

Module System Architect Toolkit

by *Gerrit Muller* Embedded Systems Institute

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Abstract

This module addresses tools and techniques available to the System Architect. It explains the basic CAFCR method and addresses story telling as method.

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Embedded Systems
INSTITUTE

Basic Working Methods of a System Architect

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Abstract

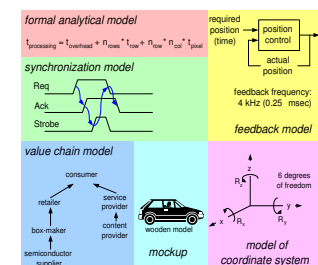
The challenge for the architect is to cover a wide range of subjects, with many unknowns and uncertainties, while decisions are required all the time.

The basic working methods, such as viewpoint hopping, modelling, handling uncertainties and WWHWWW questions are described.

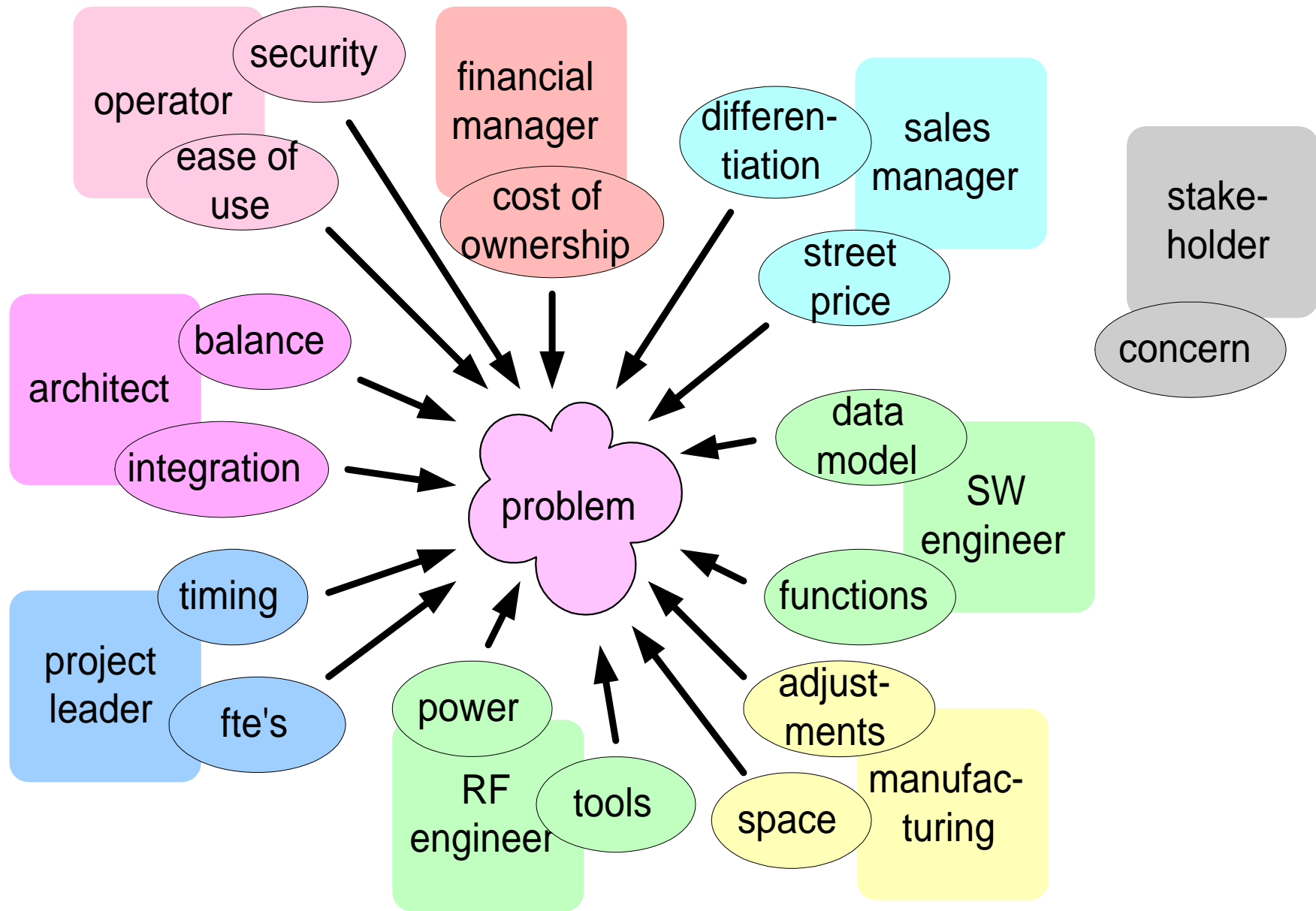
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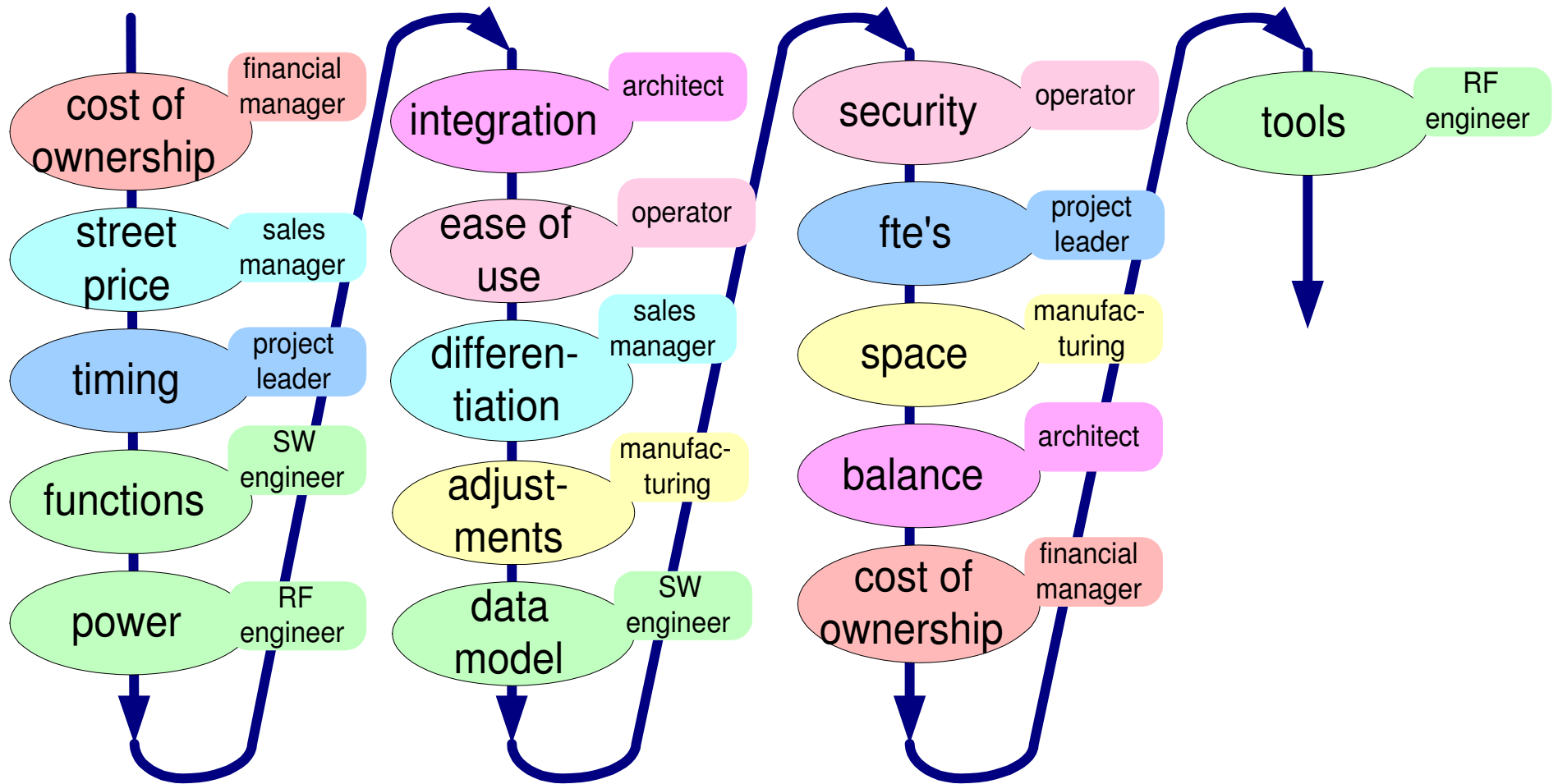
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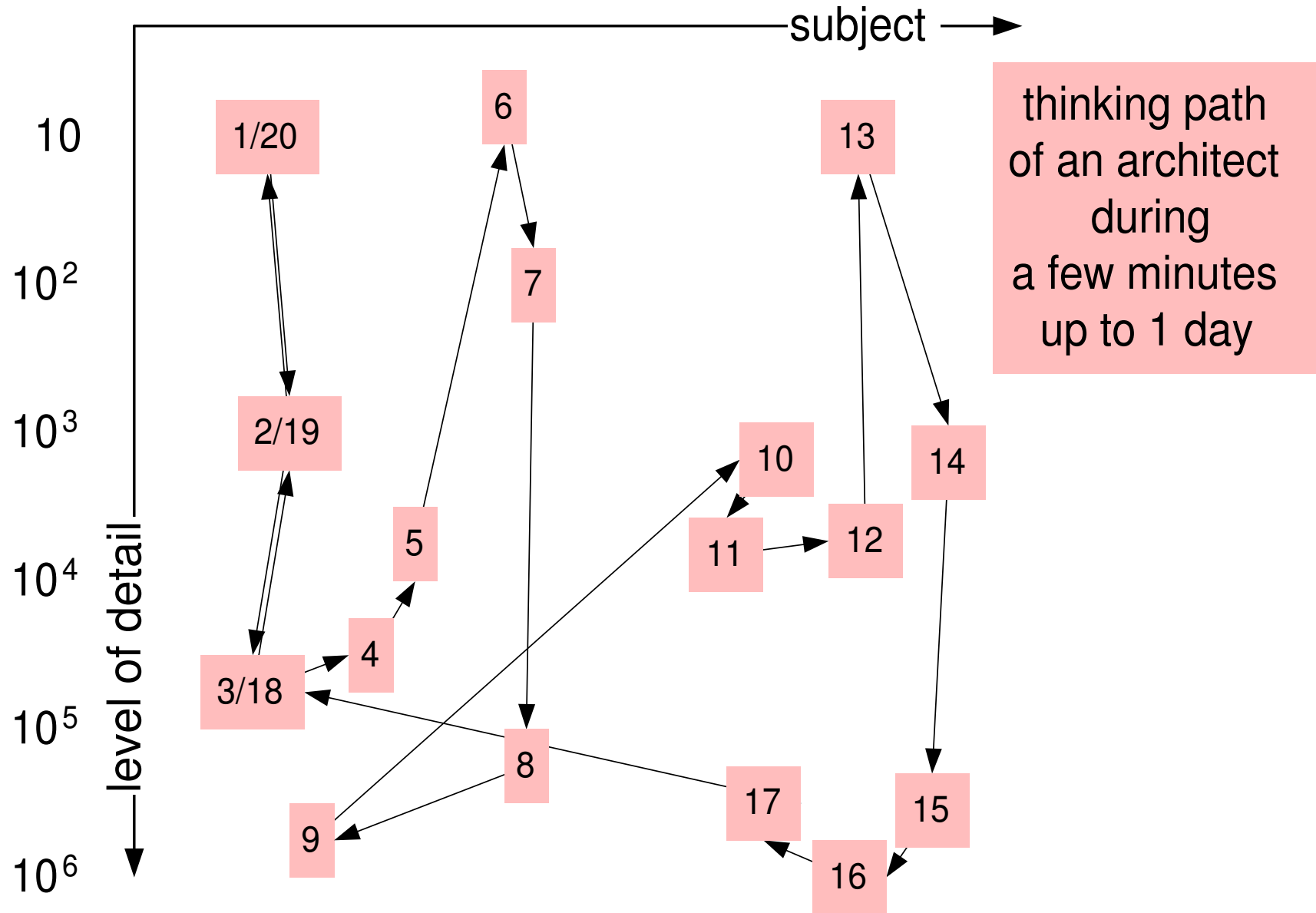
Many viewpoints



Viewpoint Hopping



The seemingly random exploration path



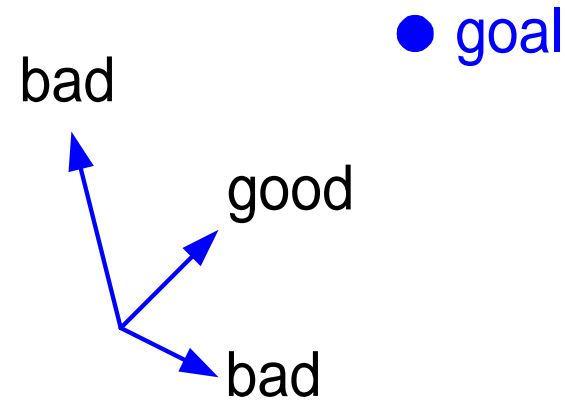
Scanning modes of the architect

open
perceptive
scanning



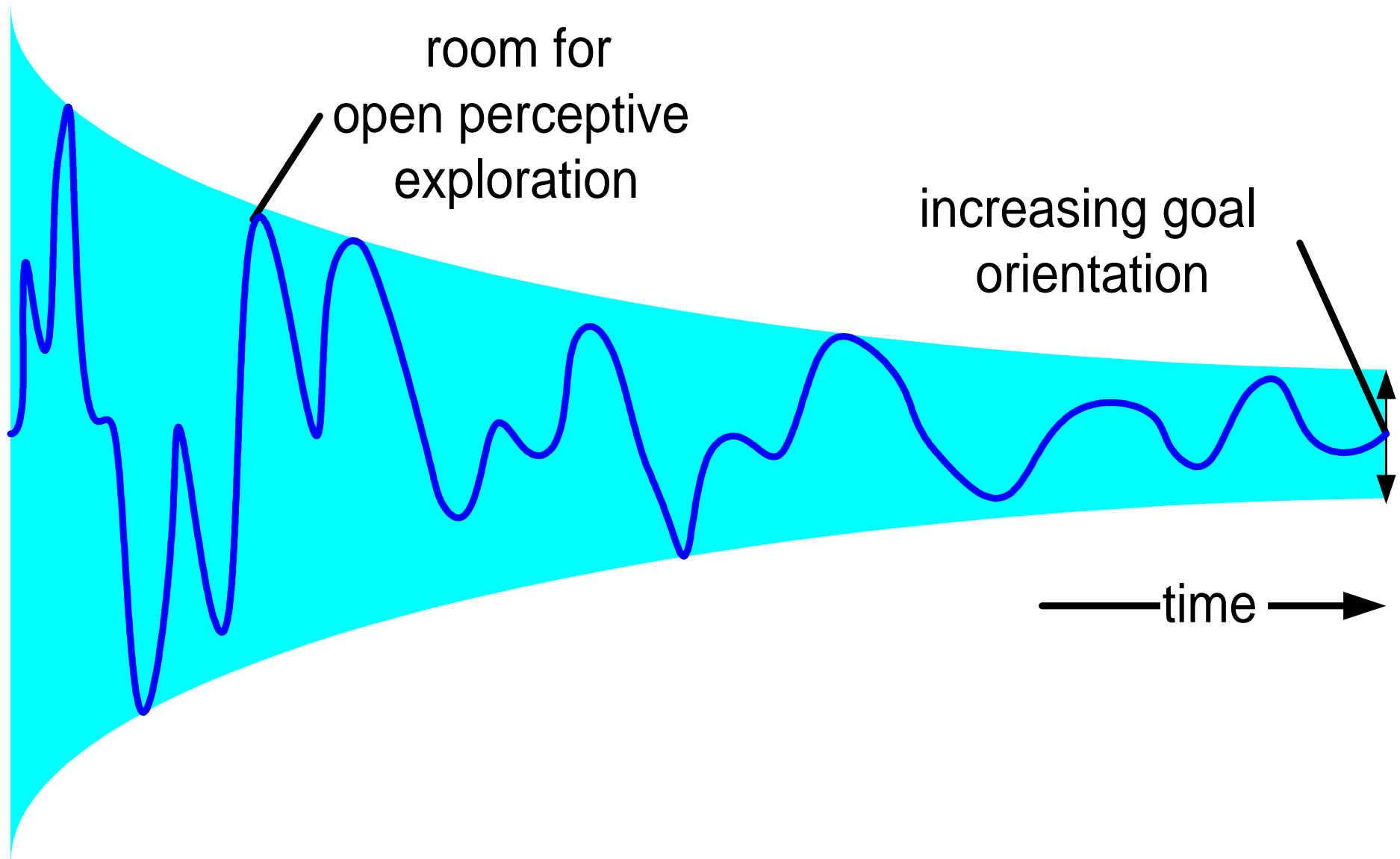
drunkard's walk
the world is full
of interesting
needs, technologies, ...

scanning
while
structuring
and judging

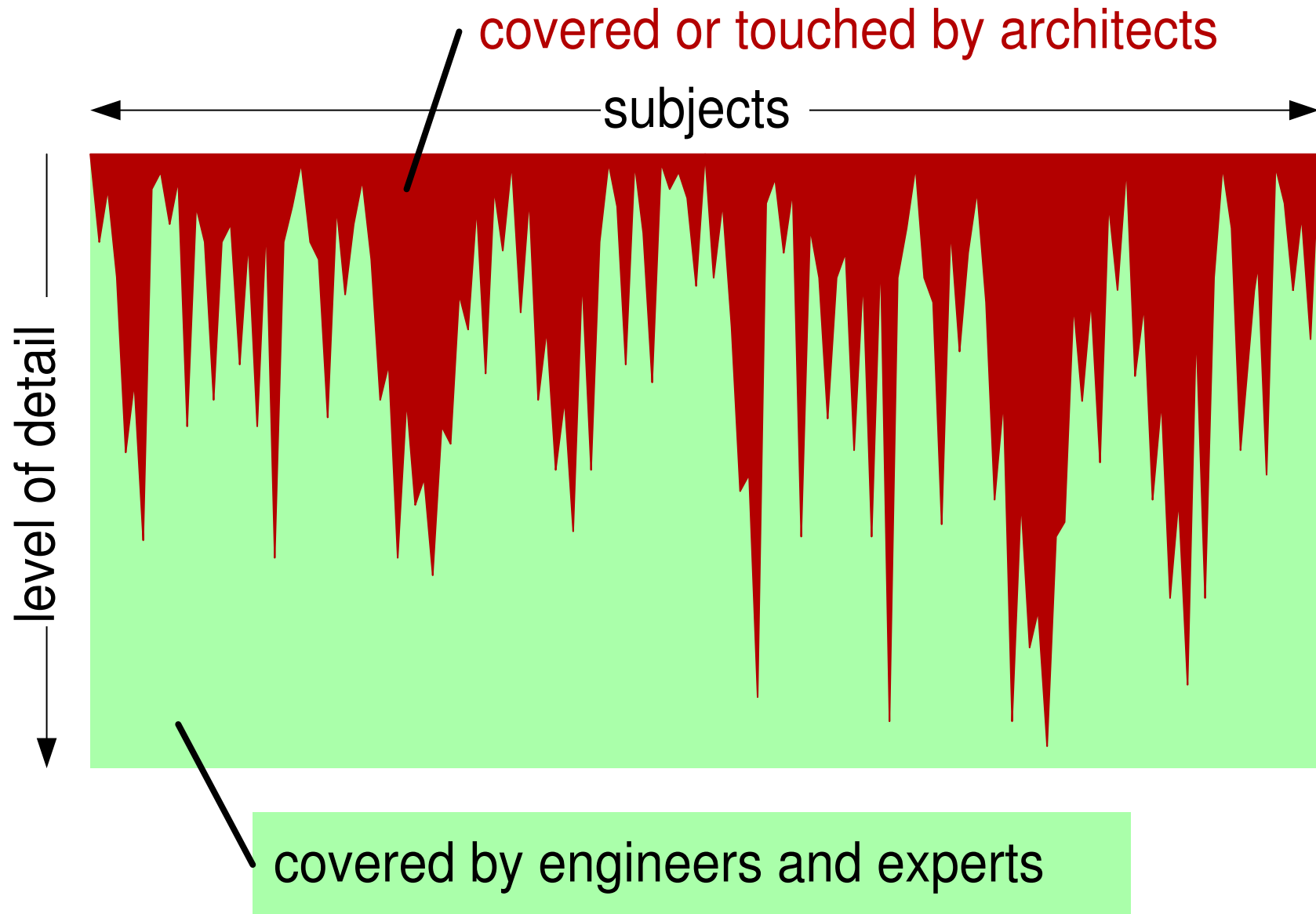


straight for the goal
ignore everything
that is not contributing
directly to the goal

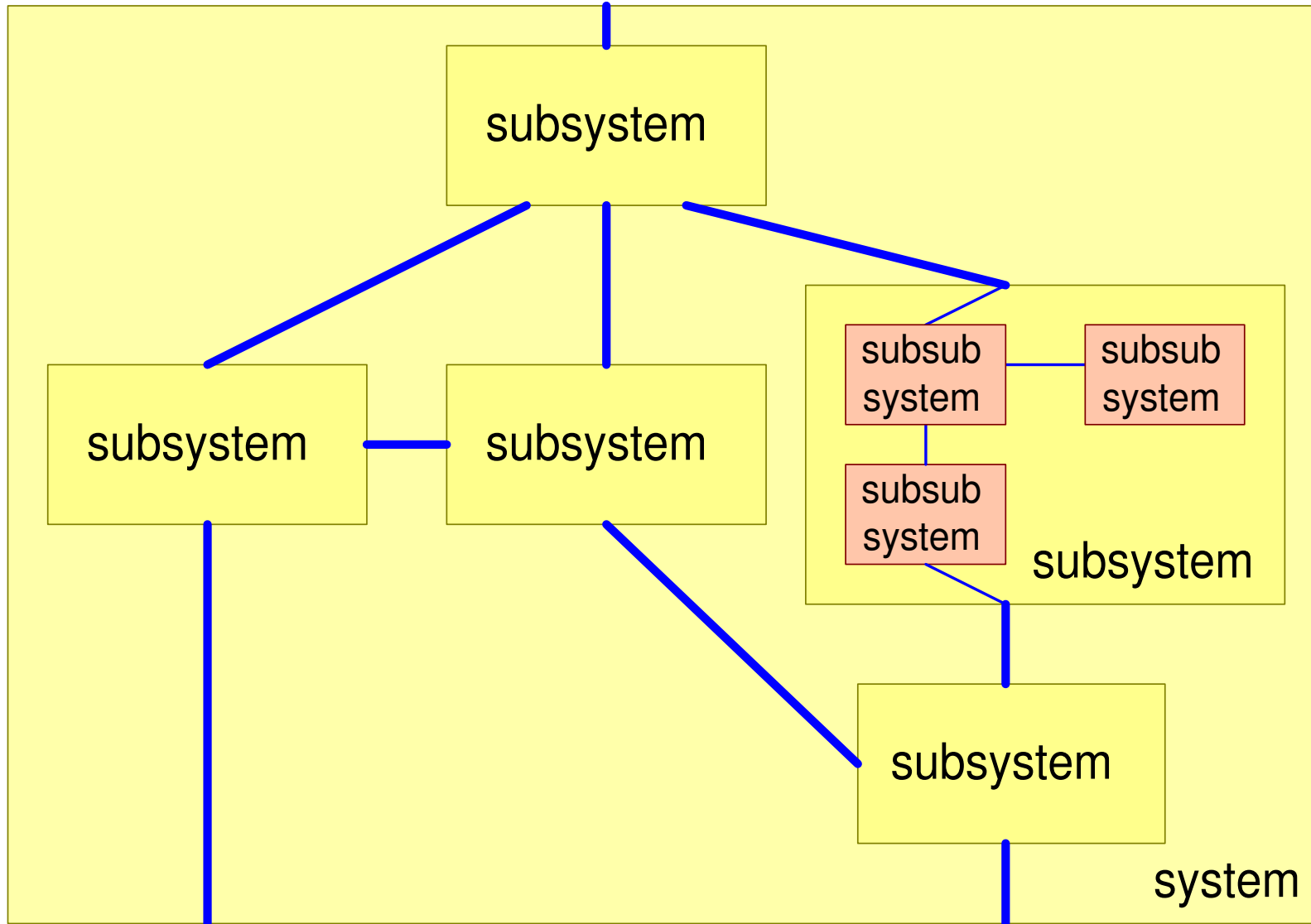
Combined open perceptive and goal oriented scanning



Coverage of problem and solution space

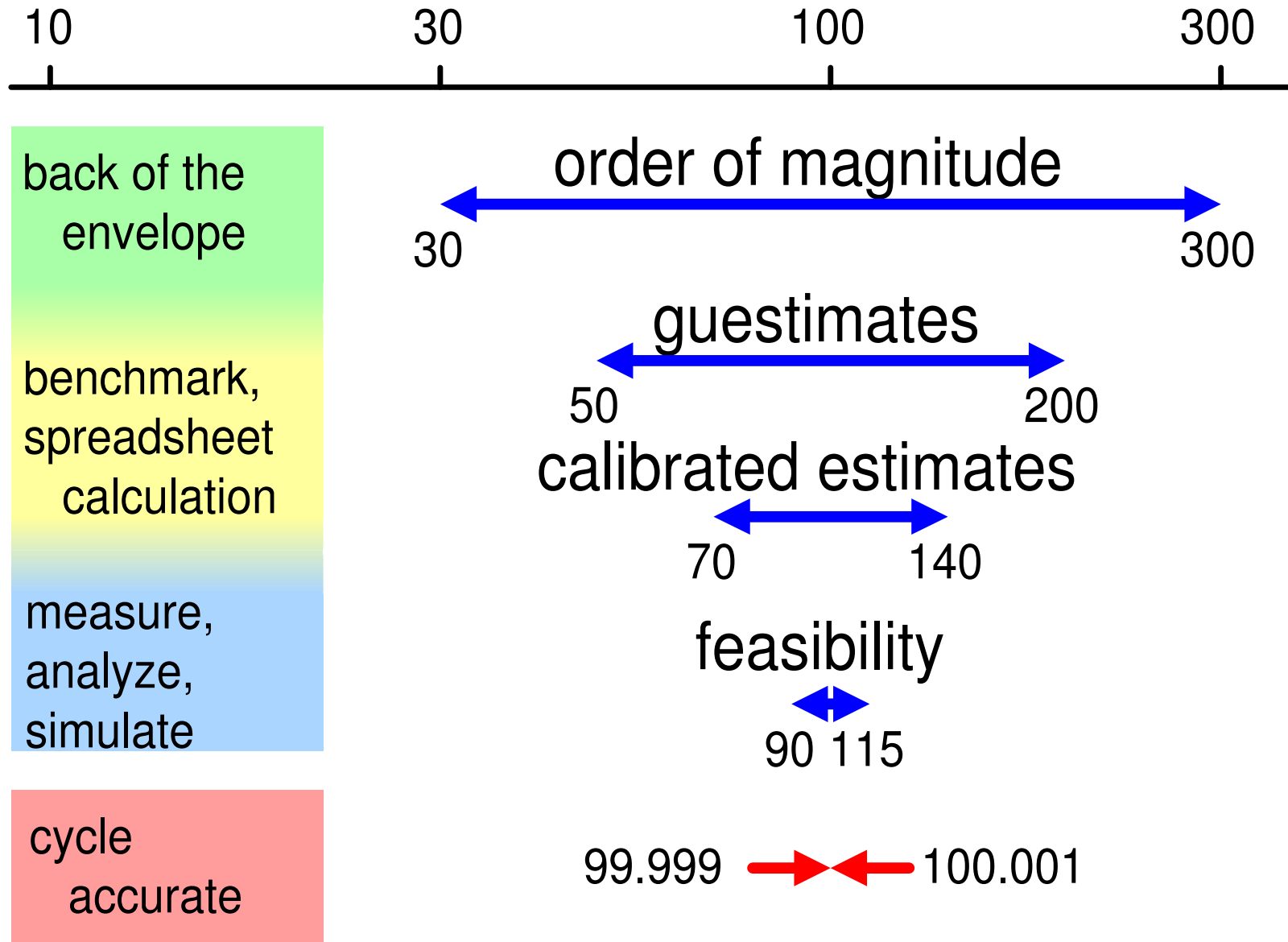


Decomposition, interfaces and integration

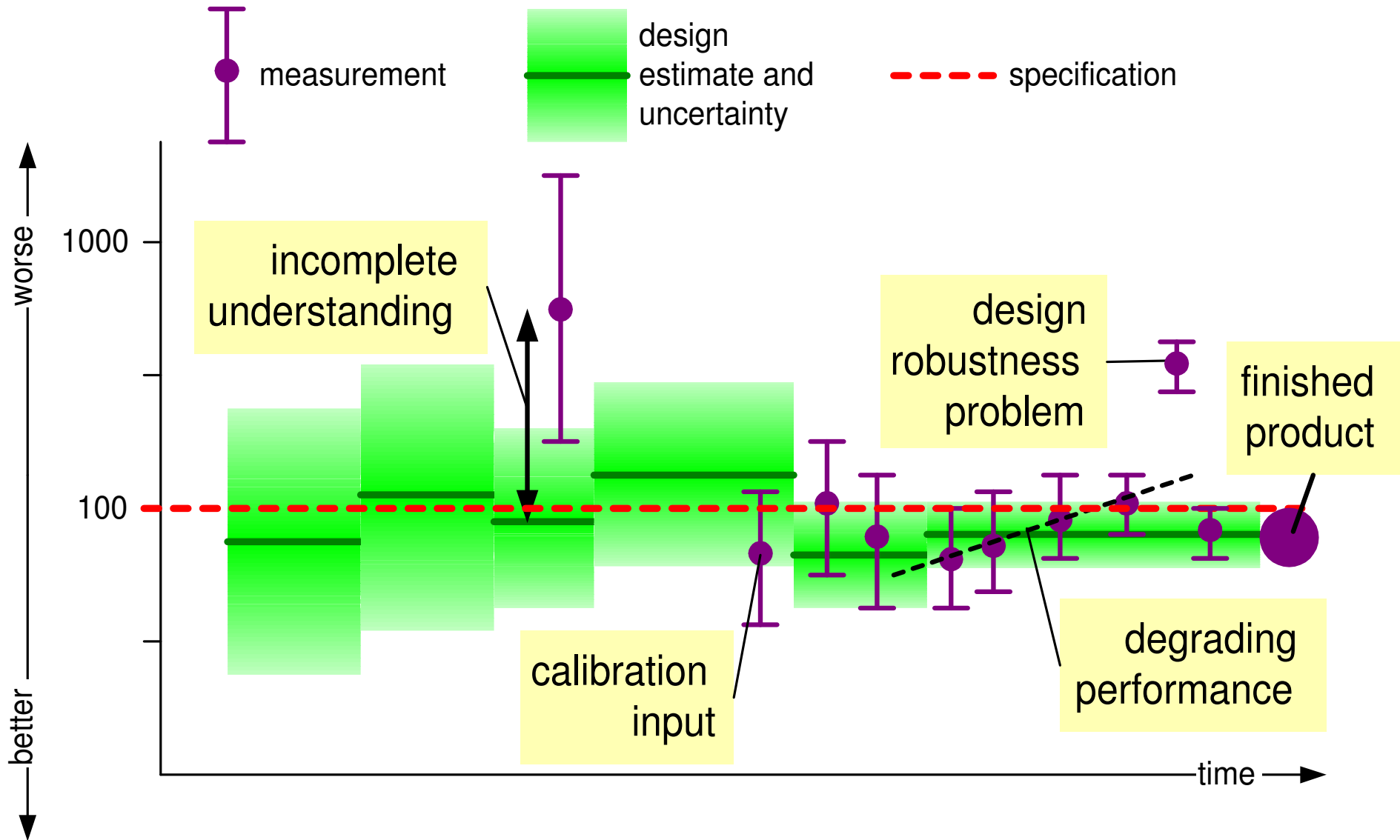


interface

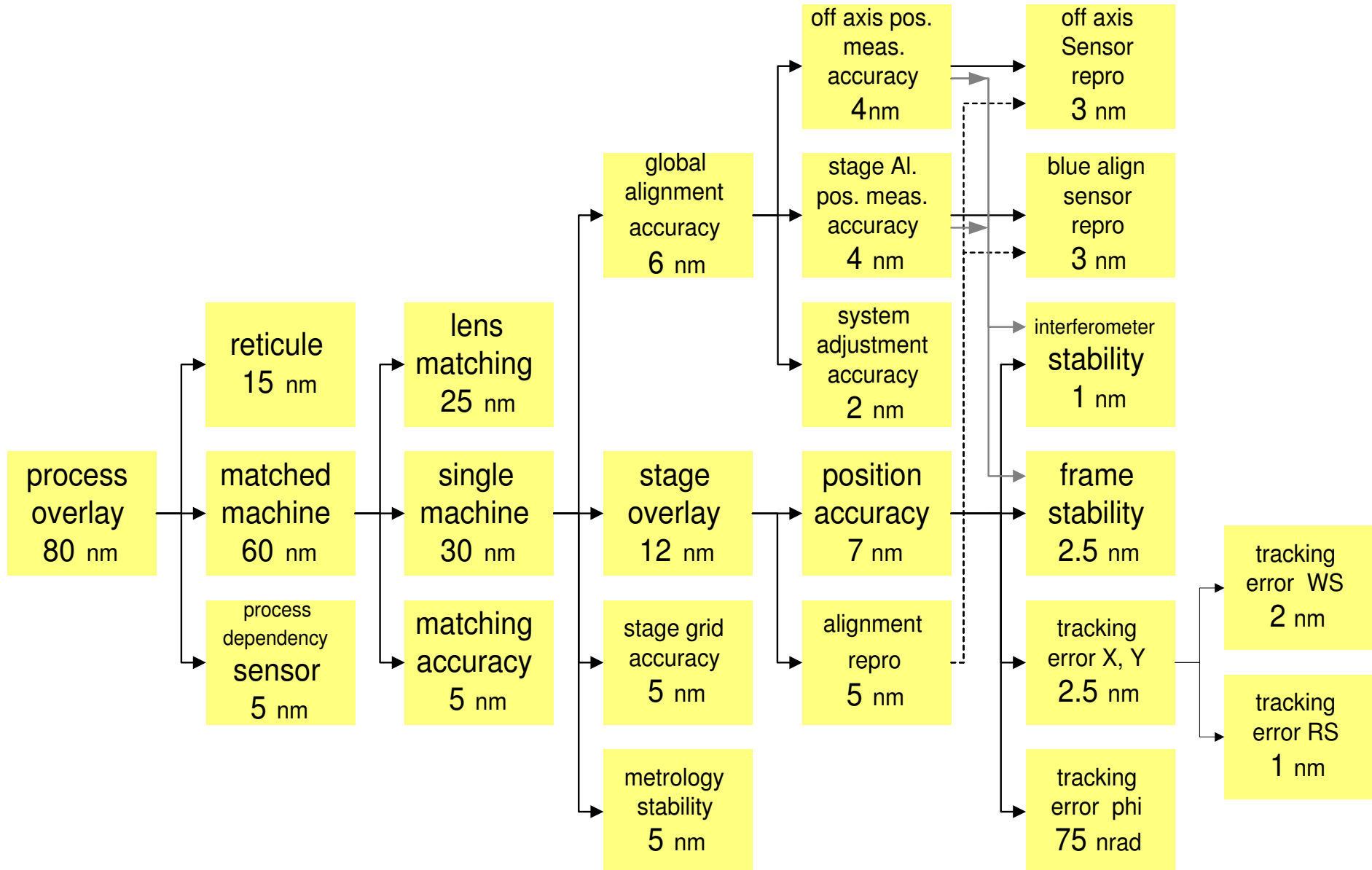
Successive quantification refinement



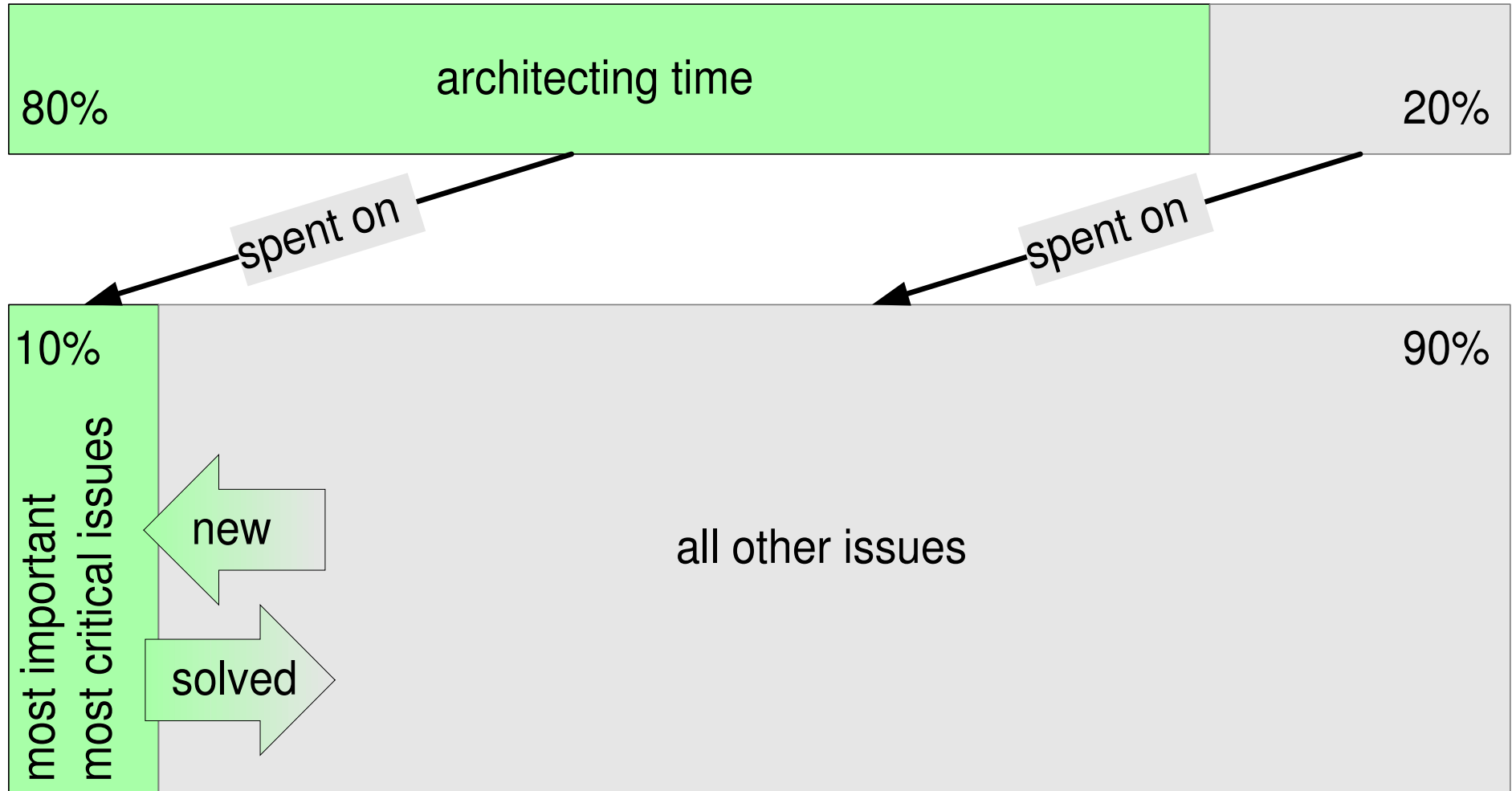
Example evolution of quantification



Quantified understanding of waferstepper overlay



Architect focus on important issues



Architect “worry” list

1. response time

from key press
until first image
on display

2. cost price

resource budgets

3. layering to separate

separation of concerns
self sustained
life-cycle separation
robust: paranoia validations

4. reliability of storage

5. database redesign

6. integration schedule

7. movement artefact

8. standby power

9. weak signal handling

10. location-based twiddle

A **model** is
a **simplified** representation of
part of the **real world** used for:

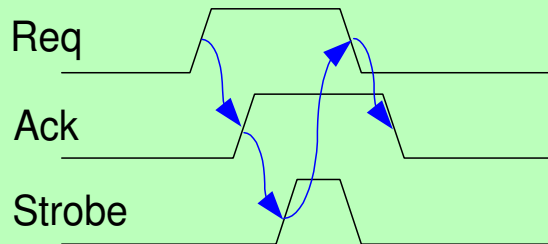
communication, documentation
analysis, simulation,
decision making, verification

Some examples of models

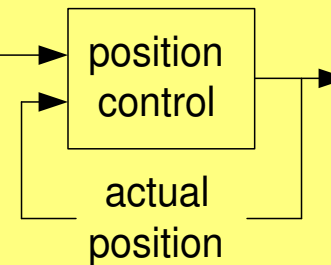
formal analytical model

$$t_{\text{processing}} = t_{\text{overhead}} + n_{\text{rows}} * t_{\text{row}} + n_{\text{row}} * n_{\text{col}} * t_{\text{pixel}}$$

synchronization model



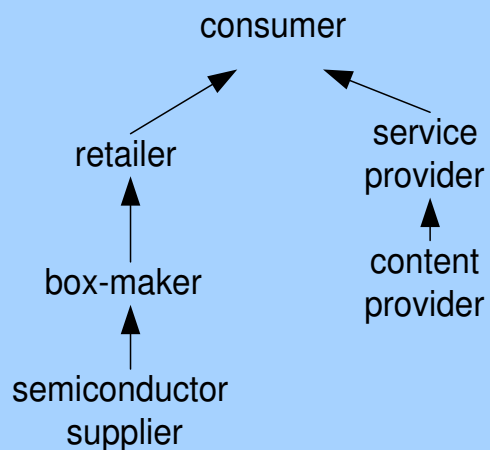
required
position
(time)



feedback frequency:
4 kHz (0.25 msec)

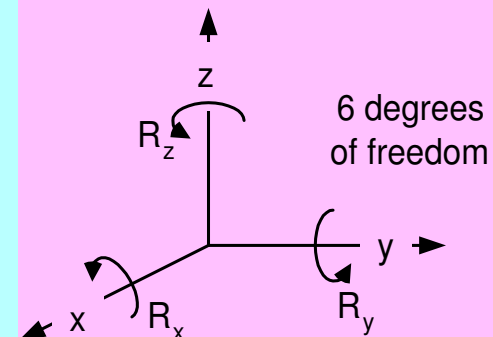
feedback model

value chain model



wooden model

mockup



model of coordinate system

Types of models

mathematical

linguistic

visual

formal

informal

quantitative

qualitative

detailed

global

concrete

abstract

accurate

approximate

executable

read only

← rational —

— intuitive →

Why

Who

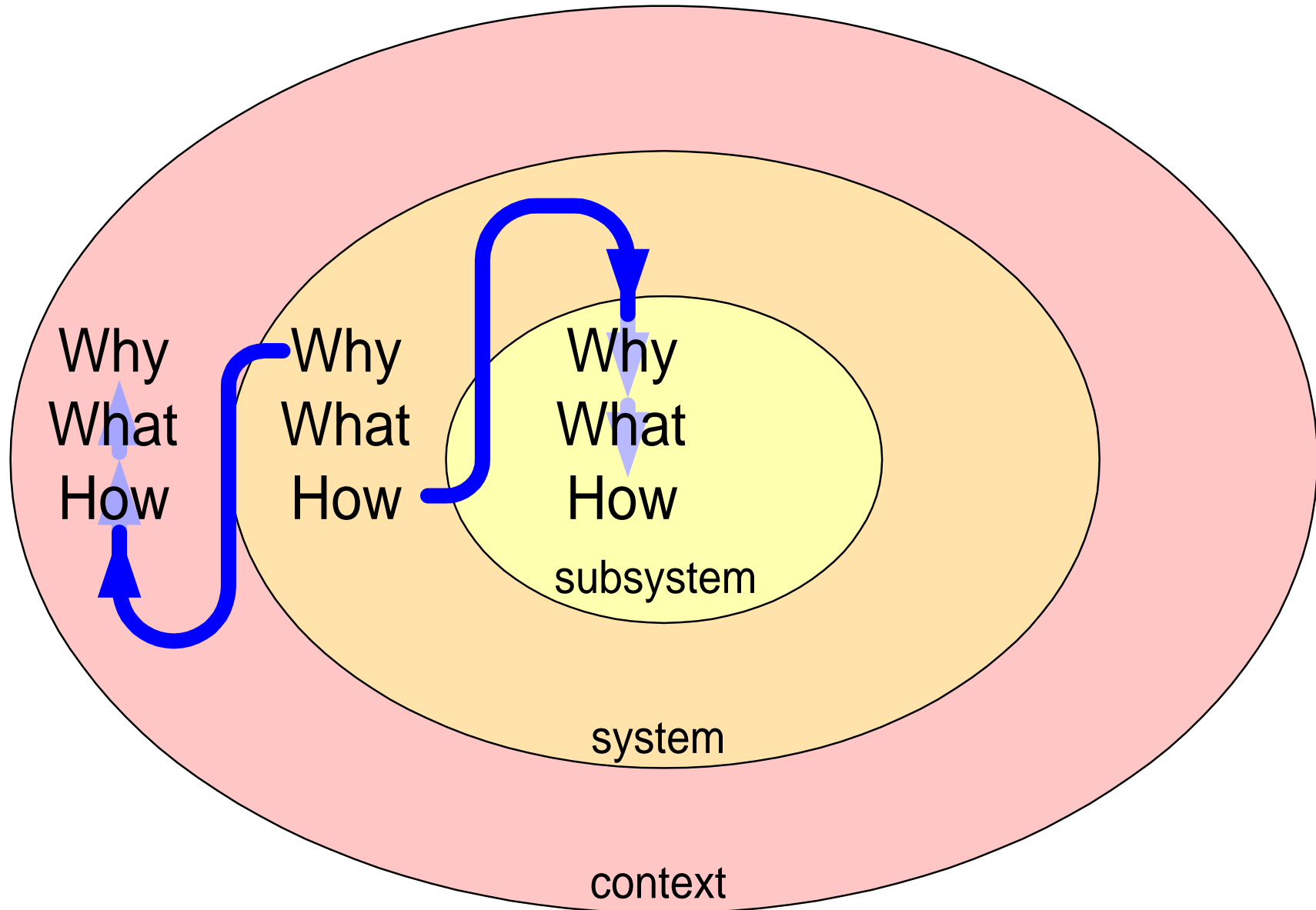
What

When

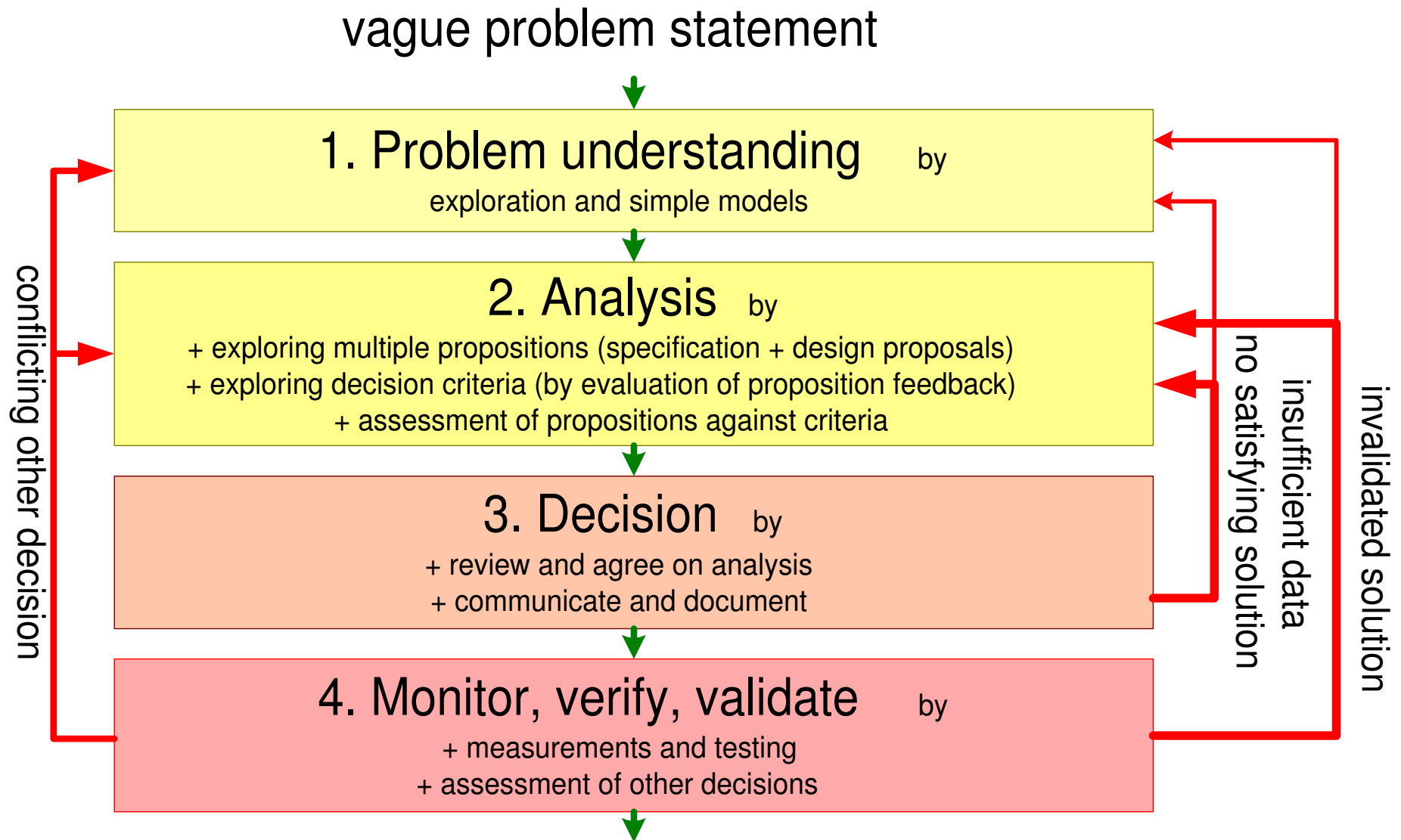
How

Where

Why broadens scope, How opens details



Flow from problem to solution



Multiple propositions

| | | | |
|------------|--------|-------------------------|--------|
| throughput | 20 p/m | high-performance sensor | 350 ns |
| cost | 5 k\$ | high-speed moves | 9 m/s |
| safety | | additional pipelining | |

low cost and performance 1

| | | | |
|------------|--------|-------------------------|--------|
| throughput | 20 p/m | high-performance sensor | 300 ns |
| cost | 5 k\$ | high-speed moves | 10 m/s |
| safety | | | |

low cost and performance 2

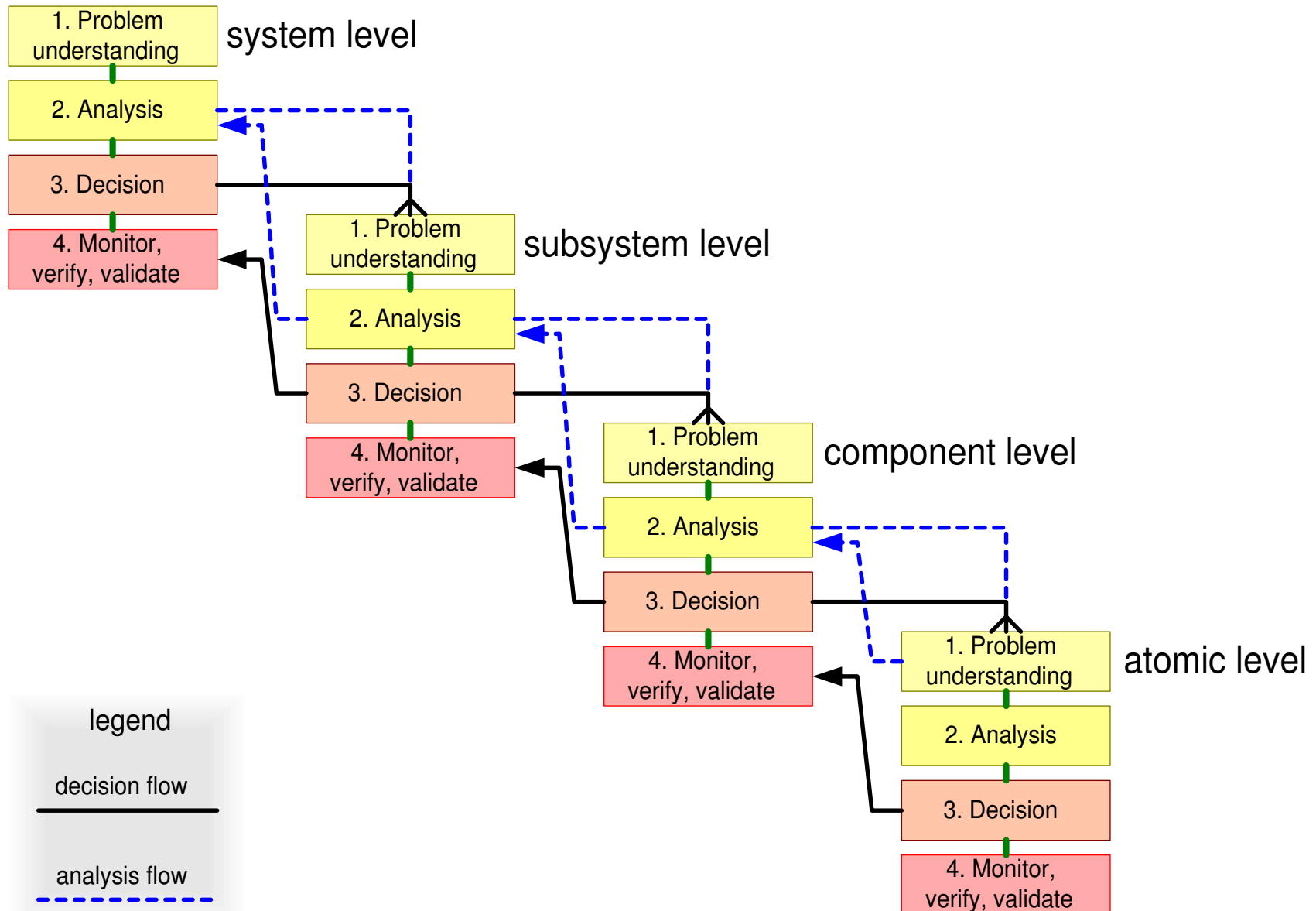
| | | | |
|------------|--------|-------------------------------|--------|
| throughput | 25 p/m | highperformance sensor | 200 ns |
| cost | 7 k\$ | high-speed moves | 12 m/s |
| safety | | additional collision detector | |

high cost and performance

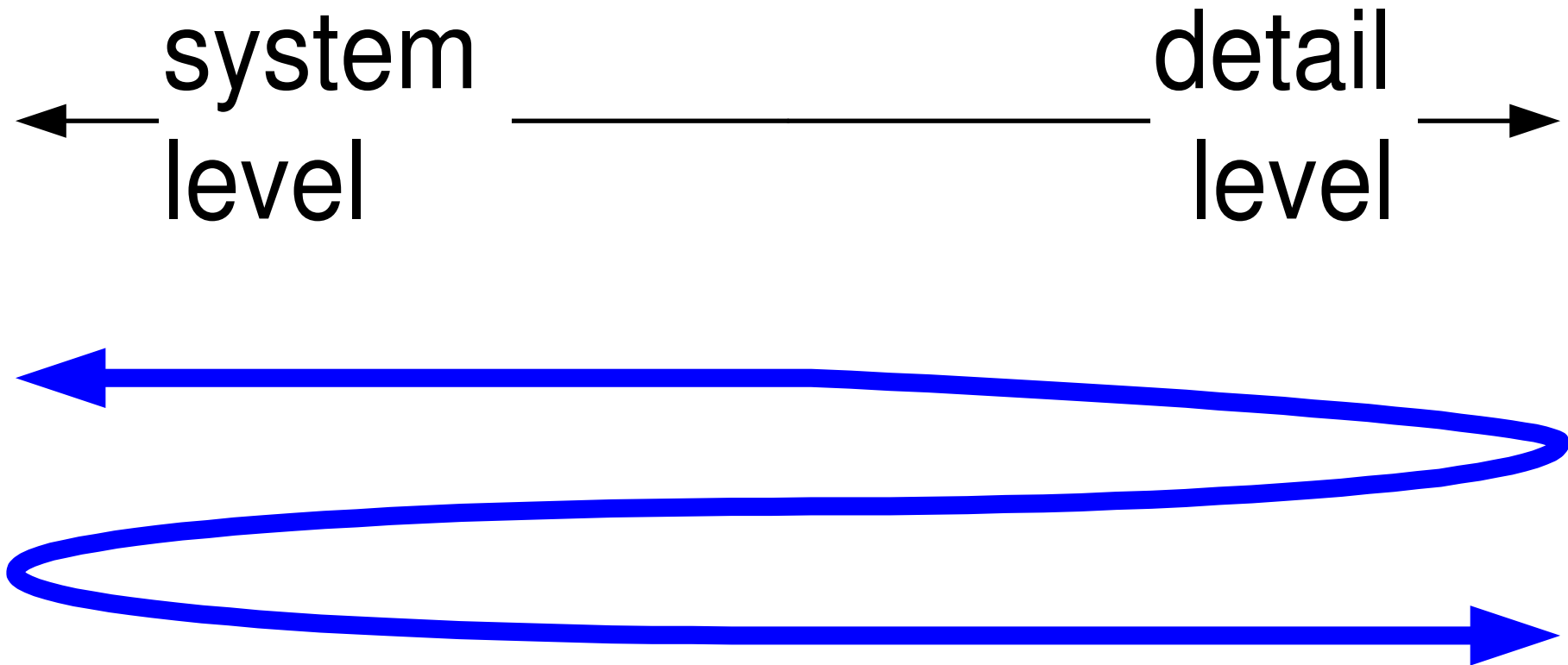
Assessment of propositions

| <i>criteria</i> | <i>weight</i> | <i>low cost and performance 1</i> | <i>low cost and performance 2</i> | <i>high cost and performance</i> |
|-----------------|---------------|-----------------------------------|-----------------------------------|----------------------------------|
| throughput | 5 | 2 | 2 | 3 |
| cost | 5 | 3 | 3 | 2 |
| safety | 5 | 5 | 5 | 5 |
| future proof | 2 | 2 | 3 | 3 |
| effort | 4 | 5 | 4 | 4 |
| dev. time | 5 | 5 | 4 | 4 |
| risk | 4 | 4 | 3 | 3 |
| maintenance | 3 | 2 | 3 | 3 |

Recursive and concurrent application of flow



Exploration by rapid iteration



Story How To

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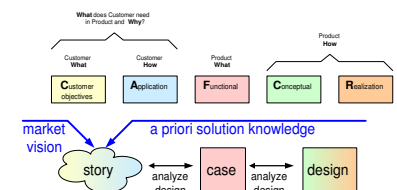
Abstract

A story is an easily accessible story or narrative to make an application live. A good story is highly specific and articulated entirely in the problem domain: the native world of the users. An important function of a story is to enable specific (*quantified, relevant, explicit*) discussions.

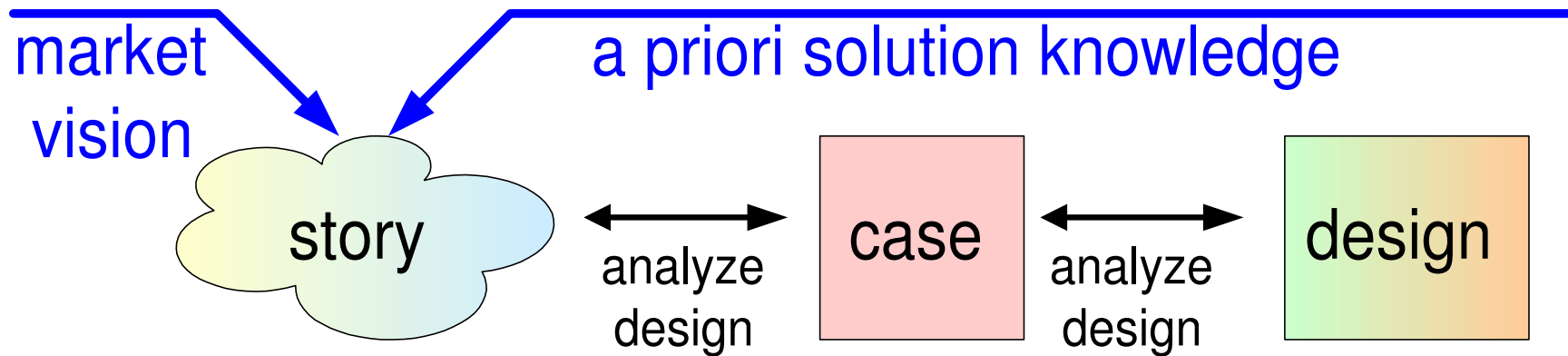
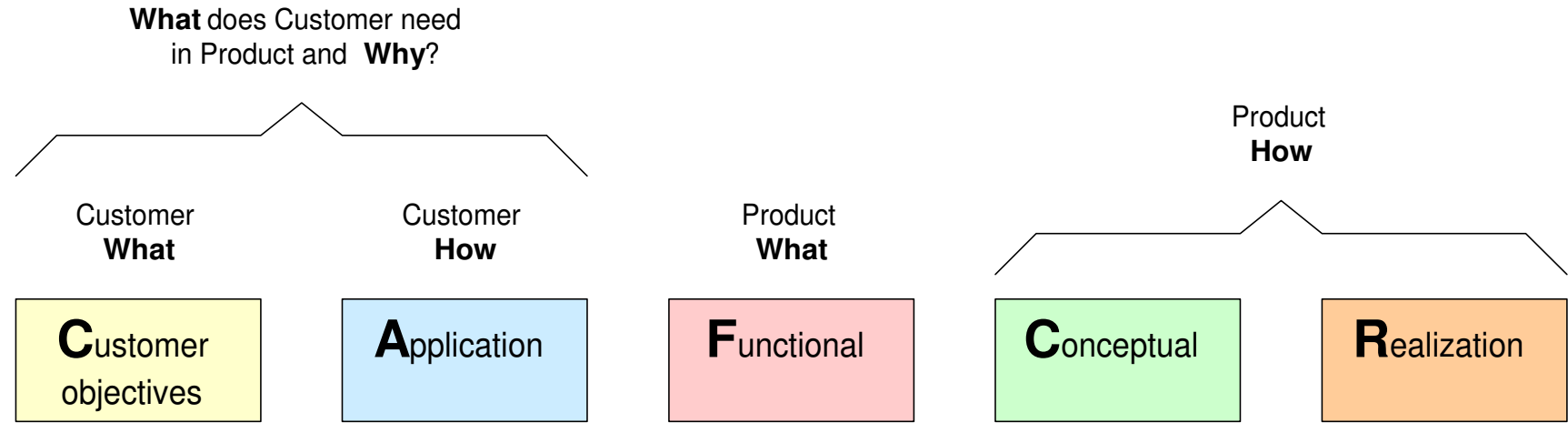
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From story to design



Example story layout

ca. half a page of plain English text

A day in the life of Bob

bla blah bla, rabarber music
bla bla composer bla bla
qwerty30 zepts.

nja nja njet njippie est quo
vadis? Pjotr jaleski bla bla
bla brree fgfg gsg hgrg

mjimm bas engel heeft een
interessant excuus, lex stelt
voor om vanavond door te
werken.

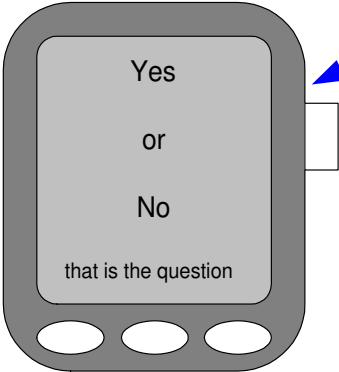
In the middle of the night he
is awake and decides to
change the world forever.

The next hour the great
event takes place:

This brilliant invention will change the world foreverbecause it is so unique and
valuable that nobody believes the feasibility. It is great and WOW at the same time,
highly exciting.

Vtables are seen as the soltution for an indirection problem. The invention of Bob will
obsolete all of this in one incredibke move, which will make him famous forever.

He opens his PDA, logs in and enters his provate secure unqie non trivial
password, followed by a thorough authentication. The PDA asks for the fingerprint of
this little left toe and to pronounce the word shit. After passing this test Bob can
continue.



draft or sketch of
some essential
appliance

Points of attention

- purpose
- scope
- viewpoint, stakeholders
- visualization
- size (max 1 A4)
- recursive decomposition, refinement

Criteria for a good story

Customer
objectives

- accessible, understandable

Application

"Do you see it in front of you?"

Customer
objectives

- valuable, appealing

Application

attractive, important

"Are customers queuing up for this?"

Conceptual

- critical, challenging

Realization

"What is difficult in the realization?"

"What do you learn w.r.t. the design?"

Application

- frequent, no exceptional niche

"Does it add significantly to the bottom line?"

Application

- specific

names, ages, amounts, durations, titles, ...

Functional

Example of a story

Betty is a 70-year-old woman who lives in Eindhoven. Three years ago her husband passed away and since then she lives in a home for the elderly. Her 2 children, Angela and Robert, come and visit her every weekend, often with Betty's grandchildren Ashley and Christopher. As so many women of her age, Betty is reluctant to touch anything that has a technical appearance. She knows how to operate her television, but a VCR or even a DVD player is way to complex.

When Betty turned 60, she stopped working in a sewing studio. Her work in this noisy environment made her hard-of-hearing with a hearing-loss of 70dB around 2kHz. The rest of the frequency spectrum shows a loss of about 45dB. This is why she had problems understanding her grandchildren and why her children urged her to apply for hearing aids two years ago. Her technophobia (and her first hints or arthritis) inhibit her to change her hearing aids' batteries. Fortunately her children can do this every weekend.

This Wednesday Betty visits the weekly Bingo afternoon in the meetingplace of the old-folk's home. It's summer now and the tables are outside. With all those people there it's a lot of chatter and babble. Two years ago Betty would never go to the bingo: "I cannot hear a thing when everyone babbles and clatters with the coffee cups. How can I hear the winning numbers?!". Now that she has her new digital hearing instruments, even in the bingo cacophony, she can understand everyone she looks at. Her social life has improved a lot and she even won the bingo a few times.

That same night, together with her friend Janet, she attends Mozart's opera The Magic Flute. Two years earlier this would have been one big low rumbly mess, but now she even hears the sparkling high piccolos. Her other friend Carol never joins their visits to the theaters. Carol also has hearing aids, however hers only "work well" in normal conversations. "When I hear music it's as if a butcher's knife cuts through my head. It's way too sharp!". So Carol prefers to take her hearing aids out, missing most of the fun. Betty is so happy that her hearing instruments simply know where they are and adapt to their environment.



source: Roland Mathijssen
Embedded Systems Institute
Eindhoven

Value and Challenges in this story

Customer objectives

Application

Value proposition in this story:

quality of life:

active participation in different social settings

usability for nontechnical elderly people:

"intelligent" system is simple to use

loading of batteries

Conceptual

Realization

Challenges in this story:

Intelligent hearing instrument

Battery life —at least 1 week

No buttons or other fancy user interface on the hearing instrument, other than a robust On/Off method

The user does not want a technical device but a solution for a problem

Instrument can be adapted to the hearing loss of the user

Directional sensitivity (to prevent the so-called cocktail party effect)

Recognition of sound environments and automatic adaptation (adaptive filtering)

source: Roland Mathijssen, Embedded Systems Institute, Eindhoven

Personal multi media appliance

Create a story for a personal multi media appliance.

Derive a case description from the story, with functions and quantitative requirements.