



# SYST 101: Intro to Systems

## Lecture 16

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# Announcements



# Agenda

- Dr. Kathy Laskey (SEOR) on the department curriculum
- Modeling - Initial Concepts



# Modeling

- What do we mean when we say “model”?
- Models:
  - Plastic airplanes
  - Mental models
  - Simulations
  - Scale models
  - Test 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.



# Modeling - Purpose

- We build models to
  - Describe the entities they represent
  - Learn about the entities they represent,
  - Learn how the entities interact
  - Have fun!
  - Others (too numerous to mention)



# Forms of Models

- Mental models
  - how you conceive of something
  - how you perceive something
- Physical models
  - to describe
  - to predict or validate behavior
- Mathematical models
  - to understand behavior
- Others (too numerous to mention)



# Examples

- Model airplane
- Sculpture
- Drawings (pictures, sketches, blueprints, etc.)
- Equations
- Ideas
- Plans?
- Functional Flow Block Diagrams?





# Why Use Models

- Because the entity –
  - does not have to exist
  - is too complicated to understand
  - is too costly to build unless it works
  - is too dangerous to use until we understand it



# Models Are Scalable

- How detailed must a model be?
  - It depends on the use
- What kind of model should be used?
  - It depends on the use
- You can do a cost/benefit analysis of the information gained (benefit) versus the type/detail of the model (cost)



# 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



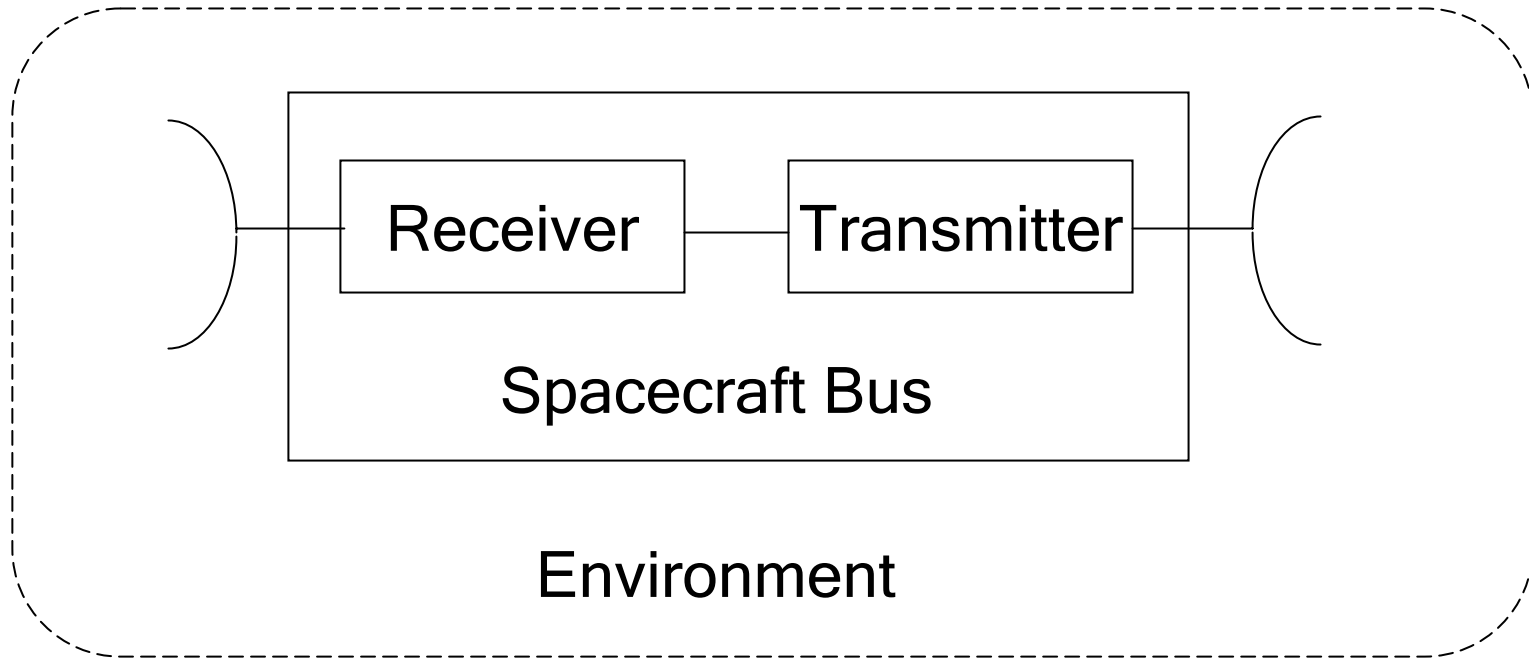
# Model Verification

- Models may need to be verified if their accuracy is questionable
  - Too simplified
  - Design far from the existing practice
  - Design close to failure
- The design may require Qualification if the accuracy of the model is questionable



# System Design Using Models

- Design a satellite to relay communications
- Conceptual (first guess) model





# Typical Models in SC Design

- Element performance models
- Black box models
- Concept demonstration models
- Launch environment models
- Finite element mechanical models
- Qualification models
- Orbital mechanics models
- Space environment models
- Propagation models





# Assignments

- Reading
  - None today.
- Homework (due next class)
  - Give examples of 5 models to include
    - Form
    - Purpose