LECTURE 1

DISPLAYS

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TRANSPORTATION SYSTEM PHASES

- Conceptualization
- Planning
- Construction
- Operations/Maintenance
- Decommissioning
MODES OF ANALYSIS

- **QUANTITATIVE ANALYSIS -- MODELS**
- **QUALITATIVE ANALYSIS -- FRAMEWORKS**
- **HYBRID ANALYSIS -- USING BOTH OF THE ABOVE IN TANDEM -- E.G., INTEGRATED ASSESSMENT**
IRON TRIANGLE

LAND USE

TRANSPORTATION

ENVIRONMENT

Economic Growth

Quality of Life
We introduce CLIOS (Complex, Large-Scale, Integrated, Open Systems), defined as follows:

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).

CLIOS have impacts that are large in magnitude, and often long-lived and of large-scale geographical extent.

Subsystems within CLIOS are integrated, closely coupled through feedback loops.

By “open” we mean that CLIOS explicitly include social, political and economic aspects.

Often CLIOS are counterintuitive in their behavior. At the least, developing models that will predict their performance can be very difficult to do. Often the performance measures for CLIOS are difficult to define and, perhaps, even difficult to agree about, depending upon your viewpoint. In CLIOS there is often human agency involved.
Transportation systems are complex, dynamic and internally interconnected, as well as interconnected with other complex dynamic systems (e.g., the environment, the economy). They vary in space and time (at different time scales for different components). Service is provided on complex networks. The systems are stochastic in nature.

Human decision-makers with complex decision calculi make choices that shape the transportation system.

Modeling the entire system is almost inconceivable. Our challenge is to choose relevant subsystems and model them appropriately for the intended purpose, mindfully reflecting the boundary effects of the unmodeled components.

“All Models Are Wrong; However, Some Are Useful.”
CRITICAL CONTEMPORARY ISSUES (CCI)

- Mobility
- Energy
- Global Climate Change
- Urban Form
  - Developing world
  - Developed world
- Population
  - Growth in developing world
  - Shrinkage in parts of developed world
- Economic development/growth
- Environmental issues
- Social equity
- Productivity
  - Manufacturing
- Security
THE TRANSPORTATION SYSTEM WITH PHYSICAL DOMAIN AND INSTITUTIONAL SPHERE

Other systems:
• Environmental
• Energy
• Economic

Physical Domain

Institutional Sphere

Organizations
• Formal
• Informal
Institutional sphere

Various physical domains:

- Transportation
- Environment
- Energy
- Economic
US DEPARTMENT OF TRANSPORTATION
STRATEGIC PLAN 2003-2008
“Safer, Simpler, Smarter Transportation Solutions”

KEY ISSUES

◆ Safety
◆ Mobility
◆ Global Connectivity
◆ Environmental Stewardship
◆ Security

“Transportation is a strategic investment essential to strengthening the American economy. America needs a fully integrated domestic transportation system as well as safe and efficient connections to the rest of the world.”
The transportation system is vulnerable to attacks by terrorists and saboteurs.

The demand for passenger travel and freight movement is straining the capacity of the U.S. transportation system.
Current institutional arrangements constrain the orderly development, operation, and coordination of the U.S. transportation system, including facilities, modes, and services.

Worthy environmental goals and values pose serious challenges to the operation and expansion of transportation facilities to meet growing demand.
The aging transportation infrastructure must be rebuilt, but the costs involved exceed revenues.

Transportation organizations are having difficulty attracting and retaining the technically diverse personnel needed in the 21st century.
Consumer benefits from deregulation are threatened by industry consolidation.

The burden of owning and operating vehicles is increasing for the lowest-income families.
Telecommunications and information technologies are likely to have significant but uncertain consequences.

Transportation faces formidable barriers to innovation, which are compounded by growing constraints on research investments.
THE “T-SHAPED” NEW TRANSPORTATION PROFESSIONAL

Breadth in:

- Transportation fundamentals
  - Technology
  - Systems
  - Institutions

In-depth knowledge within a transportation specialty