

Module Reasoning: Linking Business to Technology

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Abstract

This module addresses *Threads of Reasoning* as a means to connect business and operational needs to design and technology choices.

August 16, 2025
status: preliminary
draft
version: 0.2

Module Content

goal of this module

Be able to relate *Customer* and *Operational* objectives to design and technology choices.

Be able to provide rationale for design decisions.

content of this module

Key driver method and recommendations

Threads of reasoning approach

Example in Health Care domain

exercise

Key driver graph

Key Drivers How To

by *Gerrit Muller* University of South-Eastern Norway-NISE

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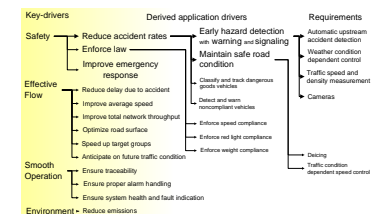
Abstract

The notion of "business key drivers" is introduced and a method is described to link these key drivers to the product specification.

Distribution

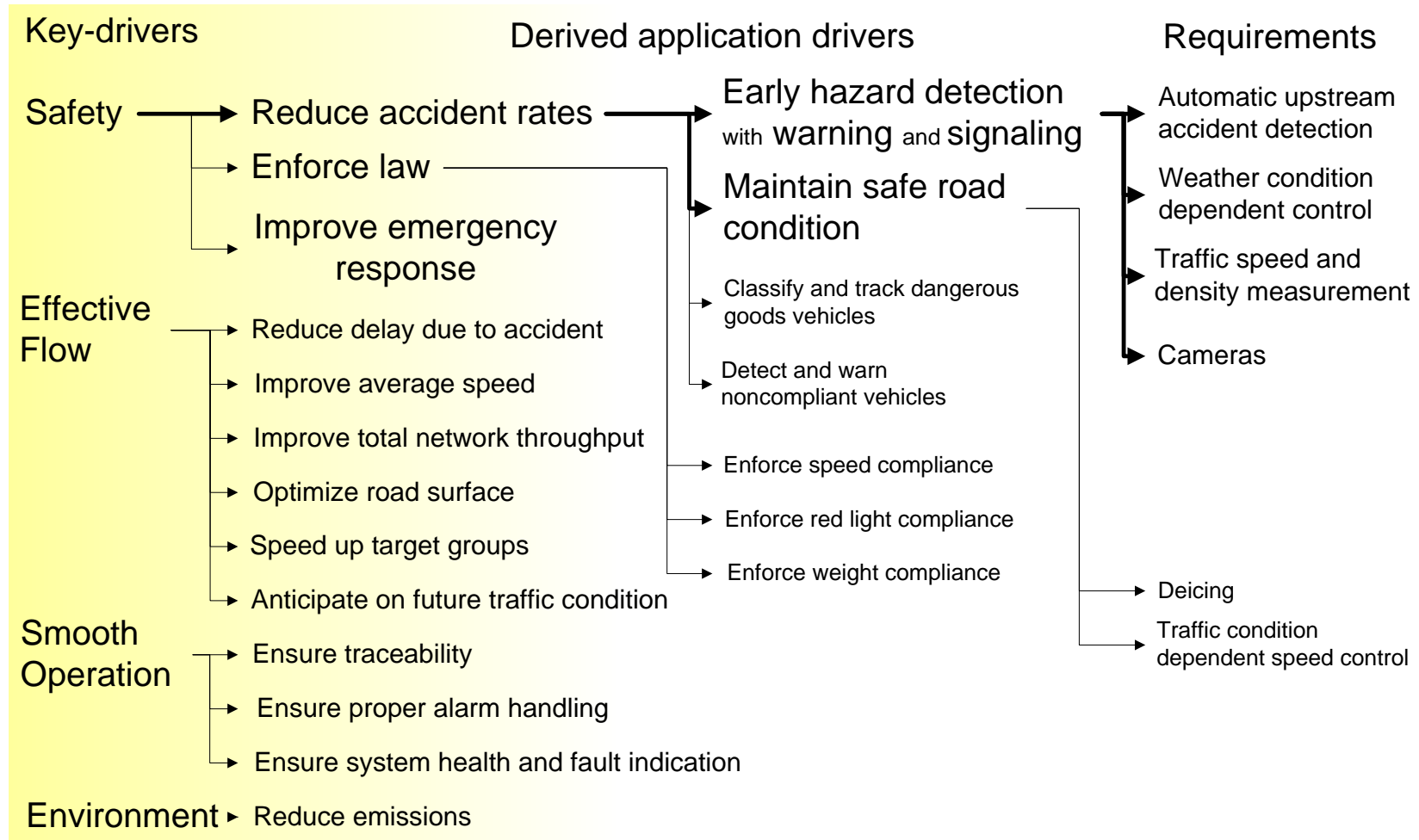
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Note: the graph is only partially elaborated for application drivers and requirements

Example Motorway Management Analysis



Note: the graph is only partially elaborated for application drivers and requirements

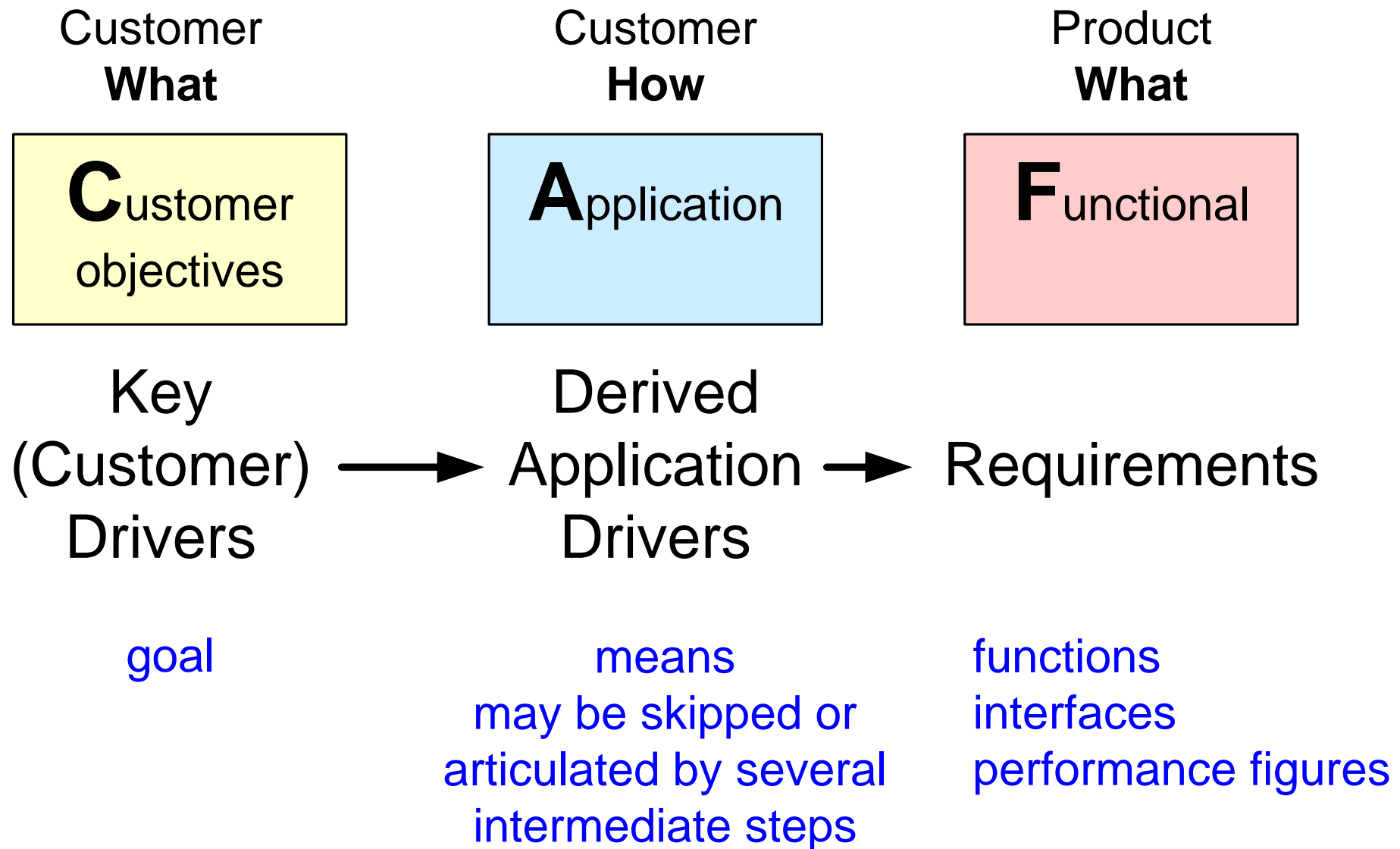
Method to create Key Driver Graph

- | | |
|--|--|
| • Define the scope specific. | in terms of stakeholder or market segments |
| • Acquire and analyze facts | extract facts from the product specification
and ask why questions about the specification of existing products. |
| • Build a graph of relations between drivers and requirements
by means of brainstorming and discussions | where requirements
may have multiple drivers |
| • Obtain feedback | discuss with customers, observe their reactions |
| • Iterate many times | increased understanding often triggers the move of issues
from driver to requirement or vice versa and rephrasing |

Recommendation for the Definition of Key Drivers

- Limit the number of key-drivers minimal 3, maximal 6
- Don't leave out the obvious key-drivers for instance the well-known main function of the product
- Use short names, recognized by the customer.
- Use market-/customer- specific names, no generic names for instance replace “ease of use” by “minimal number of actions for experienced users”, or “efficiency” by “integral cost per patient”
- Do not worry about the exact boundary between Customer Objective and Application create clear goal means relations

Transformation of Key Drivers into Requirements



Threads of Reasoning

by *Gerrit Muller* University of South-Eastern Norway-NISE

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Abstract

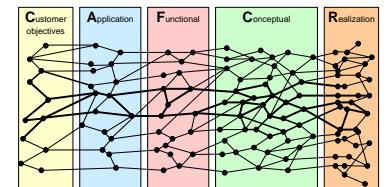
A method of reasoning is described, which addresses cross-cutting issues. The basis is fast iteration in the problem and solution space.

A thread of reasoning is a set of highly relevant related issues, which are addressed by articulating the problem in terms of tension and analyzing it in the CAFCR framework.

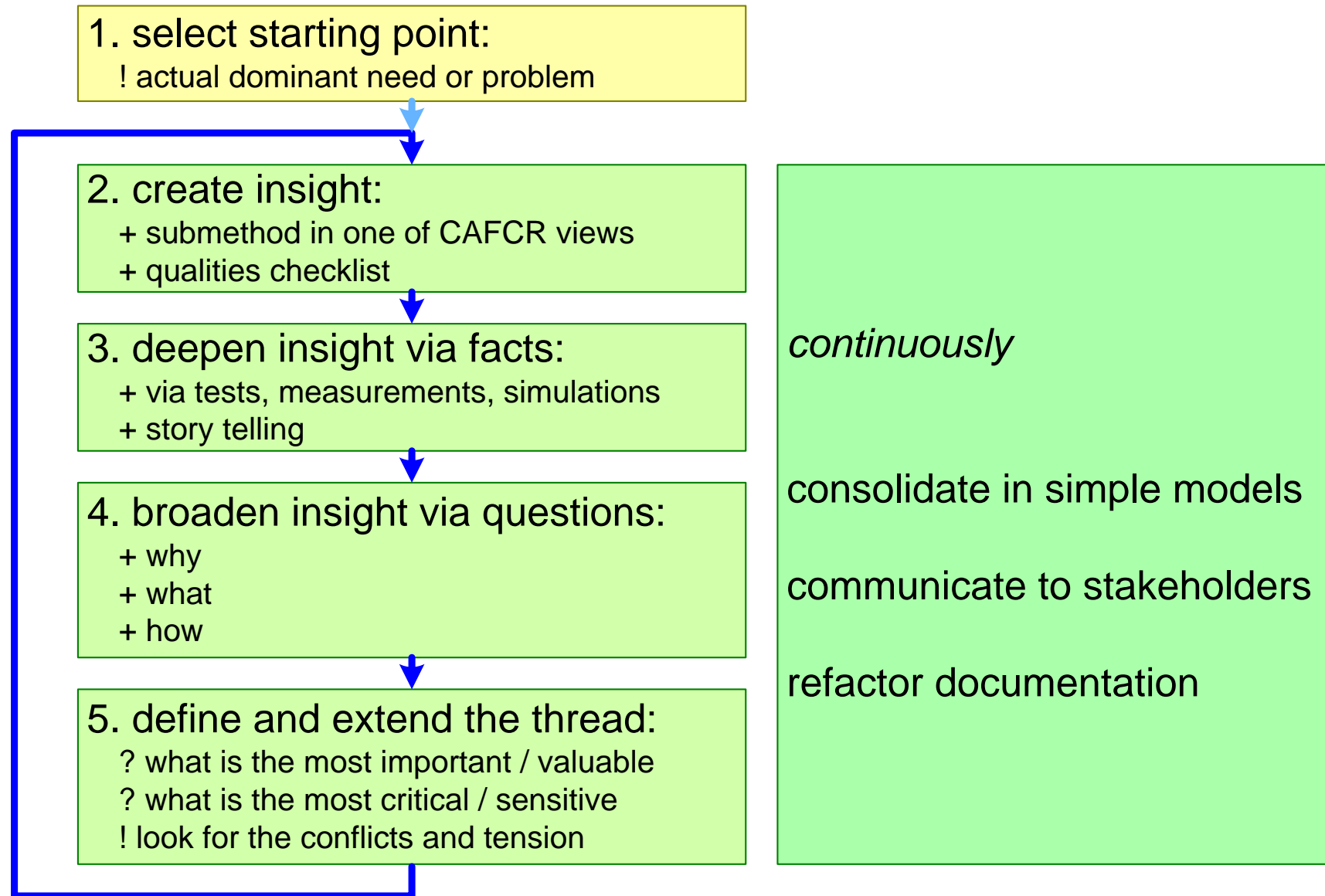
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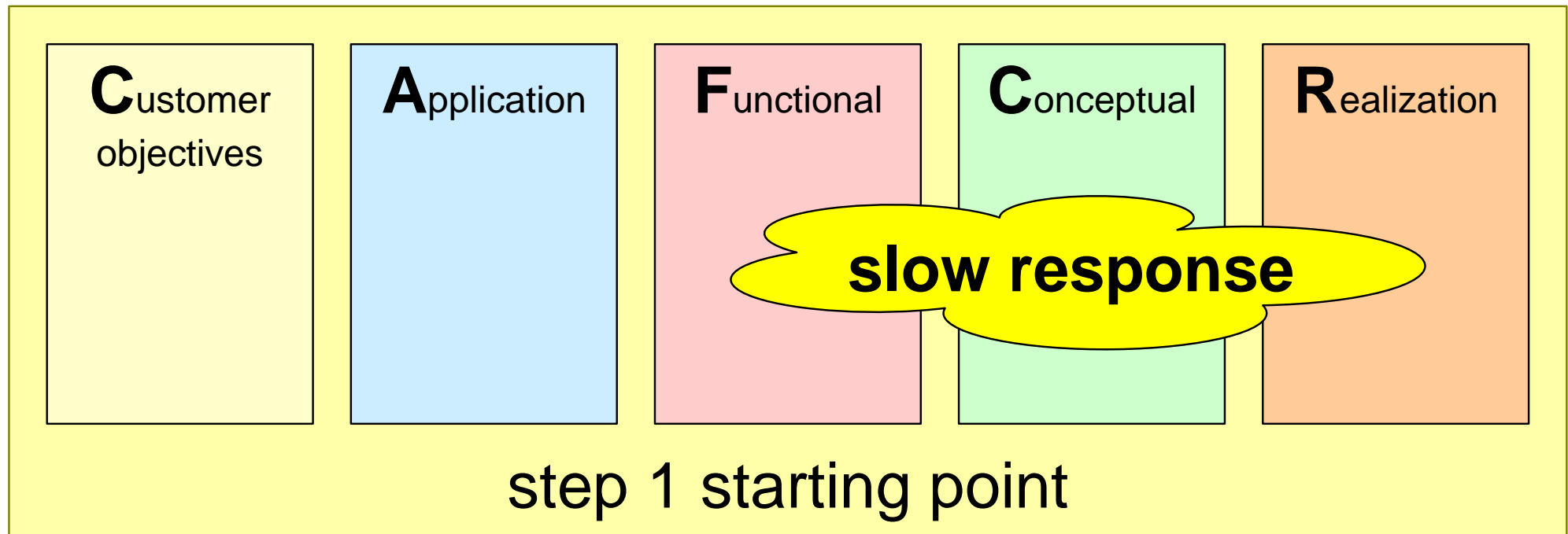
August 16, 2025
status: finished
version: 2.4



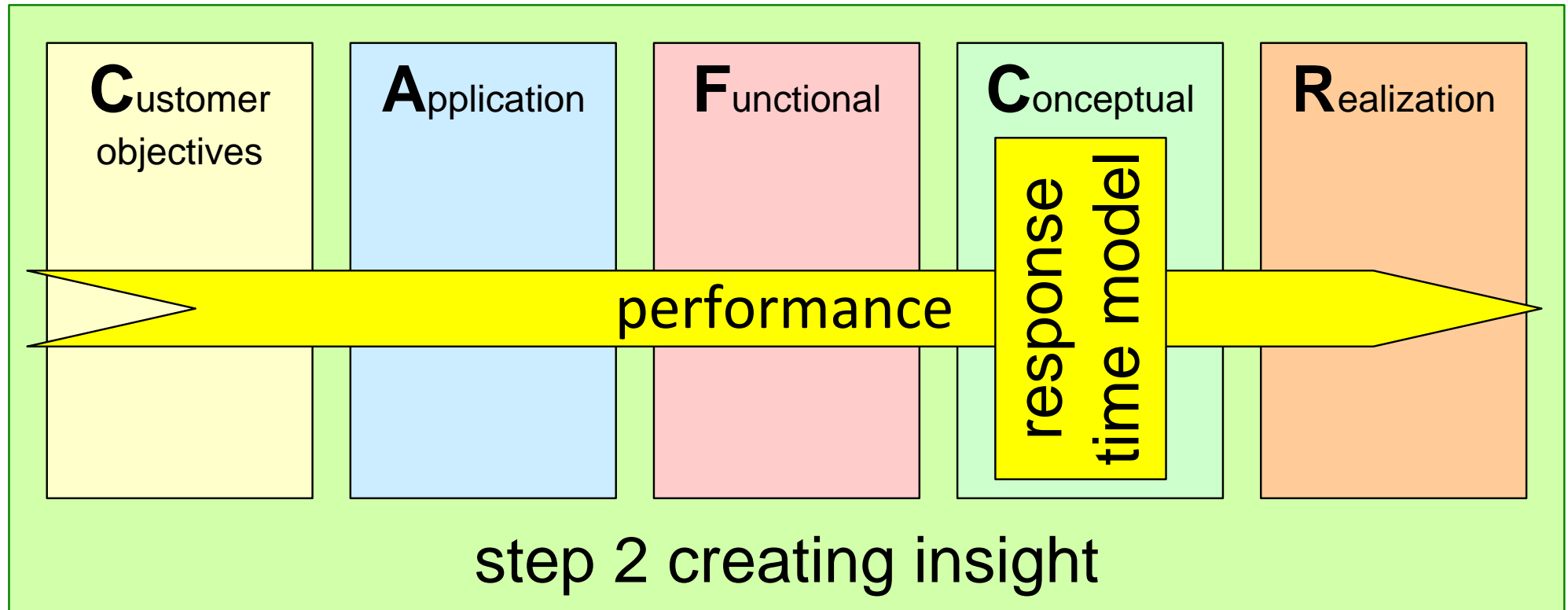
Overview of the reasoning approach



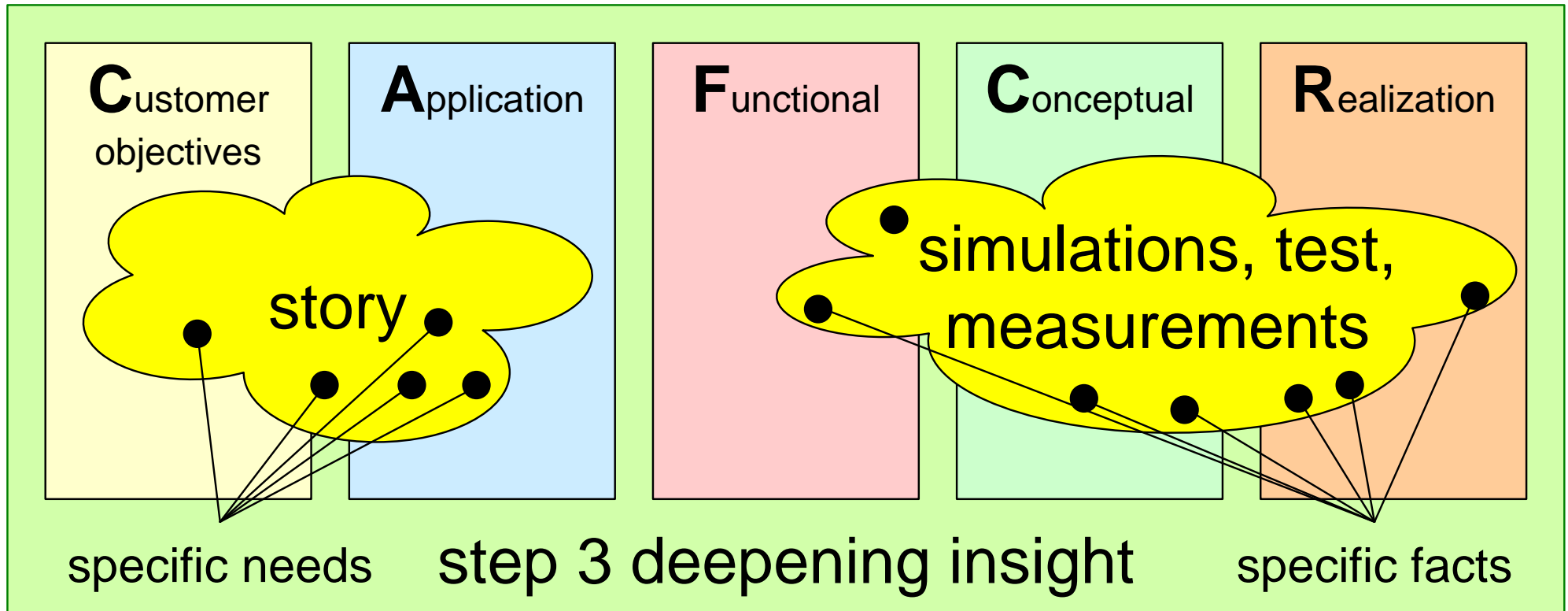
From starting point to insight



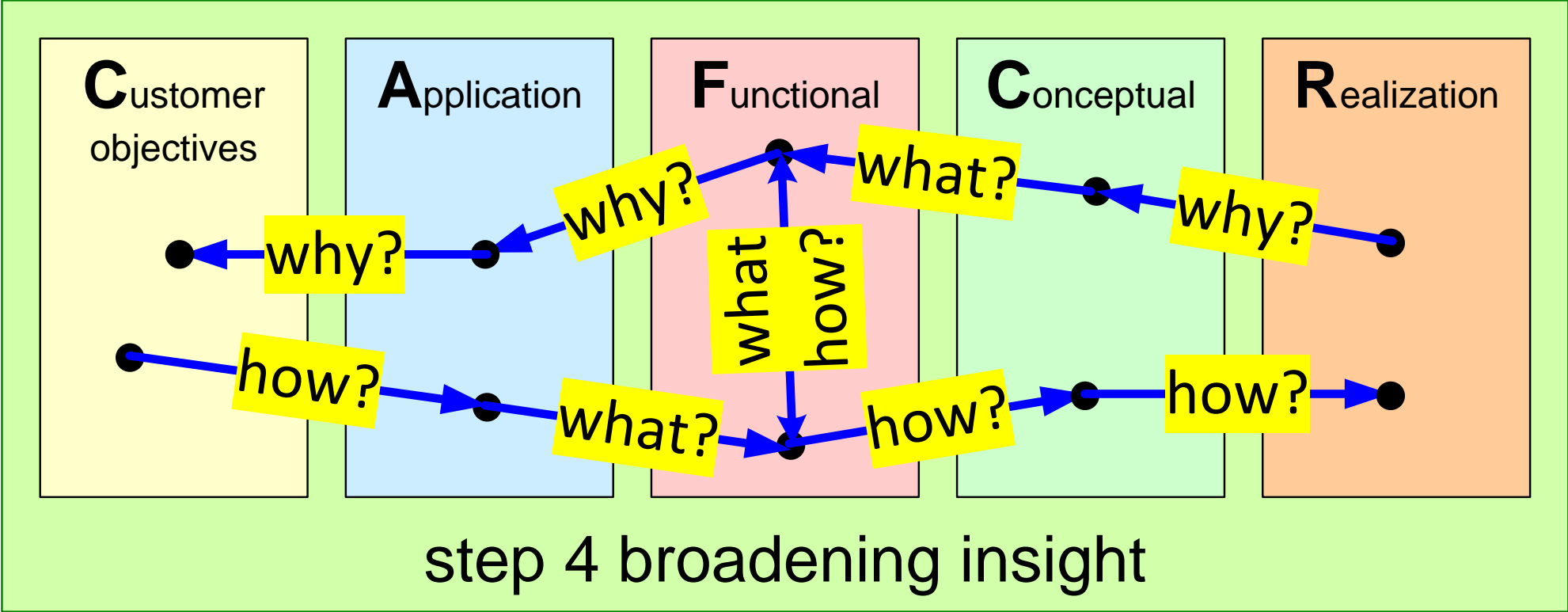
Creating Insight



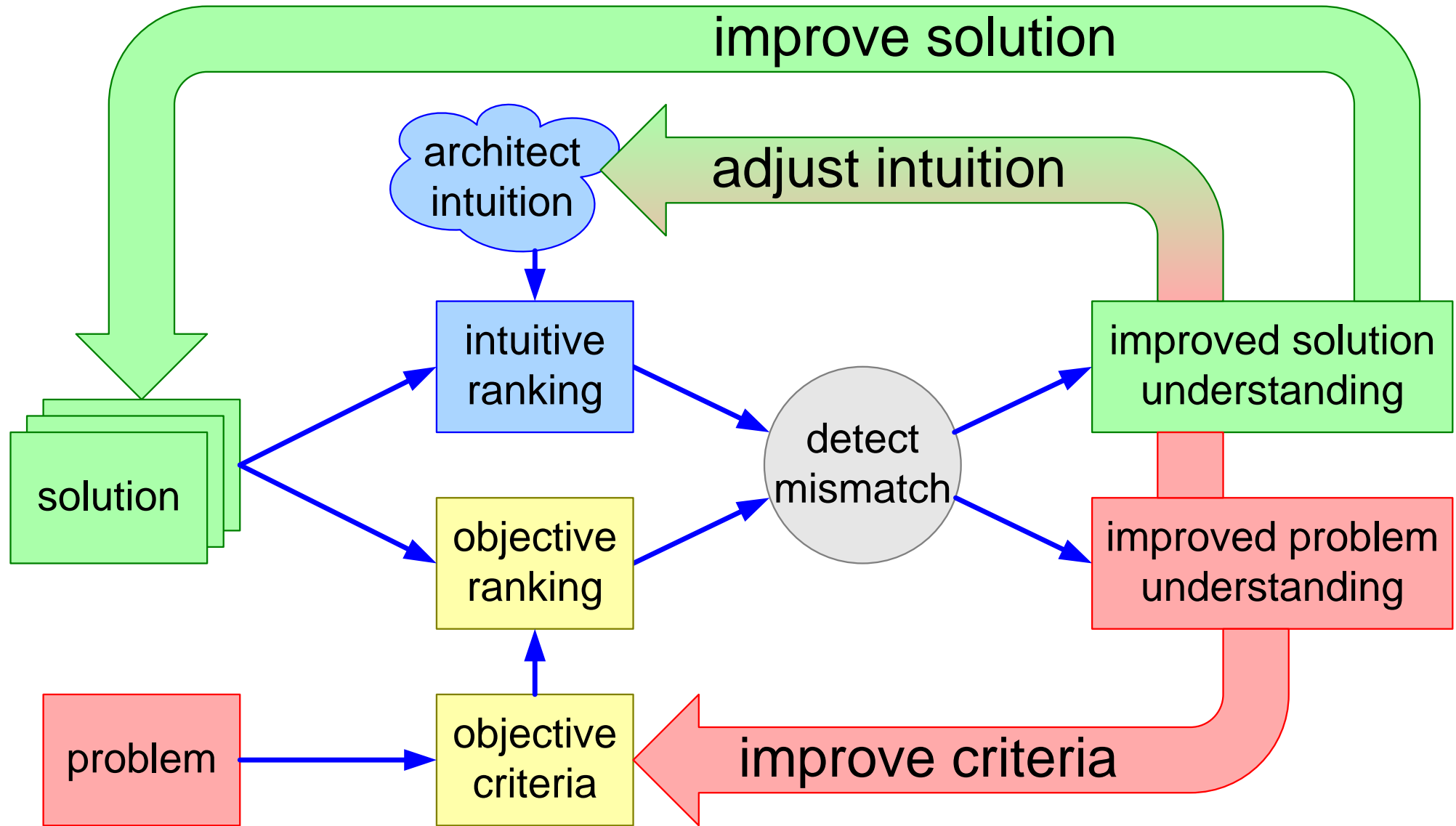
Deepening Insight



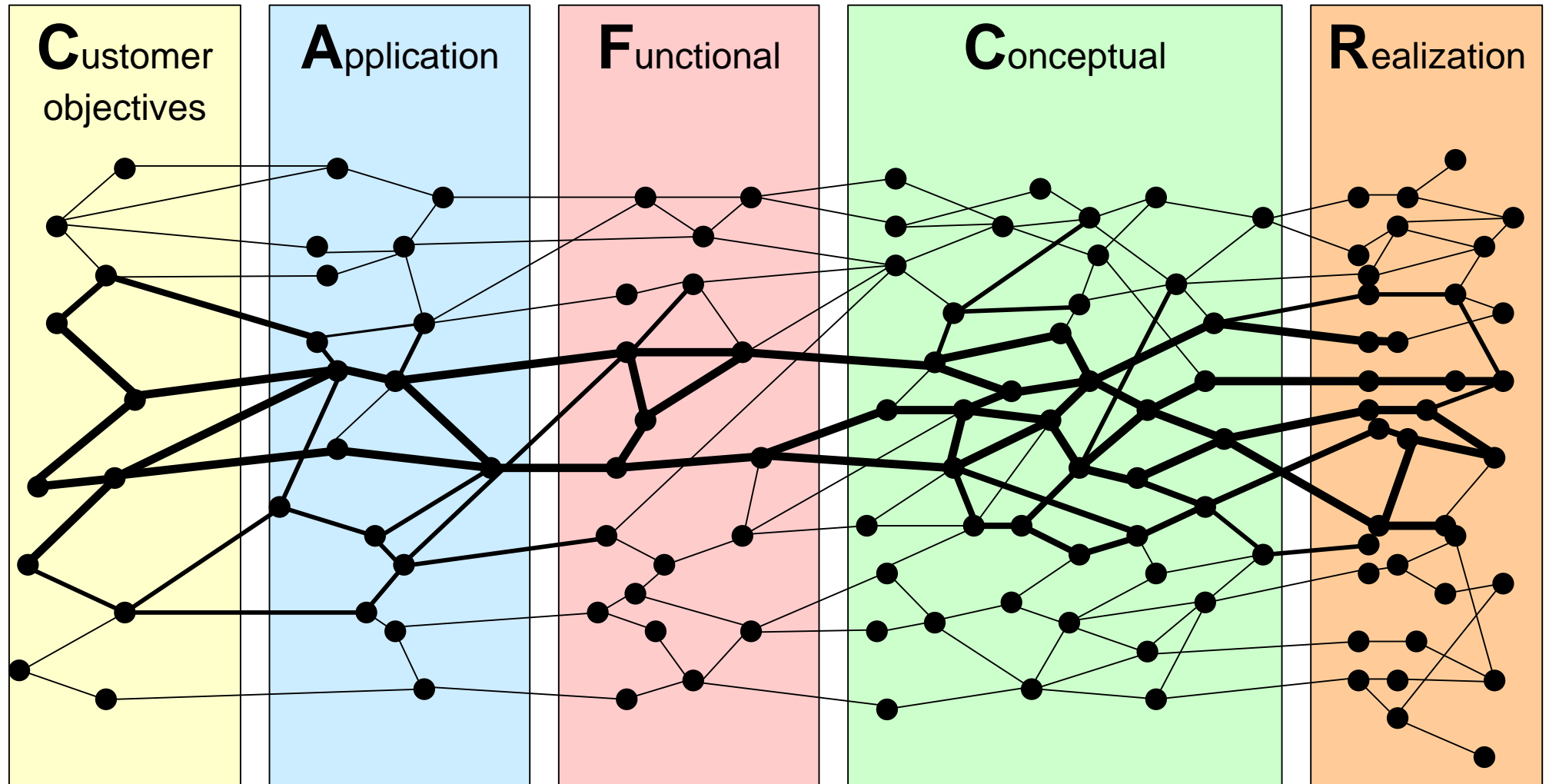
Broadening Insight



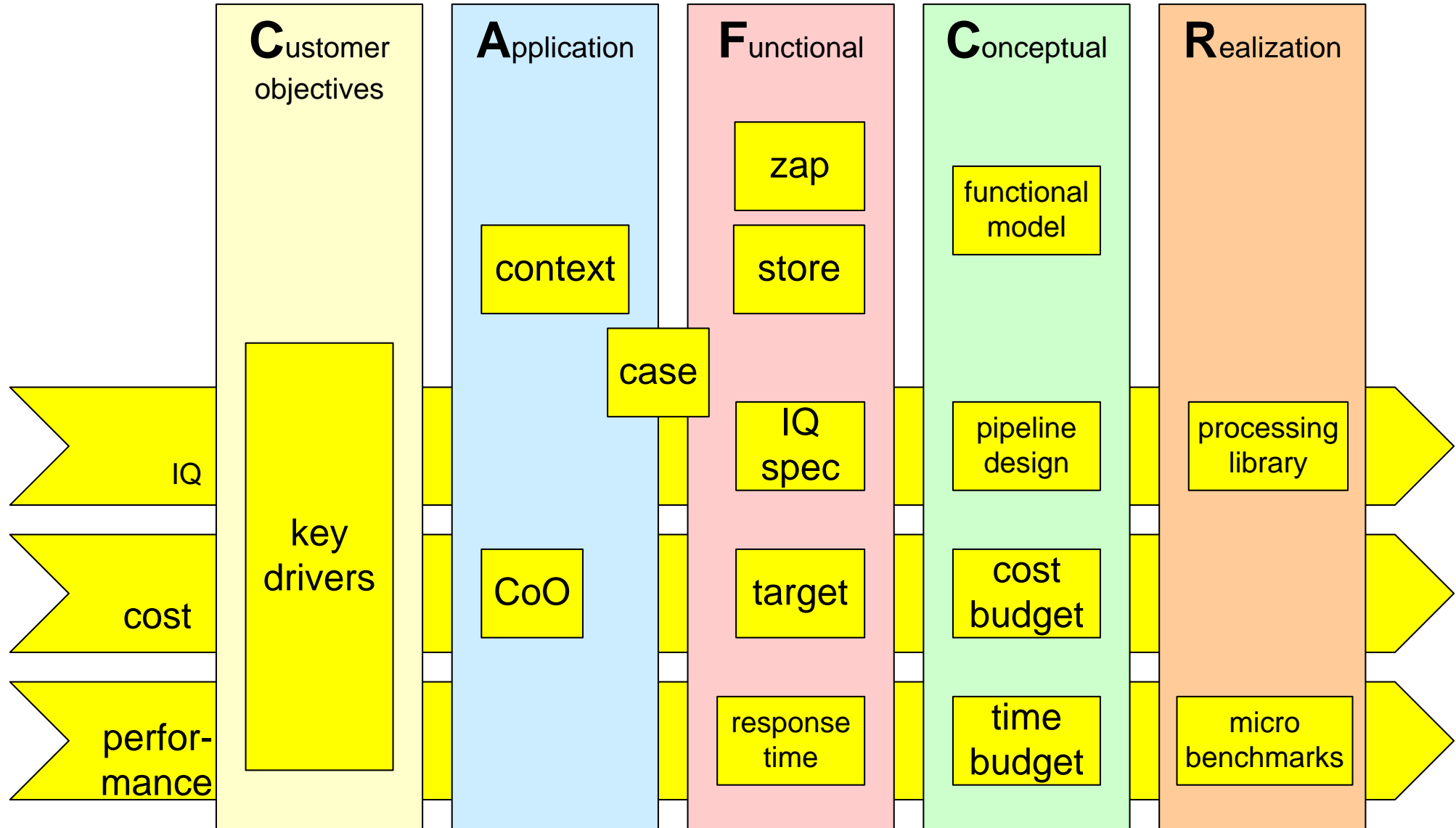
Iteration during the analysis



Thread of related issues



Documentation and communication structure



Threads of reasoning illustrated by medical imaging case

by *Gerrit Muller* University of South-Eastern Norway-NISE

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Abstract

The medical imaging workstation case is introduced. An architecting method based on the CAFCR viewpoints is explained, consisting of 4 elements:

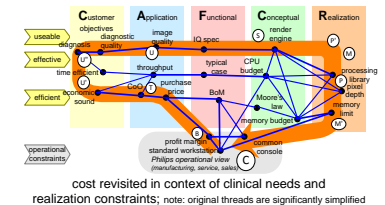
- the CAFCR viewpoints
- qualities as integrating needles
- story telling
- threads of reasoning

A thread of reasoning is build up in steps, based on this case. The underlying reasoning is explained.

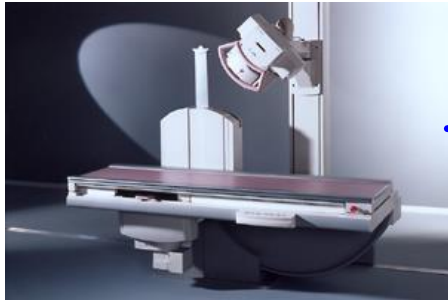
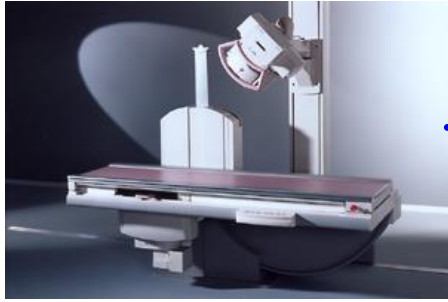
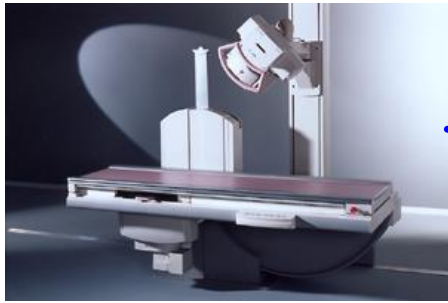
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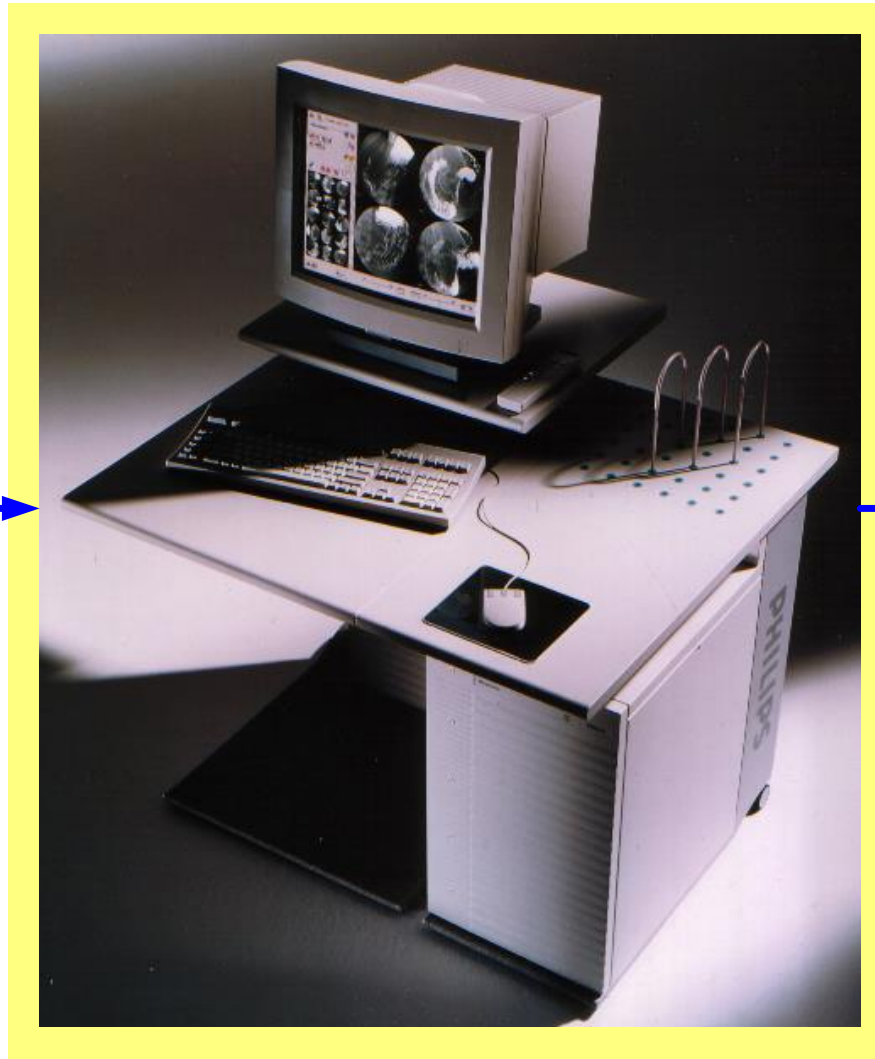
August 16, 2025
status: preliminary
draft
version: 0



Easyvision serving three URF examination rooms



URF-systems

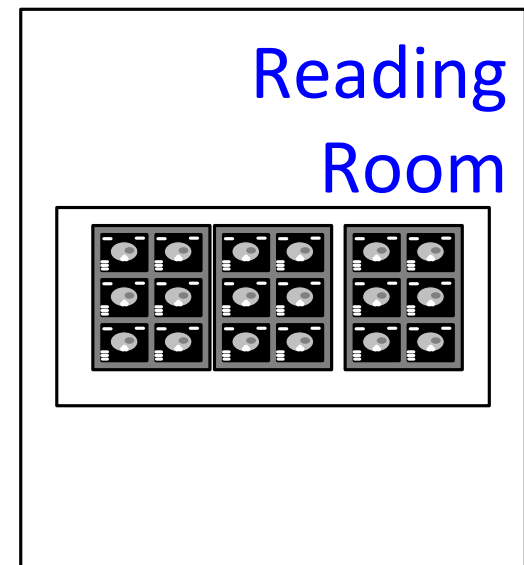
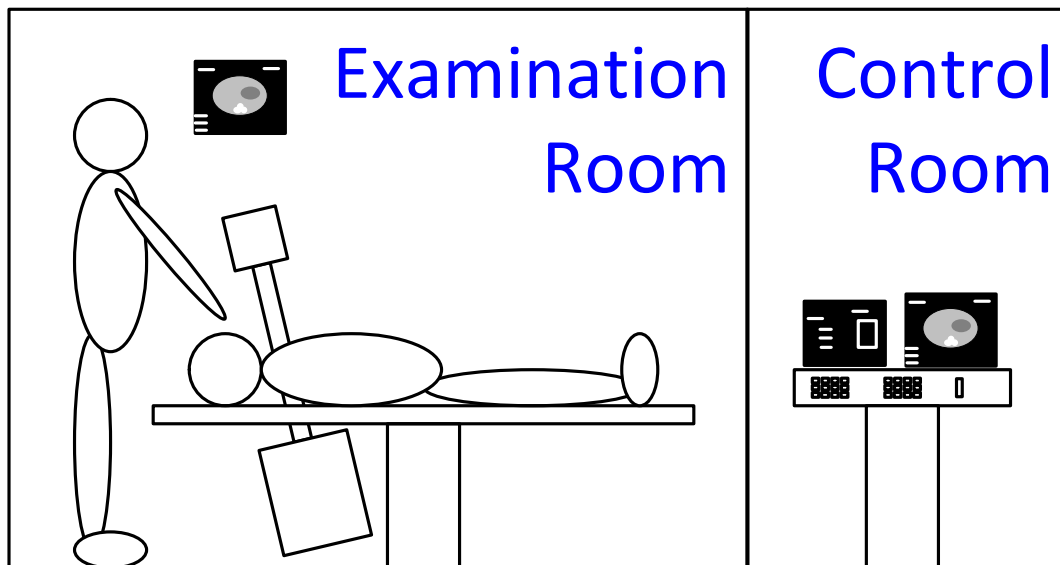
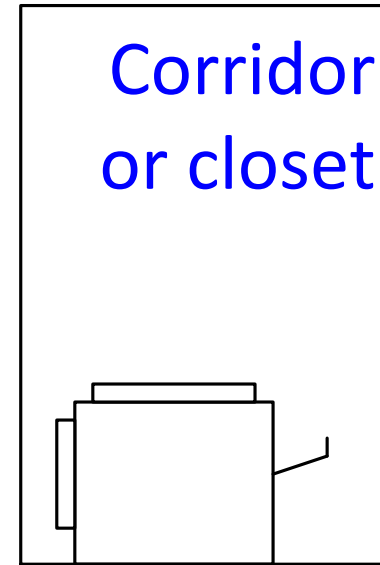
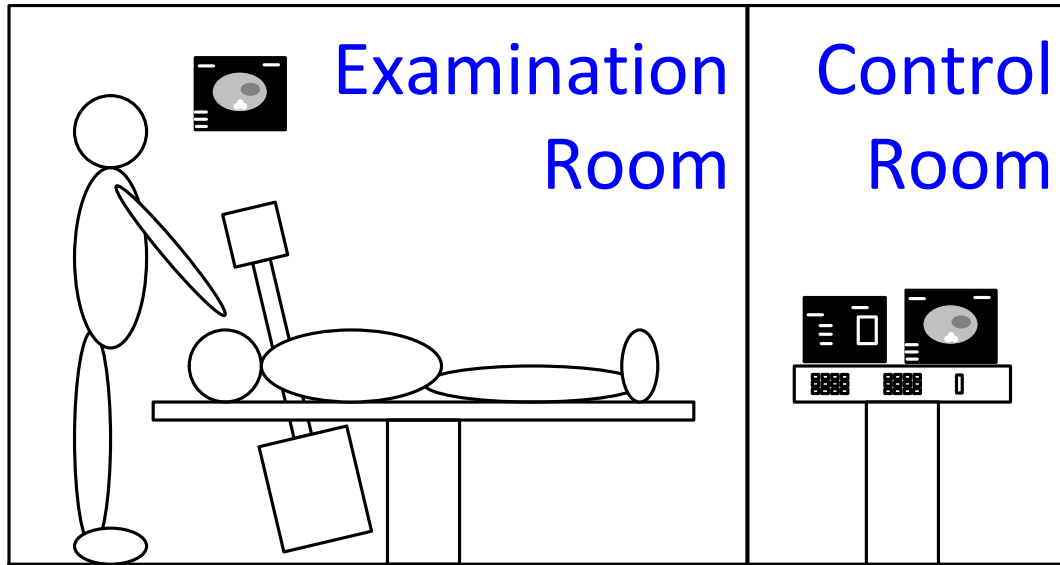


EasyVision: Medical Imaging Workstation

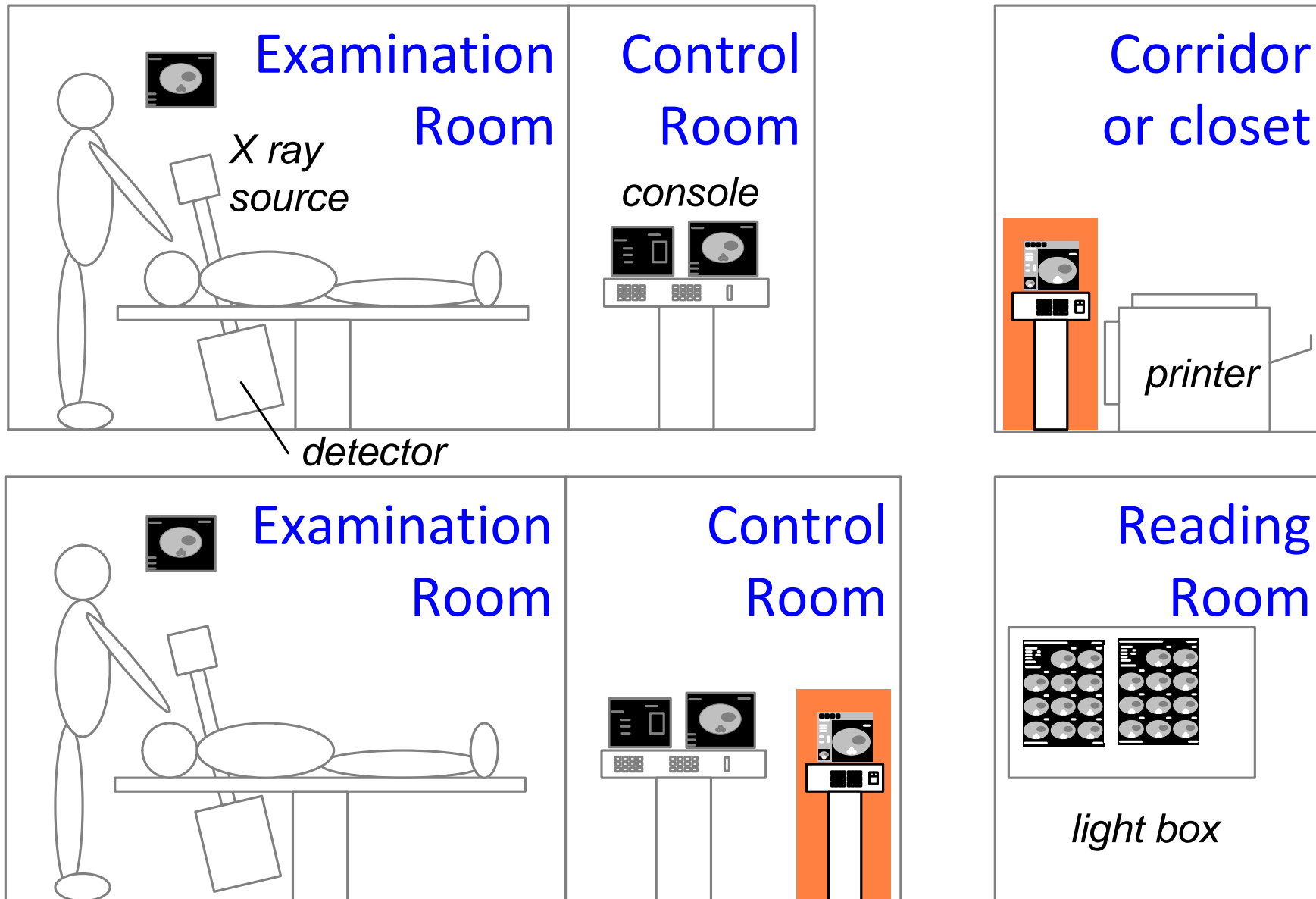


typical clinical image (intestines)

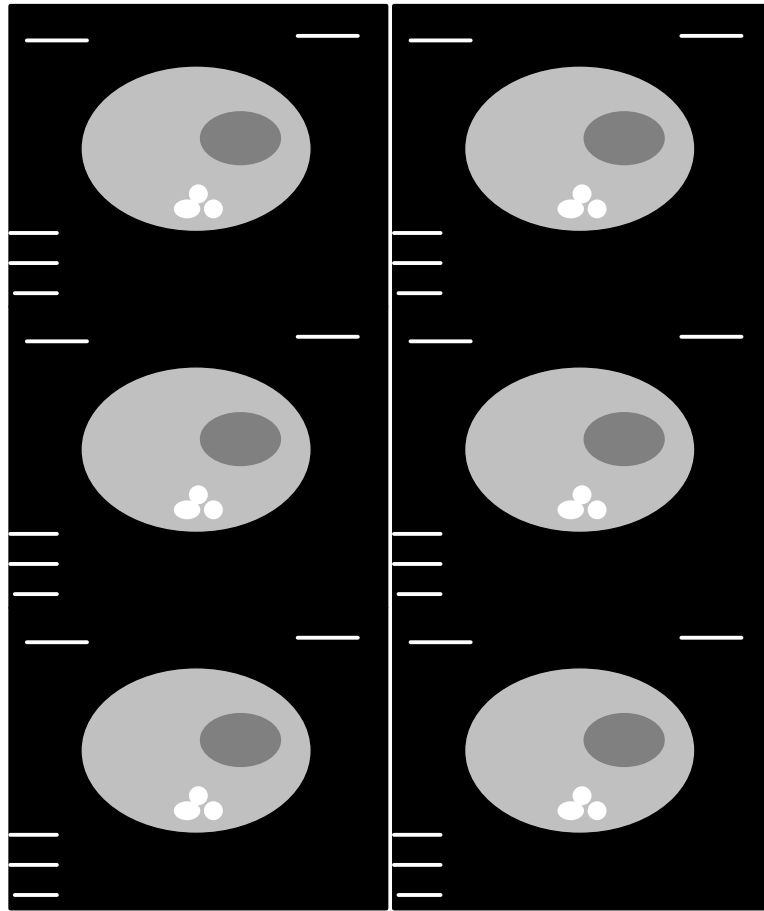
X-ray rooms from examination to reading around 1990



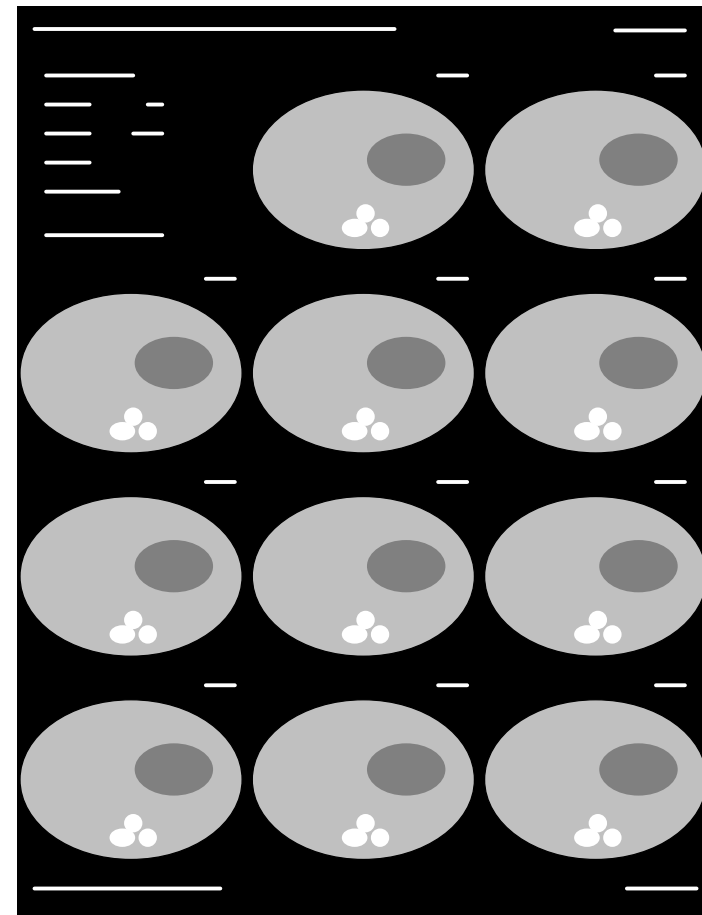
X-ray rooms with Easyvision applied as printserver



Comparison screen copy versus optimized film



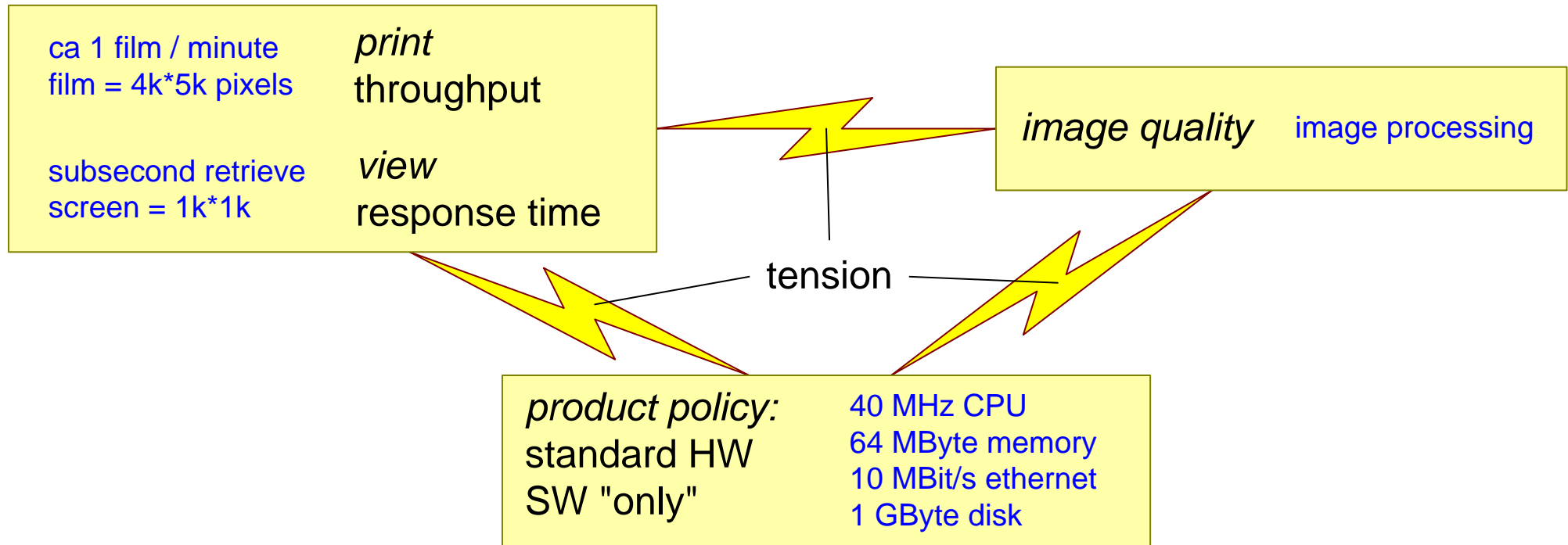
old: screen copy



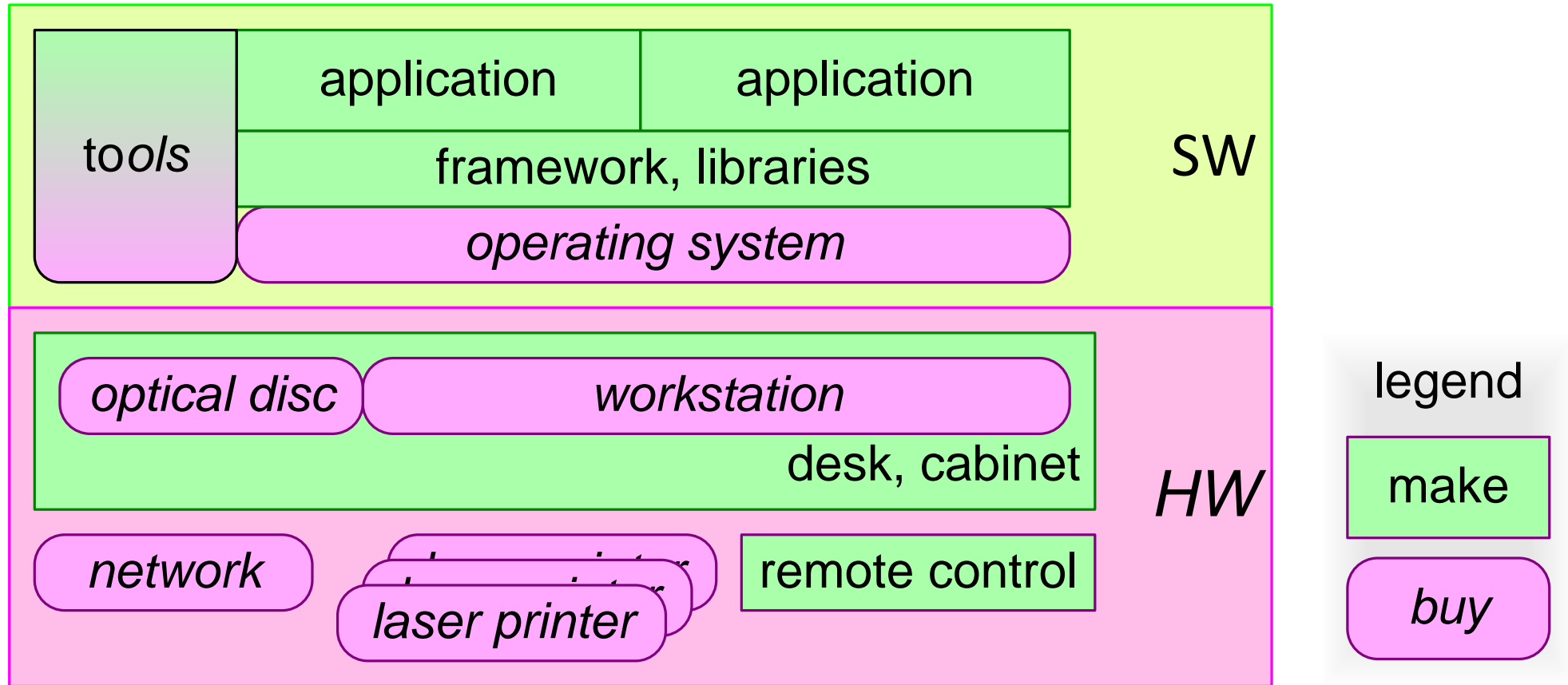
new: SW formatting

20 to 50% less film needed

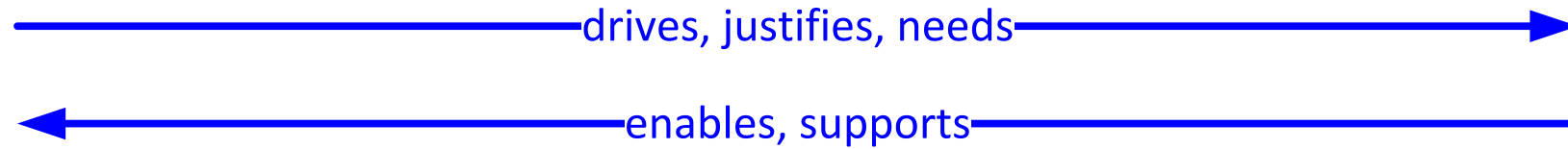
Challenges for product creation



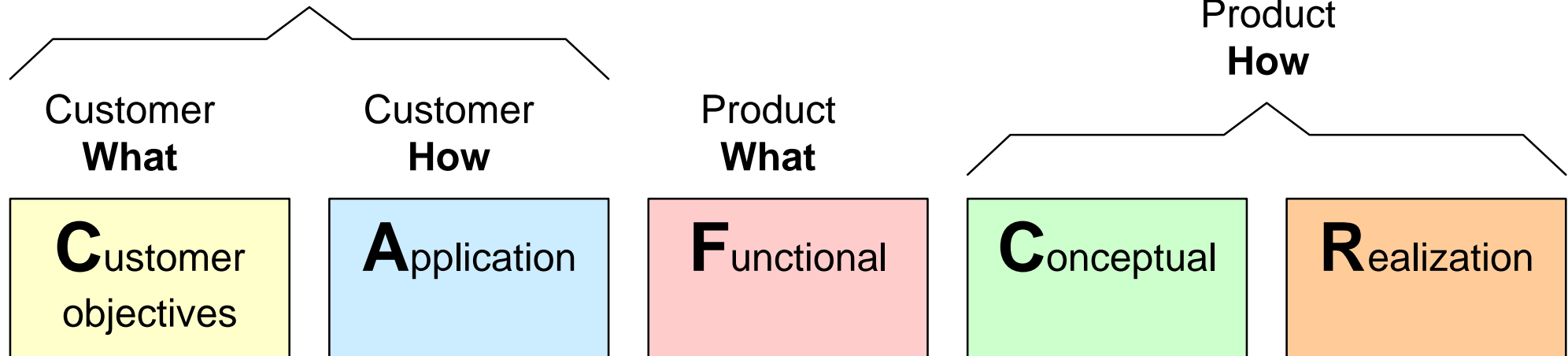
Top level decomposition



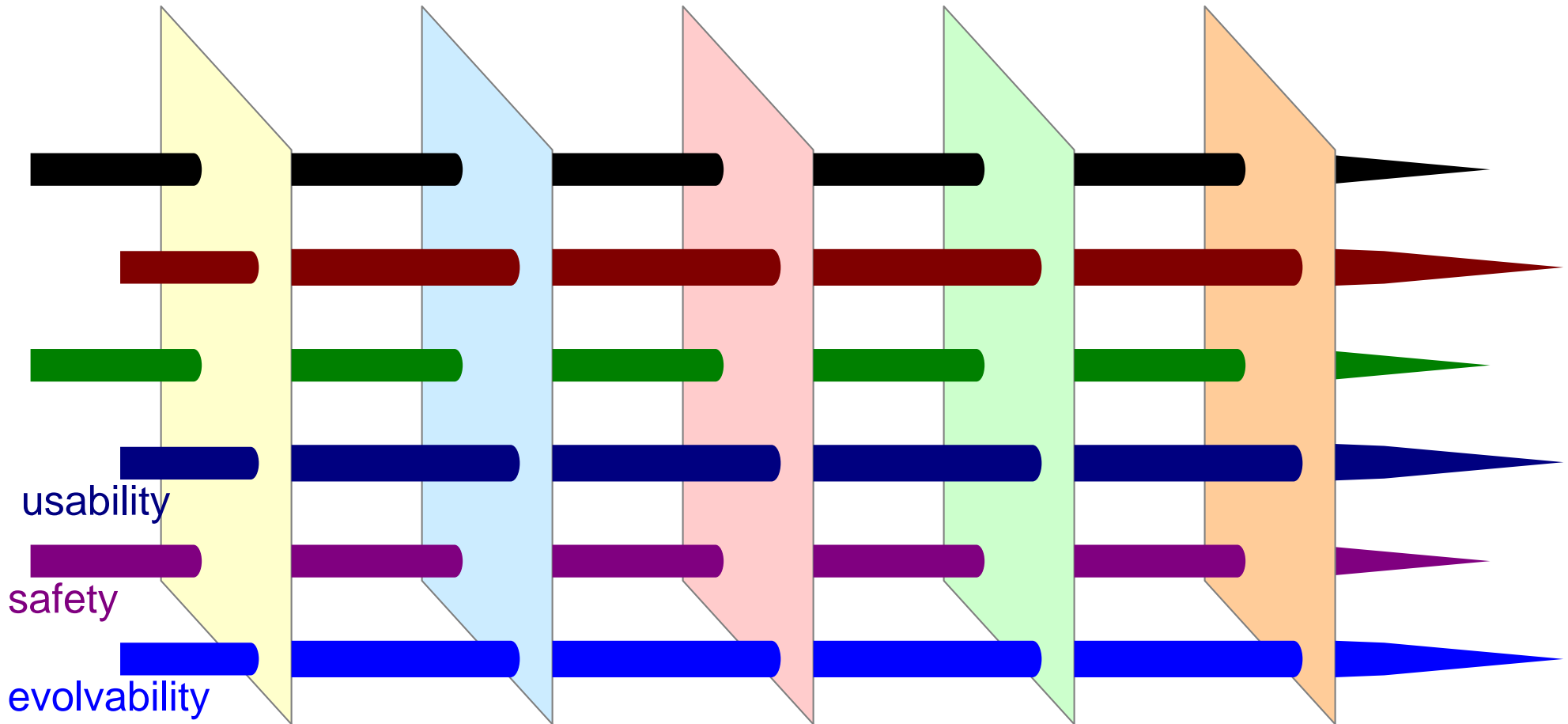
CAFCR viewpoints



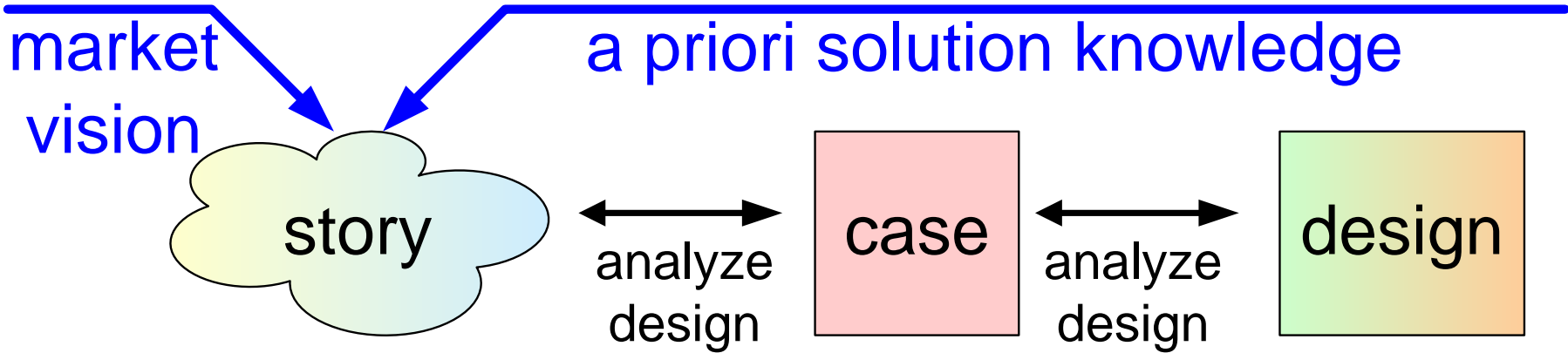
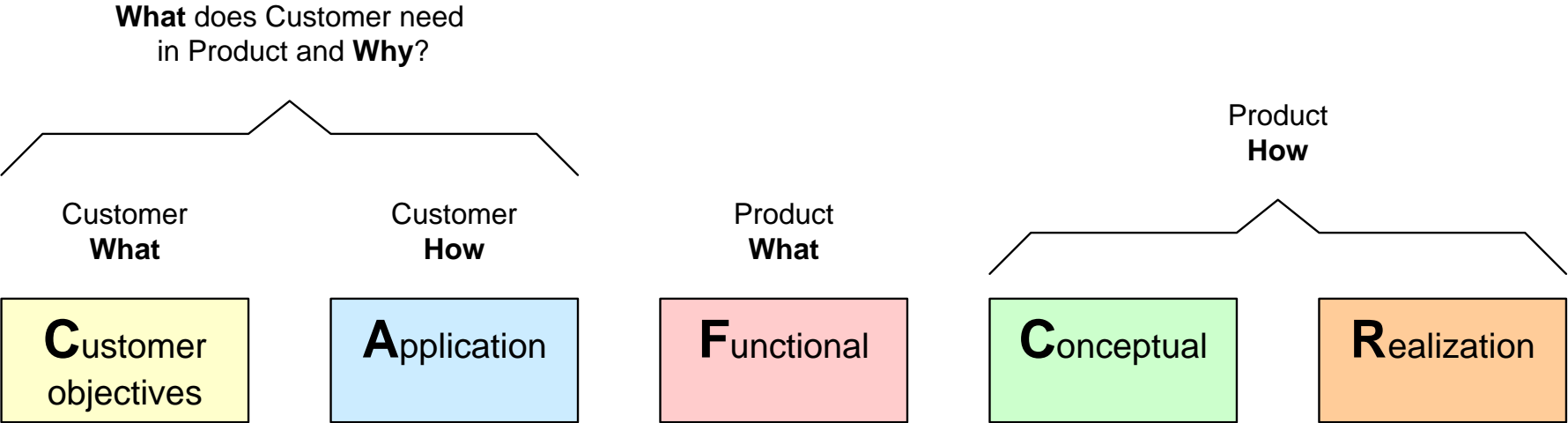
What does Customer need
in Product and **Why?**



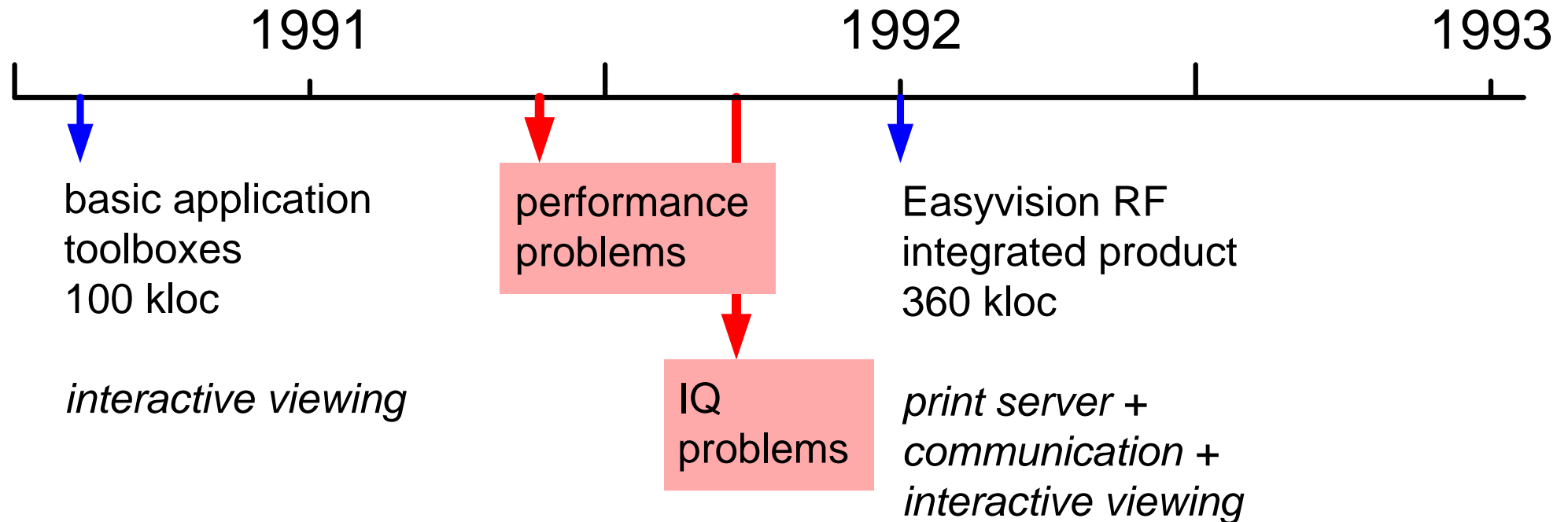
Quality needles as generic integrating concepts



From story to design



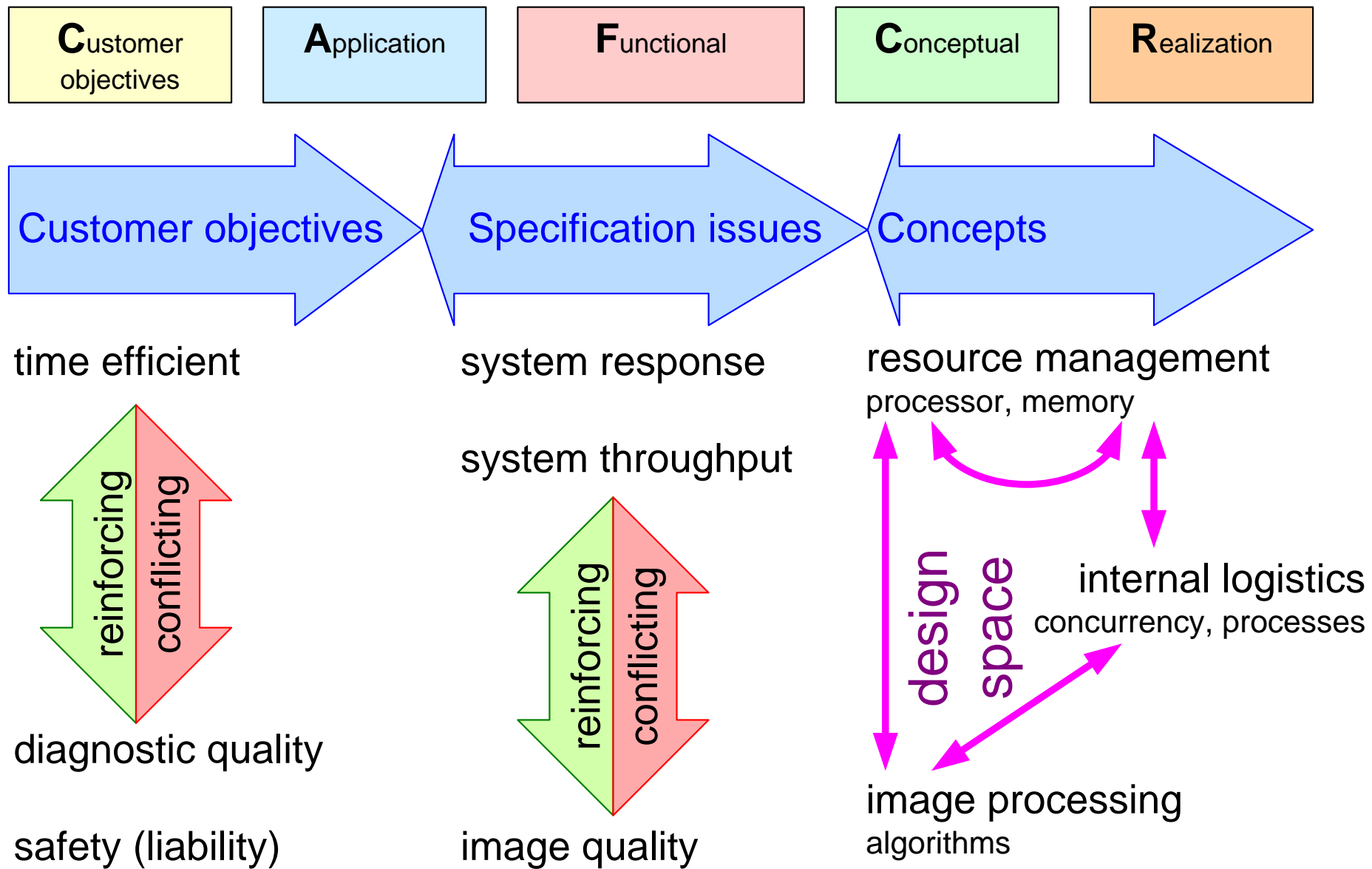
Chronology of Easyvision RF R1 development



marketing opinion:

"All the functionality is available,
we only have to provide a clinical UI"

Thread of reasoning based on efficiency-quality tension



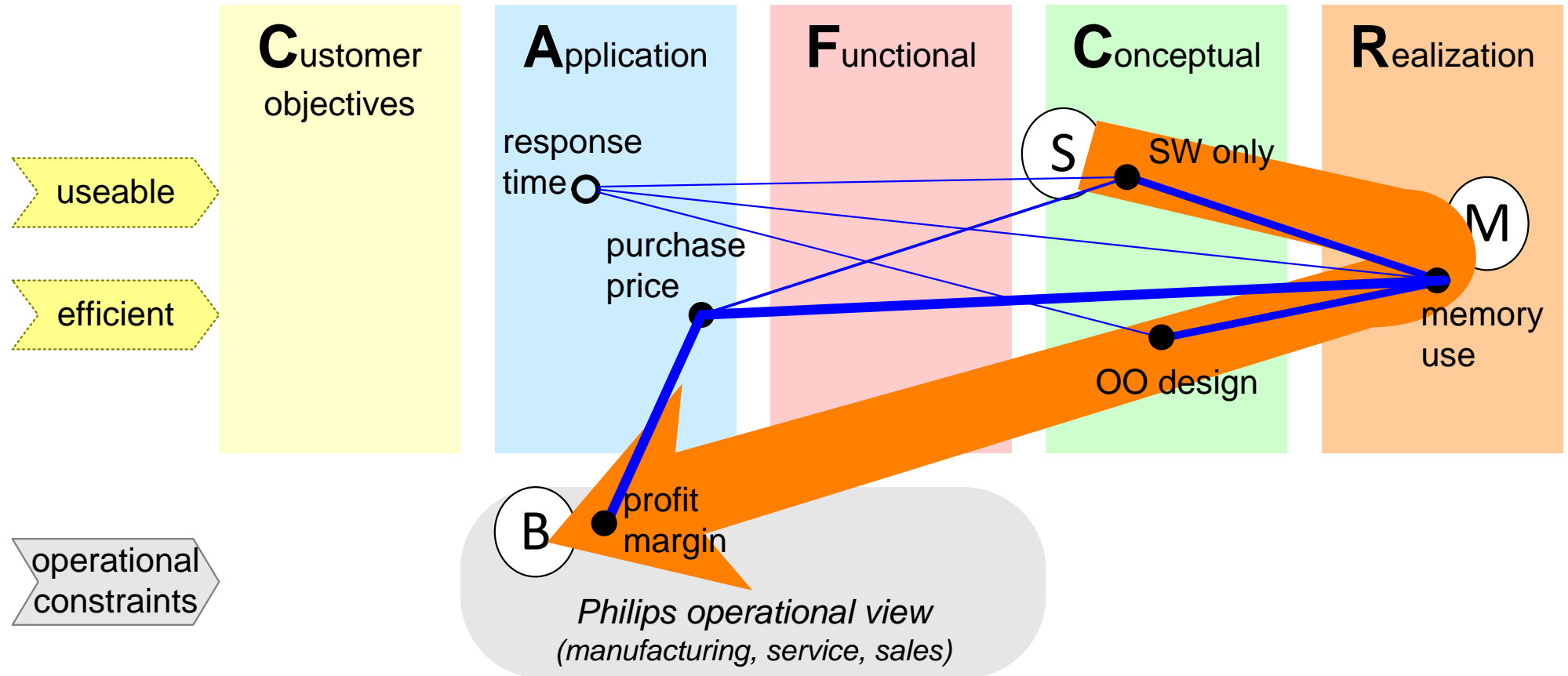
Technology innovations

performance
cost



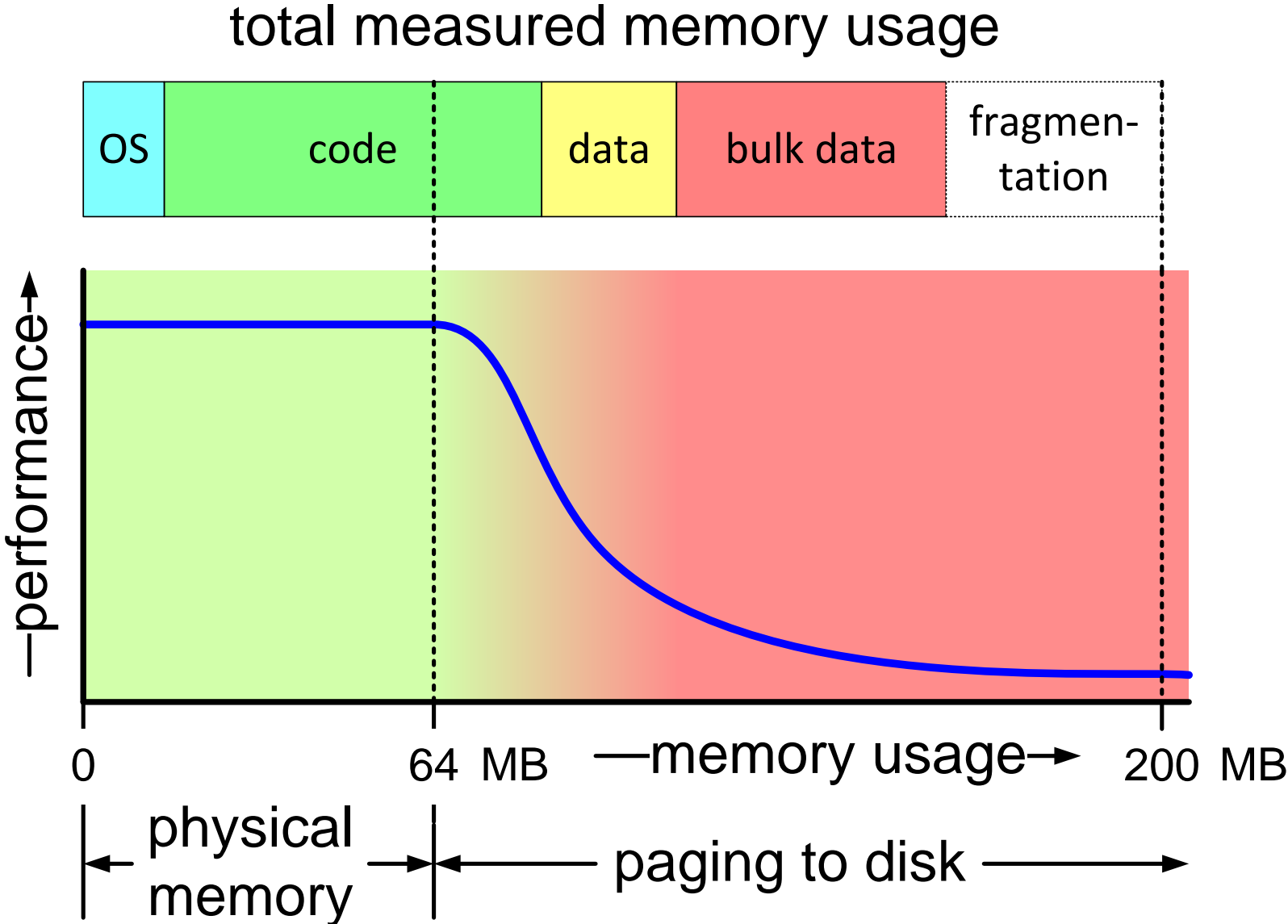
standard UNIX based workstation
full SW implementation, more flexible
object oriented design and implementation (Objective-C)
graphical User Interface, with windows, mouse etcetera
call back scheduling, fine-grained notification
data base engine, fast, reliable and robust
extensive set of toolboxes
property based configuration
multiple coordinate spaces

Thread of reasoning; introvert phase

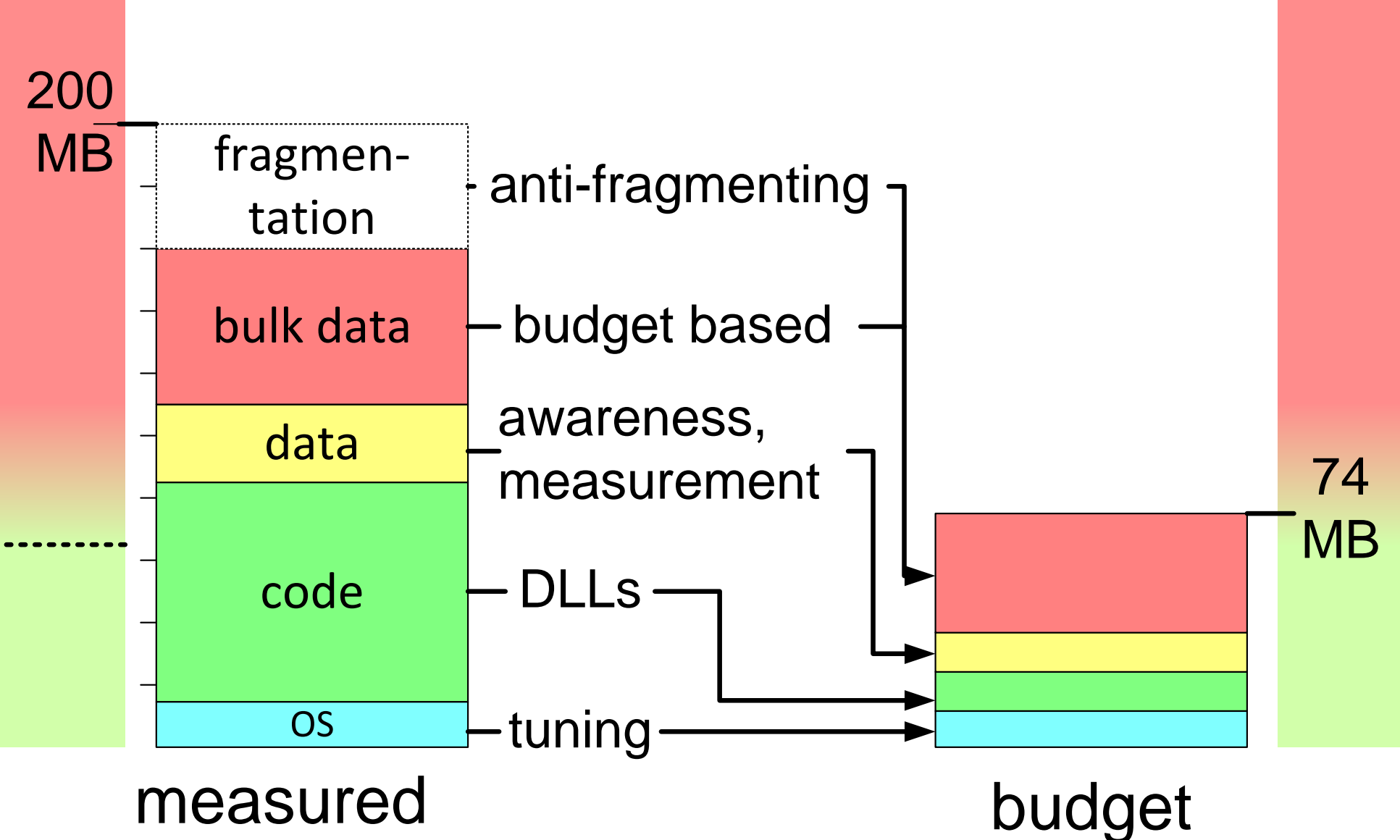


Introvert view: cost and impact of new technologies

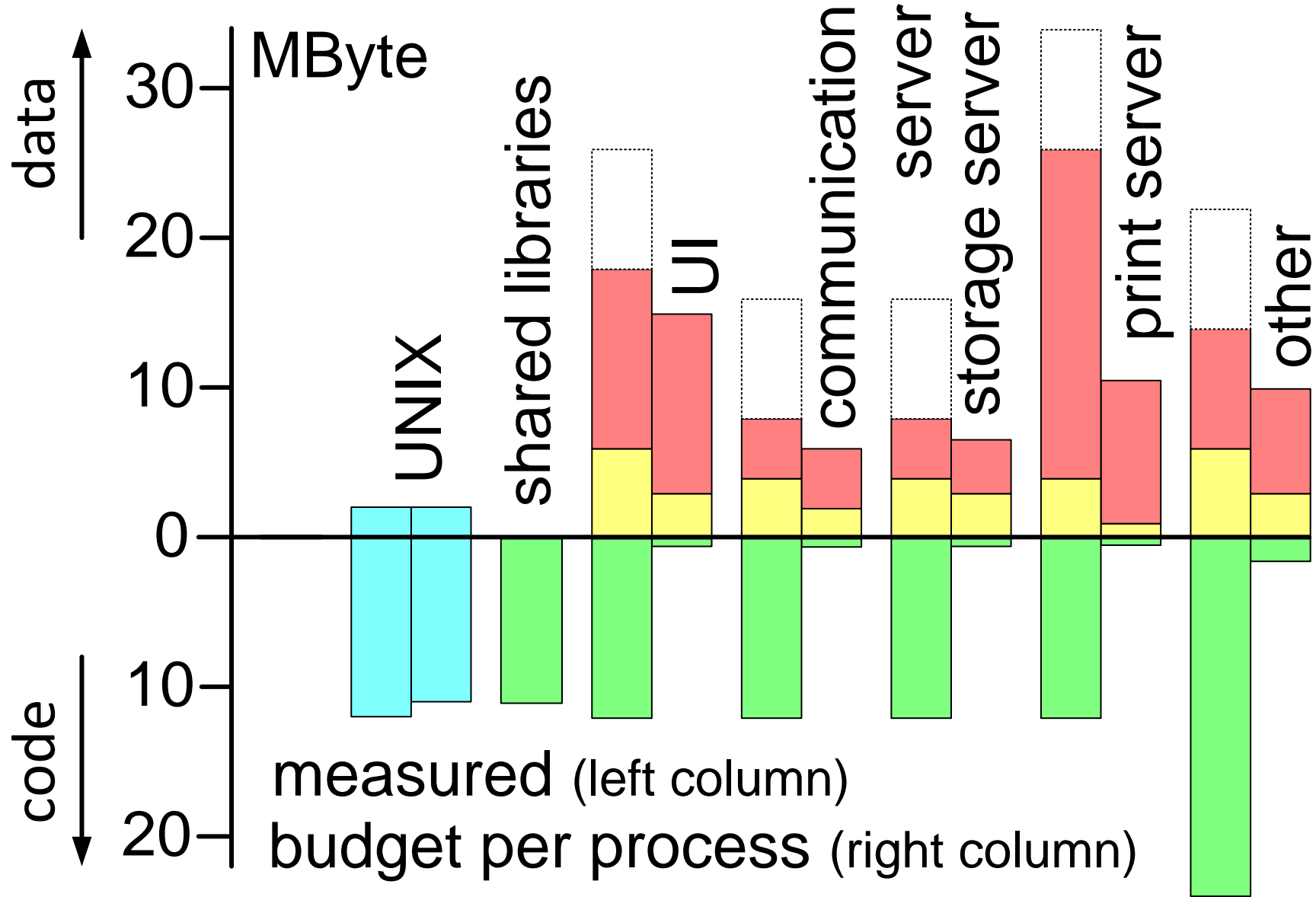
Memory usage half way R1



Solution of memory performance problem



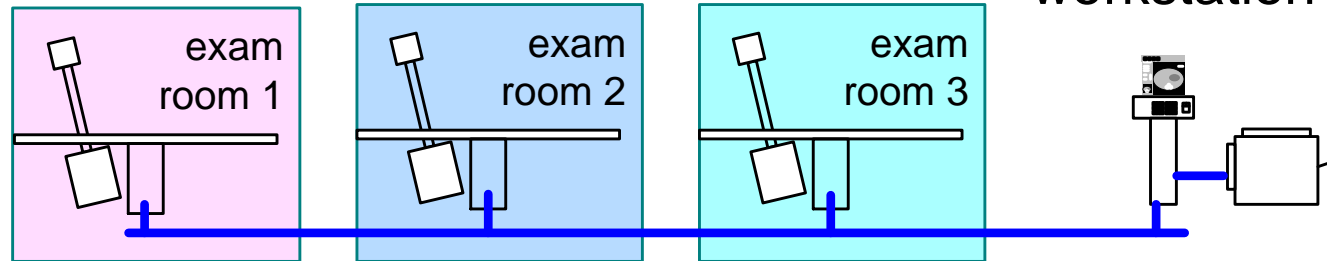
Visualization memory use per process



Typical case URF examination

3 examination rooms connected to

1 medical imaging workstation + printer

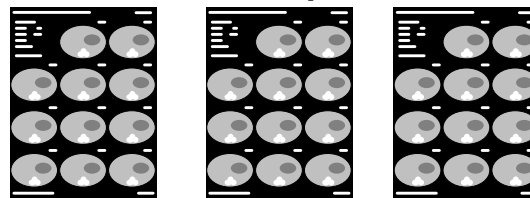


examination room: average 4 interleaved examinations / hour

image production: 20 1024^2 8 bit images per examination

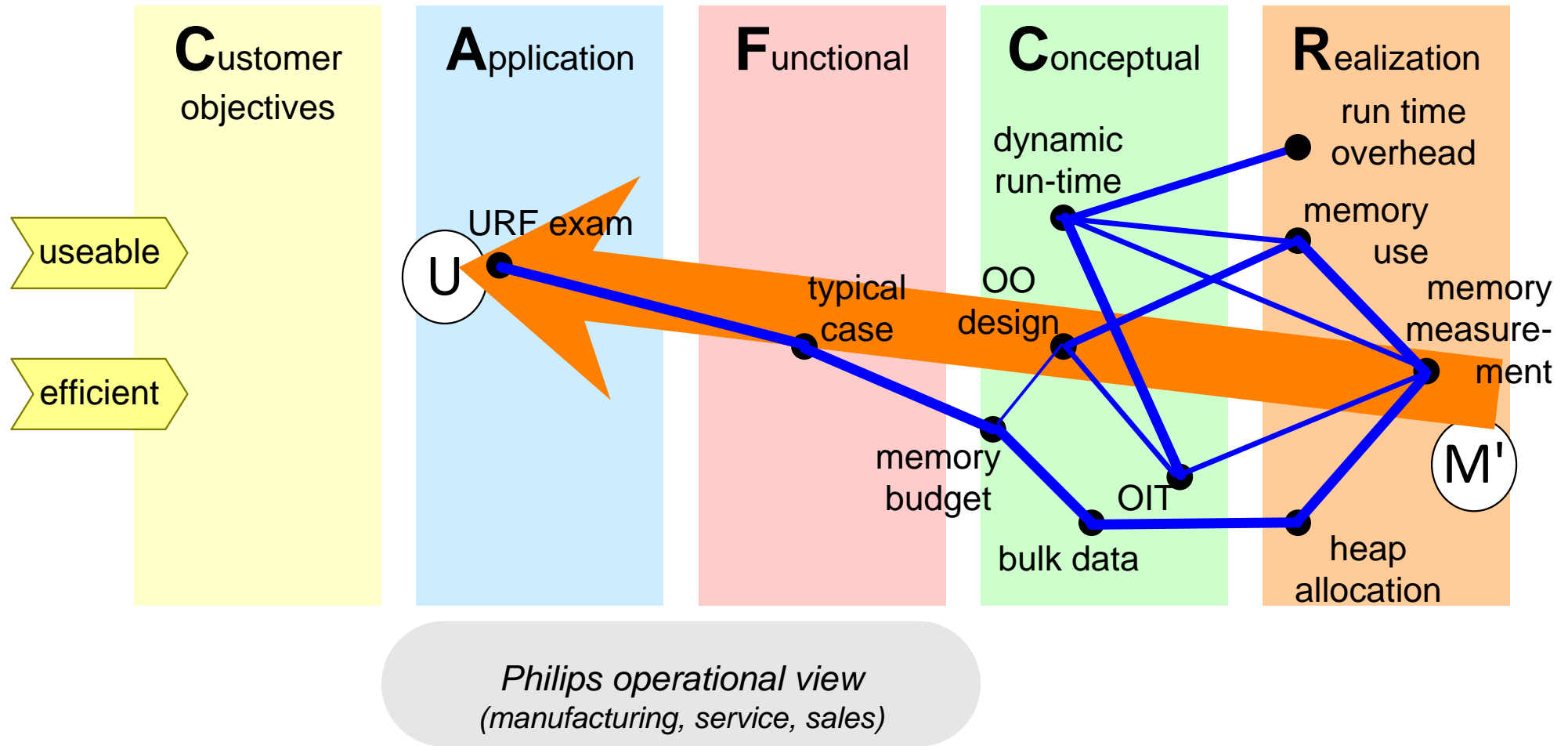


film production: 3 films of 4k*5k pixels each



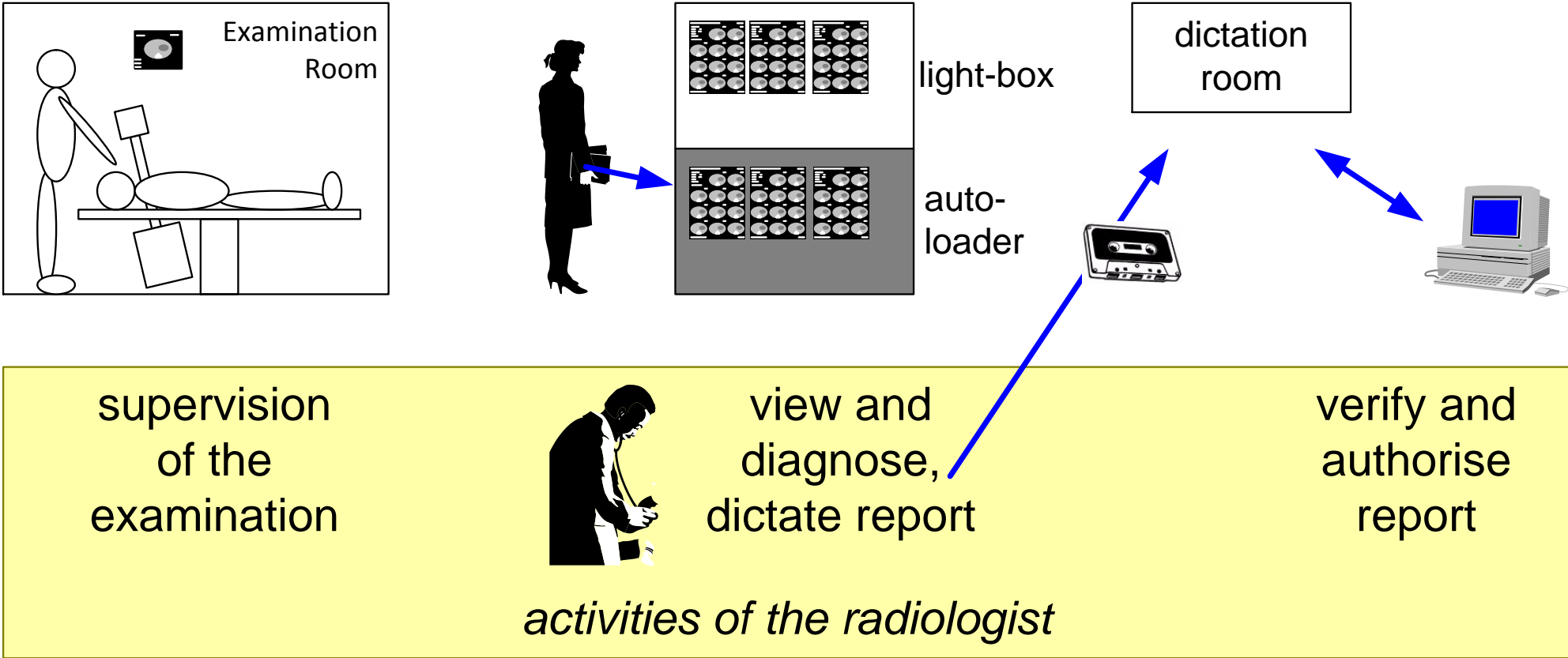
high quality output
(bi-cubic interpolation)

Thread of reasoning; phase 2

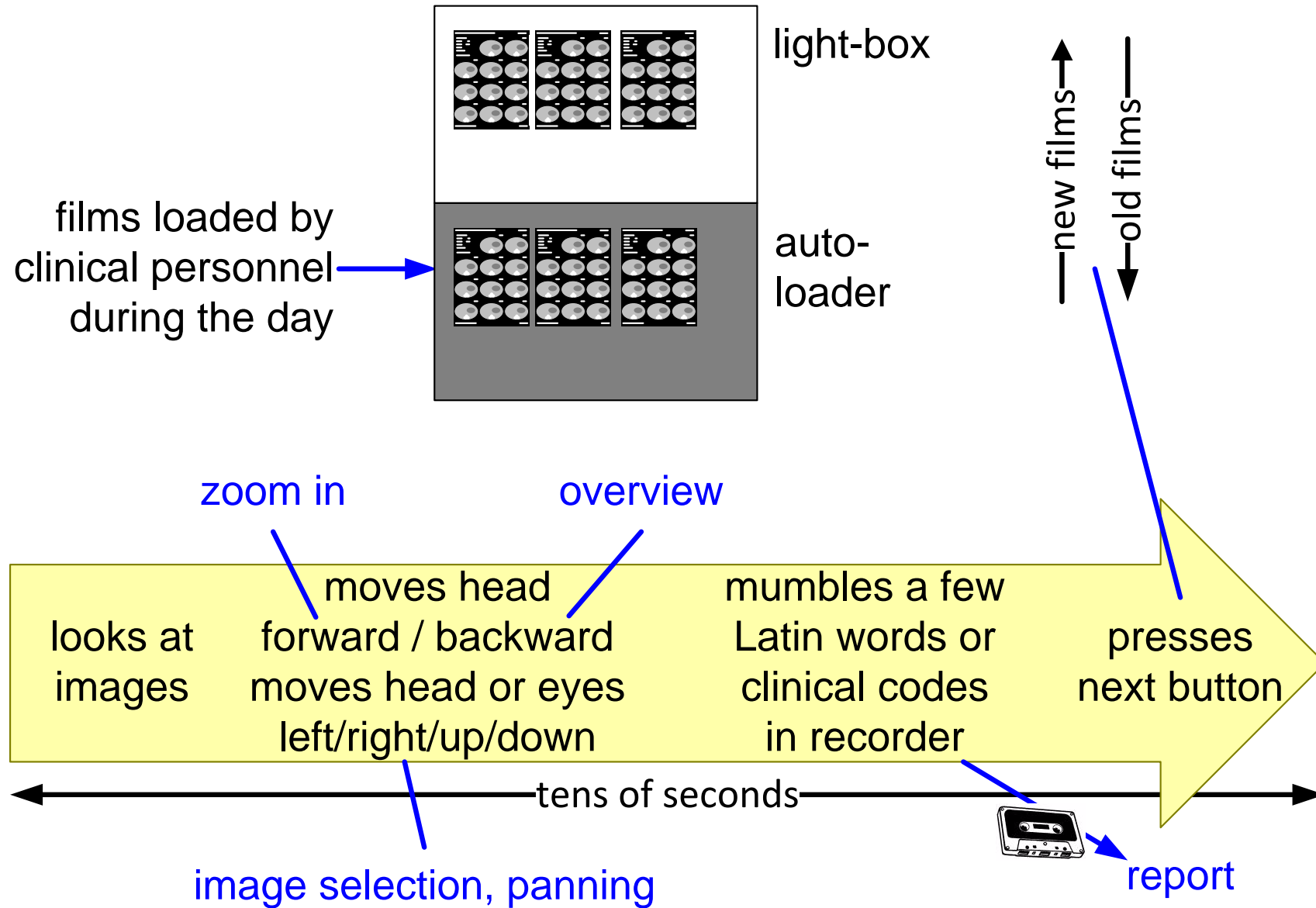


How to measure memory, how much is needed?
from introvert to extrovert

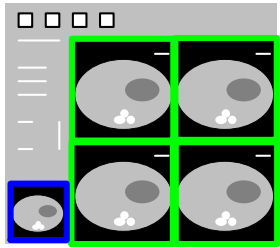
Radiologist workspots and activities



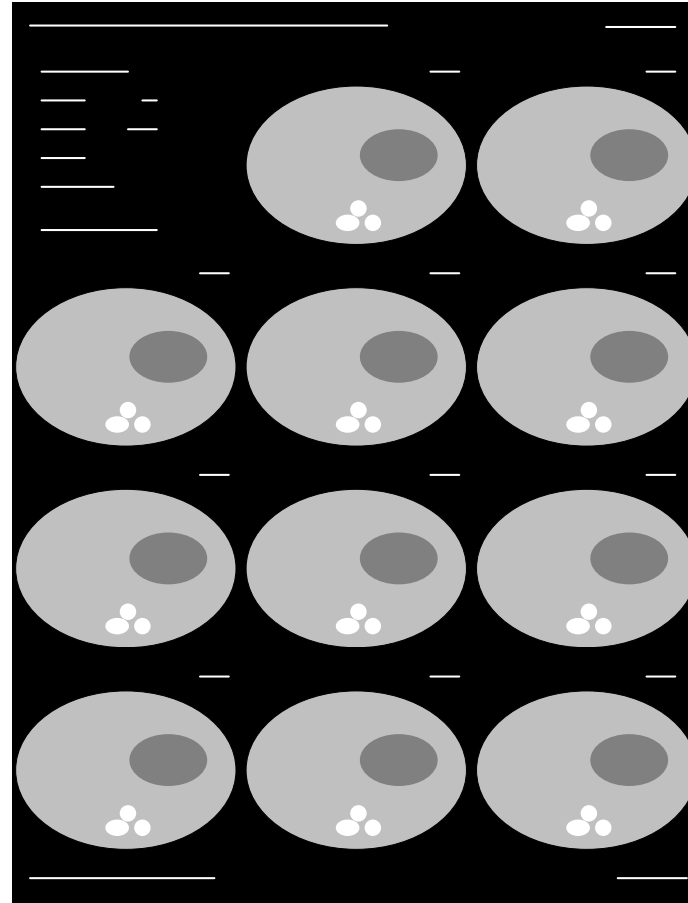
Diagnosis in tens of seconds



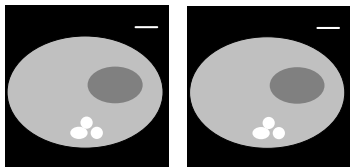
Rendered images at different destinations



Screen:
low resolution
fast response



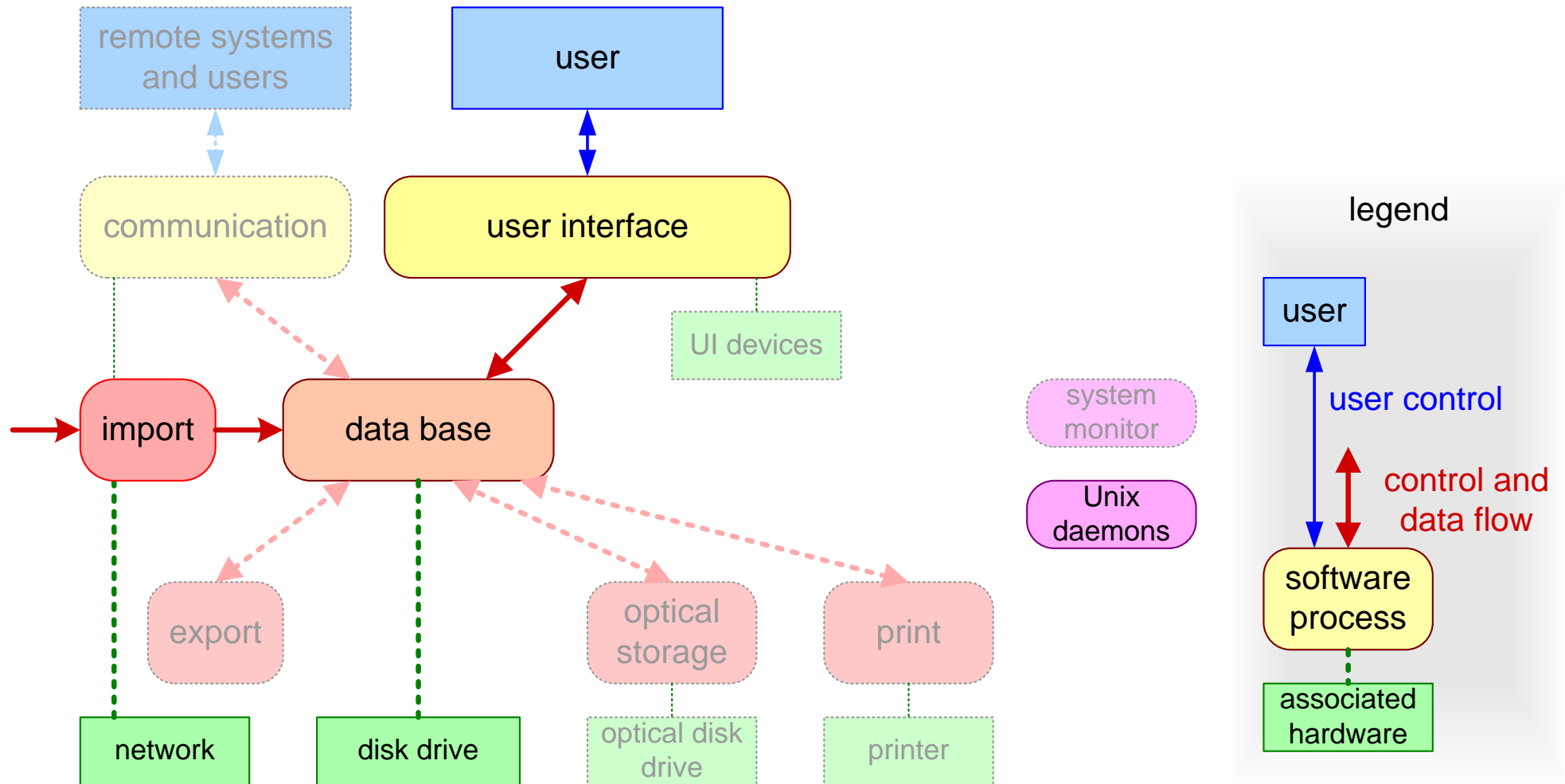
Film:
high resolution
high throughput



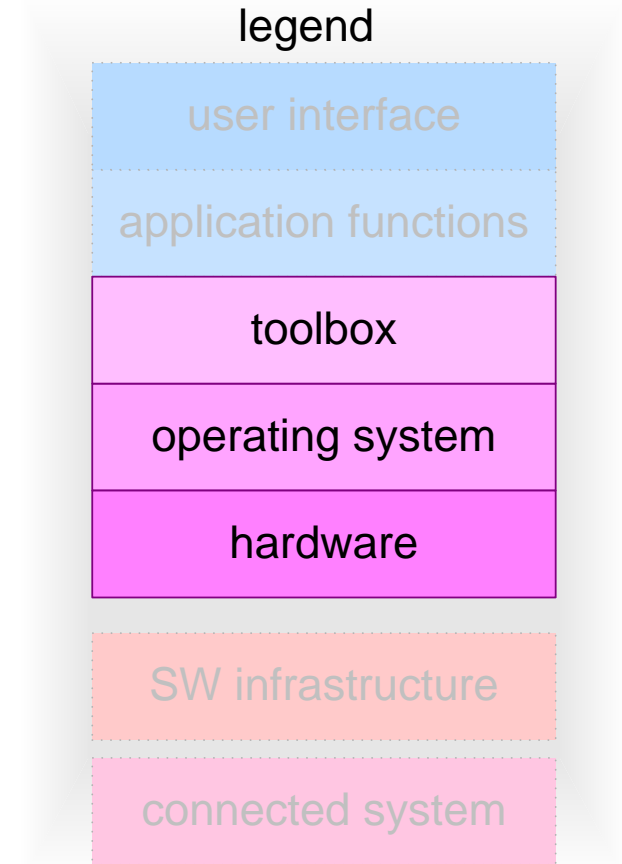
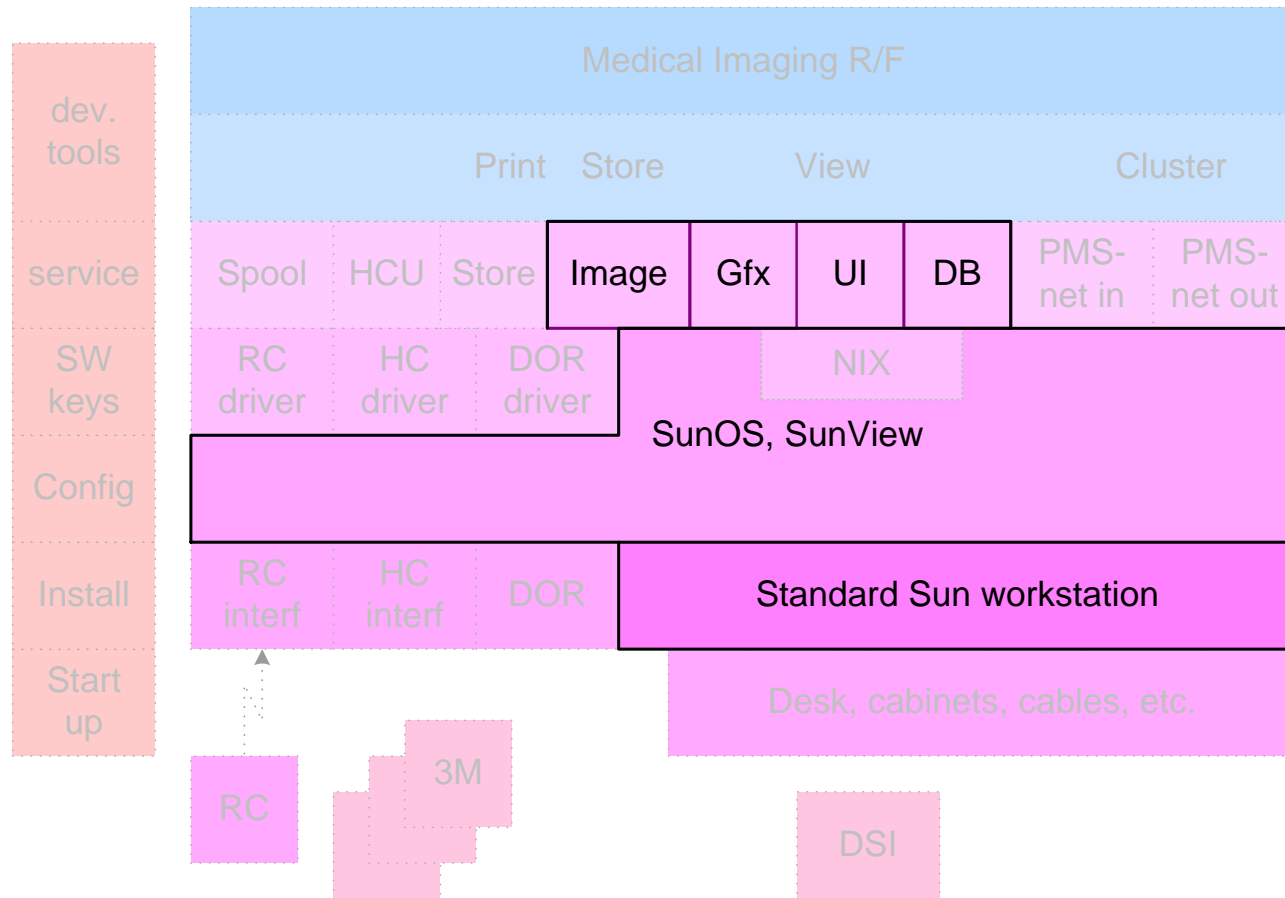
Network:
medium resolution
high throughput



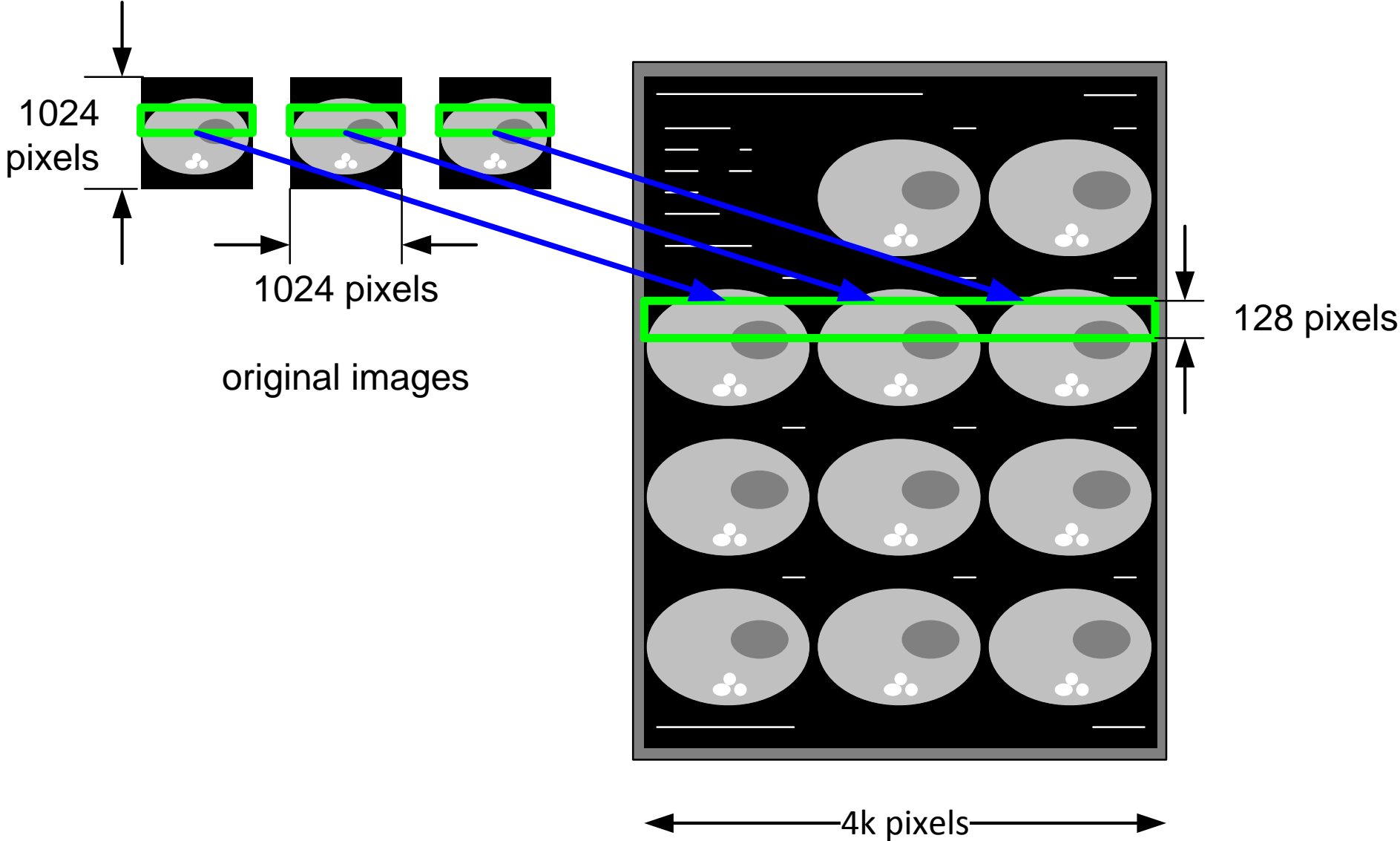
SW Process structure 1991



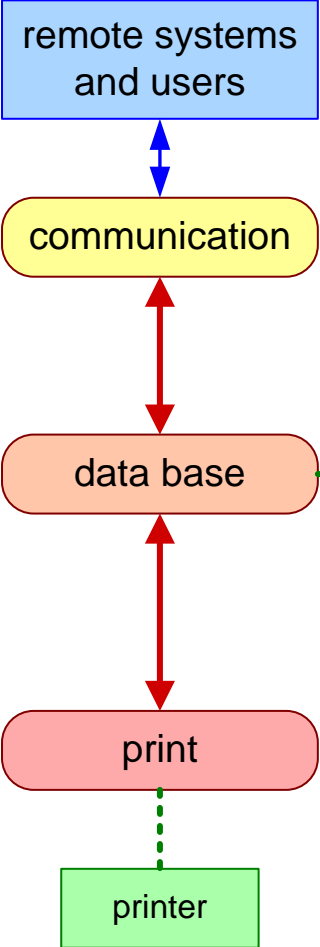
SW layers 1991



Print server is based on banding



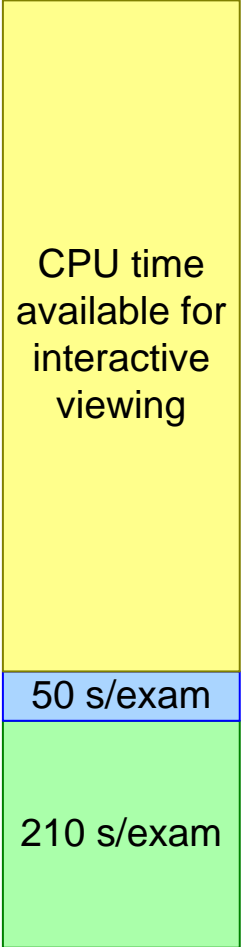
Server CPU load



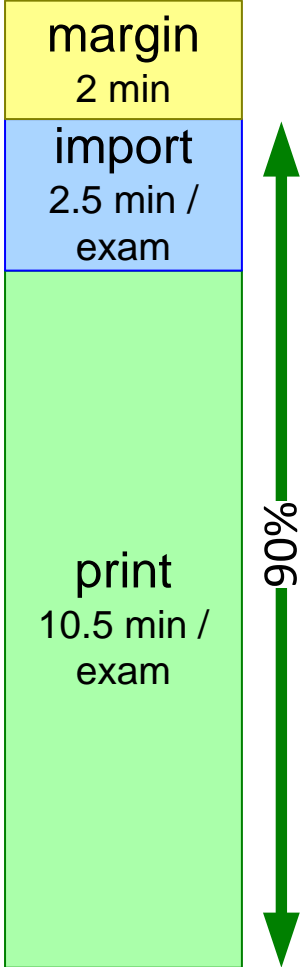
2.5 CPU second per Mbyte input
import

3.5 CPU second per Mpixel output
print

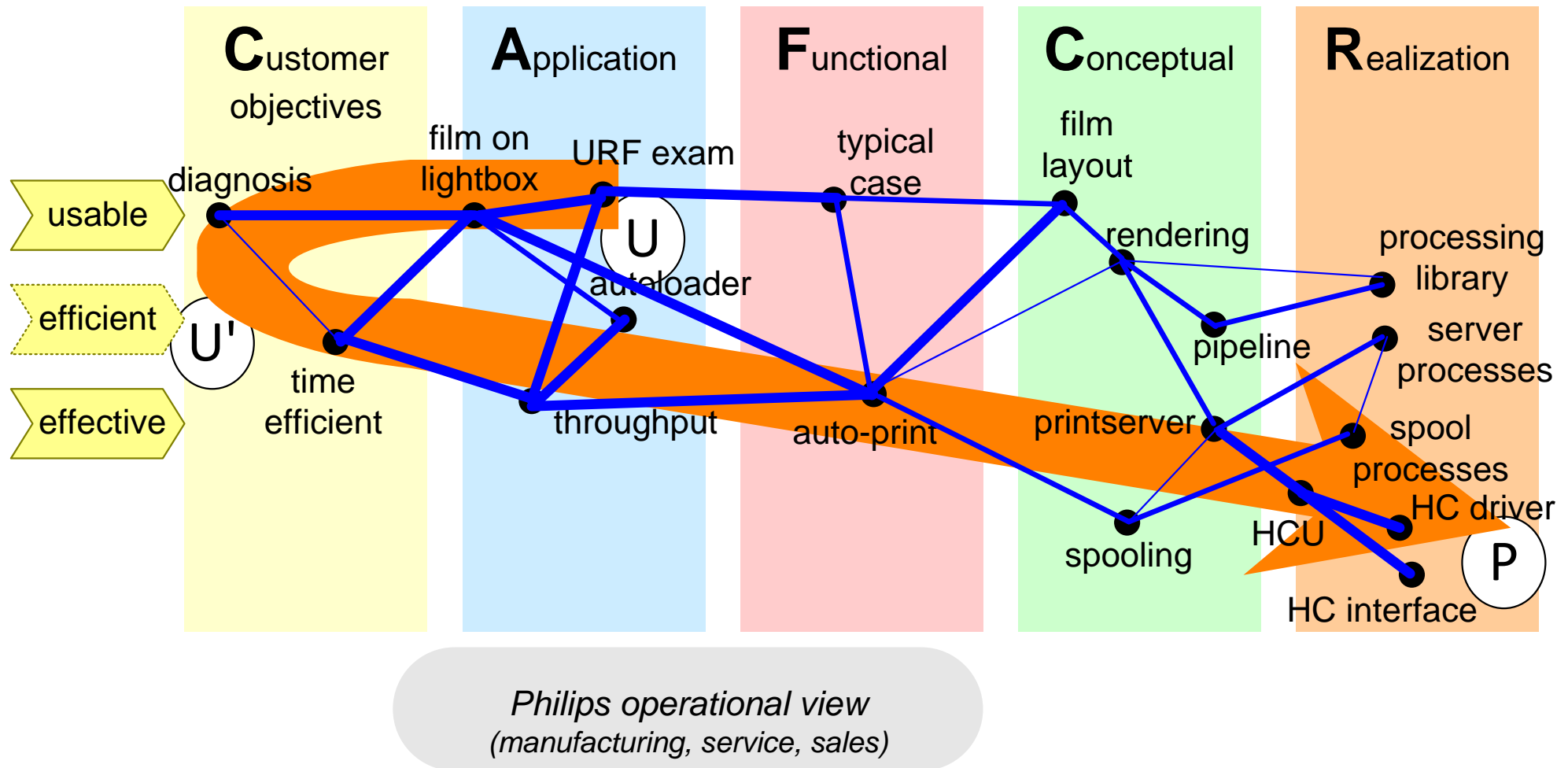
serving one examination room



serving 3 examination rooms

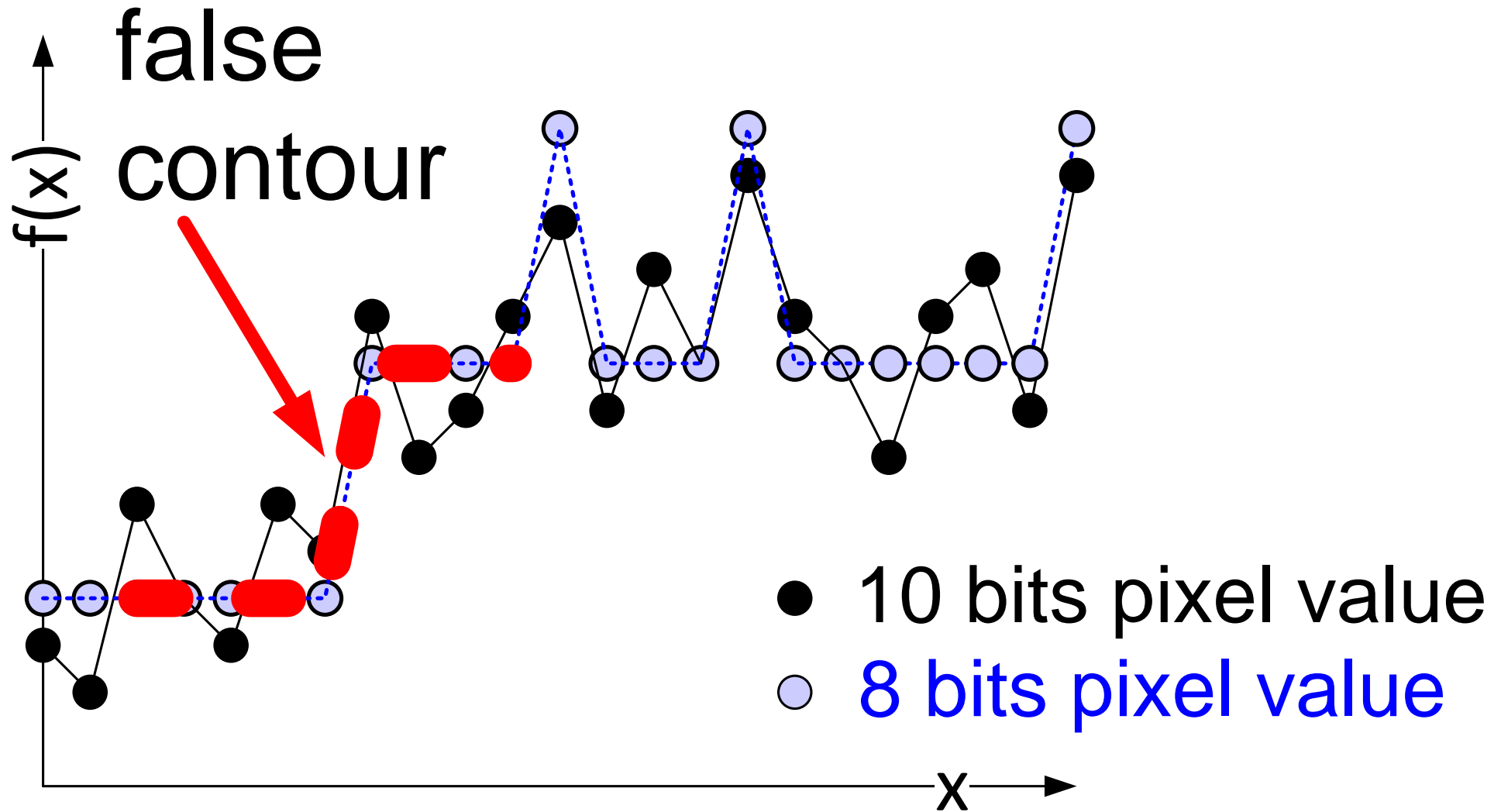


Thread of reasoning; phase 3



Radiologists diagnose from film, throughput is important
 Extrovert view shows conceptual and realization gaps!

Image quality and safety problem



Presentation pipeline for X-ray images

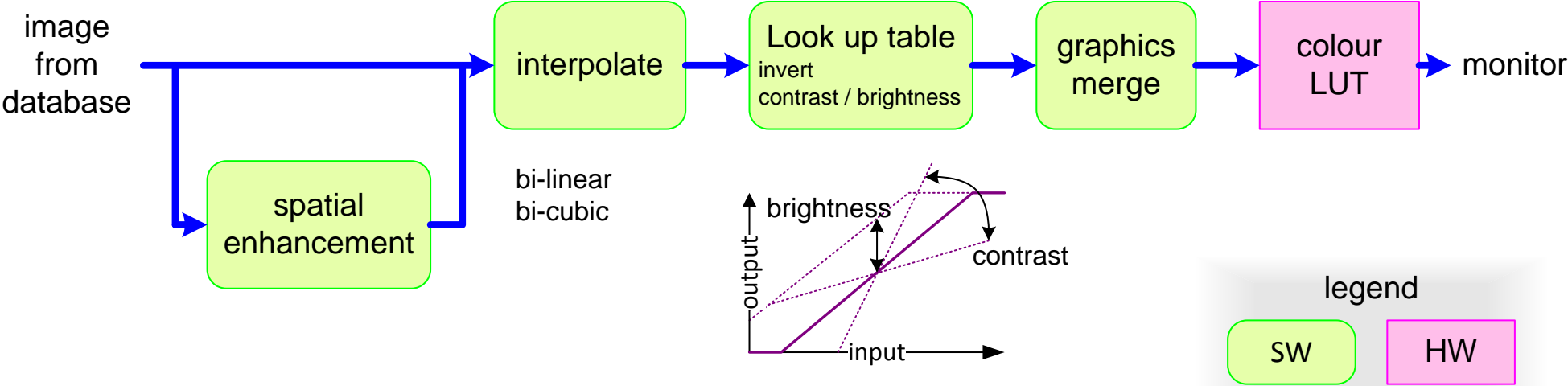
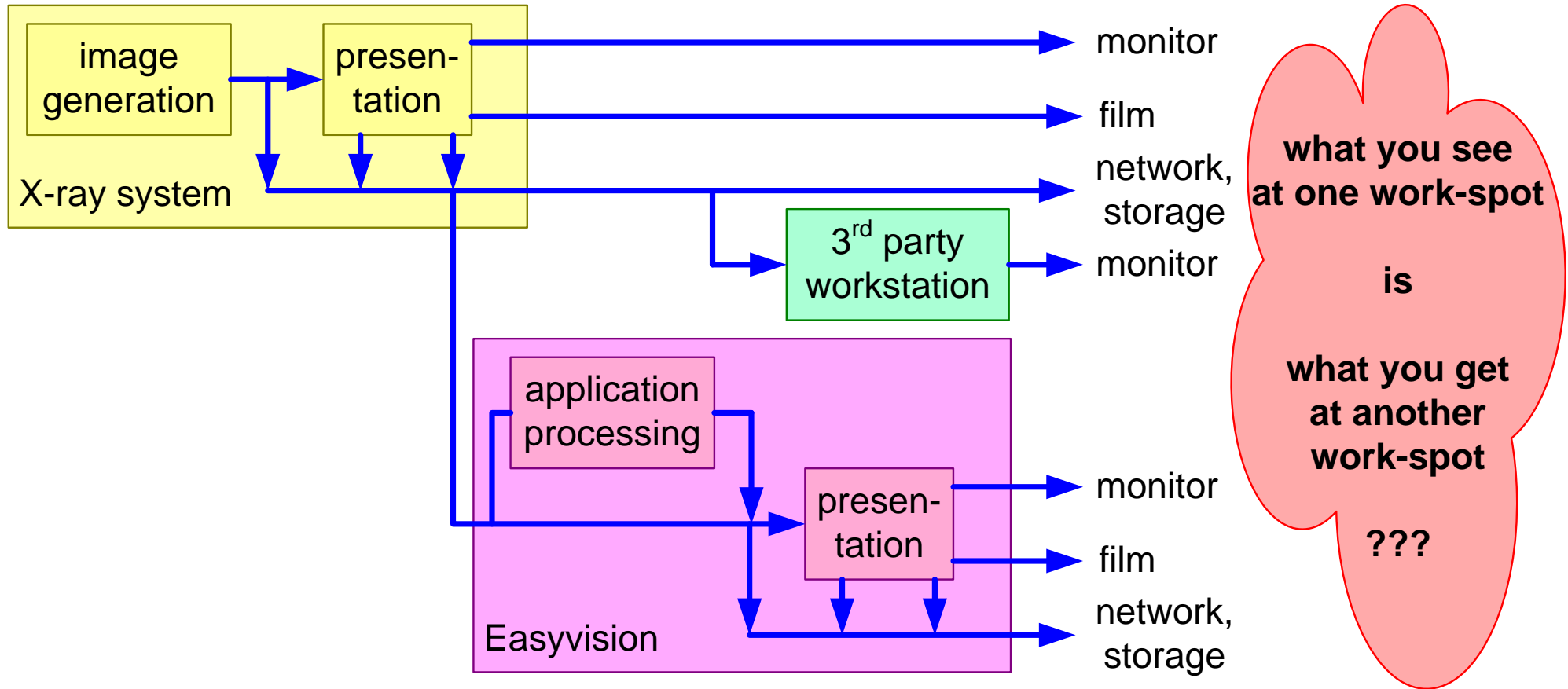
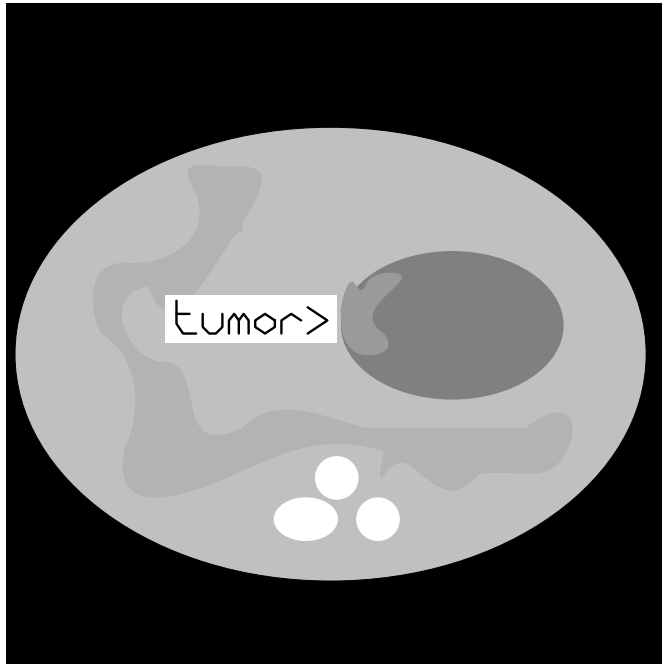


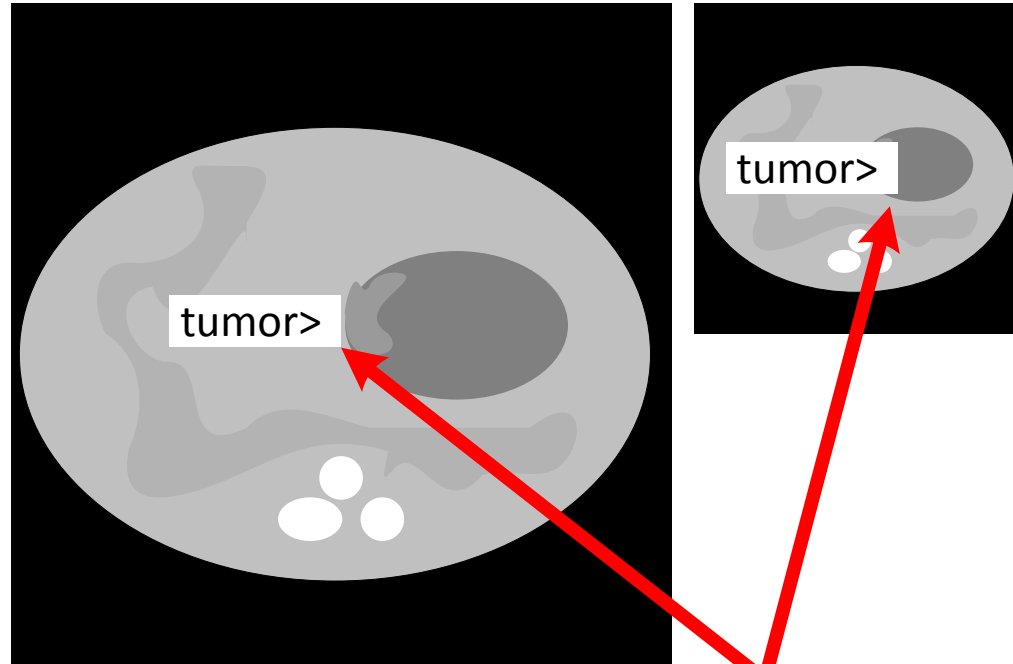
Image Quality expectation WYSIWYG



Safety problem



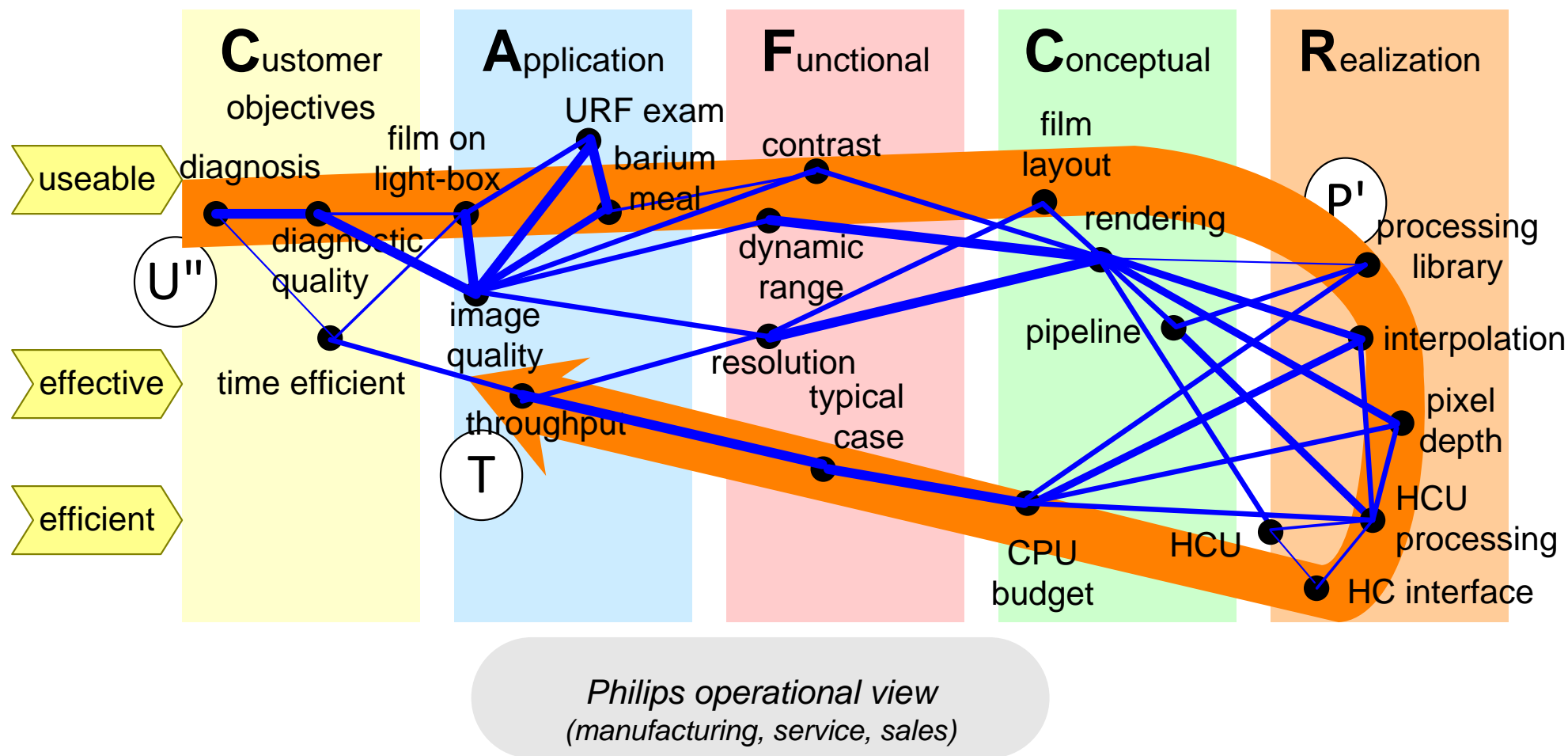
URF monitor output:
fixed size letters at fixed grid



for user readability the font-size was determined "intelligently"; causing a dangerous mismatch between text and image

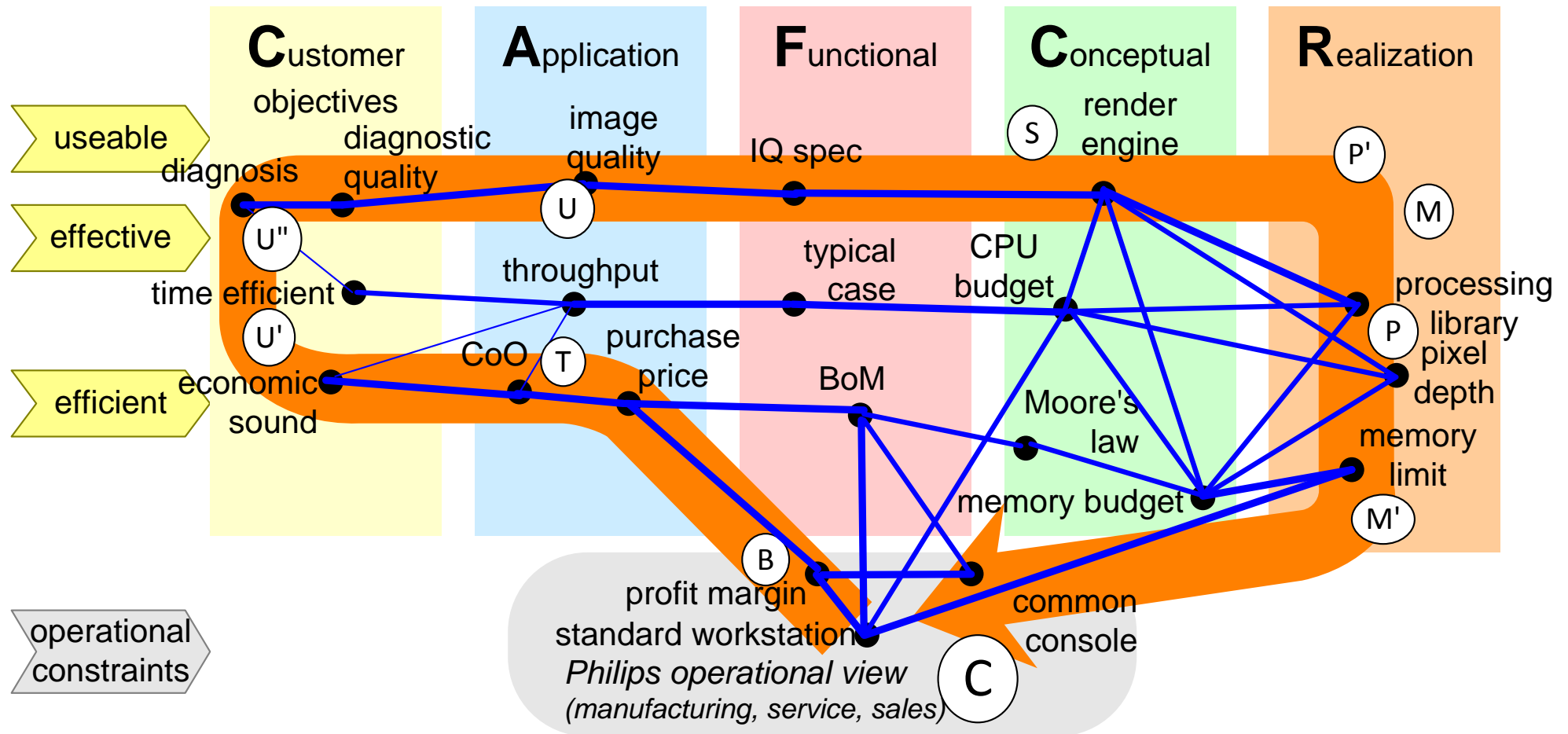
EV output: scaleable fonts in graphics overlay

Thread of reasoning; phase 4



from extrovert diagnostic quality, via image quality, algorithms and load, to extrovert throughput

Thread of reasoning; phase 5



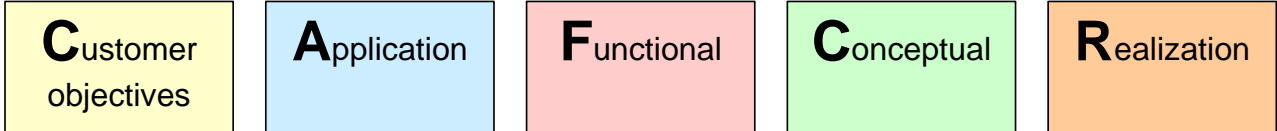
cost revisited in context of clinical needs and realization constraints; note: original threads are significantly simplified

Overview of architecting method

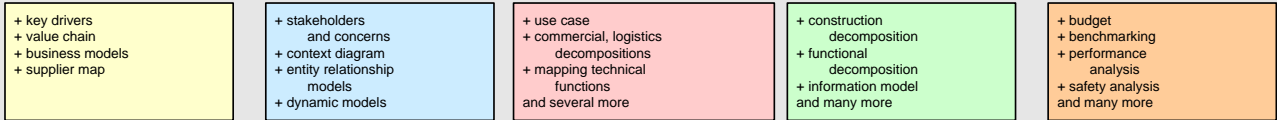
method outline

method visualization

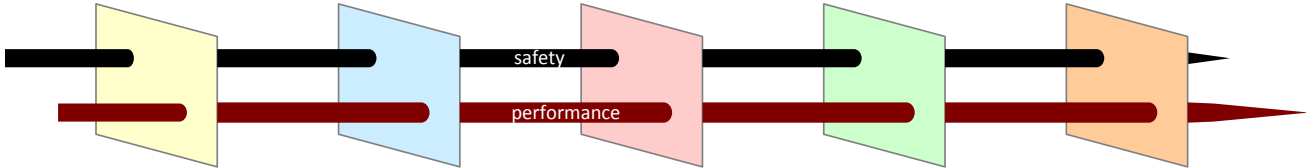
framework



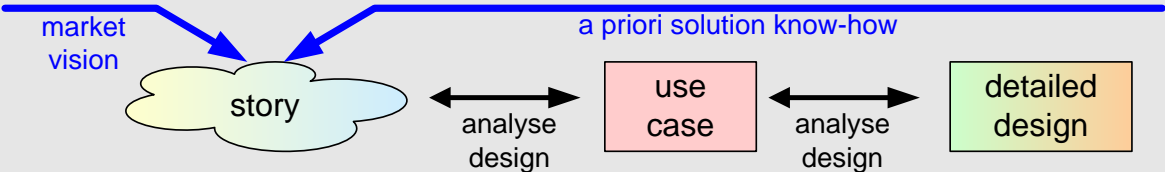
submethods



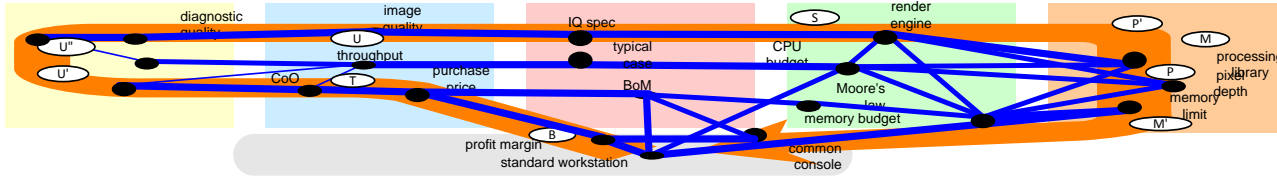
integration via qualities



explore specific details



reasoning



- Make a key driver graph

Use the key driver approach

Take the recommendations into account

- + Key drivers put requirements in broader perspective
- + Discussion creates shared understanding
- ~ The graph needs external feedback
- Are the key drivers really from the customer?
- Are the key drivers *sharp* enough?

Summary Threads of Reasoning

Conclusions

Key Driver graph connects customer objectives to system requirements

Threads of Reasoning connects Customer and Operational Objectives to design and technology choices

The overview is maintained by focusing on valuable, important, critical or sensitive aspect; Look for tensions!

Techniques, Models, Heuristics of this module

Key driver graph

Thread of reasoning

Why, What and How

Tensions

The Boderc project contributed to Key drivers and Threads of Reasoning. Especially the work of *Lou Somers, Peter van den Bosch, Zhaouri Yuan (Océ), Berry van der Wijst (Philips), Adriaan van den Brand (Centric TSolve), Heico Sandee and Maurice Heemels (TU/e, ESI)* has been valuable.