Introduction to Transportation Systems

PART I:

CONTEXT, CONCEPTS AND CHARACTERIZATION

Chapter 11:

Modeling Concepts

Hierarchies of Models

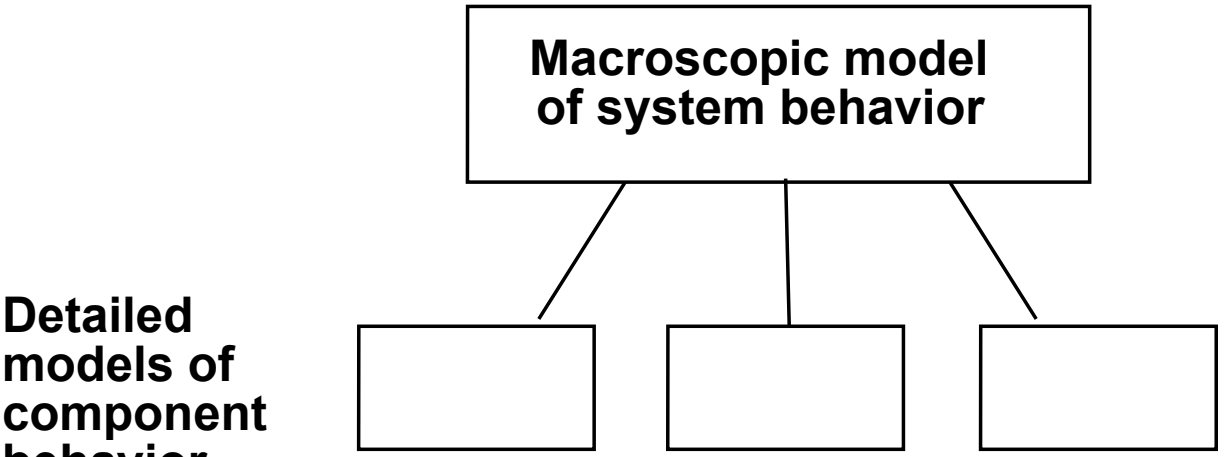


Figure 11.1

Modeling Issues

Boundaries

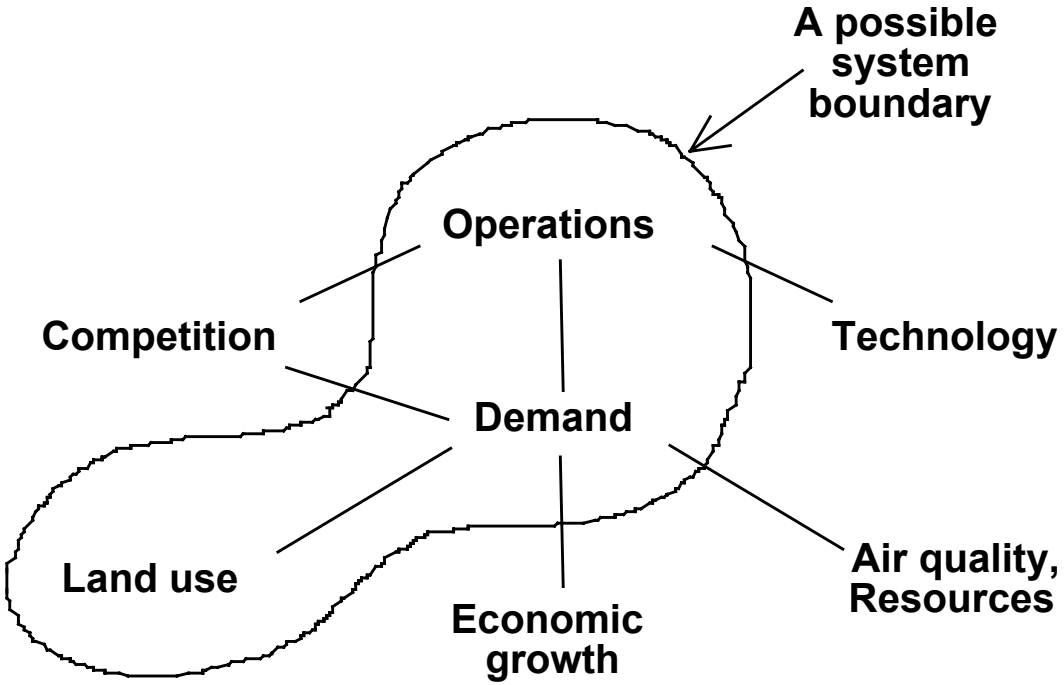


Figure 11.3

Modeling Issues (continued)

- Macroscopic vs. Microscopic Models
- Static vs. Dynamic Models
- Stochastic vs. Deterministic Models

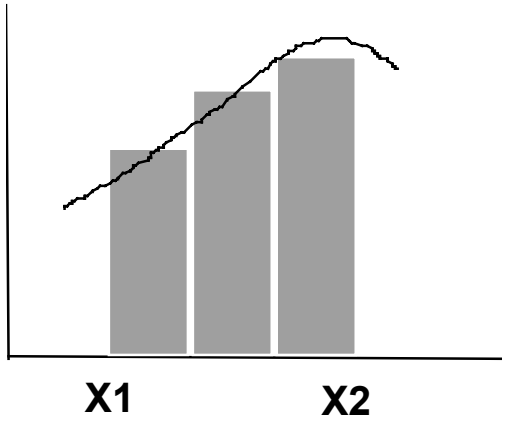
Modeling Issues (continued)

- Linear vs. Non-Linear
  - Linear vs. non-linear models is a good example of the trade-off between constructing models that can produce answers relatively easily versus models that represent the world better but turn out to be more difficult to “solve” in generating actual answers.
  - Linear vs. non-linear models illustrate the trade-off between *reality in representation and ease in generating solutions*.

Modeling Issues (continued)

- Continuous vs. Discrete Models

"Gross" Representation



"Detailed" Representation

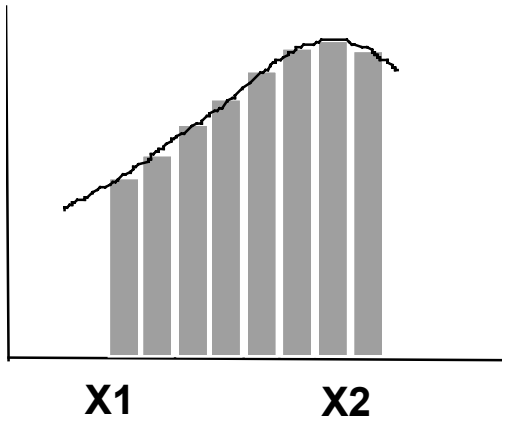


Figure 11.4

Modeling Issues (continued)

- Numerical Simulation vs. “Closed Form” Solution

  A Simulation -- Stepping a Model through Time

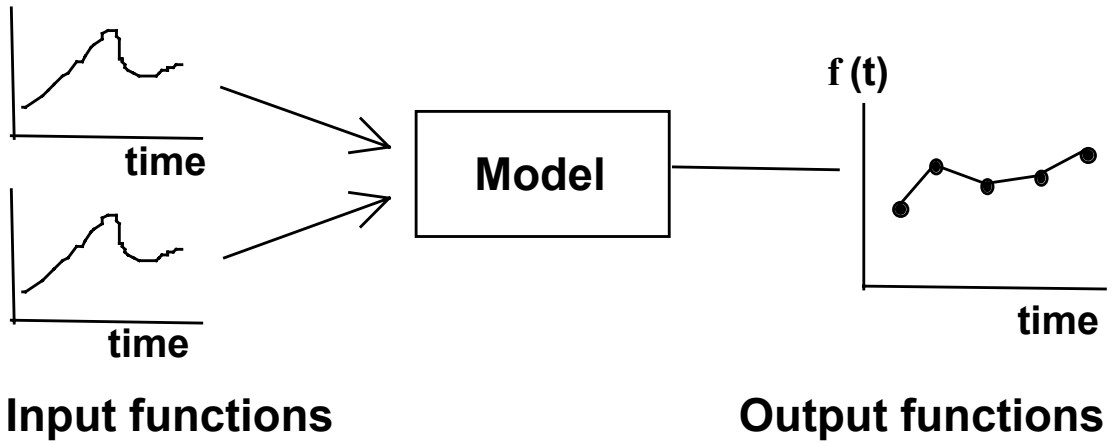


Figure 11.5

Modeling Issues (continued)

- Behavioral vs. Aggregate Models
- Physical vs. Mathematical Models

Modeling Issues (continued)

- Solution Techniques
  - Getting answers from the model is fundamental to what transportation professionals do.
  - Transportation professionals can have billions and billions of options, so coming up with some efficient method for mathematically searching through decision space using optimization theory is critical.
  - Sometimes, scaling down the problem to make it easier to solve is an appropriate strategy when we develop models to predict performance.
  - Deciding between “simple” representations using closed-form mathematical solutions or “complex” simulation models to generate answers is very important.

Why We Model

- To understand
- To explain
- To predict
- To improve

"What are we going to use the results for?"

All models are wrong.

However, some are useful.

- 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 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 unthinkable. Our challenge is to choose relevant subsystems and model them appropriately for the intended purpose, mindfully reflecting the boundary effects of the unmodeled components.

Issues in Model Building

Our model does not work in practice because it is true; rather we hold our model to be true because it works in practice.

Issues in Model Building (continued)

- Time and Resources
- Data
- Designing a Successful Model
- Ease of Use
- Convincing Models
- Growth Path
- Produce Benefits

Issues in Model Building (continued)

- Measuring Model Success
  - Research View: The ways in which people in practice and those in academia measure the success of models may differ substantially. Think about concepts like unique solutions and assuring that there is a strong theoretical base.
  - Practice View: "Does it help me in my job? Does it make me be a better Vice-President - Marketing than I was before I had this model?"

New Developments in Models and Frameworks

- Solution of Very Large Transportation Problems
- The IT Environment
- Real-Time Solutions
- Transportation on the Agenda

Now, we have completed Part I course.

Let’s go on to *FREIGHT*.