# SYST 101: Intro to Systems
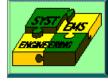
# Lecture 6

Feb. 5, 2003

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# Announcements
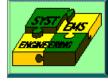
# Agenda

- Models

# Model - Definition

- A model is a representation of some entity.

- The entity does not have to actually exist.

- The model itself does not have to have physical existence.

# WARNING!

- Models are not reality
  - They represent reality
  - They are simplistic
  - They are erroneous (but may be good enough)

- The problems we encounter in system engineering are really problems in the adequacy of our models

# SEVERE WARNING

- System engineers live in the world of models more than in the real world
  - corollary: All engineers live in the world of models more than in the real world

- You may start to believe the model is the the real thing
  - The important thing is the entity the model represents (even for the model makers)

# EXTREME WARNING

- Use the models to understand the entity they represent, but --
  - Models are always in error
  - Models may not be good enough
  - Trust real performance over your model
- Manufacturers and users tend to live in the real world and not in a model world

# Creative Tasks

- Most creative tasks involve making models

  – Models are the first guess

  – Refined models are the result of analysis, interpretation and revision

- Always the question of adequacy of the model

# Engineering is ---

- a creative process

- usually involved in making models of things for others to make

- not usually involved with making things
  - Technicians and manufacturers make things

# Two Flavors of Models

- ## The "pre-reality" model
  - exists before an entity
  - used in creating an entity
  - used in understanding a hypothetical entity
- ## The "post-reality" model
  - exists after the entity exists
  - used in understanding a real entity

# Adequacy

- The problem of adequacy is exposed when we attempt to make the "entity"

  – The realized model does not match expectations

- The problem of adequacy is exposed when we attempt to model reality

  – The model's behavior does not match reality

# Risk

- There is risk whenever we go between a modeled universe and the real universe
  - Errors caused by
    - Lack of experience
    - Errors in assumptions
  - Impact of errors
    - cost
    - opportunity

# Risk Reduction

- Improve models
  - Improved fidelity
  - Improved detail
  - Validate models
- Improve analysis

# Examples of Models

- Mental models
  - Evaluation of universe
  - Expectations of people
  - Behavior of people
  - System performance
  - Organizational performance
  - Communication

- We constantly create and modify mental models based on our experiences

# Examples (cont.)

- Physical models
  - Descriptive
  - Evaluation
- Mathematical models
- Linguistic models

# Communication

- Concepts are our mental models
  - The problem is transferring them to others
  - Models can represent concepts
- Books
  - Fiction and non-fiction
- Plans
  - Schedules
  - Blue prints

# Understand Where You Stand

- Engineers live largely in a model world
  - We are "knowledge" workers
  - Our concepts, analysis, and interpretation are all model based
  - We use "models" to communicate our "knowledge" work to others
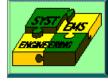- Others usually make the models into real entities

# What Is Reality

- A model represents an entity, but an entity can be a model

- Knowledge workers can be confused
  - For knowledge workers, your concepts (models) are what you are hired for
  - Your representations (models) of these concepts (models) are the products (entities) you produce
  - Will an implementation (reality) perform as expected?

# Assignments

- Reading
  - Petroski, Invention by Design Chapter 4
  - Homework
    - none