1.201J/11.545J, ESD.210J *Introduction to Transportation Systems*

Fall 2006

LECTURES 2, 3, & 4

DISPLAYS

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September 12, 14, & 19, 2006

Part I

WHY TRANSPORTATION IS A CLIOS SYSTEM

- The “Details”
  - Context
  - Internal Components
  - External Components

TRANSPORTATION AND THE SOCIAL-POLITICAL-ECONOMIC CONTEXT

- Public-Policy Lever
- Private-Sector Investment
- Industrial Base (e.g., auto and shipbuilding industries)
- Economic Development
- Employer
- Large-Scale Infrastructure with long-term Impact
- Environmental Impact -Sustainable Systems
- Energy Issues
- Equity Issues

TRANSPORTATION SYSTEM – INTERNAL COMPONENTS

- Physical system
- Management
- Labor

TRANSPORTATION PHYSICAL SYSTEM COMPONENTS

- Infrastructure
  - Guideway
  - Terminals
  - Stations
- Vehicles
- Power Systems
- Fuel
- Control, Communications & Location Systems

INFRASTRUCTURE

- Guideways: Special Purpose vs. General Purpose Guideway -- some examples
  - Highway
  - Railroad
  - Pipeline
  - Air Corridors
- Terminals/Stations -- some examples
  - Rail Freight Yards
  - Container Port
  - Airports
  - Bus Stations
  - Transit Stations
  - Street Corner Bus Stops/Taxi Stands

VEHICLES

- Automobiles
- Rail Locomotives
- Airplanes
- Tractor Trailer
- Truck Trailers
- Railroad Cars
- Containers

VEHICLE CHARACTERISTICS

- Crashworthiness
- Degree of Automation
- Energy Source: internal vs. external
- Weight
- Material
- Aerodynamics
- Emissions

EQUIPMENT -- SOME EXAMPLES

- Loading Crane at Container Port
- Railroad Track Maintenance Equipment
- Airport Baggage Handling
- Snow Removal Vehicles

POWER SYSTEMS

- Internal Combustion Engine
- Diesel Engine
- Electric Motors
- Hybrid Engines
- Fuel Cells
- Humans
- Animals
- Gravity
- Windmill
- Solar Panels
- Tidal Baffles

FUEL

- Gasoline
- Natural Gas
- Diesel
- Coal
- Electricity (e.g., as generated from coal)
- Electricity (as in an onboard battery)
- Solar Energy
- Tides/Currents
- Wind
- Hydrogen

CONTROL, COMMUNICATIONS AND LOCATION SYSTEMS

- Humans
  - Driver
  - Controllers (as in air traffic)
  - Dispatcher
- Technology
  - Traffic Lights
  - Sensors -- e.g., Loop Detectors
  - Fleet Management Systems
  - Automated Vehicles
  - Block Control (railroad)
  - Global Positioning Systems (GPS)
  - Intelligent Transportation Systems (ITS)

SUMMARY -- TRANSPORTATION PHYSICAL SYSTEM COMPONENTS

- Infrastructure
  - Guideway
  - Terminals
  - Stations
- Vehicles
- Power Systems
- Fuel
- Control, Communications & Location Systems

MANAGEMENT (I)

- Marketing: what do customers want?
  - Intramodal
  - Intermodal
  - Intersectoral (e.g., transportation vs. communication)
- Planning
  - Strategic planning (e.g., building the network, buying the vehicles)
  - Operations planning (e.g., creating an operations plan)
- Operations
  - NB: Distinct from operations planning (e.g., actually running the system)

MANAGEMENT (II)

- Maintenance Management
- Information Management
- Operations Research
- Administration

OPERATIONS/MARKETING "TENSION"

- Marketing people like to provide high-quality service. To a first approximation, they want to maximize revenues.
- Marketing people like to provide universal, direct, frequent, and high-quality service to transportation customers.
- Marketing people are basically concerned with maximizing the revenues that flow to the company.

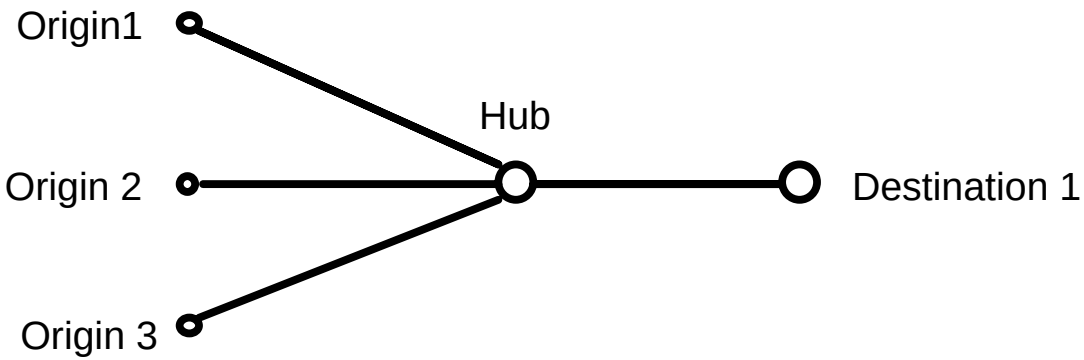
OPERATIONS/MARKETING "TENSION"

- Operations people are cost-oriented.
- Operations people are typically worried about minimizing cost.
- Operations people want to run an efficient and cost-effective operation.

OPERATING PLANS

- Schedule
- Crew Assignments
- Vehicle Distribution
- Connections
  - Intermodal
  - Intramodal

CONNECTION PATTERNS -- HUB-AND-SPOKE



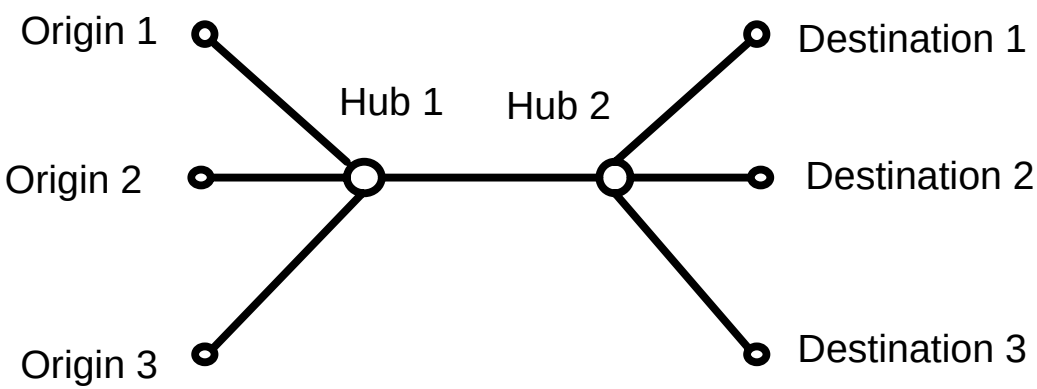


Figure 2.2

COST/LEVEL-OF-SERVICE TRADE-OFF

Two Connection Patterns

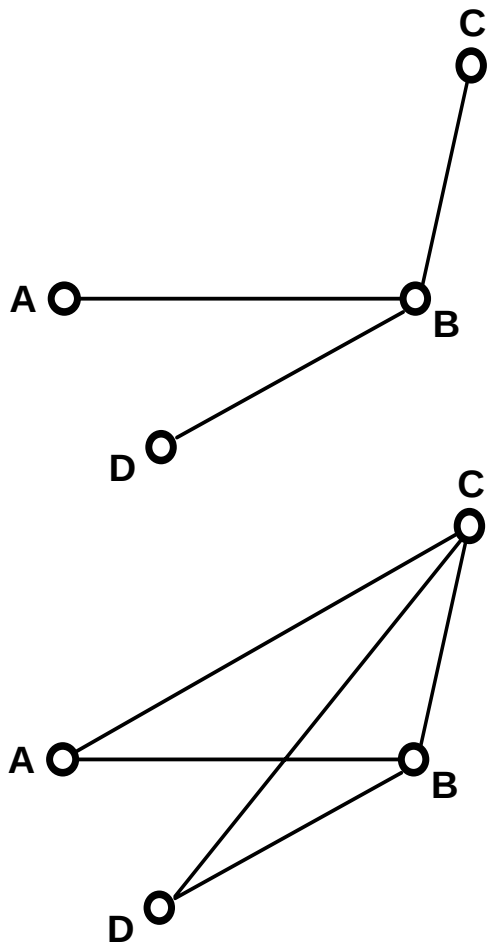


Figure 2.3

Do we provide direct, high-quality service from A to C as shown in the lower figure, or do we consolidate passengers at Node B with other passengers from Node D, into a single flight from B to C?

Here we have some fundamental *cost/level-of-service trade-offs*.

Which pattern does the VP-Marketing like? How about the VP-Operations?

CONTINGENCY PLANNING

What do we do when things go wrong? How do we decide how to alter our operating plan to reflect changes in weather, demand for service and accidents -- such as a derailment?

LABOR

- Drivers
- Dispatchers
- Fare collectors
- Mechanics

DIFFERENCE BETWEEN UNION AND NON-UNION