AN INTRODUCTION TO
INTELLIGENT TRANSPORTATION SYSTEMS

1.212
SPRING 2005

Professor Joseph M. Sussman

Mon/Wed 2:30 -4:00

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BLOCK 1
___________(Lectures 2, 3)

INTRODUCTION TO ITS

Basic Concepts

Continued

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February 9, 2005
INSTITUTIONAL ISSUES

◆ Privacy/enforcement
◆ Anti-trust
◆ Who is in Charge?
  ◆ Public/Private Partnership
◆ International Cooperation
◆ Tort Liability
◆ Procurement
◆ Marketplace
INSTITUTIONAL ISSUES

◆ Interagency Coordination and Cooperation
  ◆ Metropolitan Area Traffic Management
  ◆ Federal and State Departments and Agencies
◆ Adaptation of Existing Posers and Organizational Forms
◆ Collaborative vs. Adversarial Approaches
◆ Public/Private Partnership Agreements
DISCUSSION: What specific actions can ATMS take to improve network performance?
 Static Information (e.g., network topology) 

 Semidynamic Information (e.g., construction) 

 Dynamic Information \( \text{Neó} \) Information from field in real-time (e.g., volumes, speeds, queues) 
 Non-\( \text{Neó} \) Information (e.g., spotter aircraft, state police) 

 ATMS

 Estimate Network State 

 Generate Network Strategies 

 Prediction of Future Network State as \( f(\text{Strategy}) \) including \( \text{Neó} \) guesses about traveler reaction to ATIS 

 Select and Deploy Strategy 

 ATIS

 Information to travelers (e.g., dynamic routing, individual vehicles) (e.g., variable message signs) 

 Actual Change in Traveler Behavior?
### ITS Subsystems

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Description</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td><strong>ATMS</strong></td>
<td>Advanced Transportation Management Systems</td>
<td>Network management, including incident management, traffic light control, electronic toll collection, congestion prediction and congestion-ameliorating strategies.</td>
</tr>
<tr>
<td><strong>ATIS</strong></td>
<td>Advanced Traveler Information Systems</td>
<td>Information provided to travelers pre-trip and during the trip in the vehicle. ATMS helps provide real-time network information.</td>
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<tr>
<td><strong>AVCS</strong></td>
<td>Advanced Vehicle Control Systems</td>
<td>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.</td>
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## ITS Subsystems (Continued)

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>CVO</td>
<td>Commercial Vehicle Operations</td>
<td>Technologies to enhance commercial fleet productivity, including weigh-in-motion (WIM), pre-clearance procedures, electronic log books, interstate coordination.</td>
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<tr>
<td>APTS</td>
<td>Advanced Public Transportation Systems</td>
<td>Passenger information and technologies to enhance system operations, including fare collection, intramodal and intermodal transfers, scheduling, headway control.</td>
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<tr>
<td>ARTS</td>
<td>Advanced Rural Transportation Systems</td>
<td>Mostly safety and security technologies (e.g., May-day) for travel in sparsely-settled areas.</td>
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TRANSPORTATION AND CHANGE

Our transportation system provides fundamental and basic services to society, and has done so for thousands of years.

- However, as we begin the 21st century, the field is subject to many changes.
- These transitions occur on the dimensions of technology, systems and institutions and characterize the field in its broadest sense.
TRANSITIONS

◆ What are these transitions?

◆ What do they mean for the education of the “New Transportation Professional”? 
CLIos

Complex
Large-scale
Integrated
Open
Systems
COMPLEXITY

Complexity as in CLIQS


- A system is complex when it is composed of a group of related units (subsystems), for which the degree and nature of the relationships is imperfectly known. Its overall behavior is difficult to predict, even when subsystem behavior is readily predictable. Further, the time-scales of various subsystems may be very different (as we can see in transportation -- land-use changes, for example, vs. operating decisions).
NESTED COMPLEXITY

Policy System

Physical System
### SUMMARY OF TRANSITIONS

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
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<tbody>
<tr>
<td>1. CAPITAL PLANNING MANAGEMENT AND OPERATIONS FOCUS</td>
<td>Focus</td>
</tr>
<tr>
<td>2. LONG TIMEFRAMES</td>
<td>REAL-TIME CONTROL</td>
</tr>
<tr>
<td>3. URBAN SCALE PLANNING AND OPERATIONS</td>
<td>REGIONAL SCALE PLANNING AND OPERATIONS</td>
</tr>
<tr>
<td>4. EMPHASIS ON MOBILITY</td>
<td>EMPHASIS ON ACCESSIBILITY (THE TRANSPORTATION / LAND-USE CONNECTION)</td>
</tr>
<tr>
<td>5. “ONE SIZE FITS ALL” SERVICE</td>
<td>CUSTOMER ORIENTATION QUALITY PRICING FOR SERVICE</td>
</tr>
<tr>
<td>From</td>
<td>To</td>
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<tr>
<td>------</td>
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<tr>
<td>6. <strong>ALLOCATE CAPACITY</strong> BY QUEUING</td>
<td><strong>ALLOCATE CAPACITY</strong> BY PRICING</td>
</tr>
<tr>
<td>7. <strong>AGGREGATE METHODS FOR DEMAND PREDICTION</strong></td>
<td><strong>DISAGGREGATE METHODS FOR DEMAND PREDICTION</strong></td>
</tr>
<tr>
<td>8. <strong>EPISODIC DATA FOR INVESTMENT PLANNING</strong></td>
<td><strong>DYNAMIC DATA FOR INVESTMENT PLANNING</strong> (AND OPERATIONS)</td>
</tr>
<tr>
<td>9. <strong>PUBLIC FINANCING FOR INFRASTRUCTURE AND OPERATIONS</strong></td>
<td><strong>PRIVATE AND PUBLIC/PARTNERSHIPS FOR FINANCING OF INFRASTRUCTURE AND OPERATIONS USING HYBRID RETURN ON INVESTMENT MEASURES</strong></td>
</tr>
<tr>
<td>10. <strong>INFRASTRUCTURE CONSTRUCTION AND MAINTENANCE PROVIDERS</strong></td>
<td><strong>NEW HIGH-TECHNOLOGY PLAYERS</strong></td>
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</table>
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/D EMAND EQUILIBRIUM FrameworK

AND ON TO SYSTEMS THAT NEVER REACH EQUILIBRIUM
16. **FROM**
   - Independent Conventional Infrastructure Projects

   **TO**
   - Linked Advanced Infrastructure Projects Requiring a System Architecture

17. **FROM**
   - Vehicles and Infrastructure as Independent

   **TO**
   - Vehicles and Infrastructure as Electronically Linked

18. **FROM**
   - Reducing Consequences of Crashes

   **TO**
   - Crash Avoidance

19. **FROM**
   - Modal Perspective

   **TO**
   - Intermodal Perspective

   **AND ON TO**
   - Supply Chain Management

20. **FROM**
   - Narrow Transportation Specialists

   **TO**
   - The New Transportation Professional
Change and the Interstate

- Expansion of trucking industry; financial blow to railroads; deregulation
- “Unprecedented and Unequaled Mobility”; regional transportation concept; MPOs
- New urban structures; edge cities
- Post WWII economic expansion
- “Stop the highway” backlash; build vs no-build factions
Change and ITS

◆ Reinvention of logistics.
◆ New transportation players
◆ Changes in academia.
◆ New public sector partnerships at regional scale
◆ New public/private partnerships
Regional Deployment: A Strategic Vision (Sussman)

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

Quite different than the 1991 Strategic Plan vision!
NESTED COMPLEXITY

Policy System

Physical System
THE T-SHAPED TRANSPORTATION PROFESSIONAL

Breadth in:
♦ Transportation Fundamentals
♦ Technology
♦ Systems
♦ Institutions

In-depth knowledge within a transportation specialty.