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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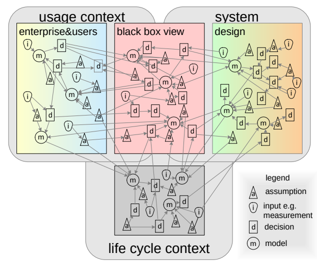


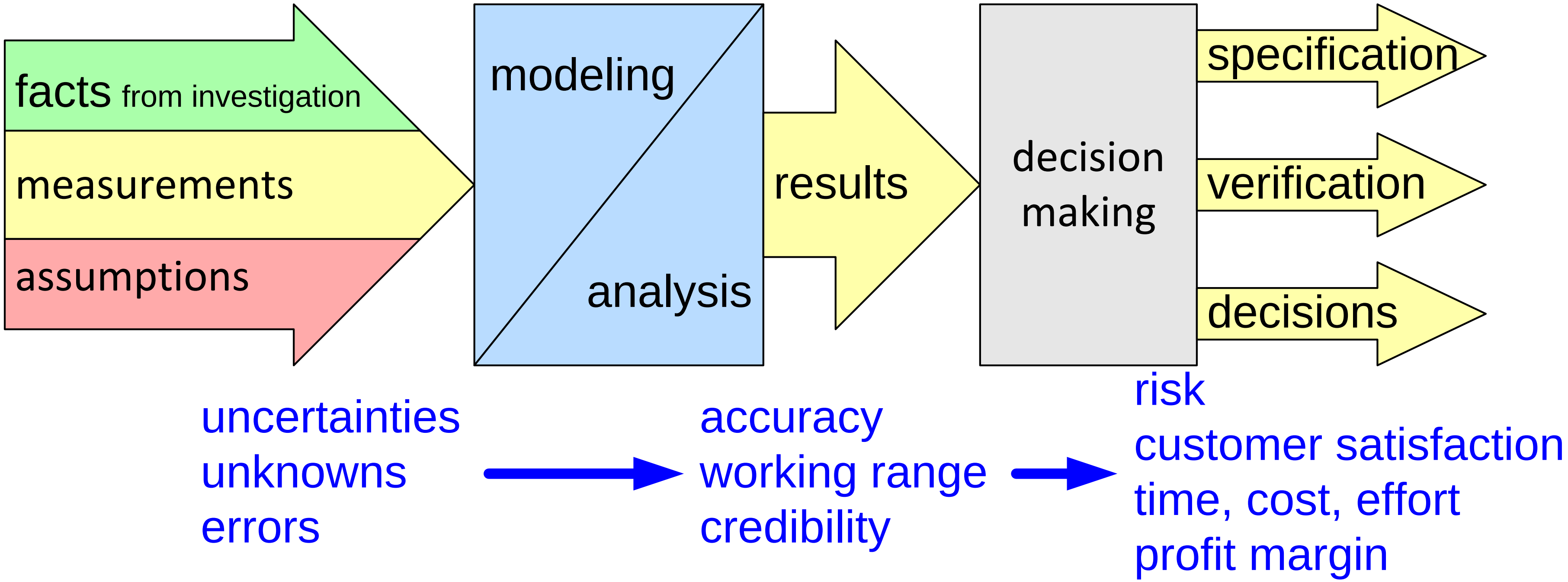
Purpose of Modeling

How to use multiple models to facilitate decisions?

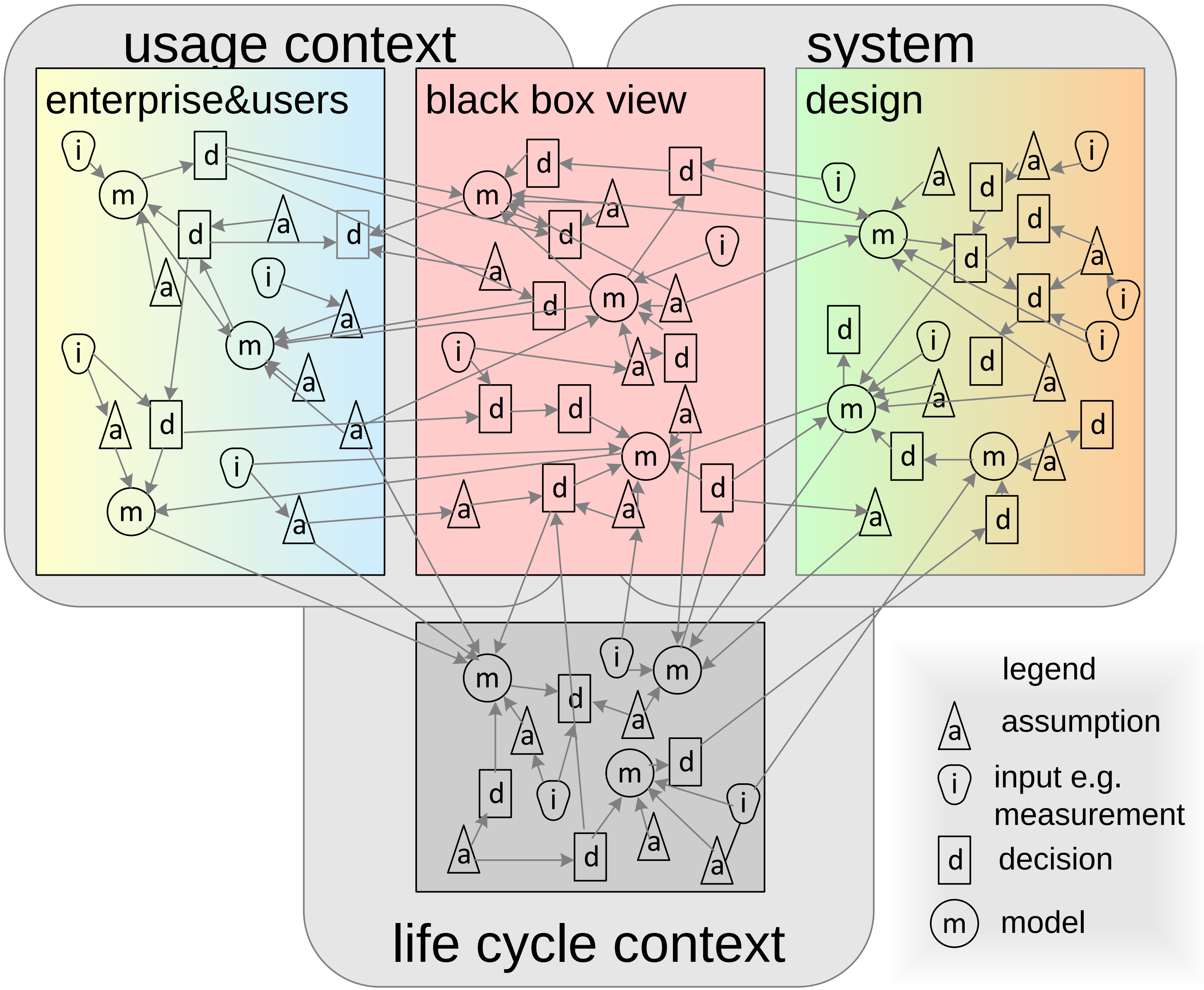
How to get from many fragments to integral insight?

How many models do we need?

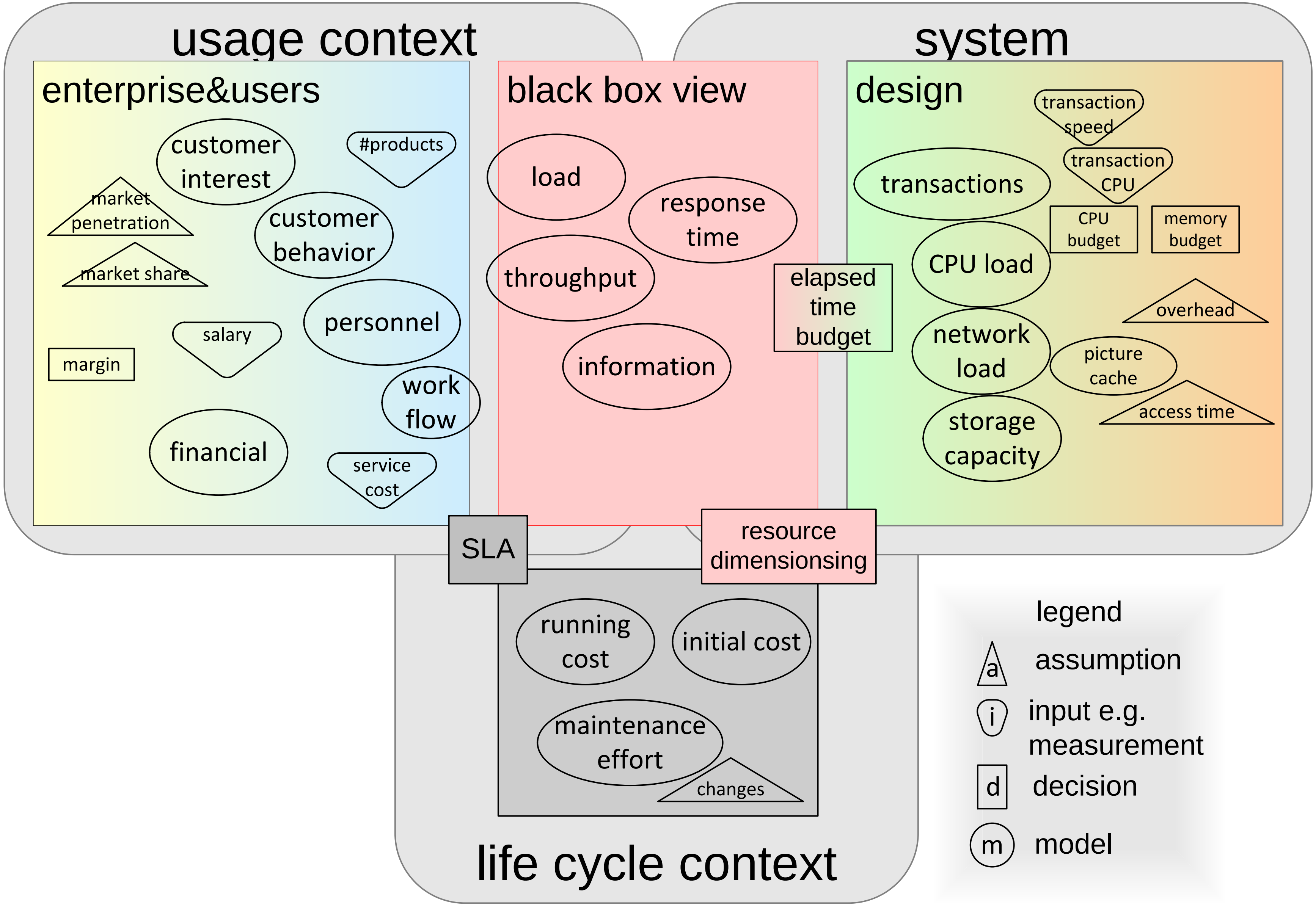
At what quality and complexity levels ?



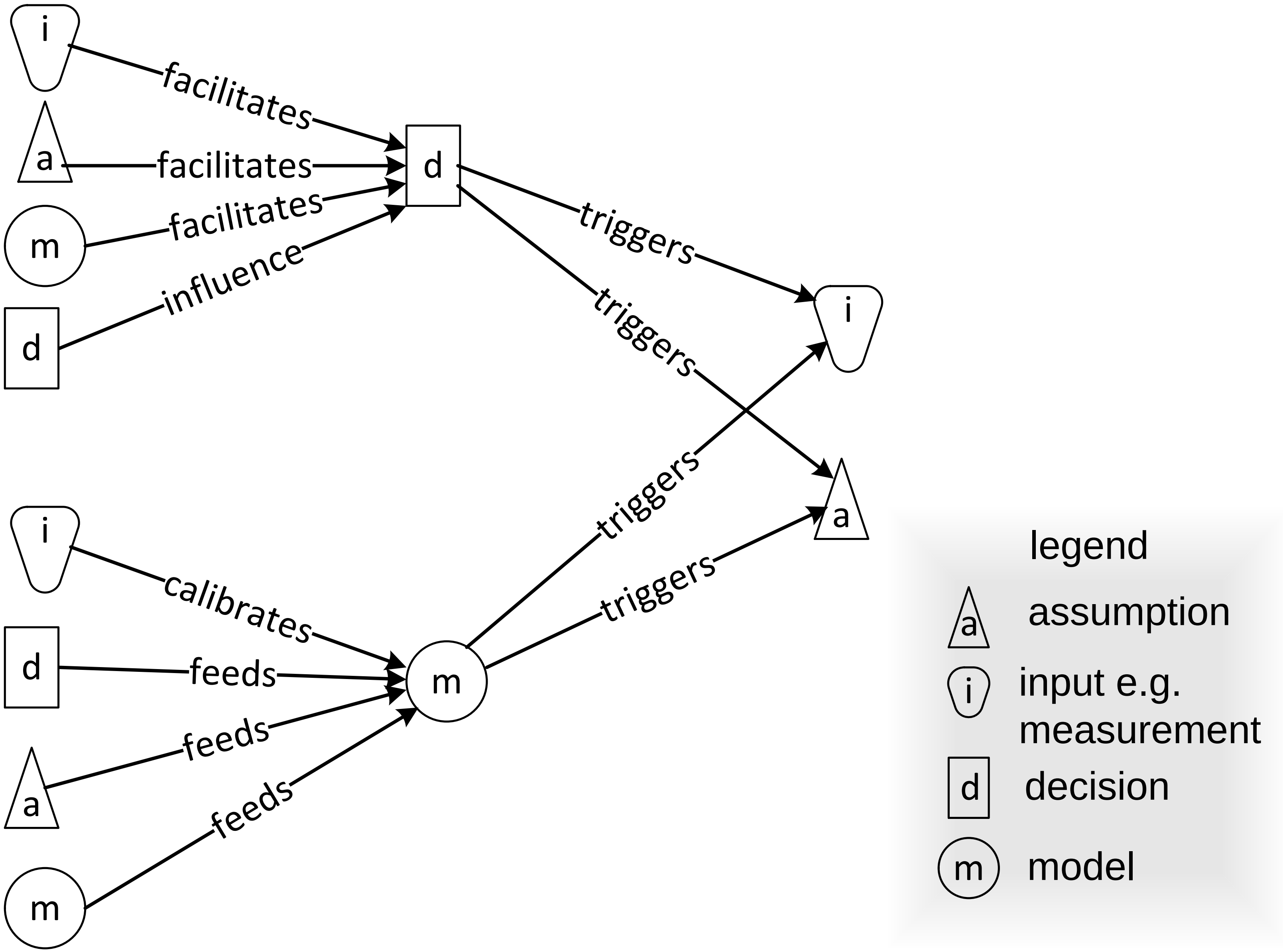
Graph of Decisions and Models



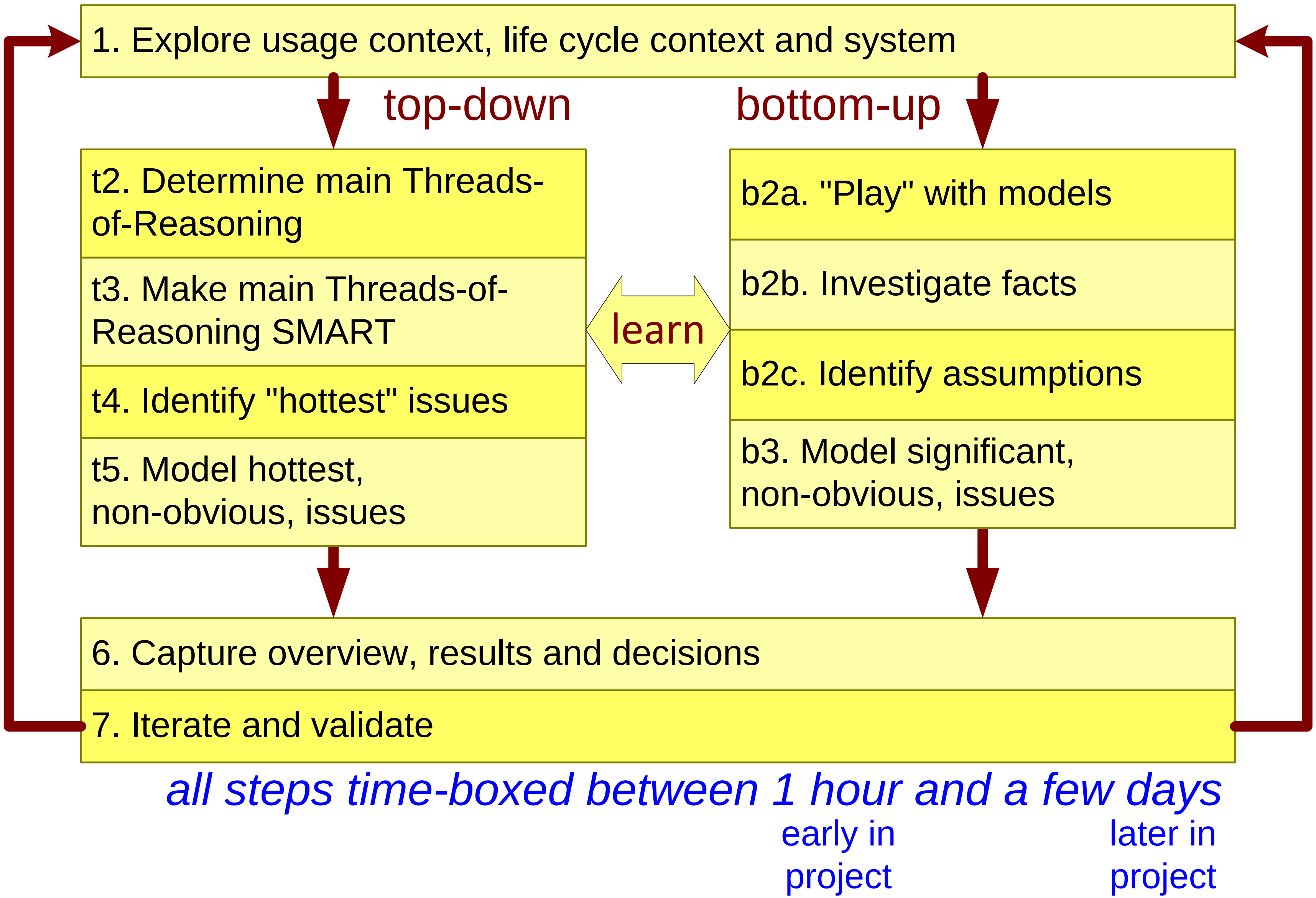
Example Graph for Web Shop



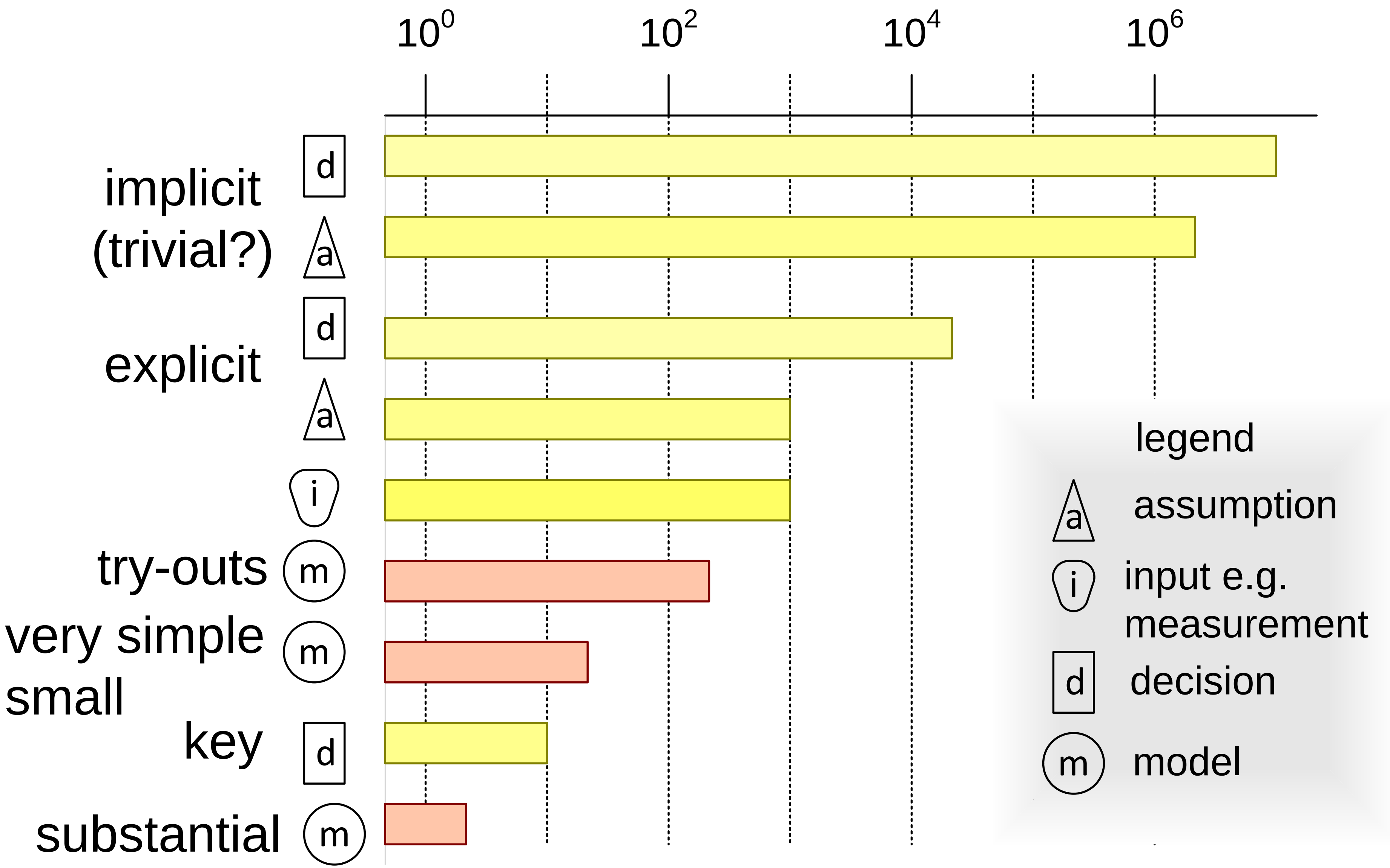
Relations: Decisions, Models, Inputs and Assumptions



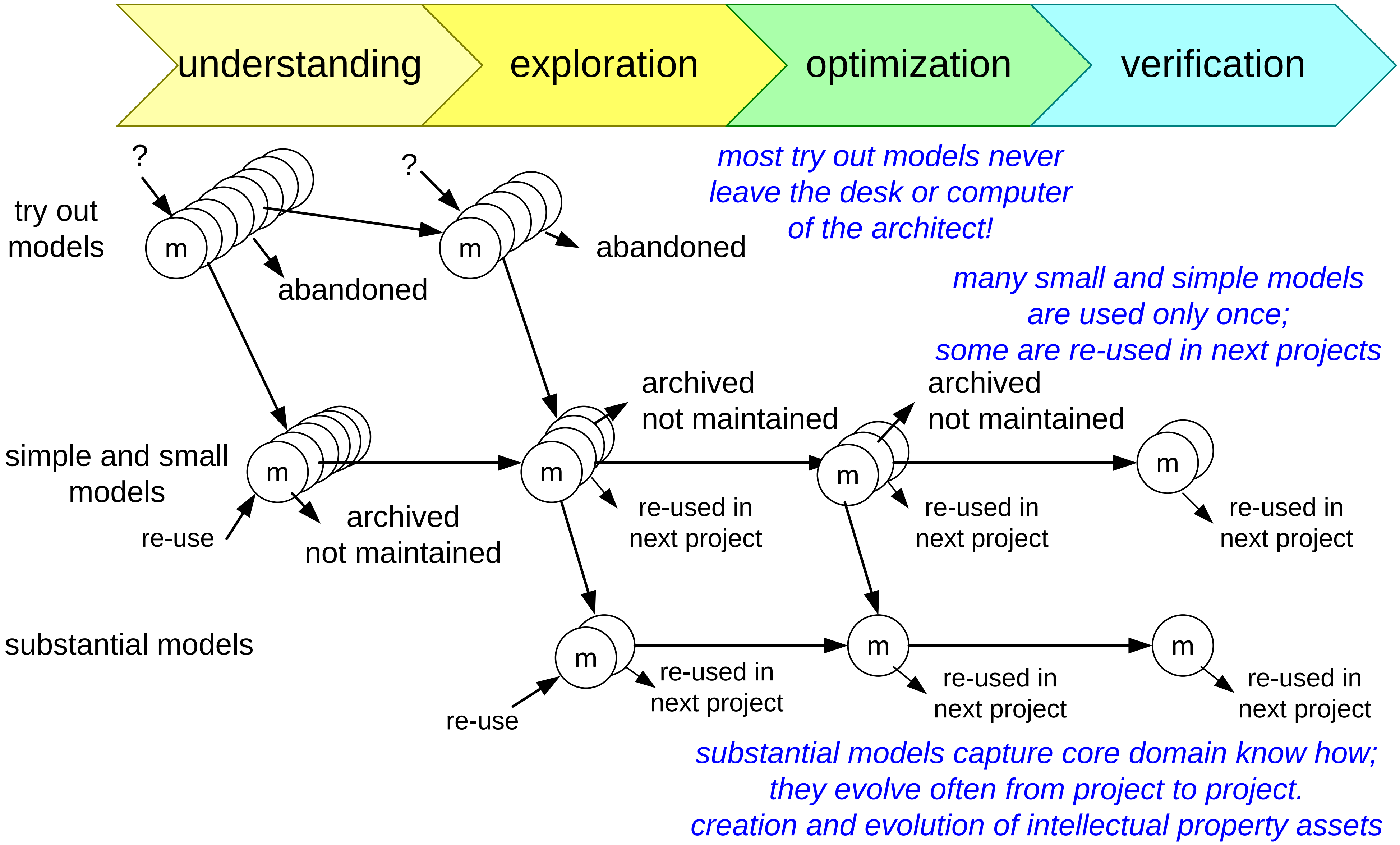
Reasoning Approach



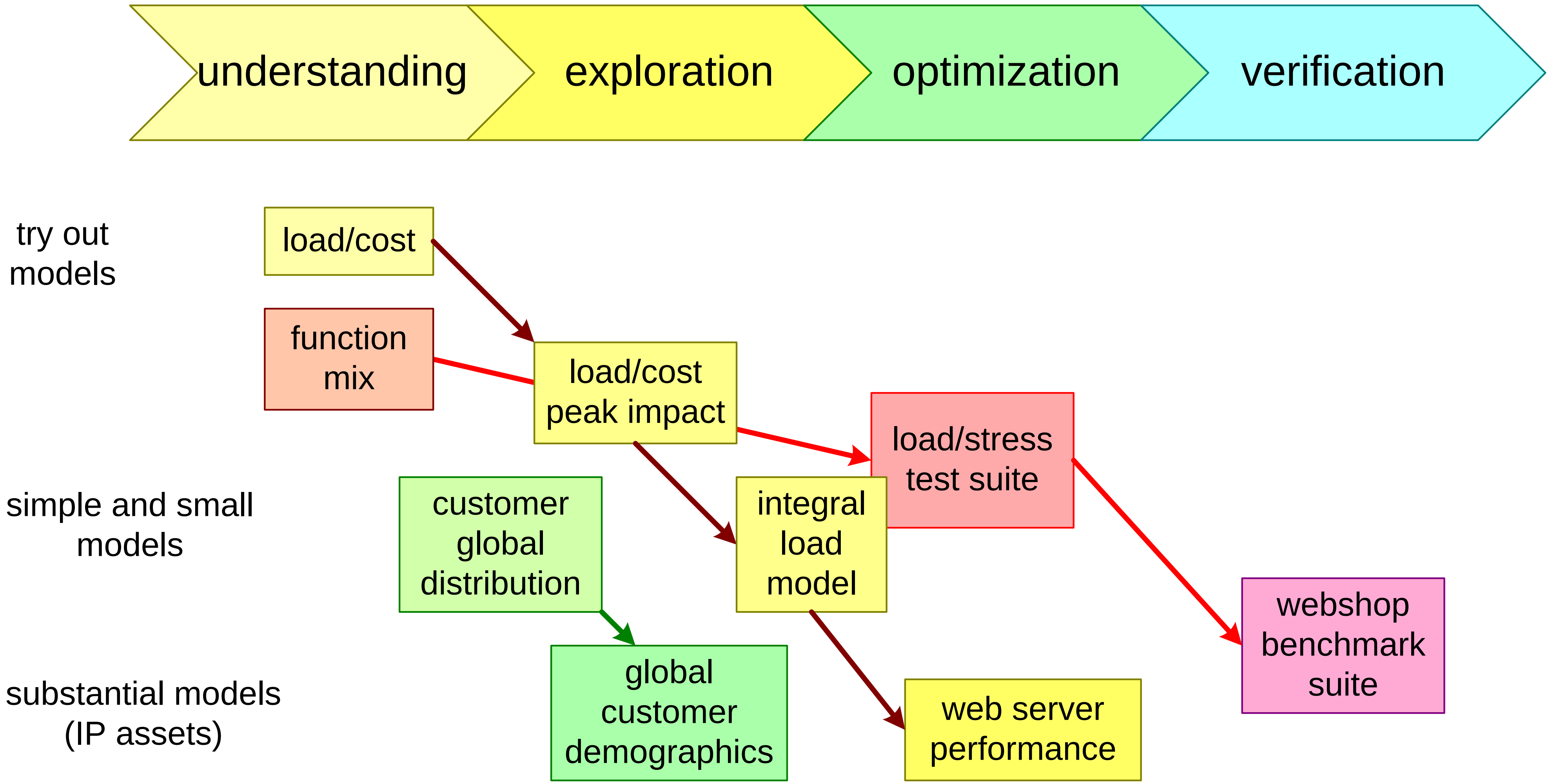
Frequency of Assumptions, Decisions and Modeling



Life Cycle of Models



Examples of Life Cycle of Models



Exercise Chain 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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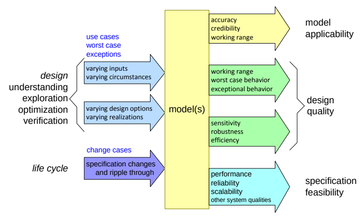
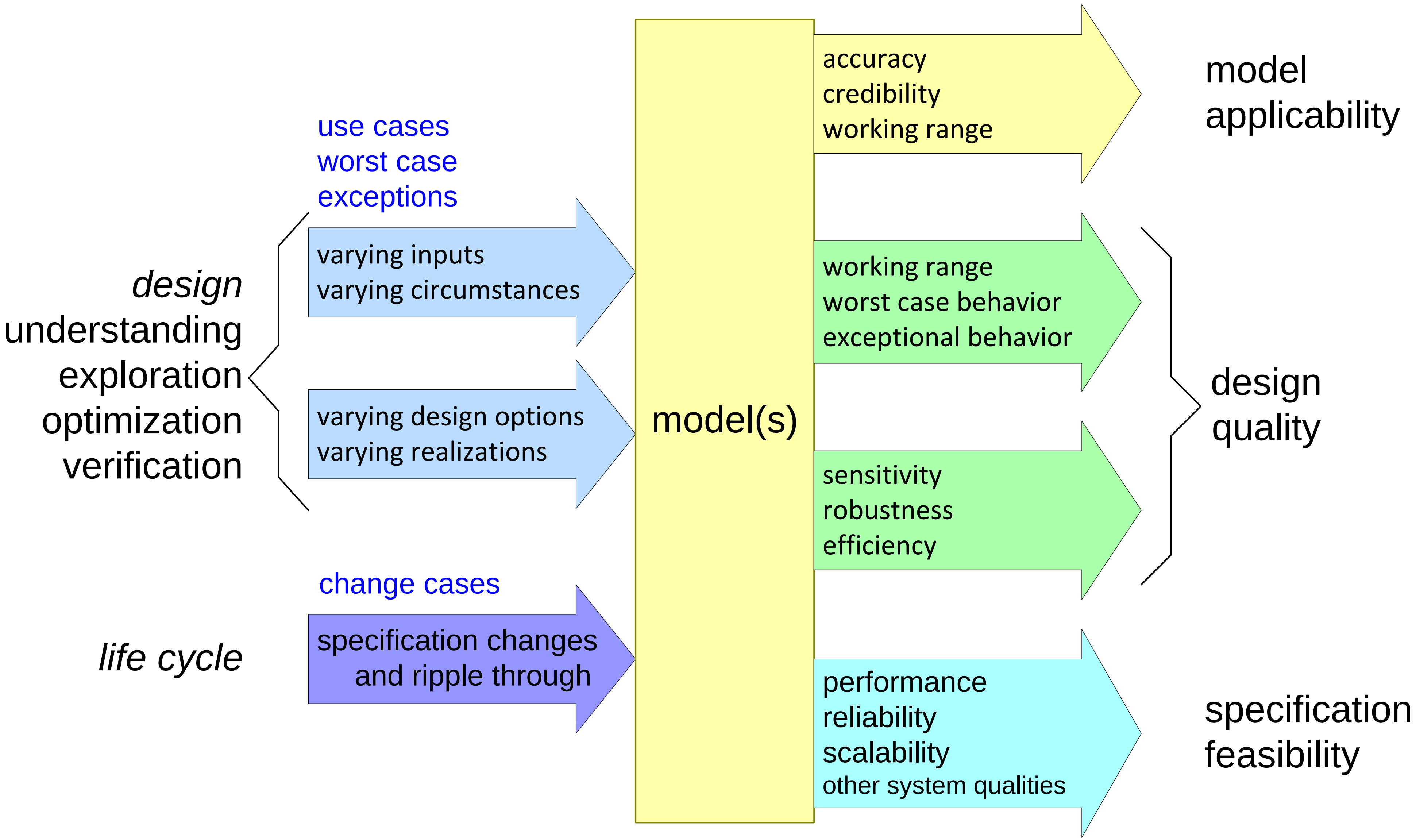
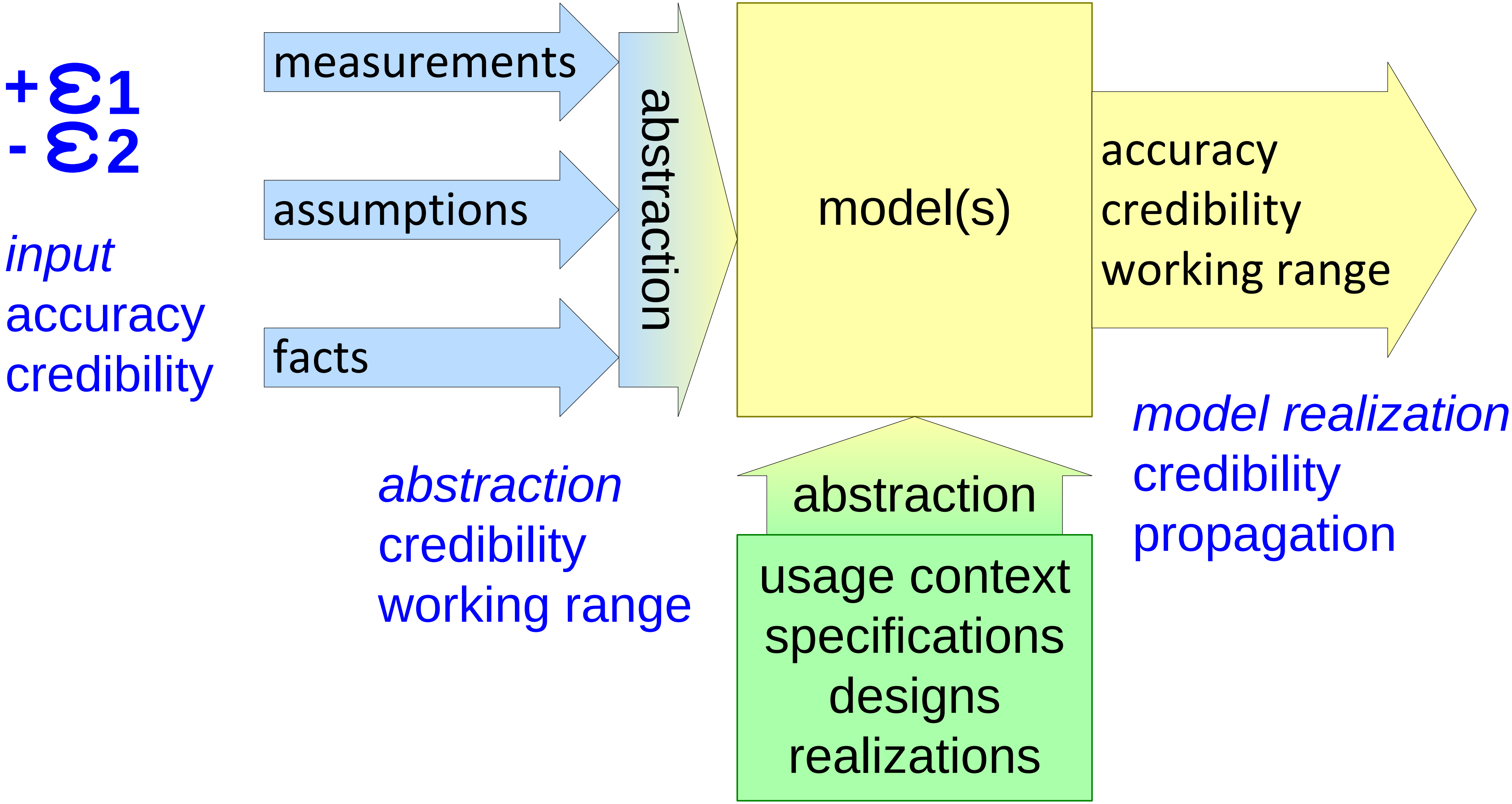


What Comes out of a Model



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

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

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

	(systematic) brainstorm	analysis and assessment probability severity propagation	improve spec, design, process, procedure, ...
safety hazard analysis	potential hazards	damage	measures
reliability FMEA	failure modes exceptional cases	effects	measures
security	vulnerability risks	consequences	measures
maintainability	change cases	impact, effort, time	decisions
performance	worst cases	system behavior	decisions

Brainstorming Phases

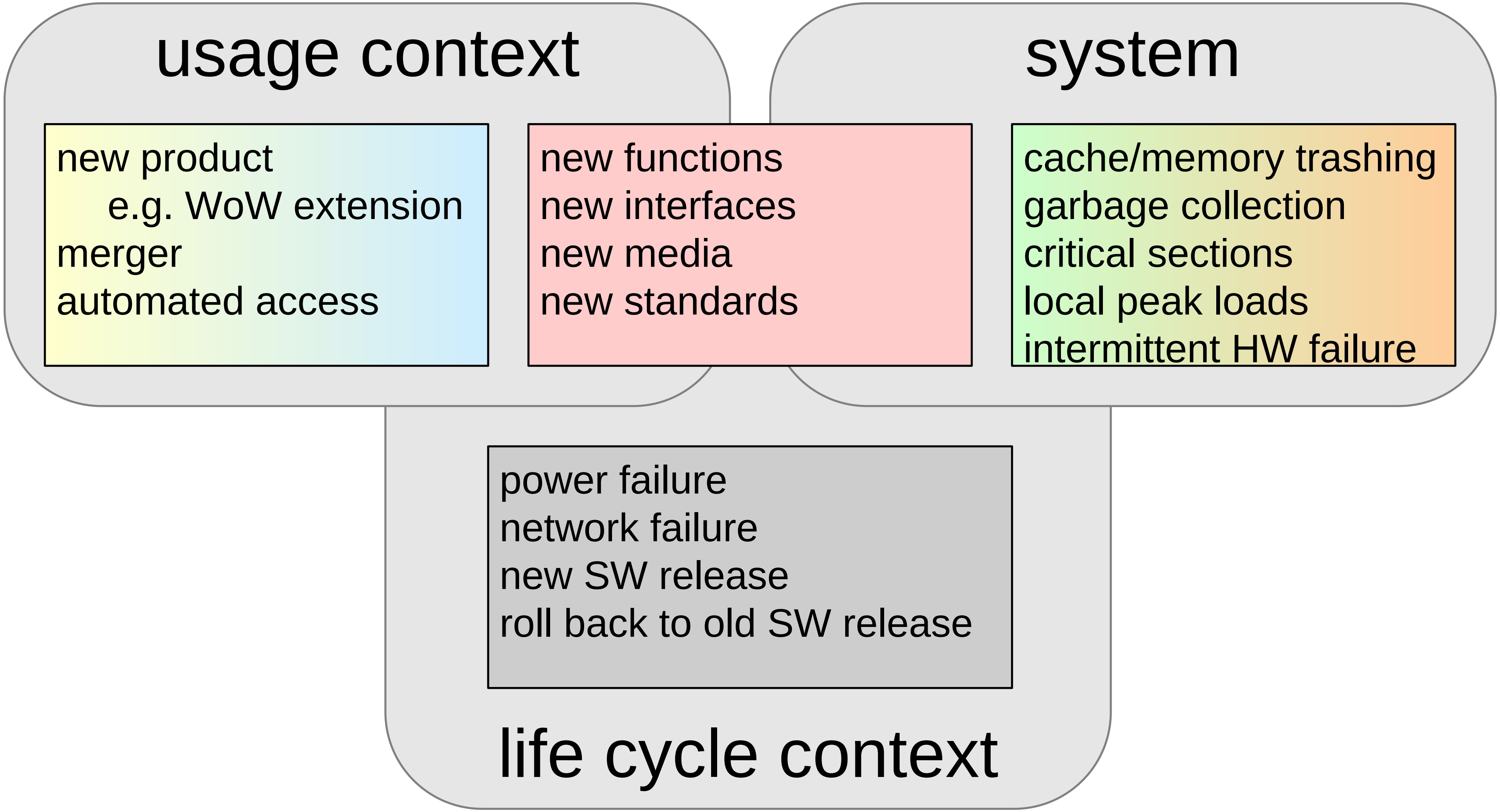
wave 1: the obvious

wave 2: more of the same

wave 3: the exotic, but potentially important

don't stop too early with brainstorming!

Different Viewpoints for Analysis



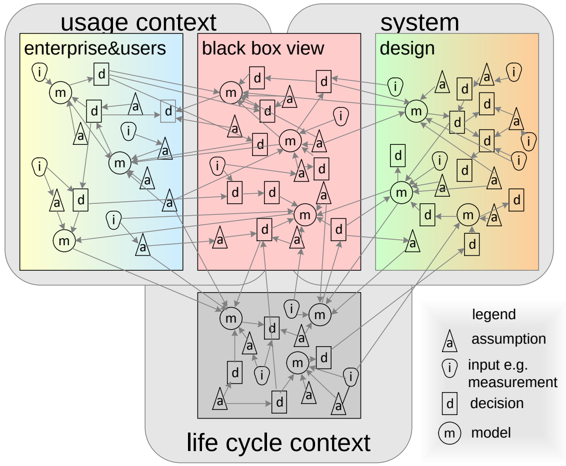
Exercise Analysis of Models

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

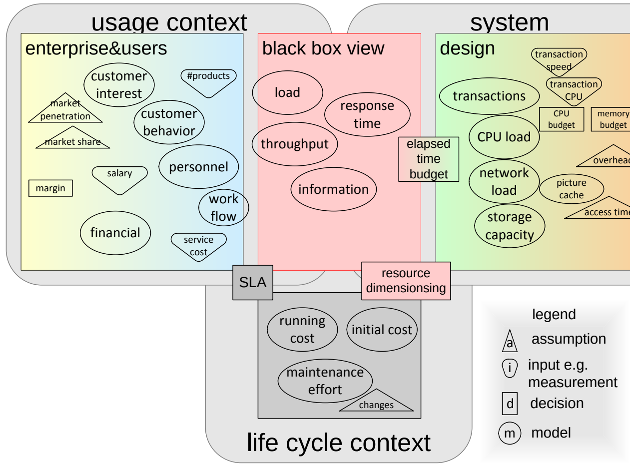
- Identify top 3 credibility risks
  - identify biggest uncertainties in inputs, abstractions and realization
- Estimate accuracy of results; quantitative, e.g. order 1% or 50%
  - based on most significant inaccuracies of inputs and assumed model propagation behavior
- Identify relevant working range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

Modeling

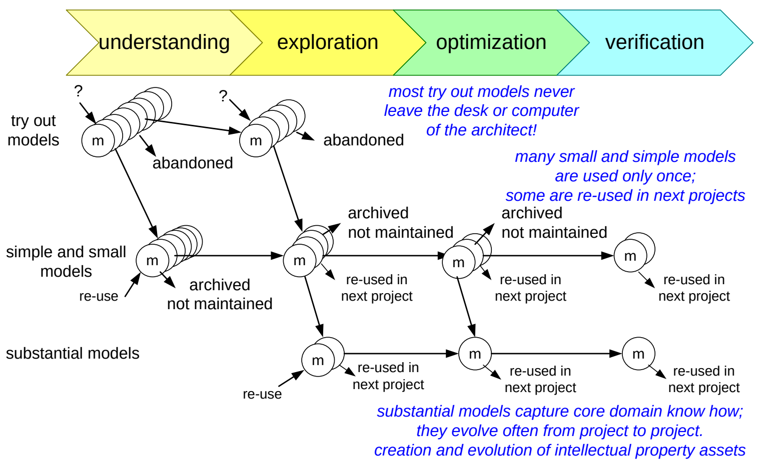
From Chaos...



... to some Order



Many Light Models, few Substantial Models



Accuracy, Credibility, Working Range