronic toll collection, congestion prediction and congestion-ameliorating strategies.
ATIS	Advanced Traveler Information Systems	Information provided to travelers pre-trip and during the trip in the vehicle. ATMS helps provide real-time network information.
AVCS	Advanced Vehicle Control Systems	A set of technologies designed to enhance driver control and vehicle safety. This ranges up to Automated Highway Systems (AHS), where the driver cedes all control to the system.

		Characteristics
CVO	Commercial Vehicle Operations	Technologies to enhance commercial fleet productivity, including weigh-in-motion (WIM), pre-clearance procedures, electronic log books, interstate coordination.
APTS	Advanced Public Transportation Systems	Passenger information and technologies to enhance system operations, including fare collection, intramodal and intermodal transfers, scheduling, headway control.
ARTS	Advanced Rural Transportation Systems	Mostly safety and security technologies (e.g., ÒMay-DayÓ) for travel in sparsely-settled areas.

Institutional Issues

- Public-Private Partnerships
- Organizational Change
- Transportation Education
- Legal Liability
- Political Strength of Traditional Construction Industry
- Intellectual Property

Transportation and Change

- Changes resulting from the Interstate in the U.S.
  - The intercity trucking industry was formed and a financial blow was dealt to the railroad industry, as it lost substantial market share in high-value freight. This led, in turn, to a fundamental redefinition of the relationship between the public and private sectors in the freight industry in 1980, through substantial deregulation.
  - The Interstate led to an unprecedented and unequaled mobility between and into U.S. cities and gave rise to the regional transportation concept, with wholly new methods of planning being required for region-wide analysis and design.

Transportation and Change
(continued)

- The Interstate System included the development of circumferential belts around major cities, leading to development patterns quite at variance with the ability of public transportation to service it and, as described by authors such as Joel Garreau, the development of “edge cities”, a fundamentally new kind of urban structure.
- The Interstate led to a fueling of the post-war economic expansion and a period of unprecedented prosperity in the U.S.
- A “stop the highway” backlash in urban areas resulted from the Interstate, and a political polarization between the build vs. no-build factions became a fact of political life in U.S. transportation.

Transportation and Change
(continued)

- Changes resulting from ITS
  - The reinvention of logistics through supply chain management, linking inventory management and transportation in wholly new ways;
  - Dramatic moves into surface transportation by organizations not traditionally involved, such as the national labs and aerospace companies in the U.S.;
  - Changes to academia, with new alliances and new academic programs beginning to be formed, and faculty participating in transportation education and research who have never been part of that process before; and
  - Building of new relationships among public-sector agencies to enable regional and corridor-level system deployment.

Regional Deployment -- A Strategic Vision

- The strategic vision for ITS, then, is as the integrator of transportation, communications and intermodalism on a regional scale.

WRAP-UP

SO WHERE HAVE WE BEEN IN 1.221?

- Concepts
  - CLIOS
  - 30 Key Points
- Freight Transportation
  - Total Logistics Costs (TLC)
  - LOS for freight modes
  - Operating issues
- Traveler Transportation
  - Automobiles
  - Urban Form and Transportation
  - Urban Public Transportation
  - Megacities
  - Intercity Traveler Transportation--Air, Amtrak
  - ITS

SOME EMPHASIZED POINTS
(WE CAN'T DO EVERYTHING IN 21 HOURS!)

- The Triplet of Technology/Systems/Institutions
- Level-of-Service (LOS)--freight and travelers--the importance of the customer
- The Cost/LOS trade-off
- Supply/Demand/Equilibrium
- The Vehicle-cycle
- Transportation as a component of a larger social-political-economic system--a force for good and otherwise

TRANSITIONS IN THE WORLD OF TRANSPORTATION: A SYSTEMS VIEW

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SUMMARY OF TRANSITIONS

	From		To
1.	Capital Planning	→	Management and Operations Focus
2.	Long Timeframes	→	Real-time Control
3.	Urban Scale Planning and Operations	→	Regional Scale Planning and Operations
4.	Emphasis on Mobility	→	Emphasis on Accessibility (the Tr ansportation/ Land-Use Connection
5.	"One Size Fits All" Service	→	Customer Orientation
		→	Quality
		→	Pricing for Service

SUMMARY OF TRANSITIONS
(CONTINUED)

	From		To
6.	Allocate Capacity by Queuing	→	Allocate Capacity by Pricing
7.	Aggregate Methods for Demand Prediction	→	Disaggregate Methods for Demand Prediction
8.	Episodic Data for Investment Planning	→	Dynamic Data for Investment Planning (and Operations)
9.	Public Financing for Infrastructure and Operations	→	Private and Public/Private Partnerships for Financing of Infrastructure and Operations Using Hybrid Return on Investment Measures
10.	Infrastructure Construction and Maintenance Providers	→	New High-Technology Players

SUMMARY OF TRANSITIONS
(CONTINUED)

	From		To
11.	Static Organizations and Institutional Relationships	→	Dynamic Organizations and Institutional Relationships
12.	Professional Emphasis on Design of Physical Infrastructure	→	Professional Emphasis on Transportation as a Complex, Large-Scale, Integrated, Open System (CLIOS)
13.	Economic Development	→	Sustainable Development
14.	Computers Are "Just a Tool"	→	Ubiquitous Computing

15\. **From** Supply-Side Perspective → **To** Supply/Demand Equilibrium Framework → **And On To** Systems that Never Reach Equilibrium

SUMMARY OF TRANSITIONS
(CONTINUED)

	From		To
16.	Independent Conventional Infrastructure Projects	→	Linked Advanced Infrastructure Projects Requiring a System Architecture
17.	Vehicles and Infrastructure as Independent	→	Vehicles and Infrastructure as Electronically Linked
18.	Reducing Consequences of Crashes	→	Crash Avoidance

	From		To		And On To
19.	Modal Perspective	→	Intermodal Perspective	→	SupplyChain Management

20.	Narrow Transportation Specialists	→	The New Transportation Professional