

# Module 38, Modeling

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## Abstract

This module discusses modeling, especially aspects such as credibility, working range, and accuracy.

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# Modeling and Analysis: Reasoning Approach

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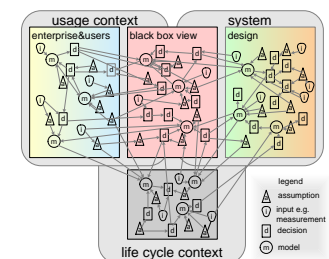
## Abstract

We make models to facilitate decision making. These decisions range from business decisions, such as Service Level Agreements, to requirements, and to detailed design decisions. The space of decisions is huge and heterogeneous. The proposed modeling approach is to use multiple small and simple models. In this paper we discuss how to reason by means of multiple models.

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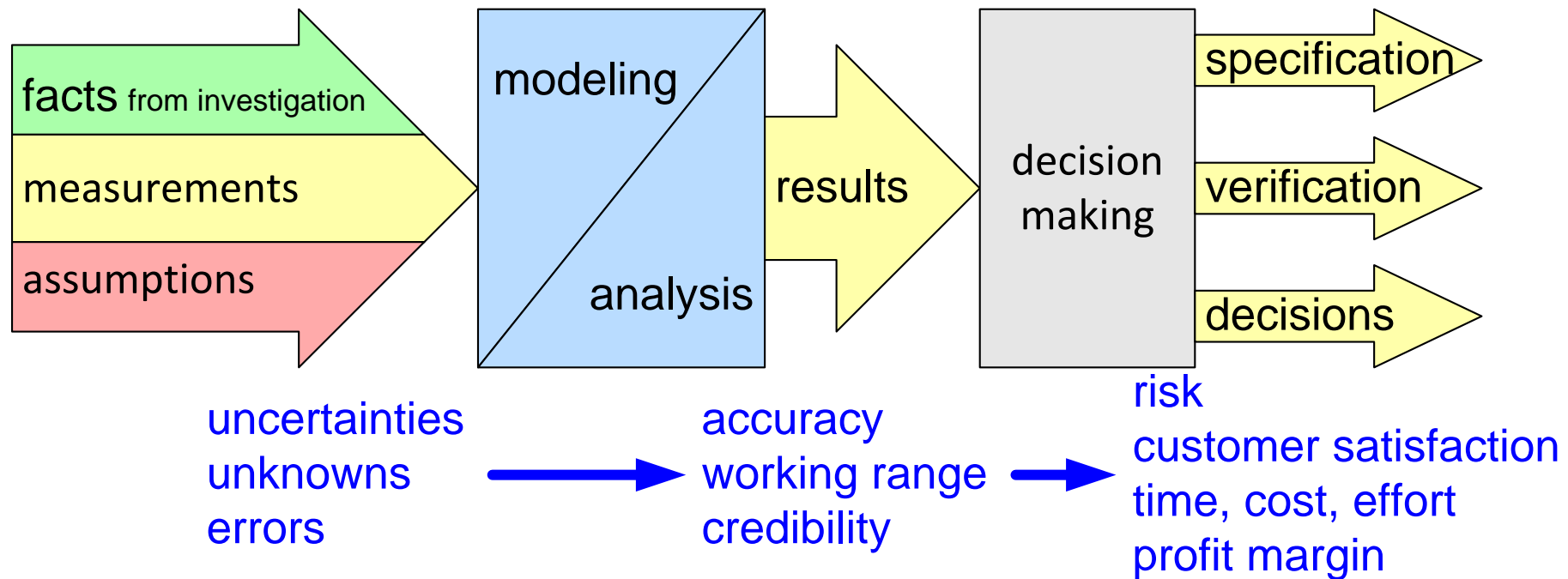
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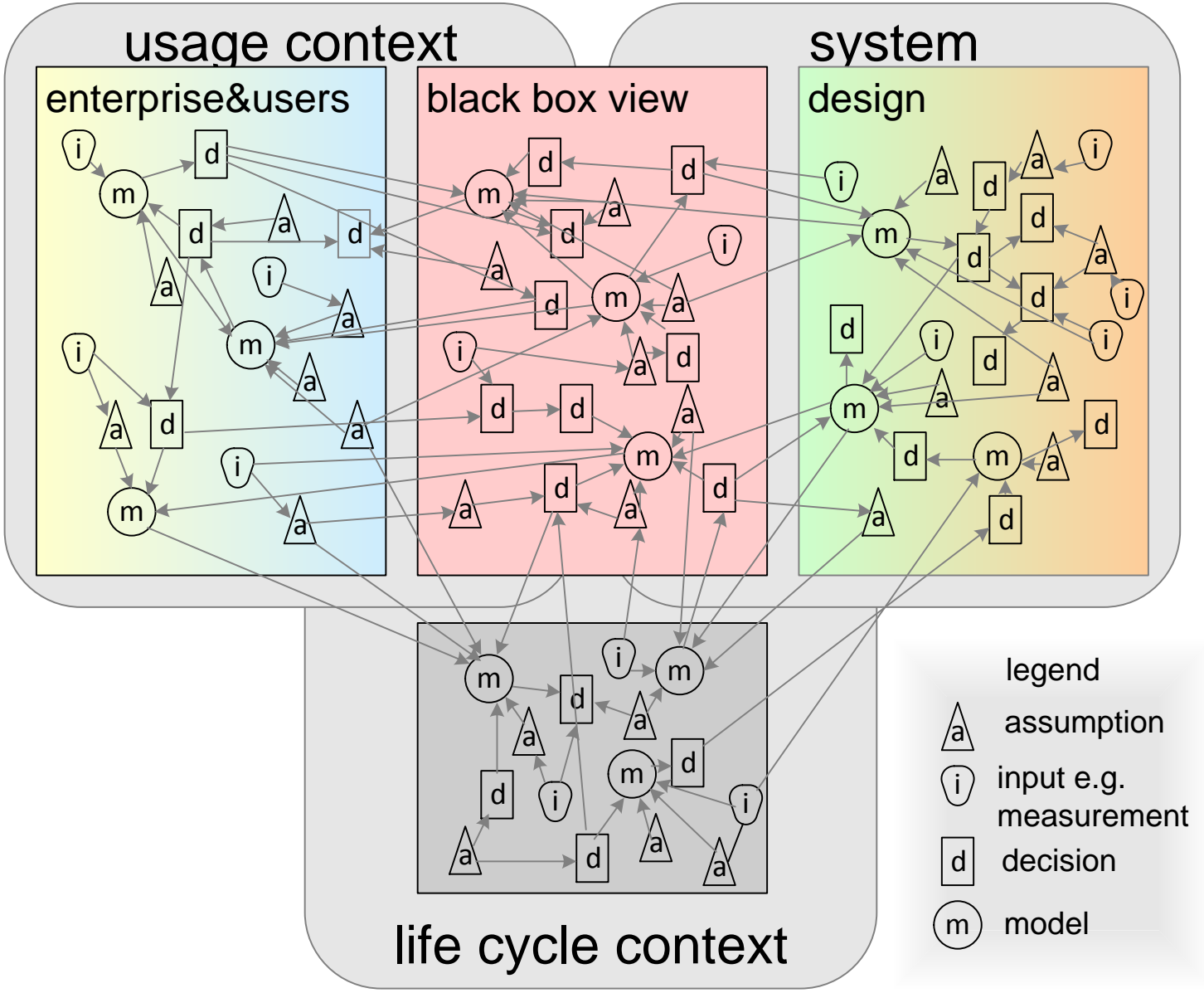


# Purpose of Modeling

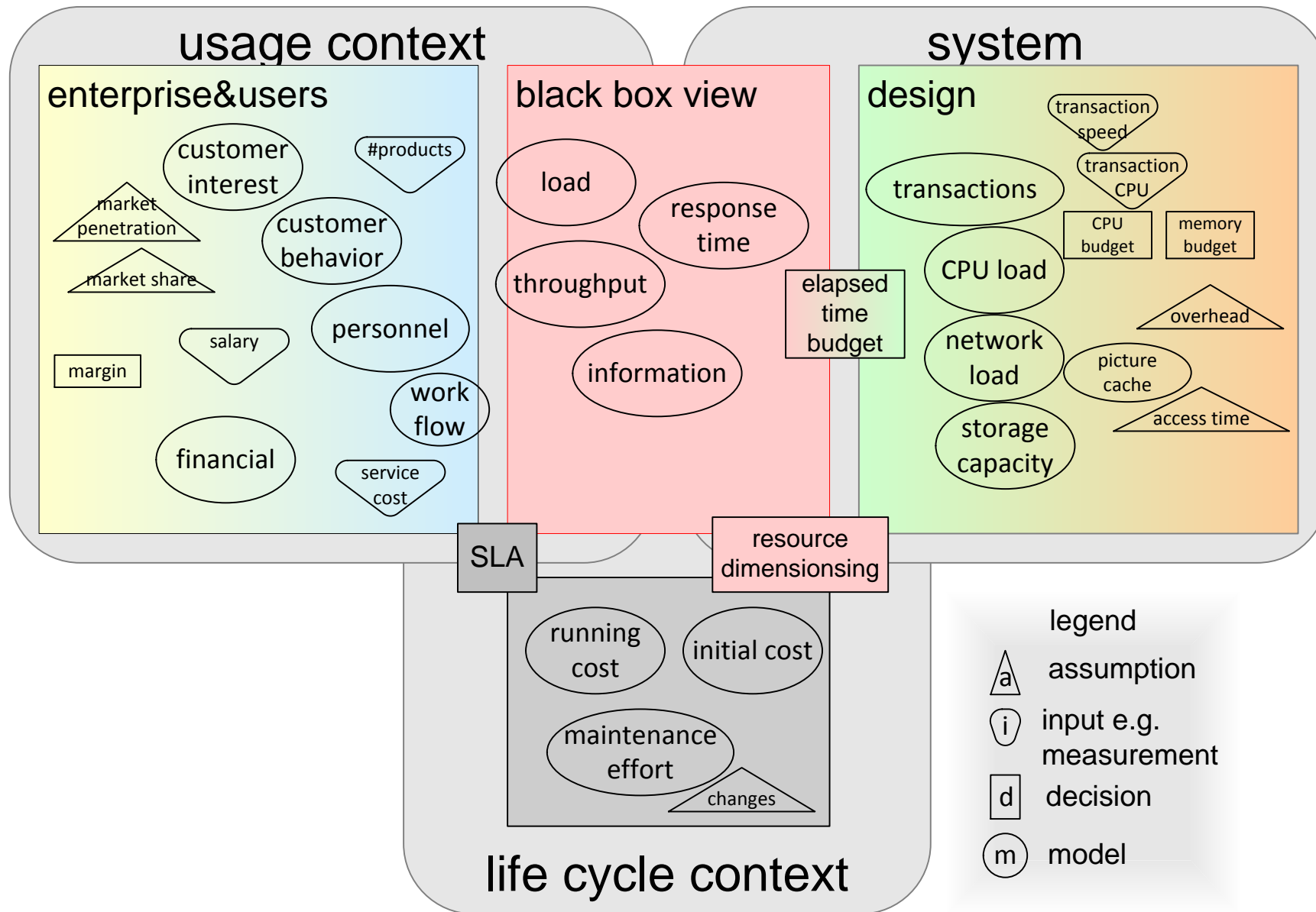
*How to use multiple models to facilitate decisions?  
How to get from many fragments to integral insight?  
How many models do we need?  
At what quality and complexity levels ?*



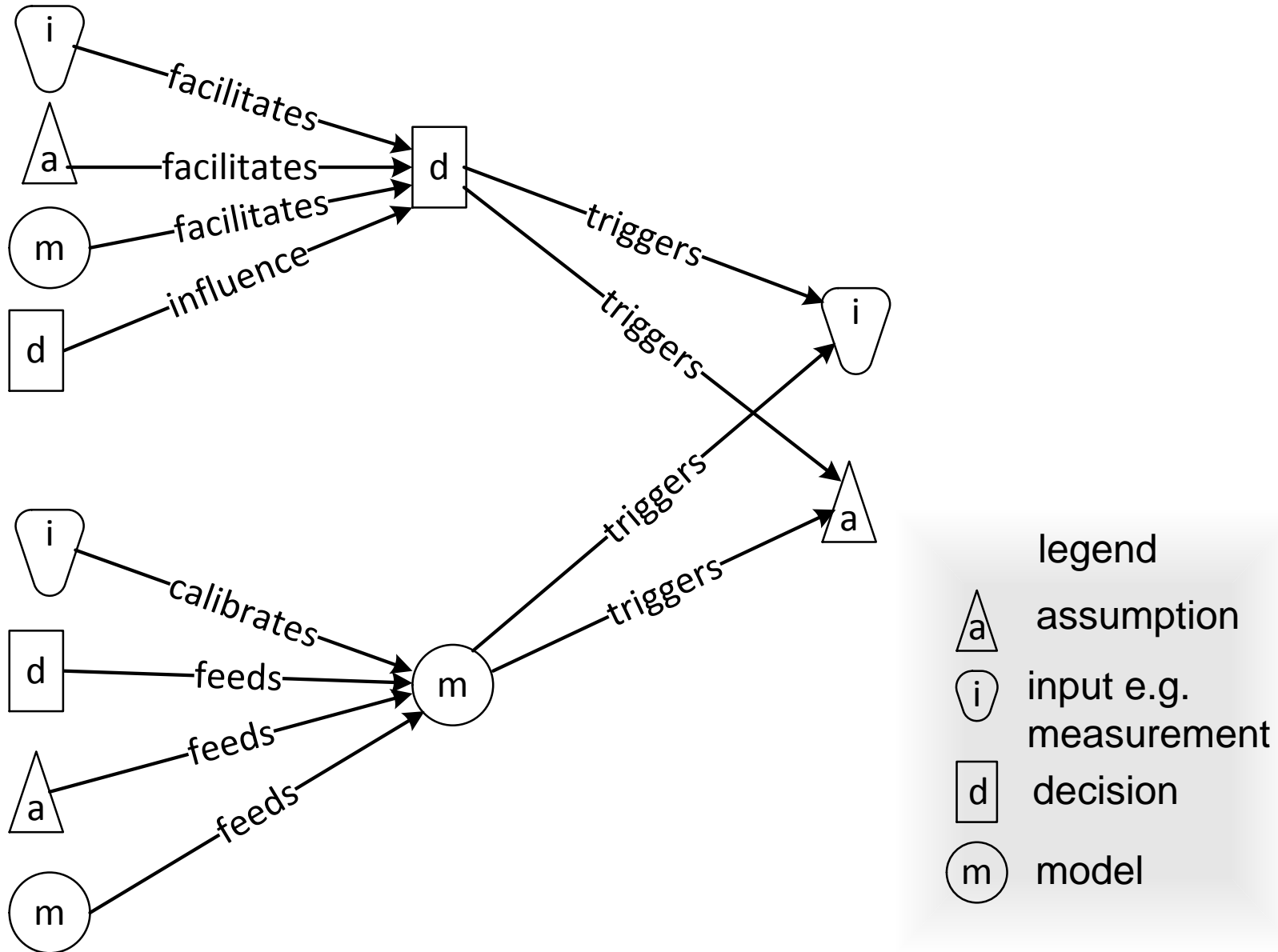
# Graph of Decisions and Models



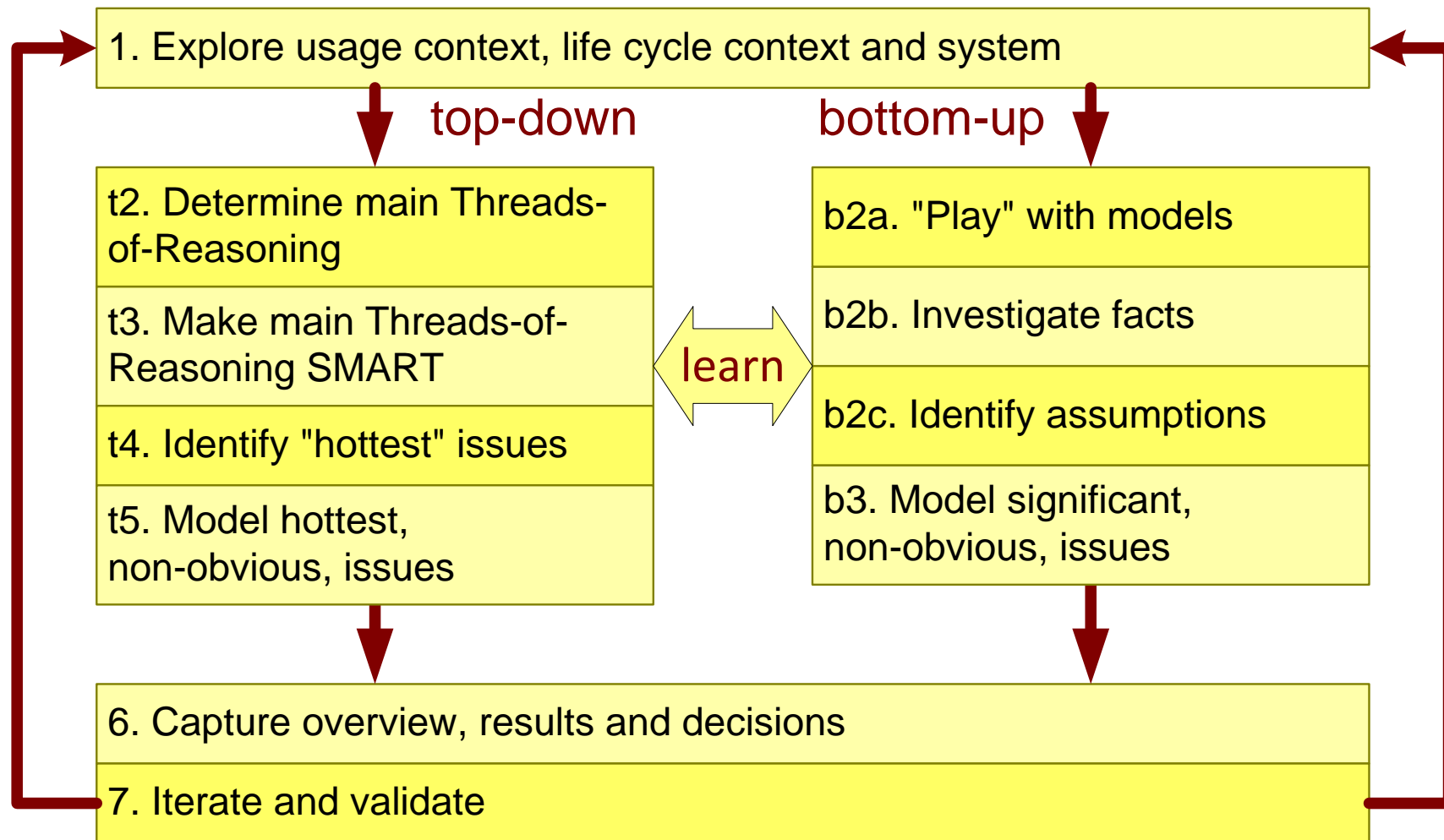
# Example Graph for Web Shop



# Relations: Decisions, Models, Inputs and Assumptions



# Reasoning Approach

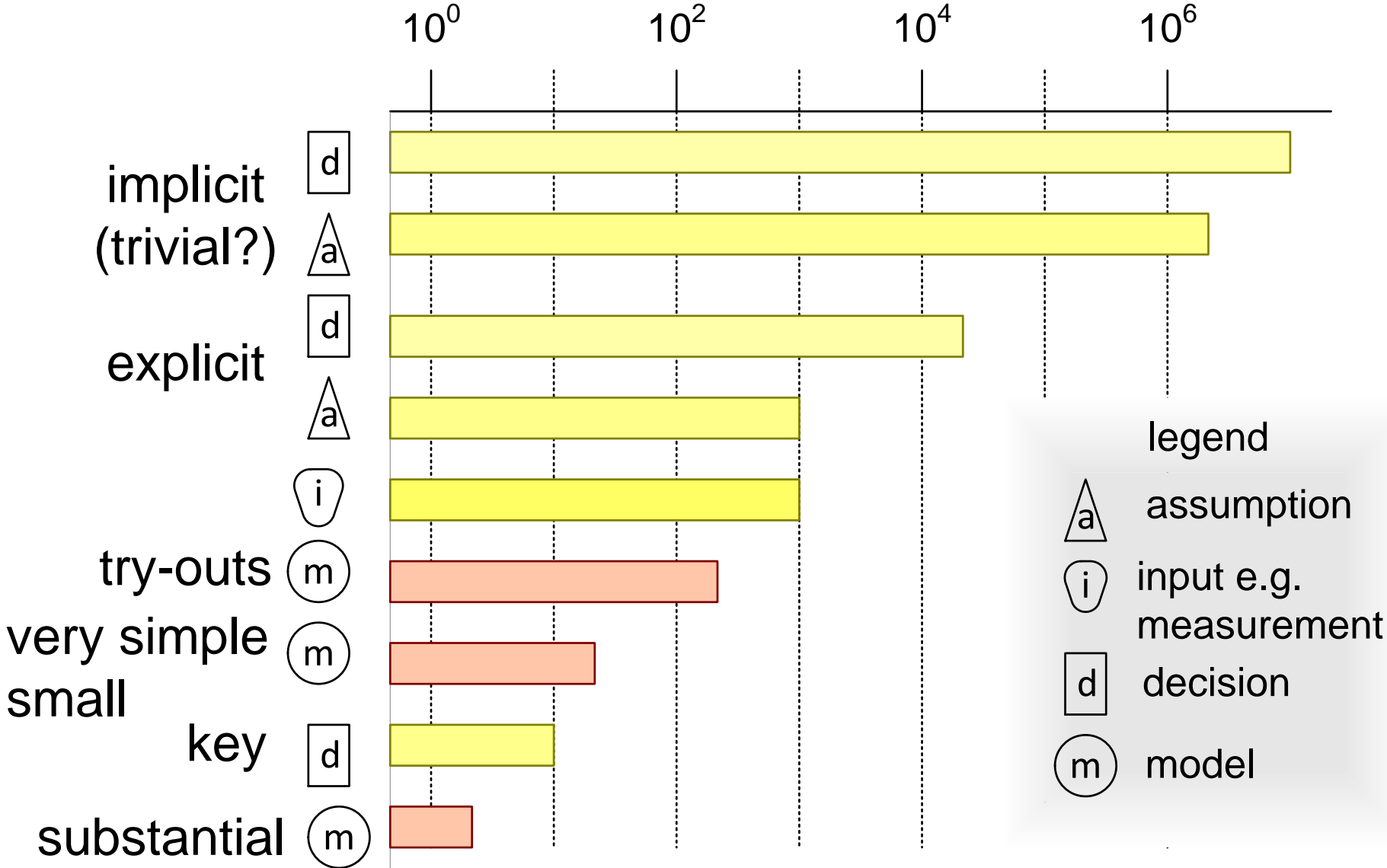


*all steps time-boxed between 1 hour and a few days*

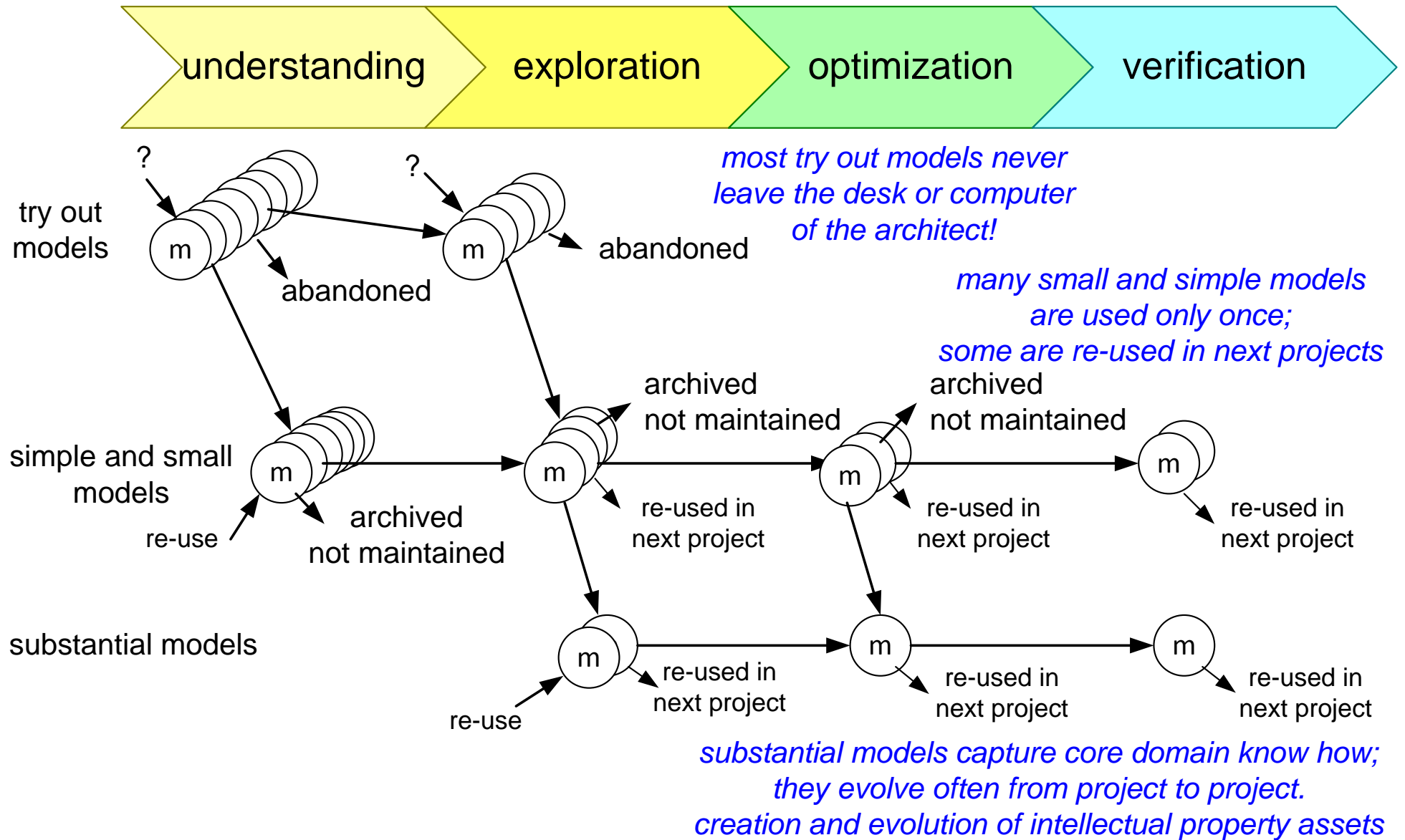
early in  
project

later in  
project

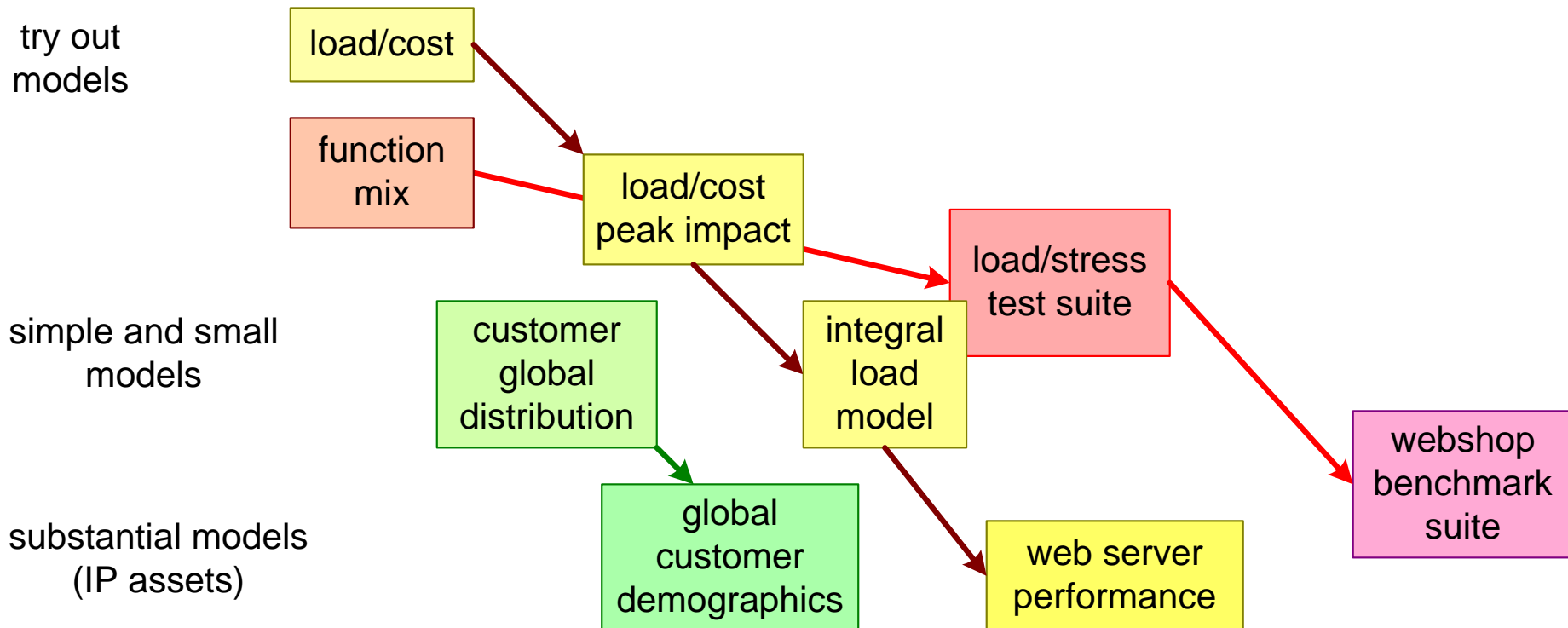
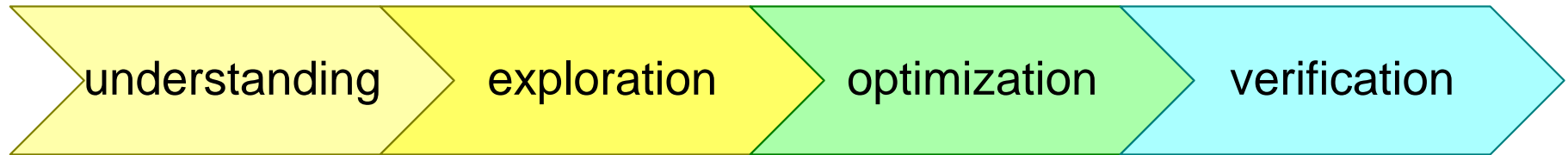
# Frequency of Assumptions, Decisions and Modeling



# Life Cycle of Models



# Examples of Life Cycle of Models



Identify a **chain of models** needed to support architecture development.

- models are related horizontally in the CAFCR model (across views), as well as vertically within a view
- models have various levels of detail; detailed models tend to feed/support less detailed models
- per model
  - formulate its purpose
  - indicate the main quantities that play a role

# Modeling and Analysis: Model Analysis

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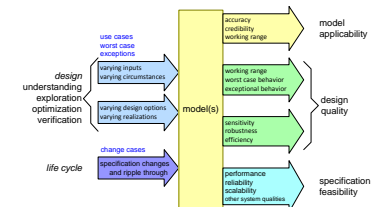
## Abstract

Models only get value when they are actively used. We will focus in this presentation on analysis aspects: accuracy, credibility, sensitivity, efficiency, robustness, reliability and scalability.

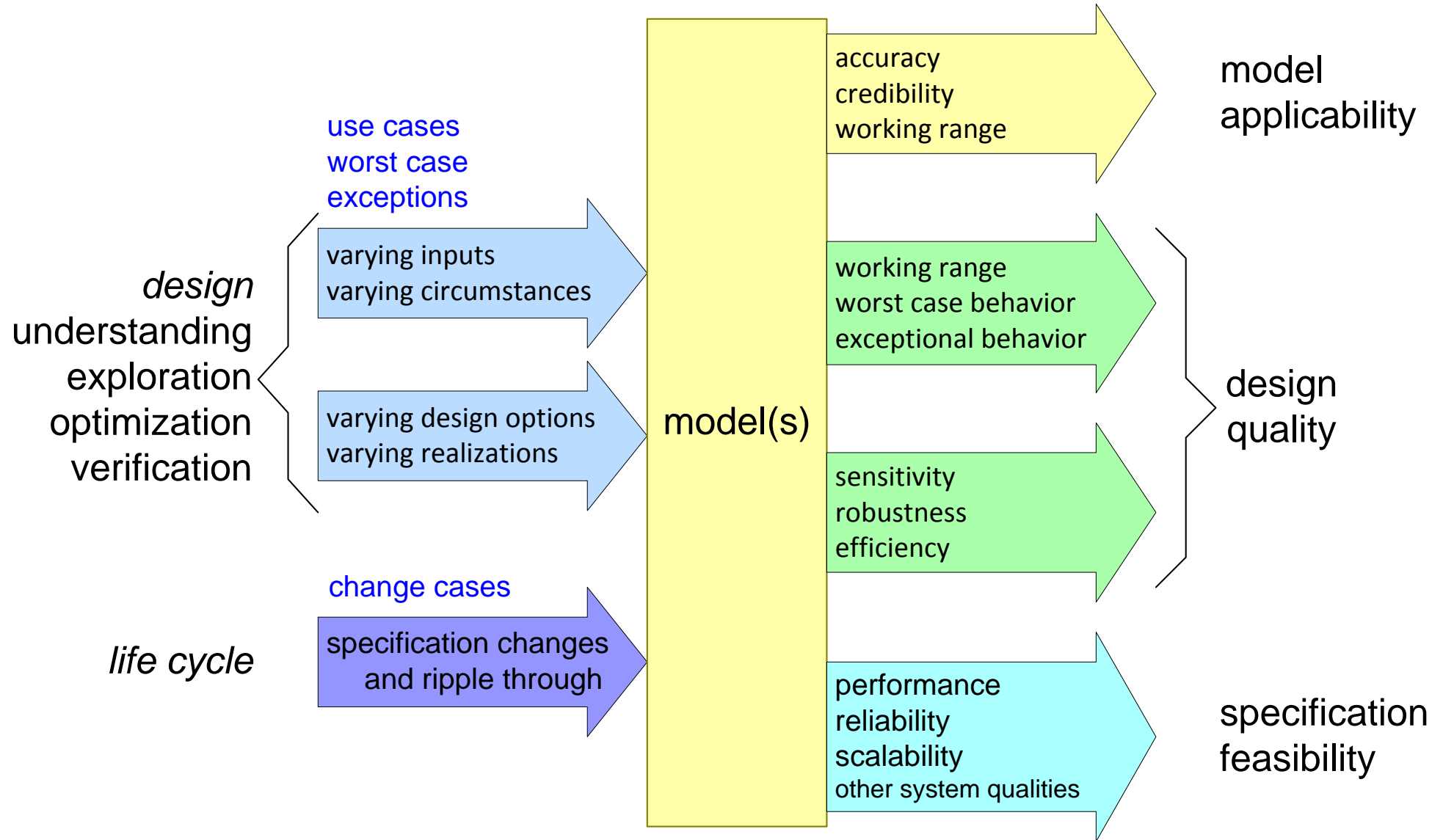
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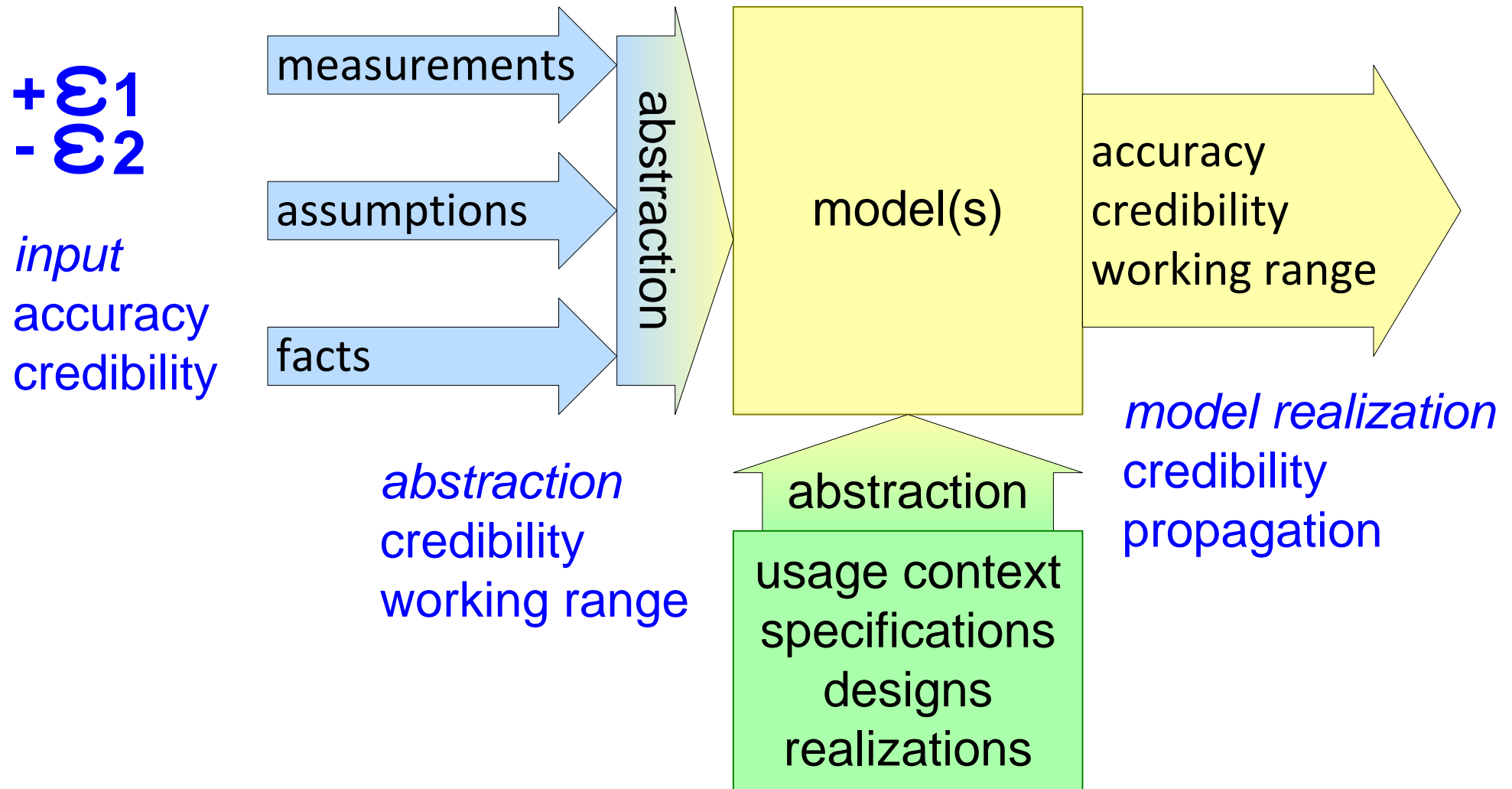
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version: 1.0



# What Comes out of a Model



# Applicability of the Model



# How to Determine Applicability

## *try out models*

be aware of accuracy, credibility and working range

## *simple and small models*

### 1. Estimate accuracy of results

based on most significant inaccuracies of inputs  
and assumed model propagation behavior

### 2. Identify top 3 credibility risks

identify biggest uncertainties in  
inputs, abstractions and realization

### 3. Identify relevant working range risks

identify required (critical) working ranges and  
compare with model working range

## *substantial models*

systematic analysis and documentation of accuracy,  
credibility and working range

# Common Pitfalls

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discrete events in continuous world

discretization artefacts  
e.g. stepwise simulations

(too) systematic input data

random data show different behavior  
e.g. memory fragmentation

fragile model

small model change results in large shift in results

self fulfilling prophecy

price erosions + cost increase (inflation) -> bankruptcy

# Worst Case Questions

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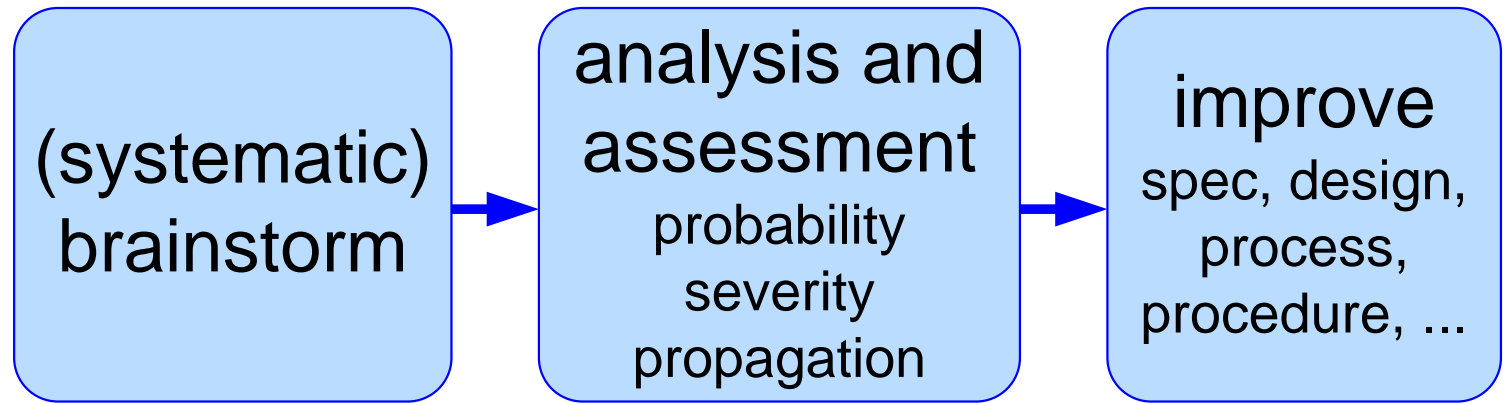
Which design assumptions have a big impact on system performance?

What are the worst cases for these assumptions?

How does the system behave in the worst case?

- a. poor performance within spec
- b. poor performance not within spec
- c. failure -> reliability issue

# FMEA-like Analysis Techniques



<b>safety</b> hazard analysis	potential hazards	damage	measures
<b>reliability</b> FMEA	failure modes exceptional cases	effects	measures
<b>security</b>	vulnerability risks	consequences	measures
<b>maintainability</b>	change cases	impact, effort, time	decisions
<b>performance</b>	worst cases	system behavior	decisions

# Brainstorming Phases

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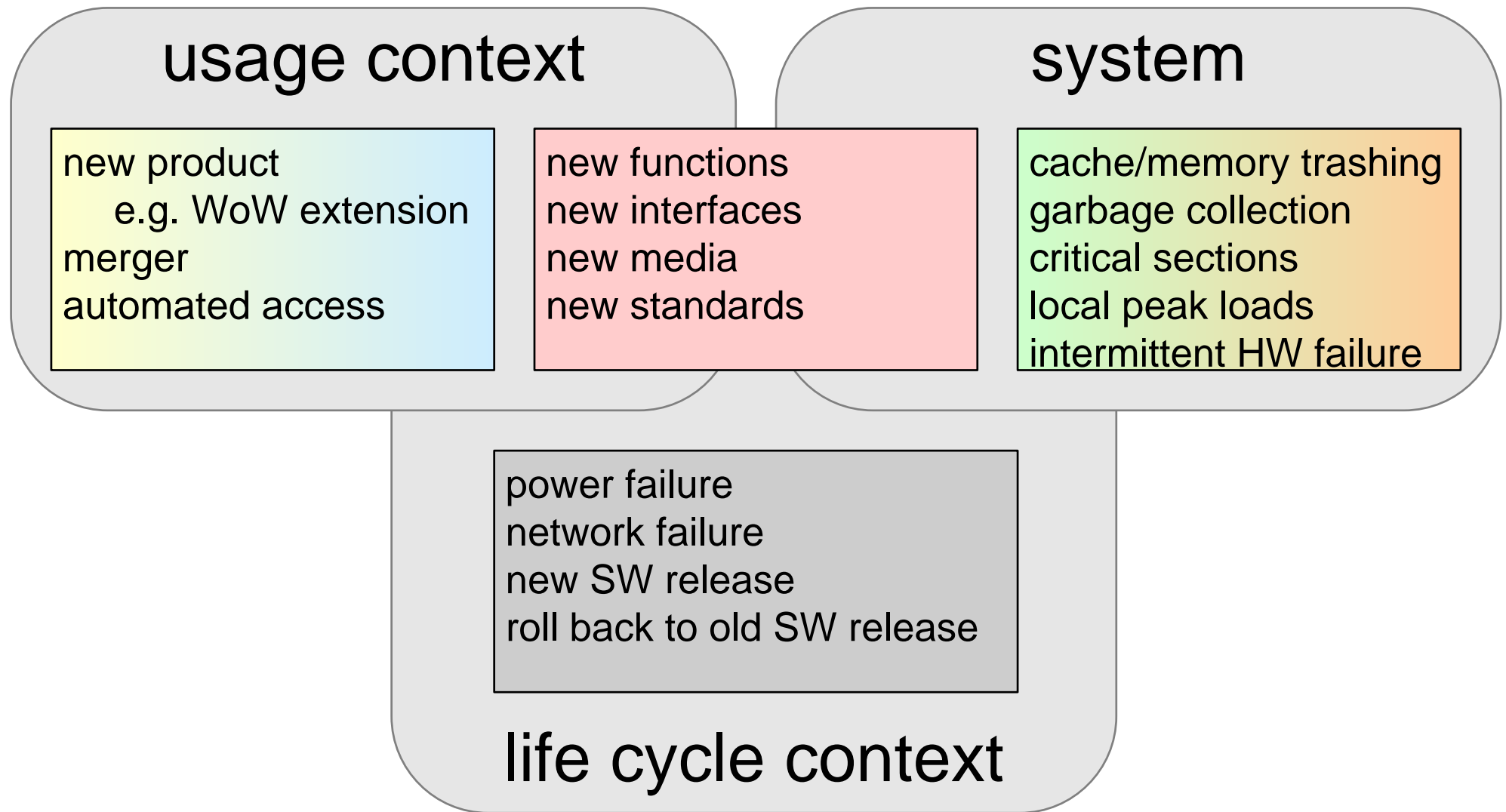
wave 1: the obvious

wave 2: more of the same

wave 3: the exotic, but potentially important

don't stop too early with brainstorming!

# Different Viewpoints for Analysis

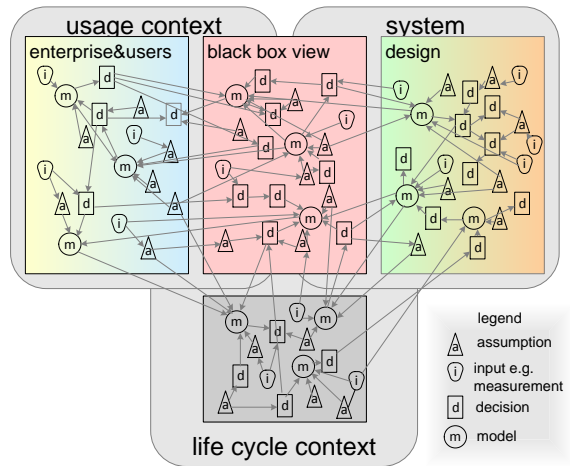


Determine for a few models their **credibility**, **accuracy**, and **working range**.

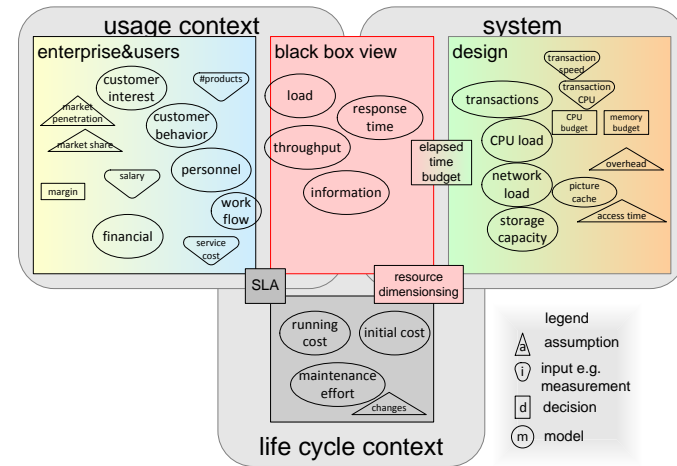
- Identify top 3 credibility risks
  - identify biggest uncertainties in inputs, abstractions and realization
- Estimate accuracy of results; quantitative, e.g. order 1% or 50%
  - based on most significant inaccuracies of inputs and assumed model propagation behavior
- Identify relevant working range risks
  - identify required (critical) working ranges and compare with model working range

# Modeling

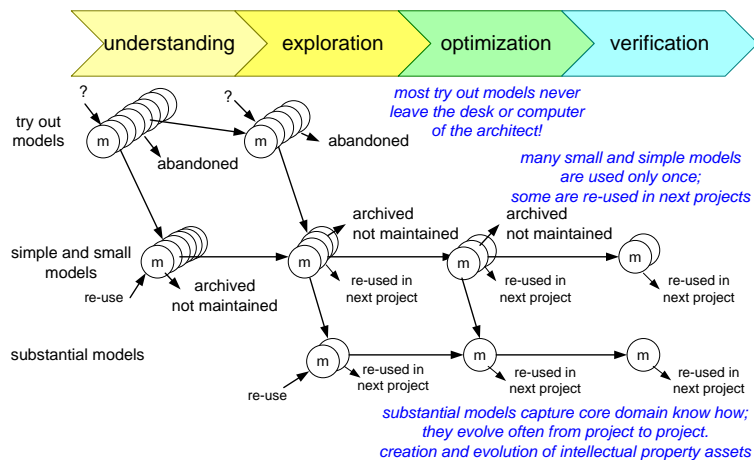
From Chaos...



... to some Order



Many Light Models, few Substantial Models



Accuracy, Credibility, Working Range

