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.
What Comes out of a Model

- varying inputs
- varying circumstances
- varying design options
- varying realizations
- specification changes
- and ripple through
  - model(s)
  - working range
  - worst case behavior
  - exceptional behavior
  - sensitivity
  - robustness
  - efficiency
  - performance
  - reliability
  - scalability
  - other system qualities

- design applicability
- design quality
- specification feasibility

- design
  - understanding
  - exploration
  - optimization
  - verification

- life cycle
  - specification changes and ripple through
  - change cases
  - use cases
  - worst case exceptions

Modeling and Analysis: Analysis
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Gerrit Muller
Applicability of the Model

+ $E_1$
- $E_2$

*input*

accuracy
credibility

**abstraction**

credibility
working range

model(s)

accuracy
credibility
working range

model realization
credibility
propagation

usage context
specifications
designs
realizations
### 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
A system design assumption is often:
the performance of this function
{ is constant | is linear | doesn't exceed x | ...}

The working range is the interval where this assumption holds
The models are simple as long as working ranges are obeyed

If the system operates outside the working range then more complex models need to be used (e.g. from 0th order to 1st order)
discrete events in continuous world

(too) systematic input data

fragile model

self fulfilling prophecy

price erosions + cost increase (inflation) -> bankruptcy
Example of Worst Case Picture Cache

Matrix of pictures in database:
- $p_{1,1}$
- $p_{1,2}$
- $p_{1,n}$
- $p_{2,1}$
- $p_{2,2}$
- $p_{2,n}$
- $p_{m,1}$
- $p_{m,2}$
- $p_{m,n}$

Partial copy in cache:
- $p_{1,1}$
- $p_{1,2}$
- $p_{1,8}$

Worst case access patterns:
- $p_{1,1}$
- $p_{1,1}$
- $p_{2,1}$
- $p_{2,2}$
- $p_{m,1}$
- $p_{4,5}$

What is the system behavior and performance for worst case access patterns?
# 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

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<td>failure modes, exceptional cases, effects, measures</td>
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(systematic) brainstorm → analysis and assessment → improve spec, design, process, procedure, ...

| (systematic) brainstorm | analysis and assessment | improve spec, design, process, procedure, ...
|-------------------------|-------------------------|------------------------------------------|
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

usage context
- new product
  - e.g. WoW extension
- merger
- automated access

system
- new functions
- new interfaces
- new media
- new standards
- cache/memory trashing
- garbage collection
- critical sections
- local peak loads
- intermittent HW failure

life cycle context
- power failure
- network failure
- new SW release
- roll back to old SW release
sensitivity: how sensitive is the system output for small changes in input or realization?
Example of CPU Utilization and Efficiency

CPU utilization is "only" 8%
what is the efficiency?
Efficiency is Context Dependent!

**low volume, labor intensive, shop**

- fixed costs and personnel cost dominate: service cost changes have negligible impact on total cost!

**high volume, highly automated, shop**

- variable service costs dominate: service cost changes have big impact on total cost!

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MAANefficiencyInContext