

Module 37, Architectural Reasoning Threads and Integration

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

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

Abstract

This module provides methods and techniques to integrate insights across views. Lines and Threads of reasoning form the main framework.

Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

August 16, 2025

status: preliminary

draft

version: 1.3

Qualities as Integrating Needles

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

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

Abstract

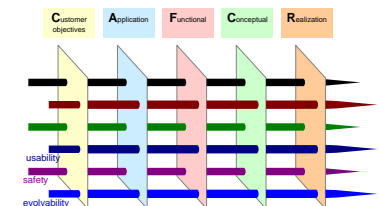
Many stakeholder concerns can be specified in terms of qualities. These qualities can be viewed from all 5 “CAFCR” viewpoints. In this way qualities can be used to relate the views to each other.

The meaning of qualities for the different views is described. A checklist of qualities is provided as a means for architecting. All qualities in the checklist are described briefly.

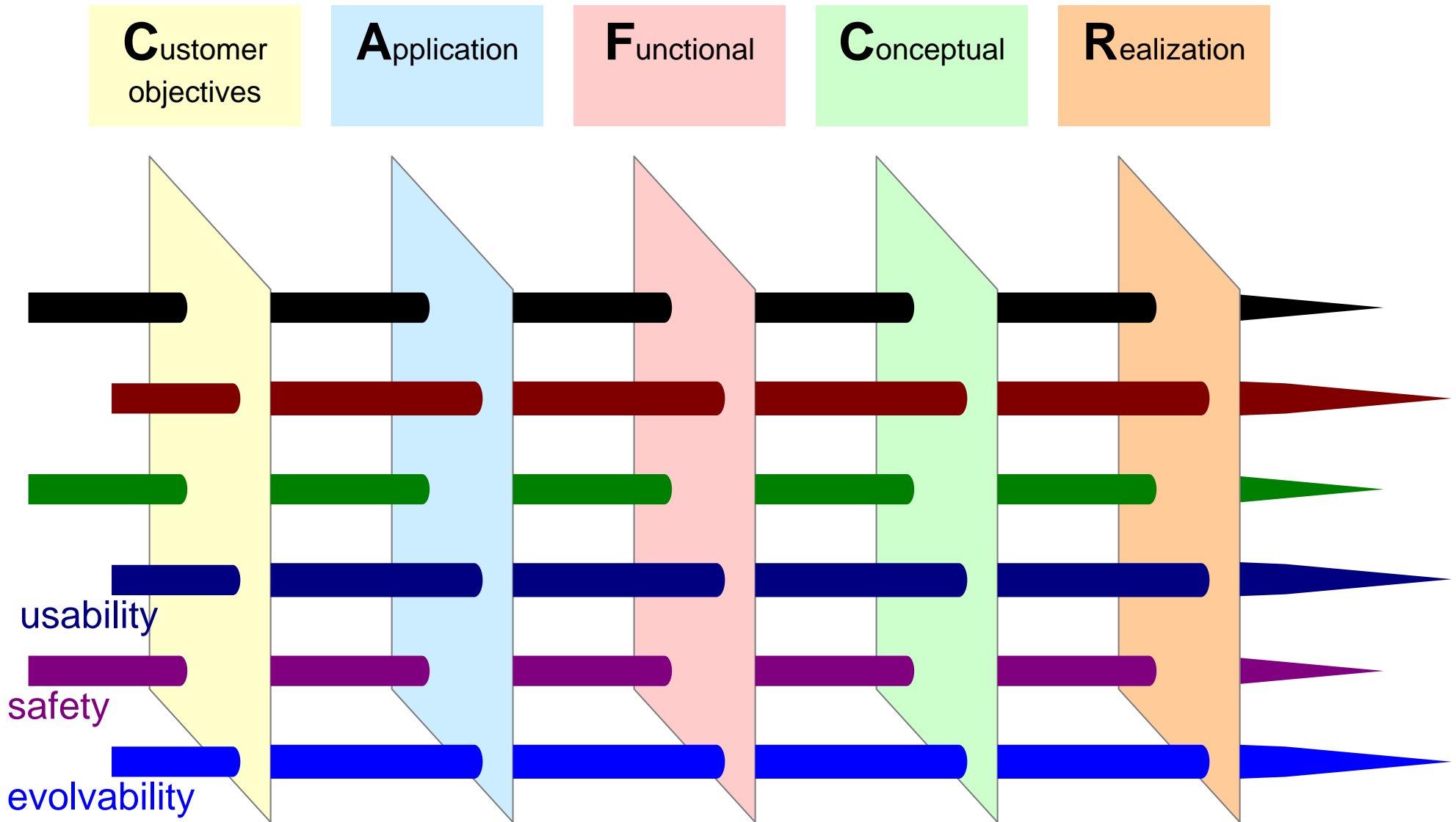
Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.



August 16, 2025
status: finished
version: 1.3



Quality needles as generic integrating concepts



Security as example through all views

Customer objectives	Application	Functional	Conceptual	Realization
 <p>sensitive information</p> <p>trusted</p>	<p>selection classification people information authentication badges passwords locks / walls guards administrators</p>	<p>functions for administration authentication intrusion detection logging quantification</p>	<p>cryptography firewall security zones authentication registry logging</p>	<p><i>specific</i> algorithms interfaces libraries servers storage protocols</p>
<p><i>desired characteristics, specifications & mechanisms</i></p>				
 <p>not trusted</p>	<p>social contacts open passwords blackmail burglary fraud unworkable procedures</p>	<p>missing functionality wrong quantification</p>	<p>holes between concepts</p>	<p>bugs buffer overflow non encrypted storage poor exception handling</p>
<p><i>threats</i></p>				

Quality Checklist

usable

usability
attractiveness
responsiveness
image quality
wearability
storability
transportability

dependable

safety
security
reliability
robustness
integrity
availability

effective

throughput or
productivity

interoperable

connectivity
3rd party extendible

liable

liability
testability
traceability
standards compliance

efficient

resource utilization
cost of ownership

consistent

reproducibility
predictability

serviceable

serviceability
configurability
installability

future proof

evolvability
portability
upgradeability
extendibility
maintainability

logistics friendly

manufacturability
logistics flexibility
lead time

ecological

ecological footprint
contamination
noise
disposability

down to earth attributes

cost price
power consumption
consumption rate
(water, air,
chemicals,
et cetera)
size, weight
accuracy

Exercise Line of Reasoning

Make a **line of reasoning** for one of the dominant qualities.

- in the CA views; determine what customers do to achieve their goal
- in the F view determine the specification of your system supporting this quality
- in the CR views determine the relevant concepts and technologies
- Take the reverse viewpoints as well: what threatens this quality?

Threads of Reasoning

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

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

Abstract

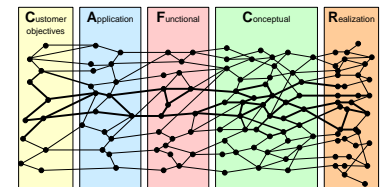
A method of reasoning is described, which addresses cross-cutting issues. The basis is fast iteration in the problem and solution space.

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.

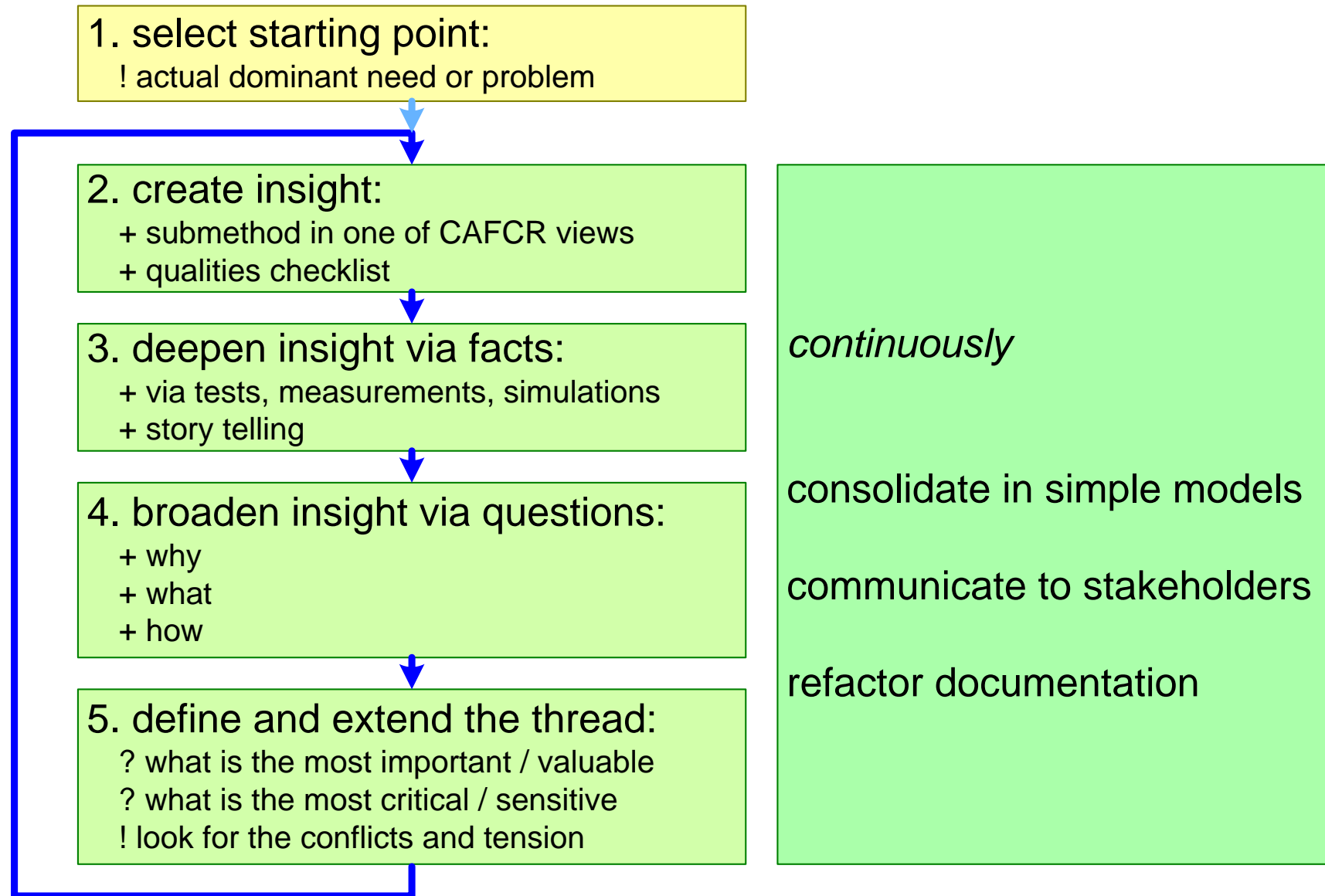
Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

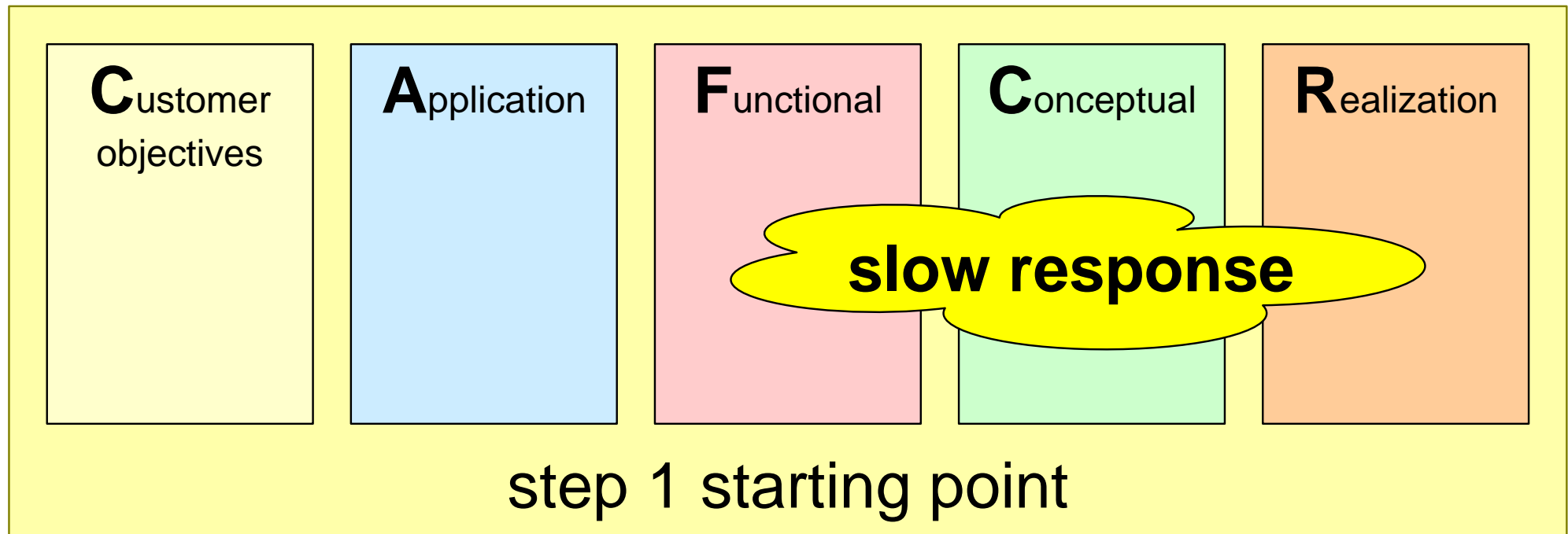
August 16, 2025
status: finished
version: 2.4



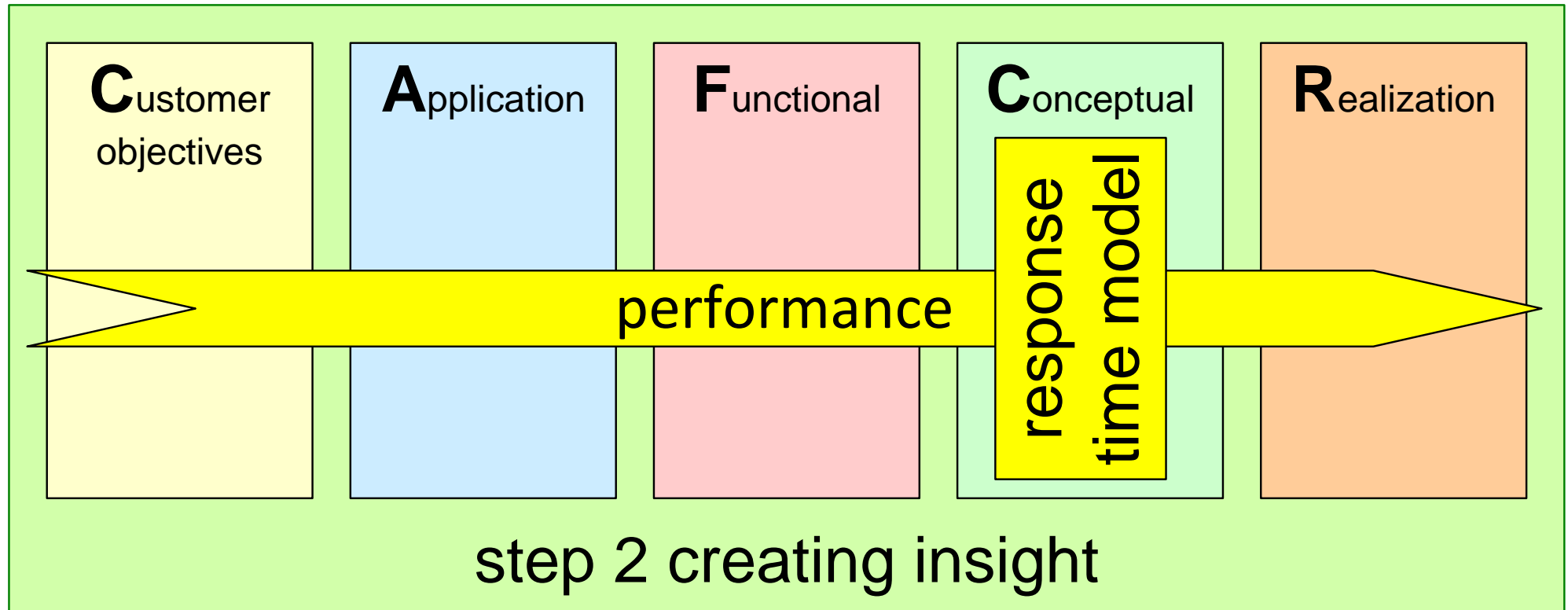
Overview of the reasoning approach



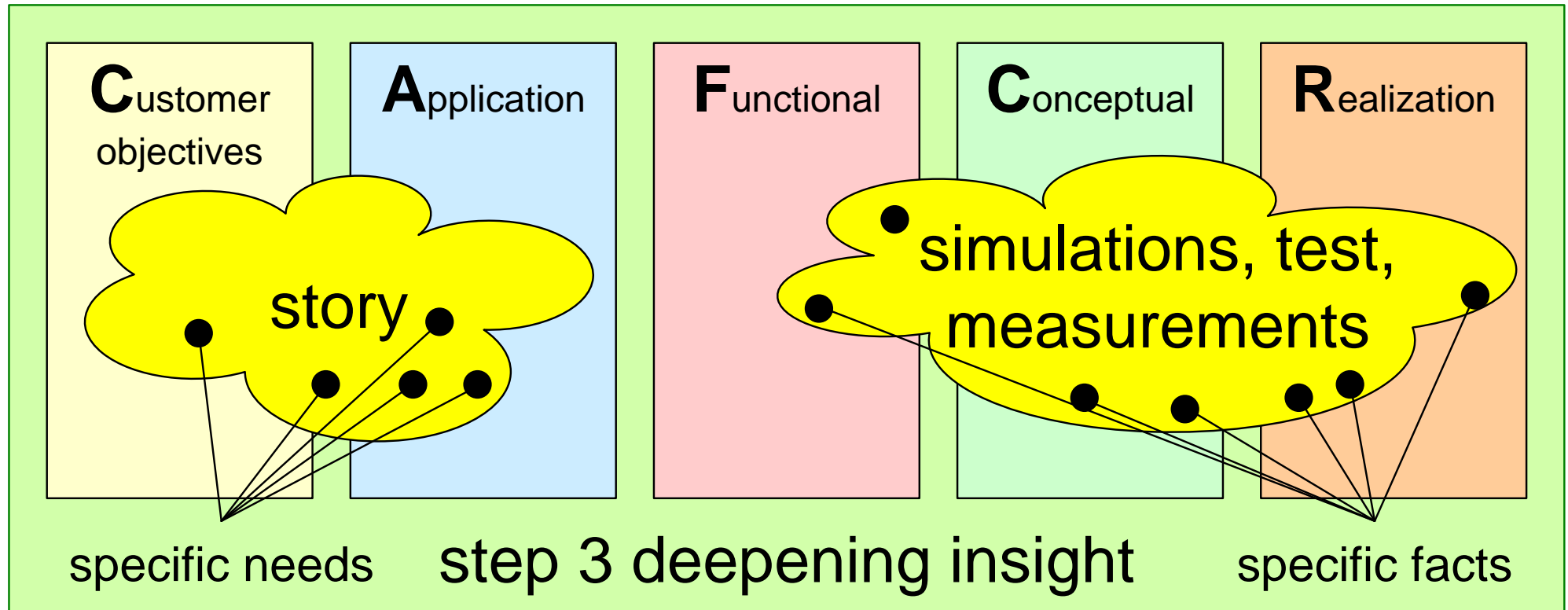
From starting point to insight



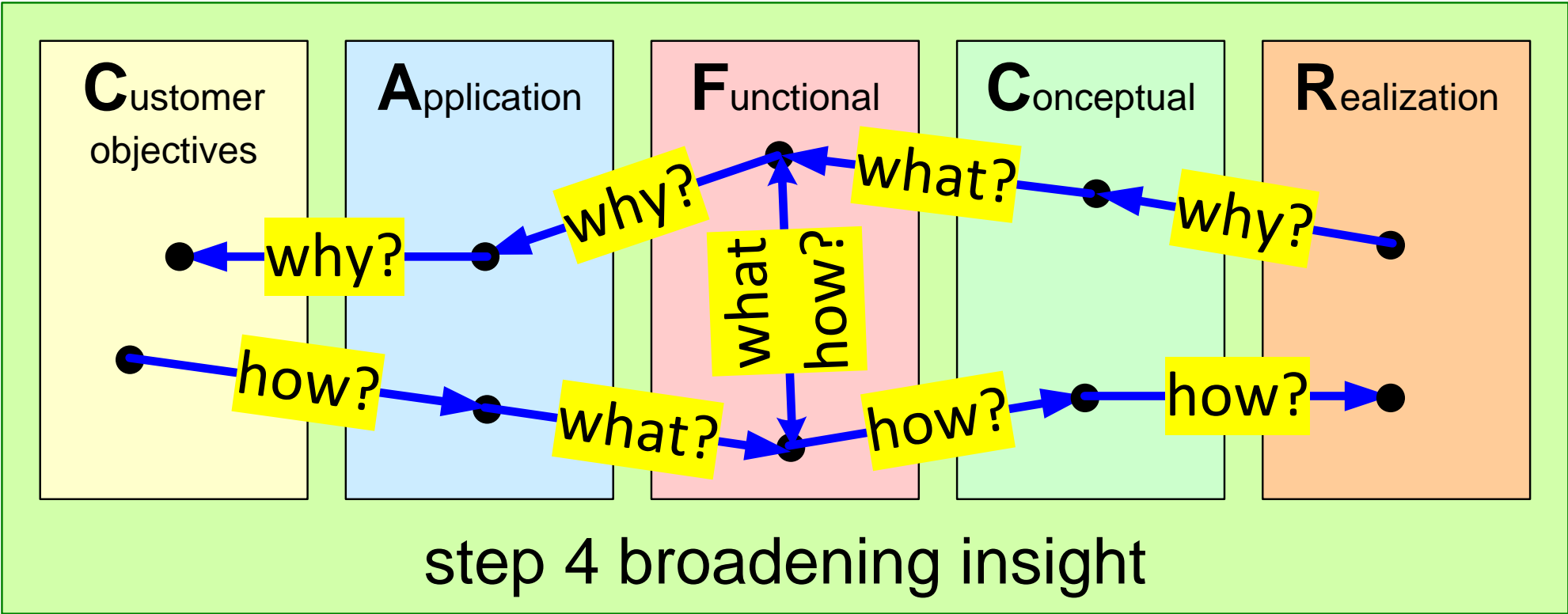
Creating Insight



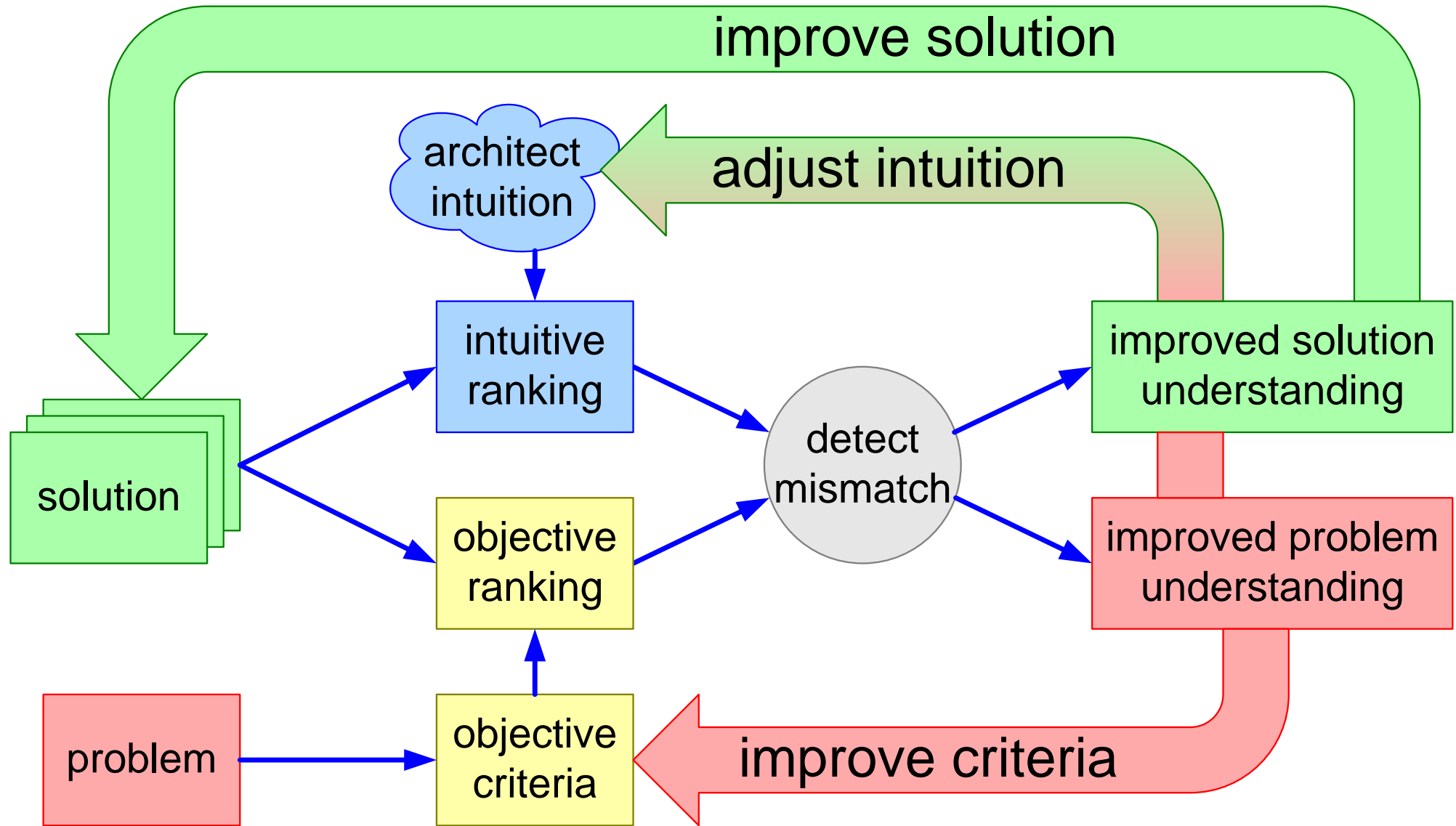
Deepening Insight



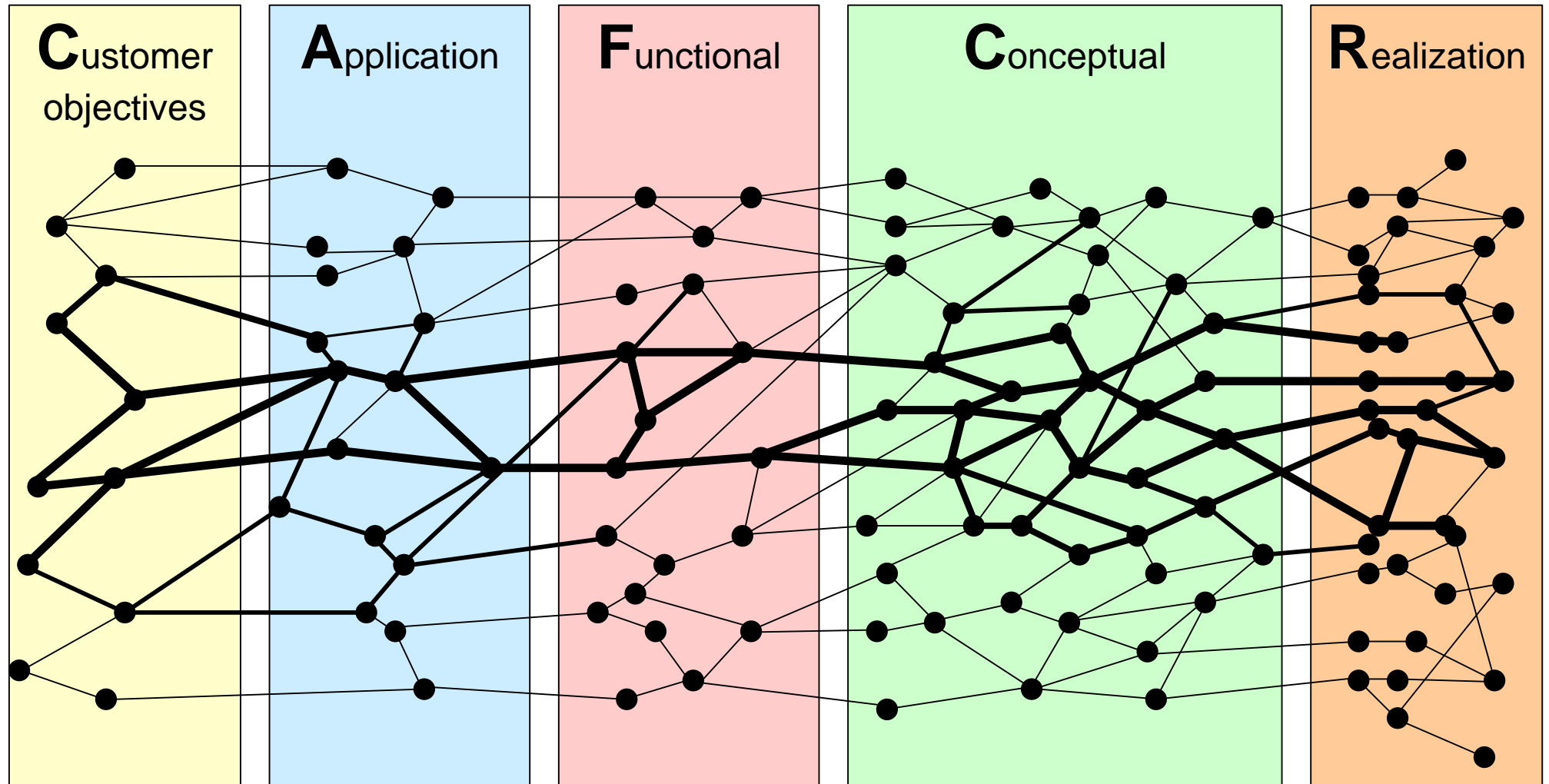
Broadening Insight



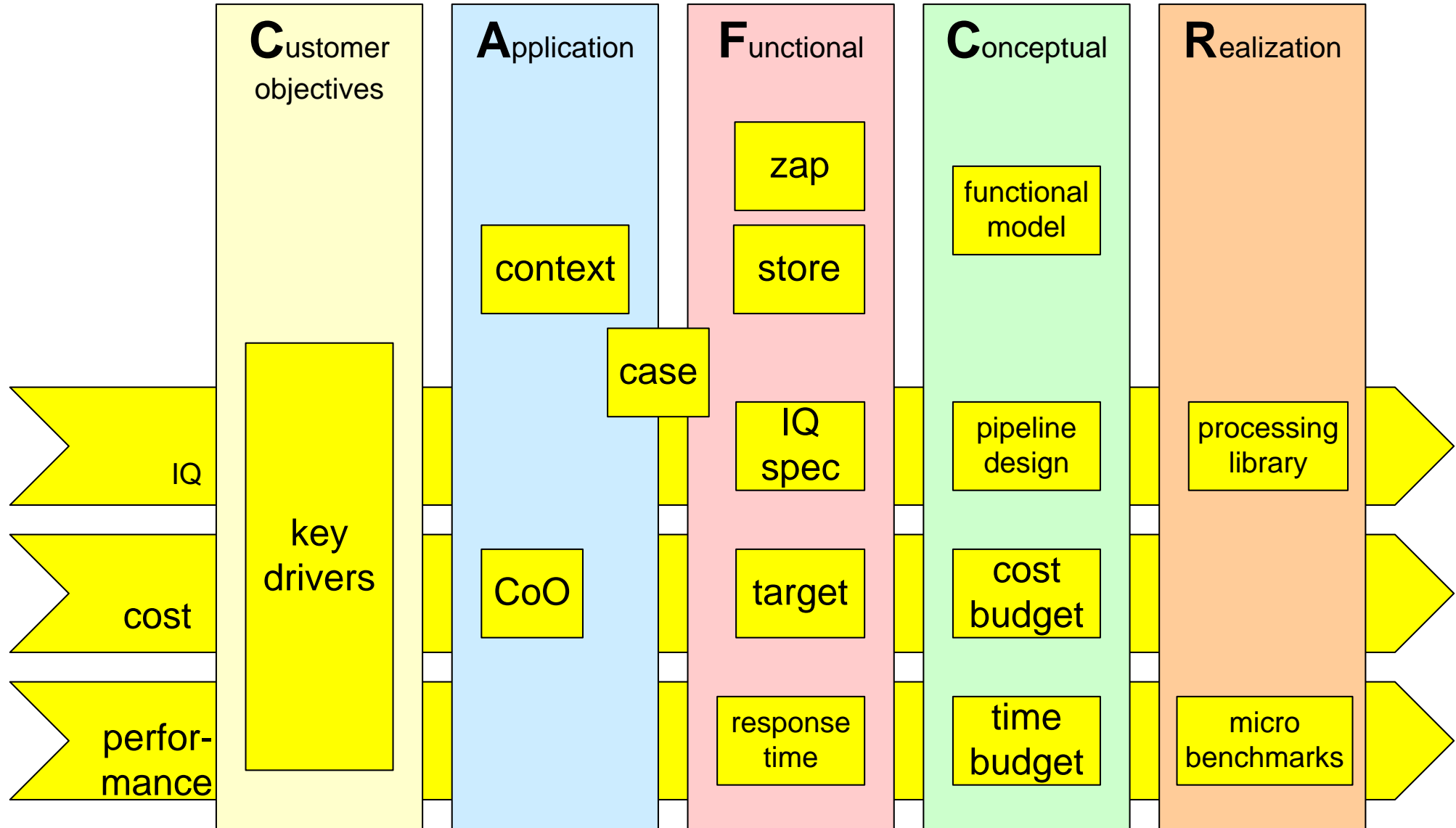
Iteration during the analysis



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

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

Abstract

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

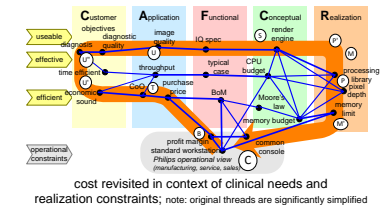
- the CAFCR viewpoints
- qualities as integrating needles
- story telling
- threads of reasoning

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

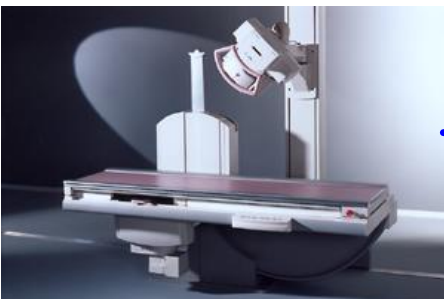
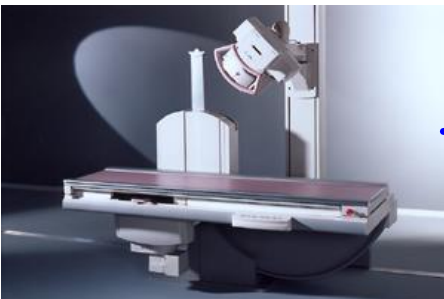
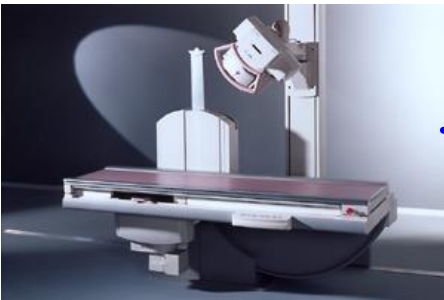
Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

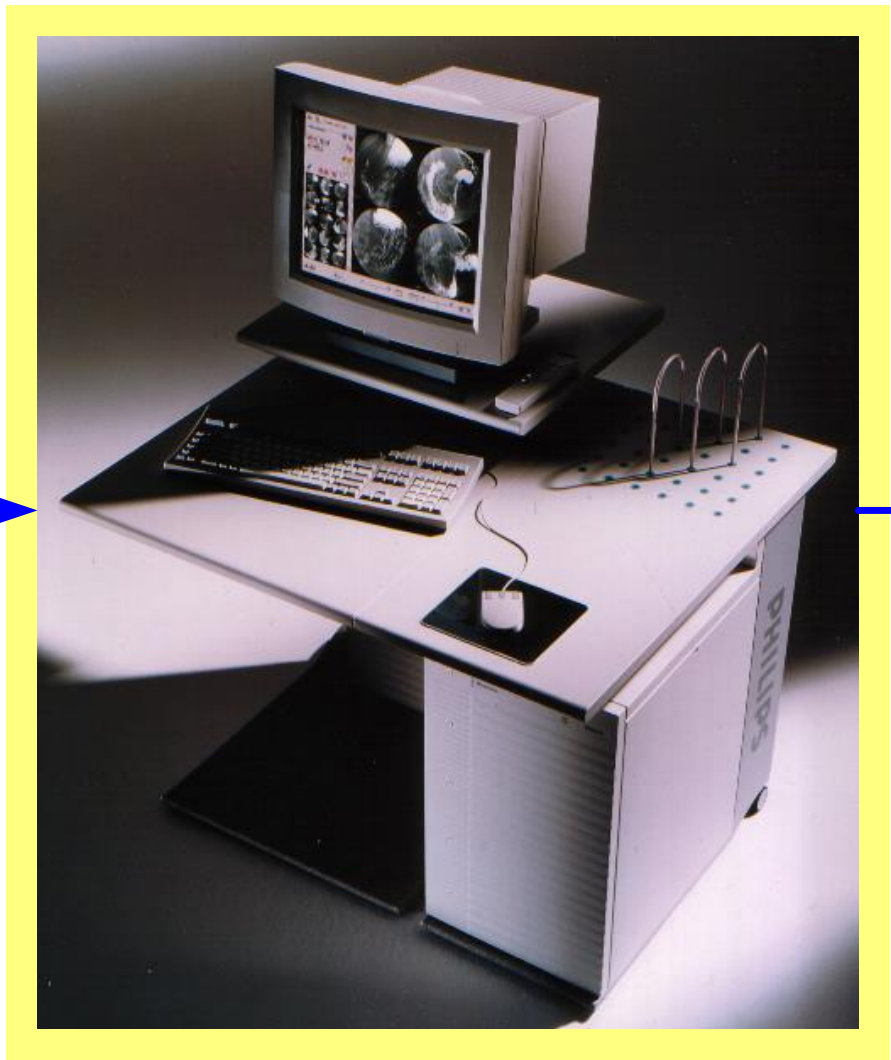
August 16, 2025
status: preliminary
draft
version: 0



Easyvision serving three URF examination rooms



URF-systems

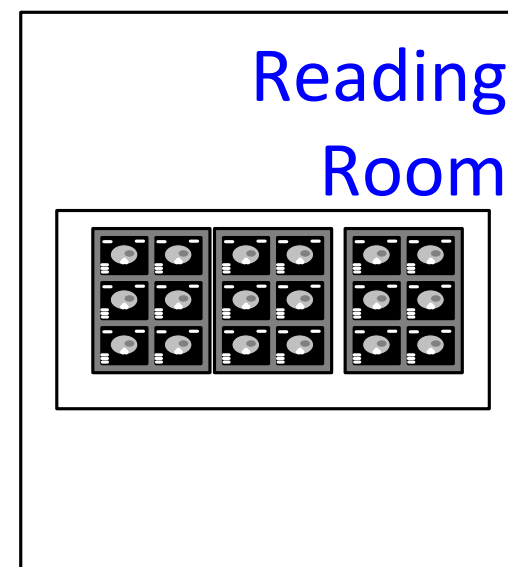
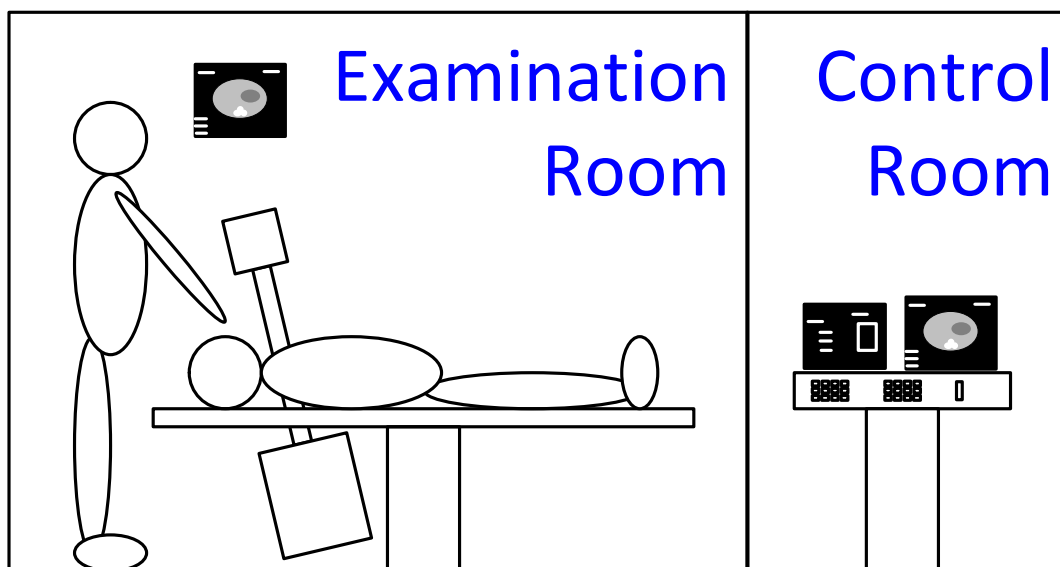
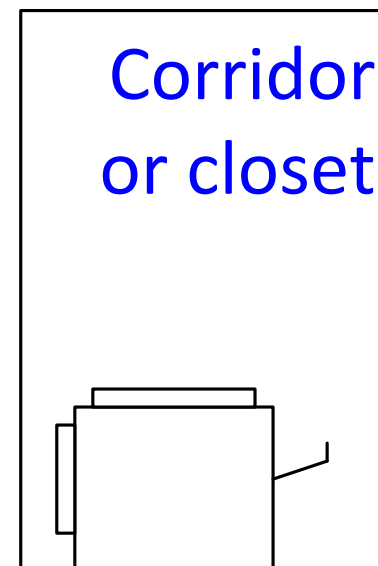
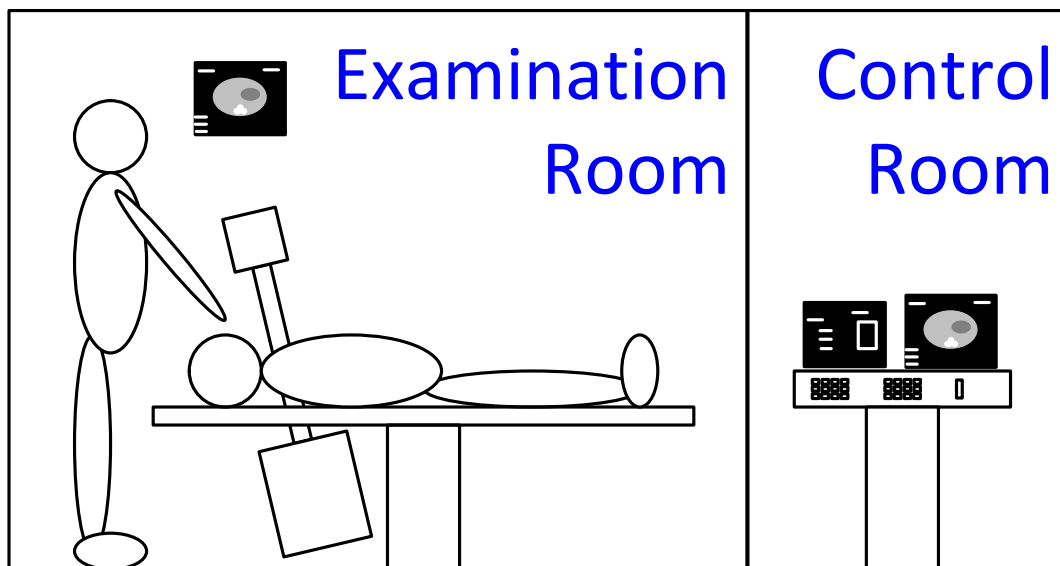


EasyVision: Medical Imaging Workstation

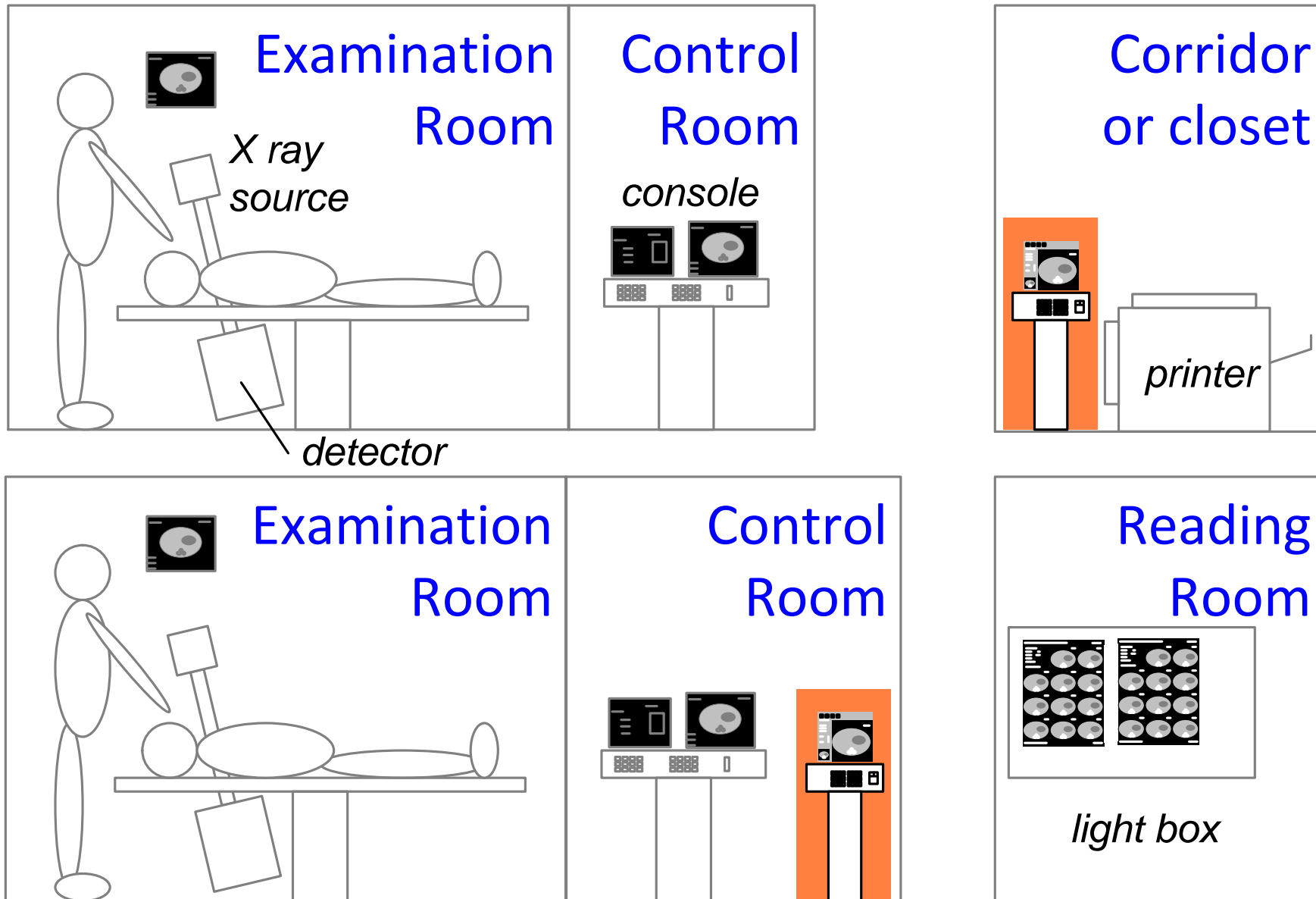


typical clinical image (intestines)

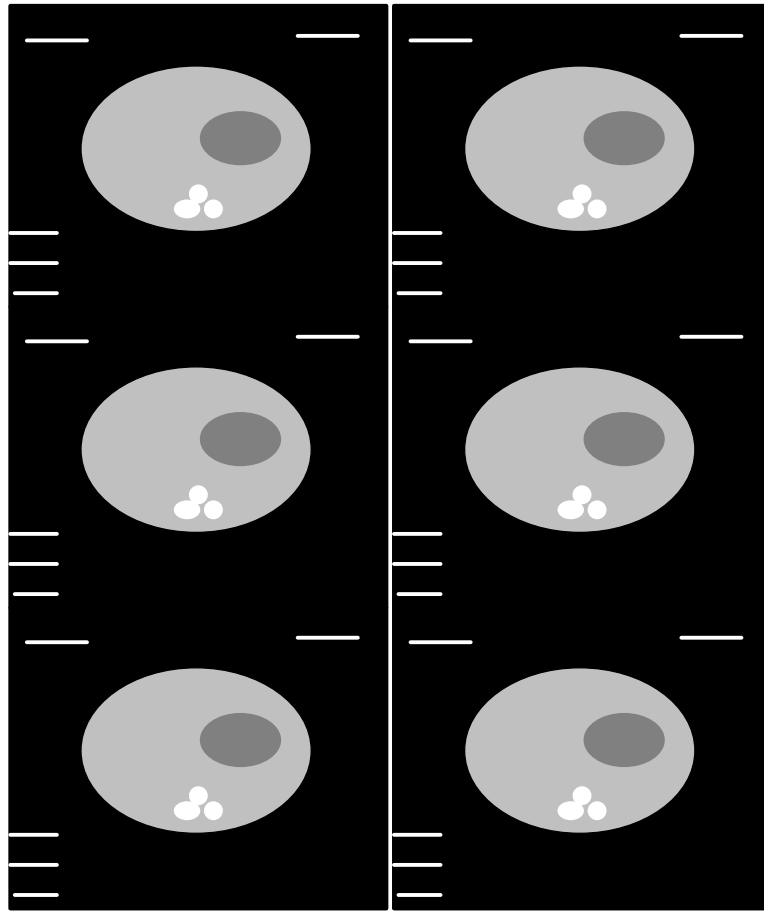
X-ray rooms from examination to reading around 1990



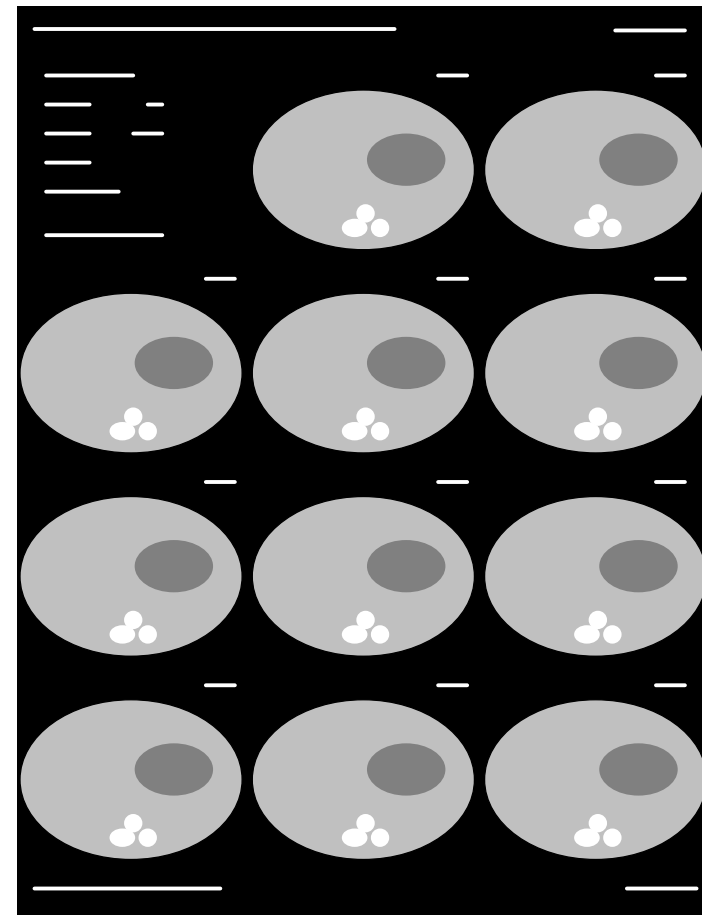
X-ray rooms with Easyvision applied as printserver



Comparison screen copy versus optimized film



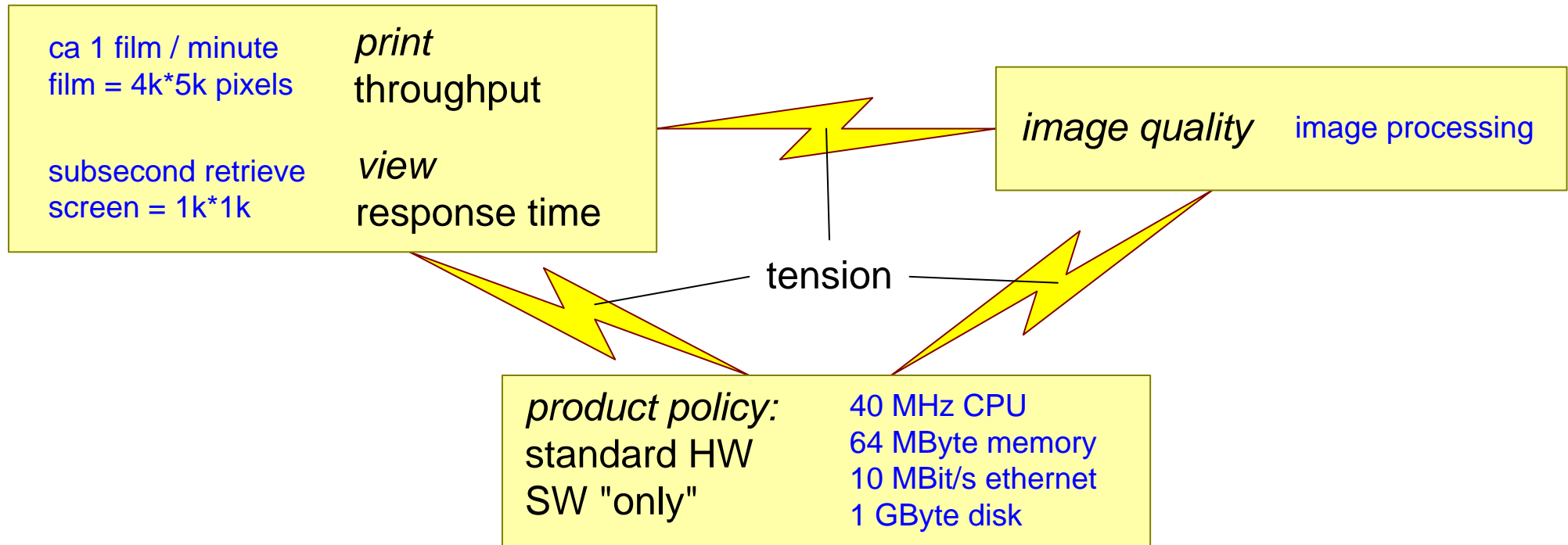
old: screen copy



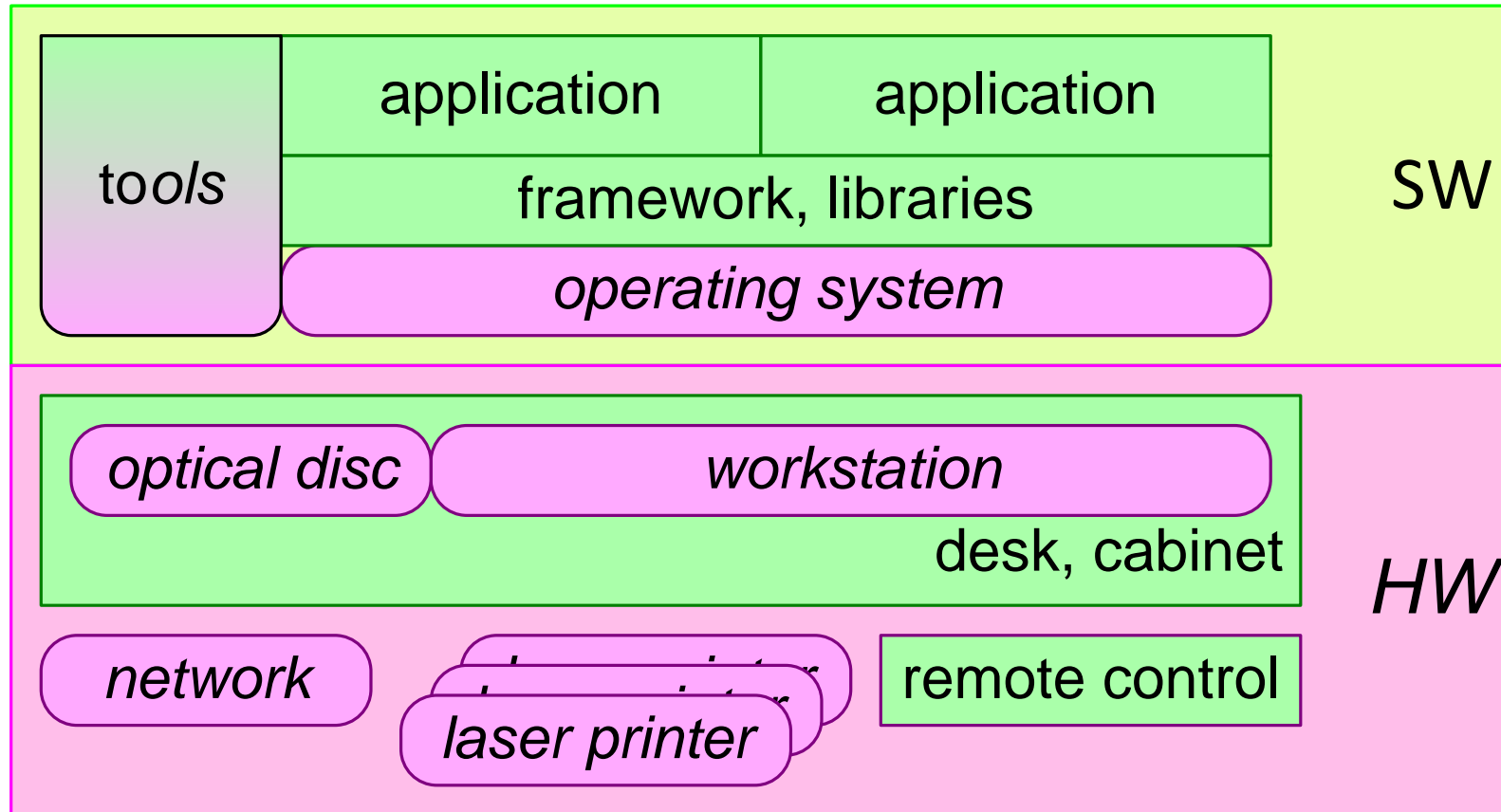
new: SW formatting

20 to 50% less film needed

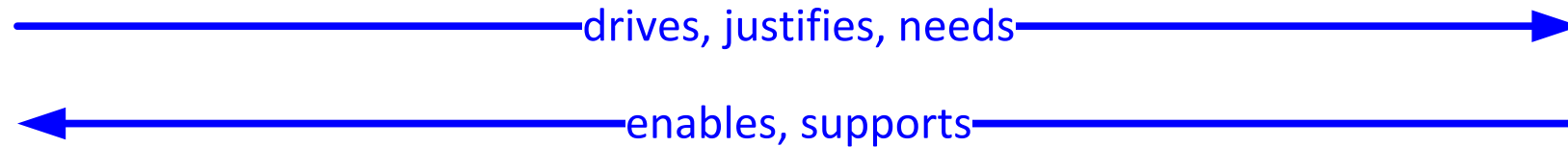
Challenges for product creation



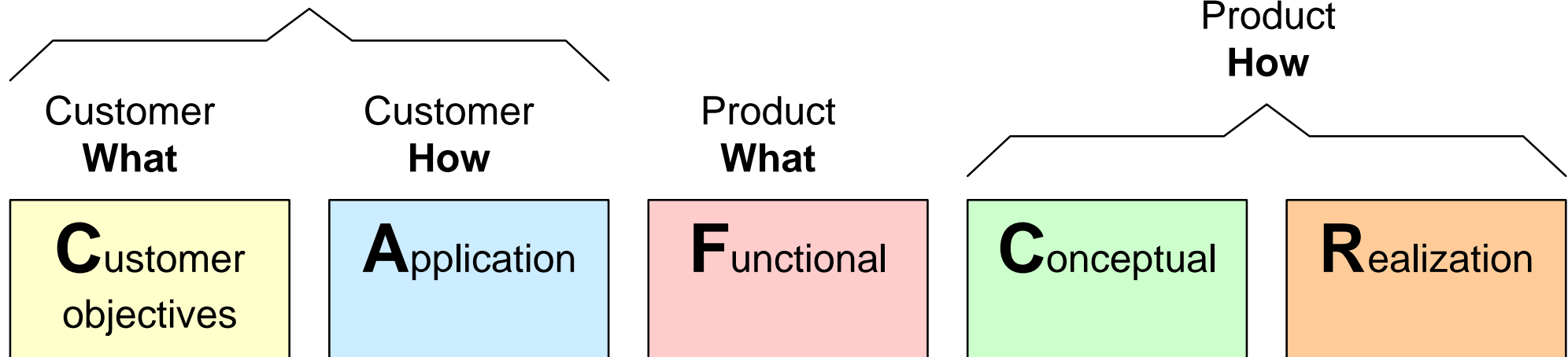
Top level decomposition



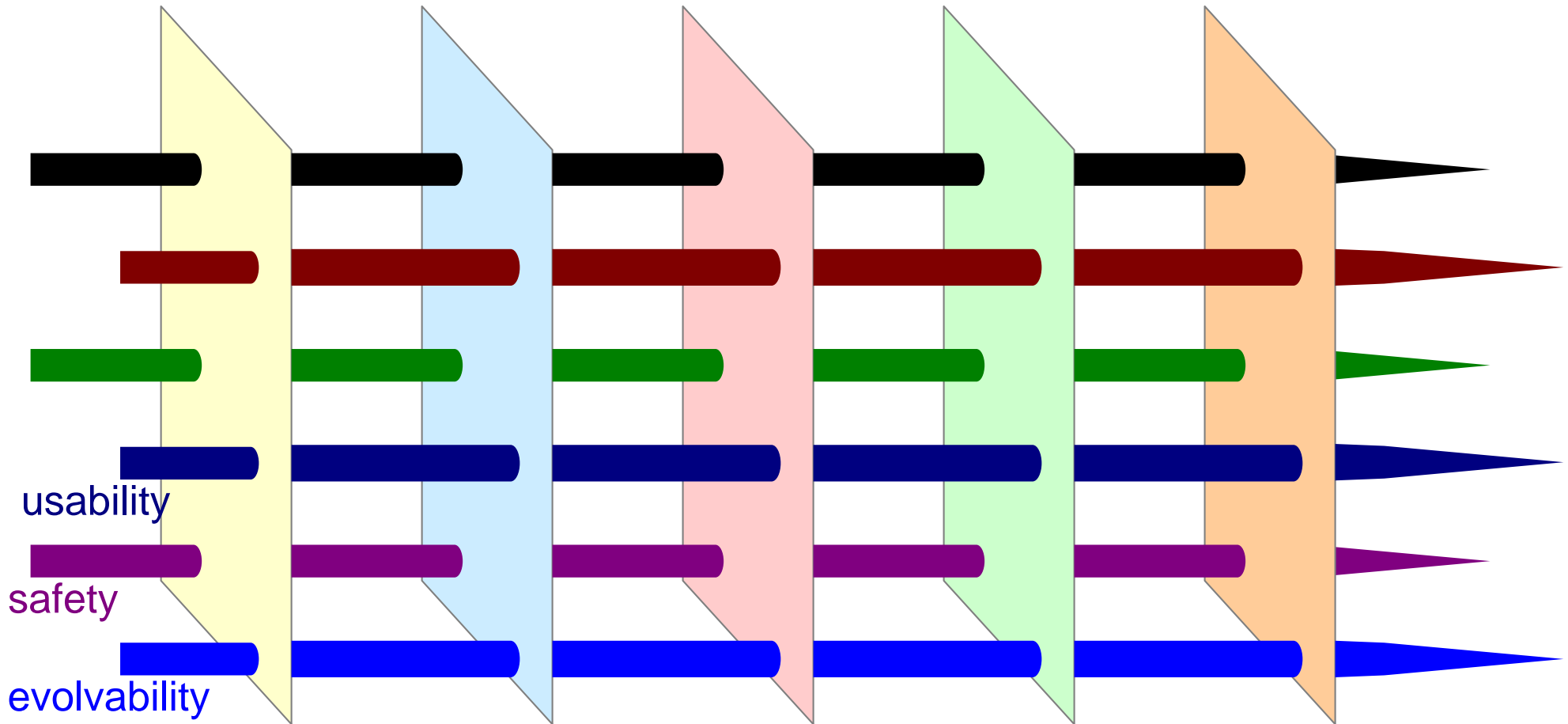
CAFCR viewpoints



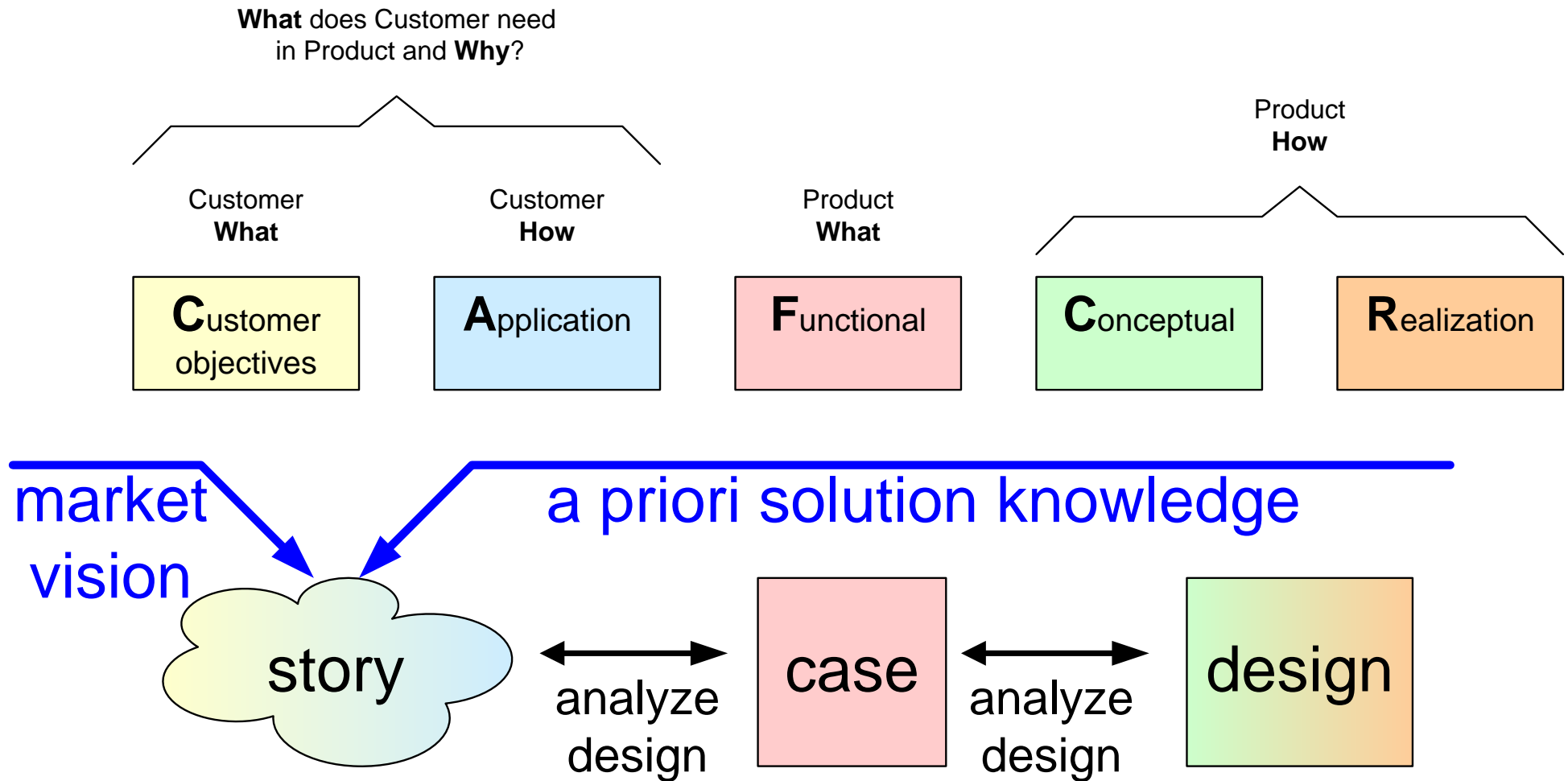
What does Customer need
in Product and **Why?**



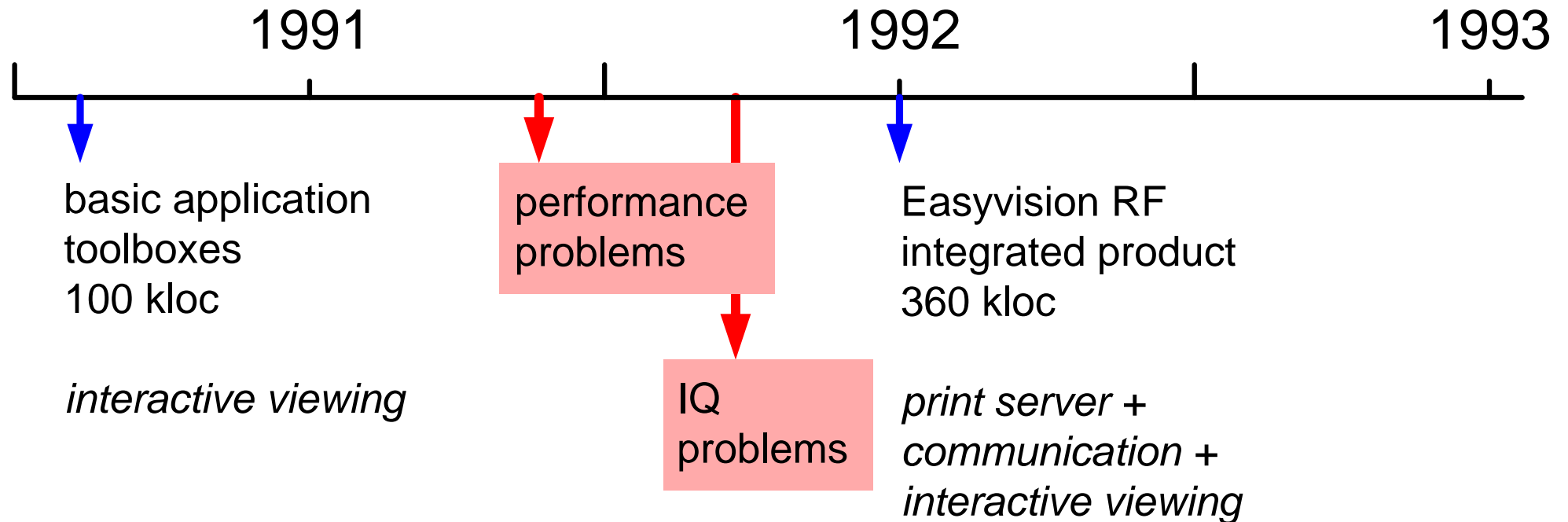
Quality needles as generic integrating concepts



From story to design



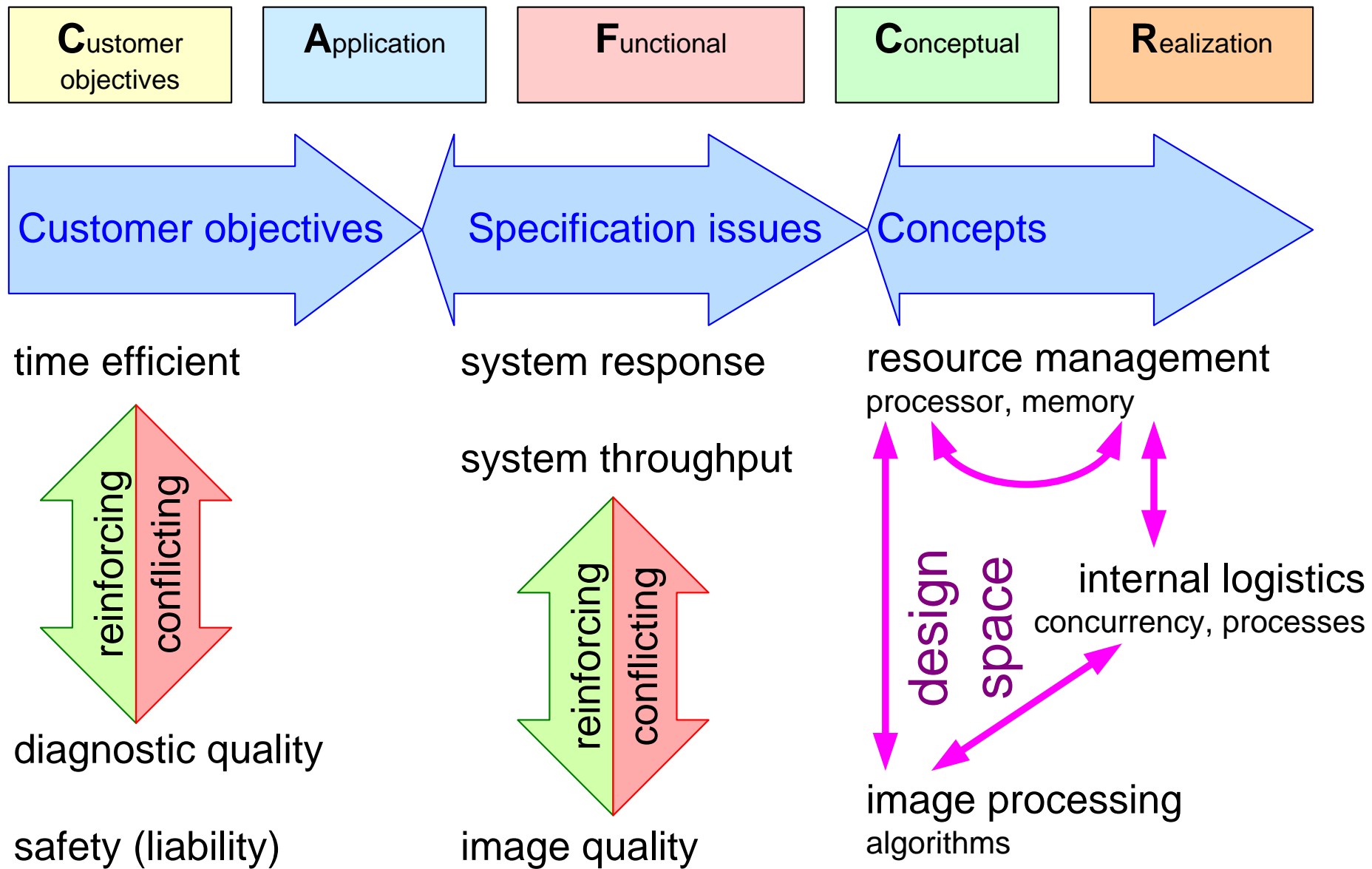
Chronology of Easyvision RF R1 development



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

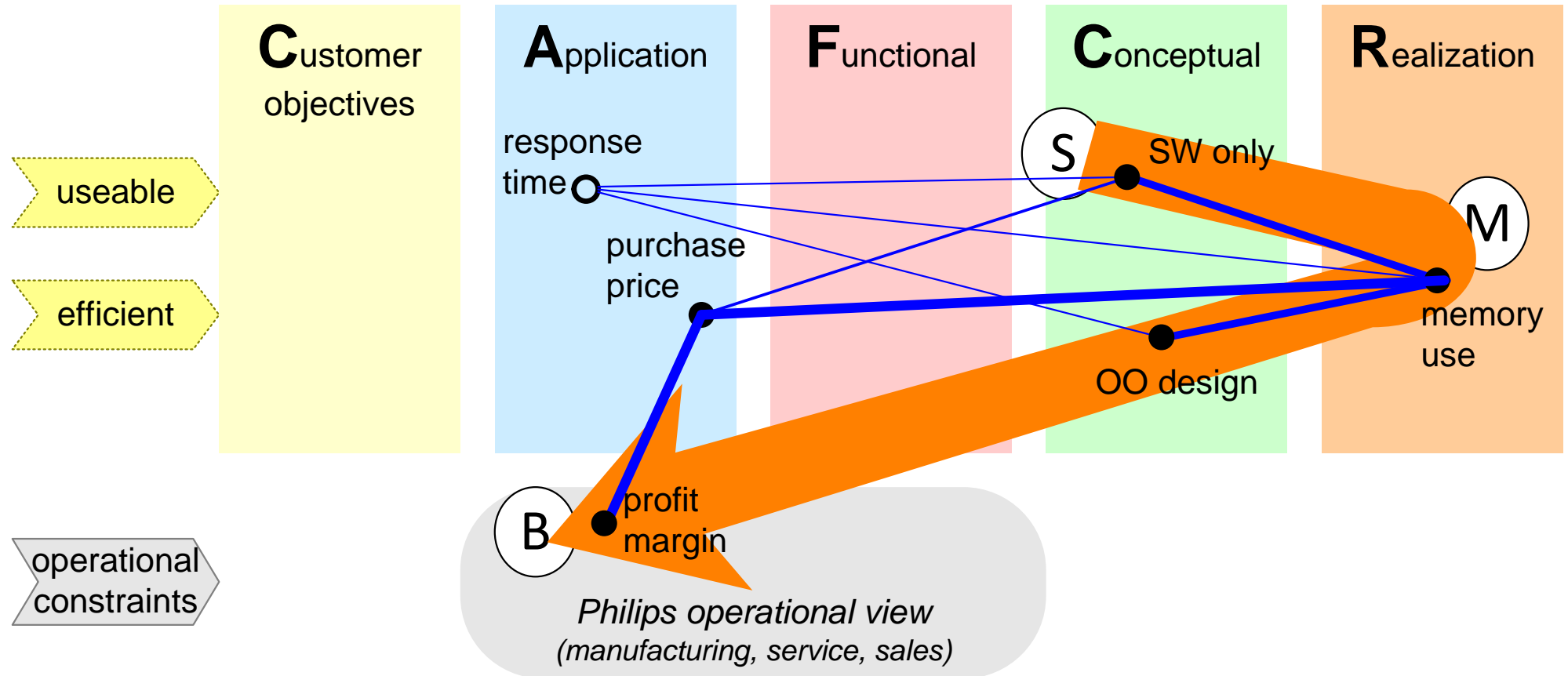
data base engine, fast, reliable and robust

extensive set of toolboxes

property based configuration

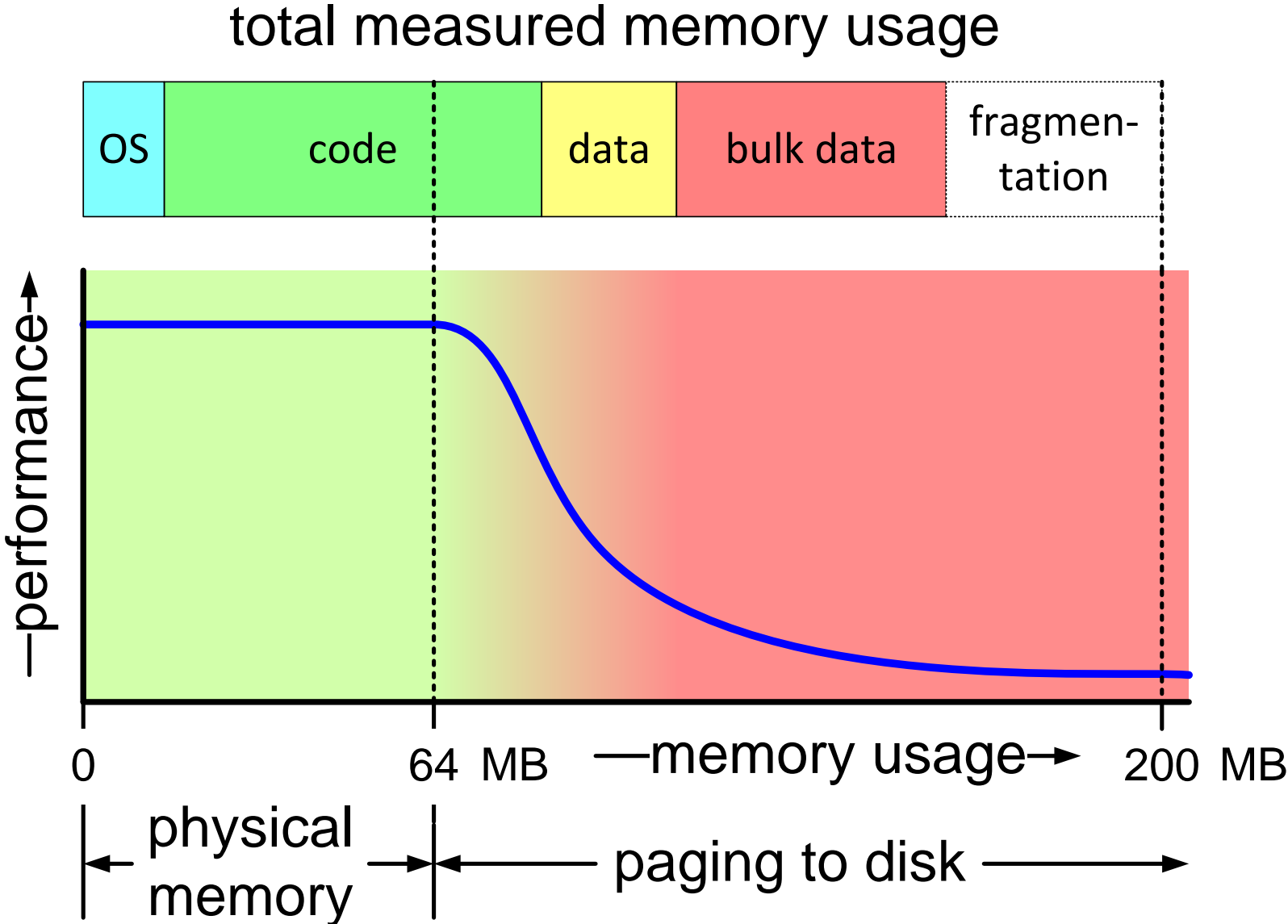
multiple coordinate spaces

Thread of reasoning; introvert phase

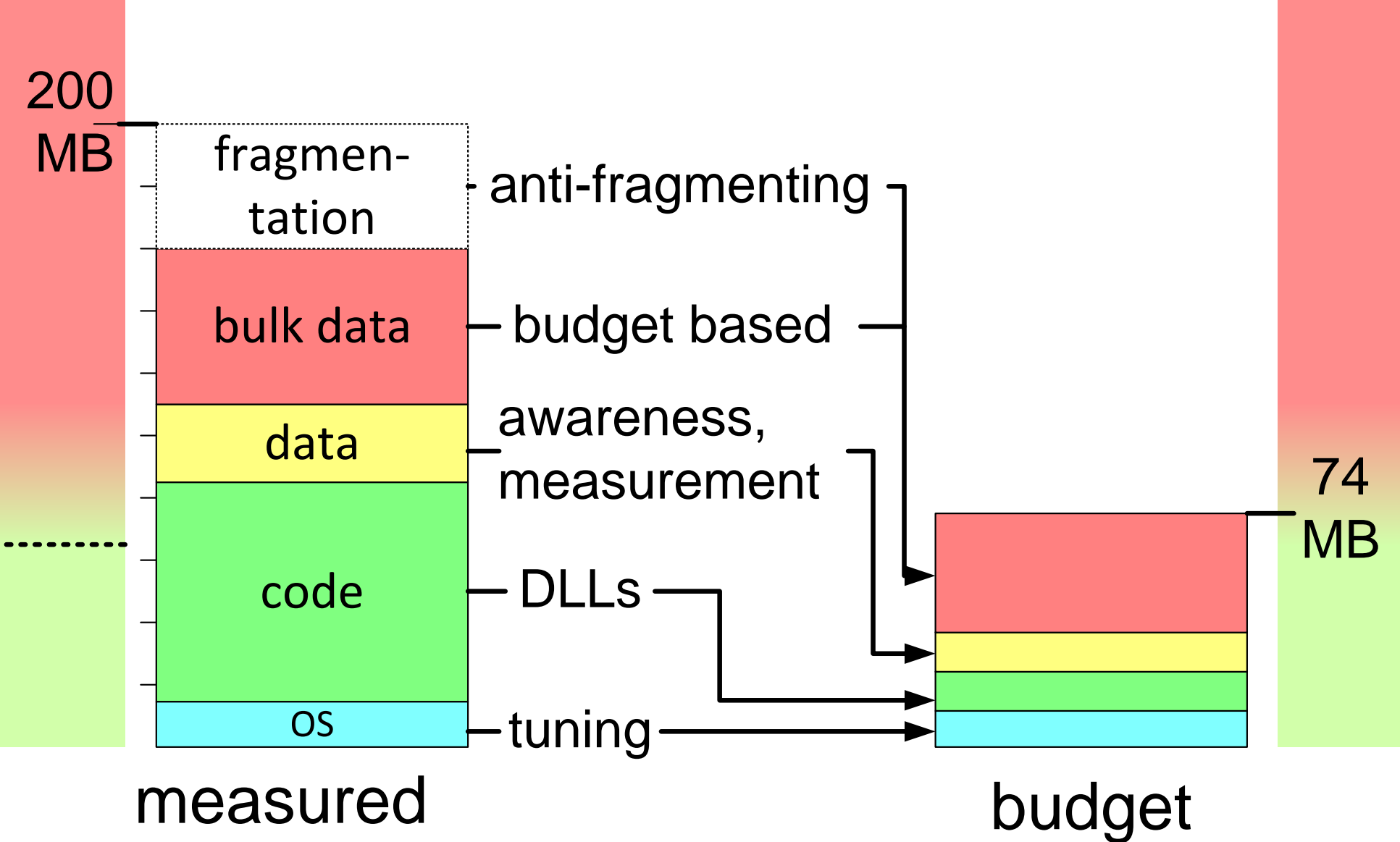


Introvert view: cost and impact of new technologies

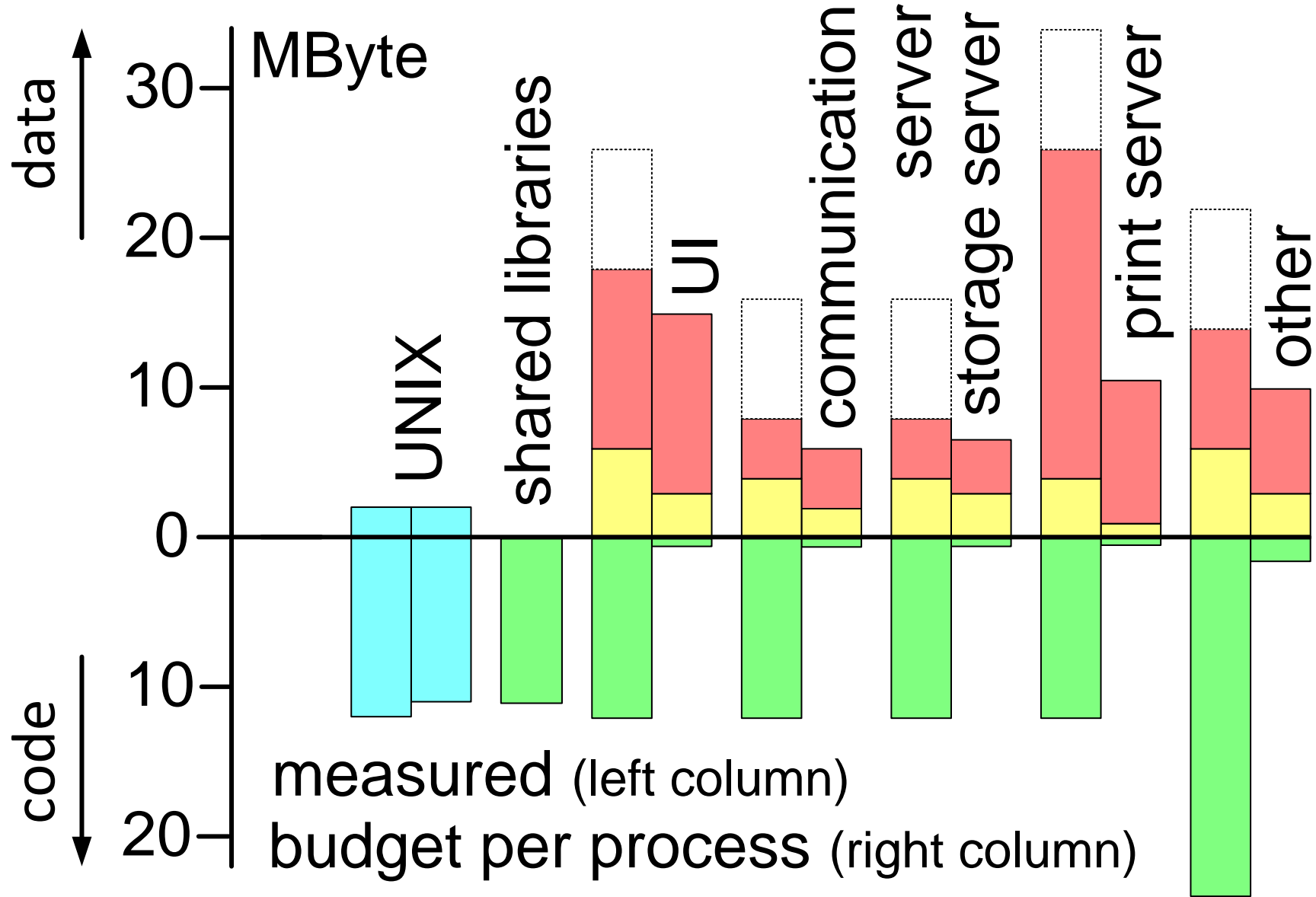
Memory usage half way R1



Solution of memory performance problem



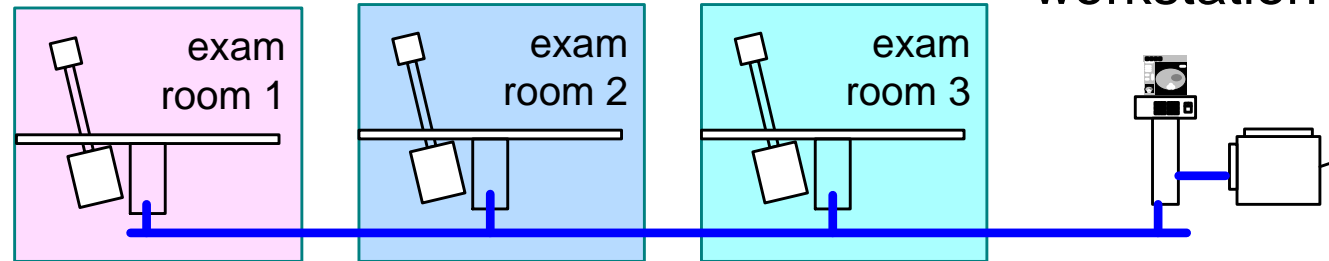
Visualization memory use per process



Typical case URF examination

3 examination rooms connected to

1 medical imaging workstation + printer

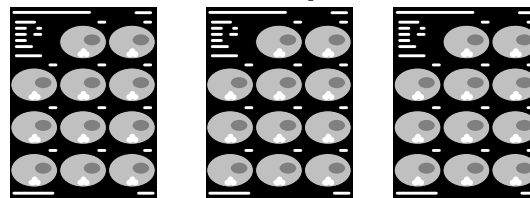


examination room: average 4 interleaved examinations / hour

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

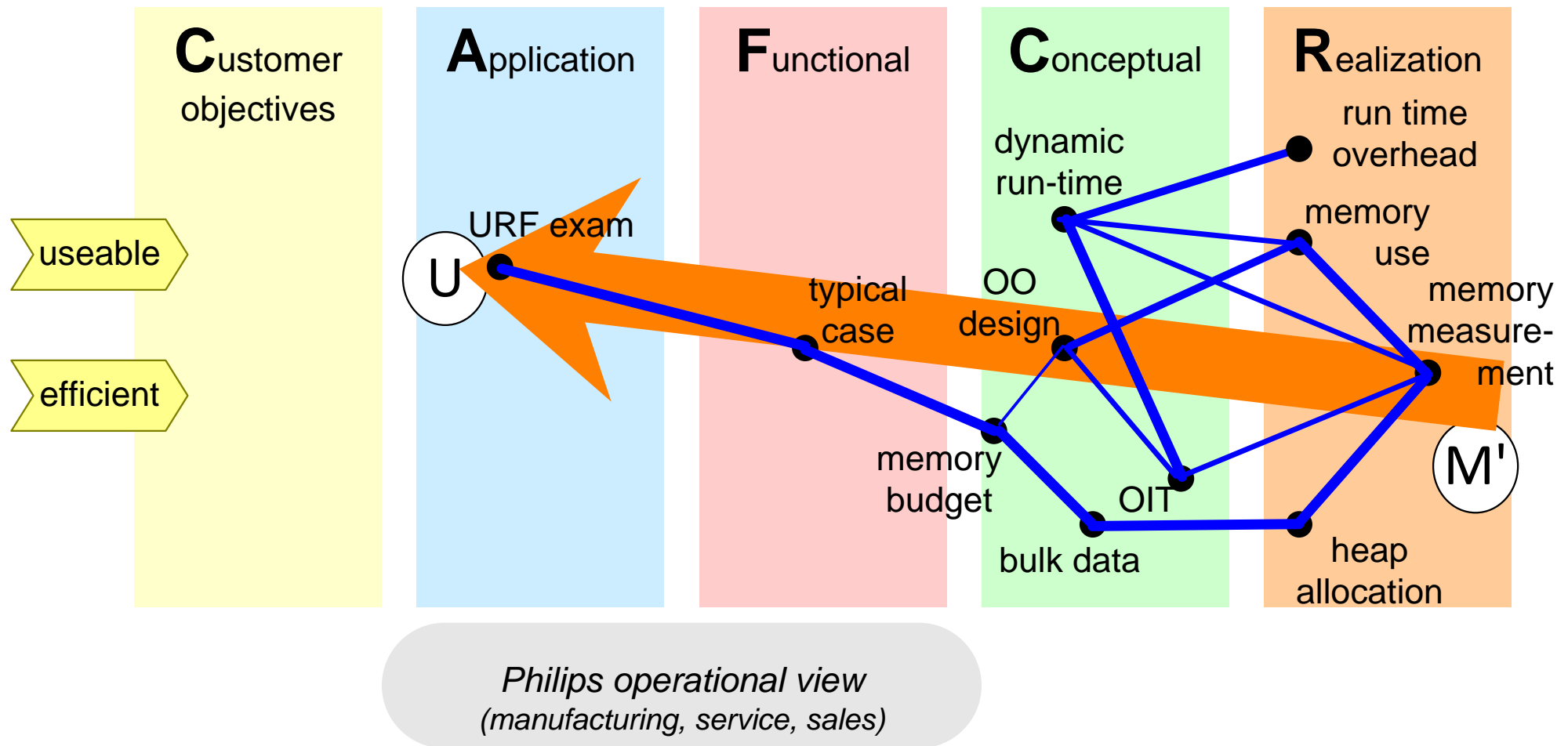


film production: 3 films of 4k*5k pixels each



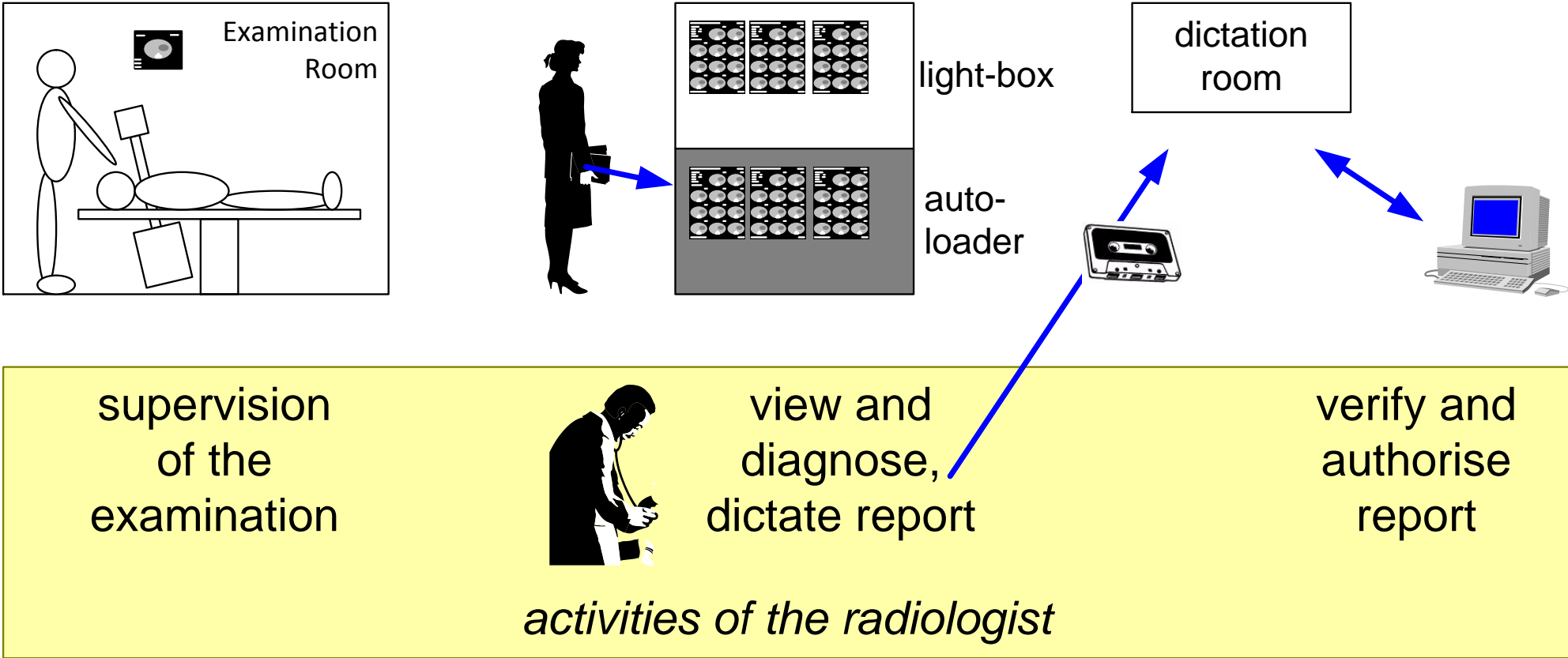
high quality output
(bi-cubic interpolation)

Thread of reasoning; phase 2

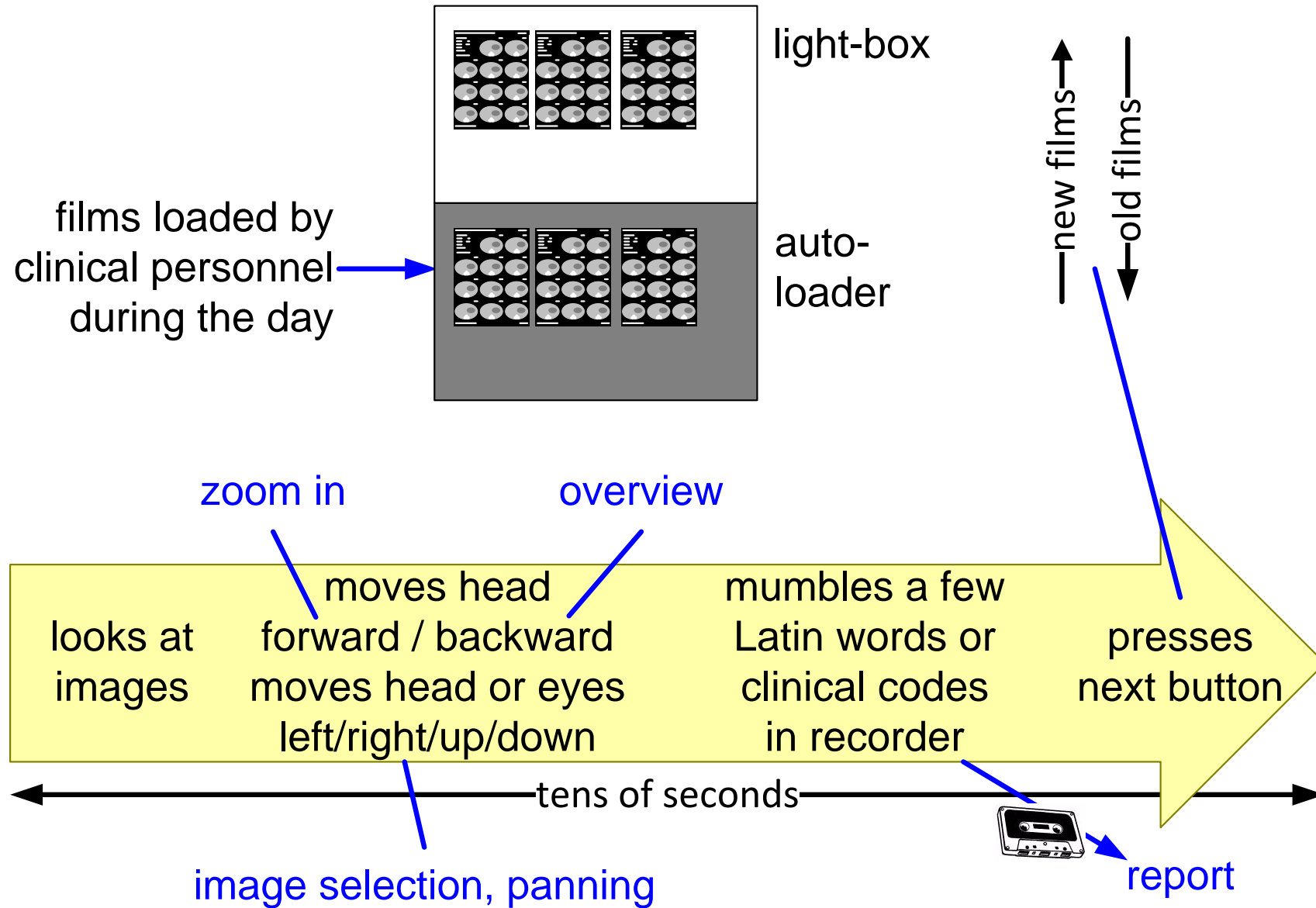


How to measure memory, how much is needed?
from introvert to extrovert

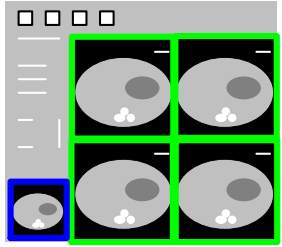
Radiologist workspots and activities



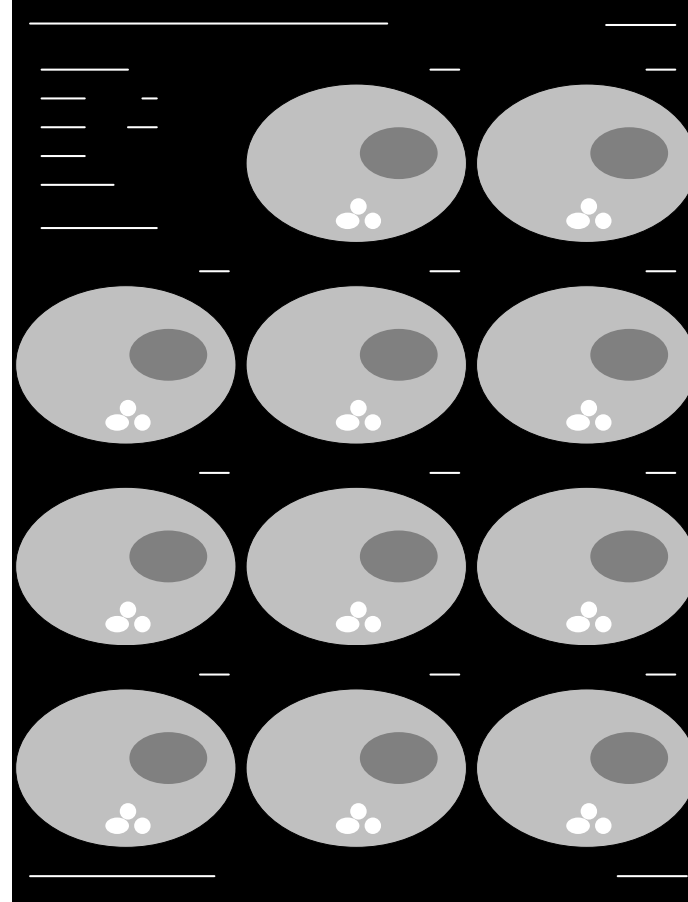
Diagnosis in tens of seconds



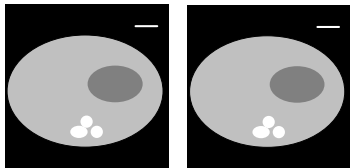
Rendered images at different destinations



Screen:
low resolution
fast response



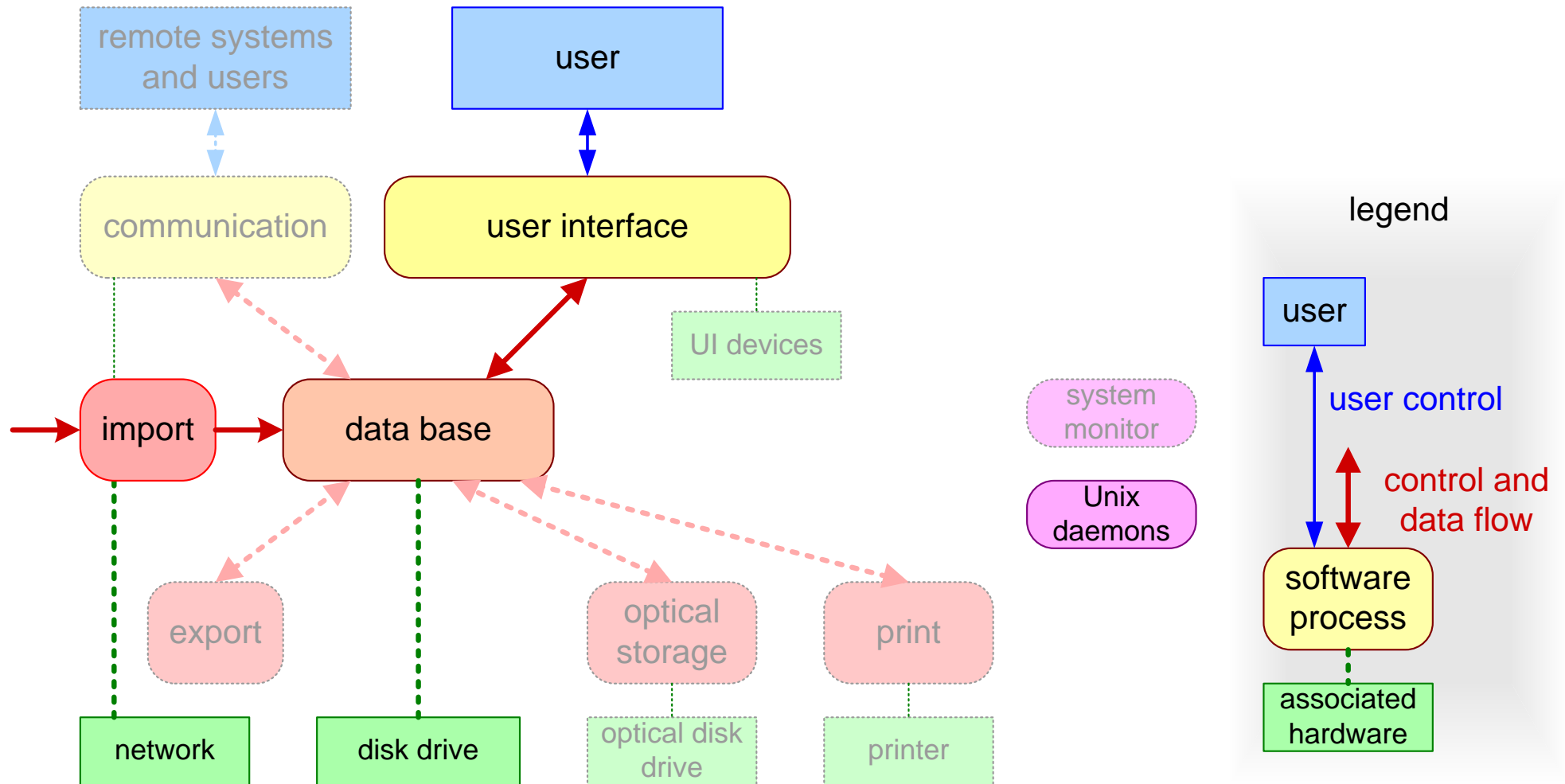
Film:
high resolution
high throughput



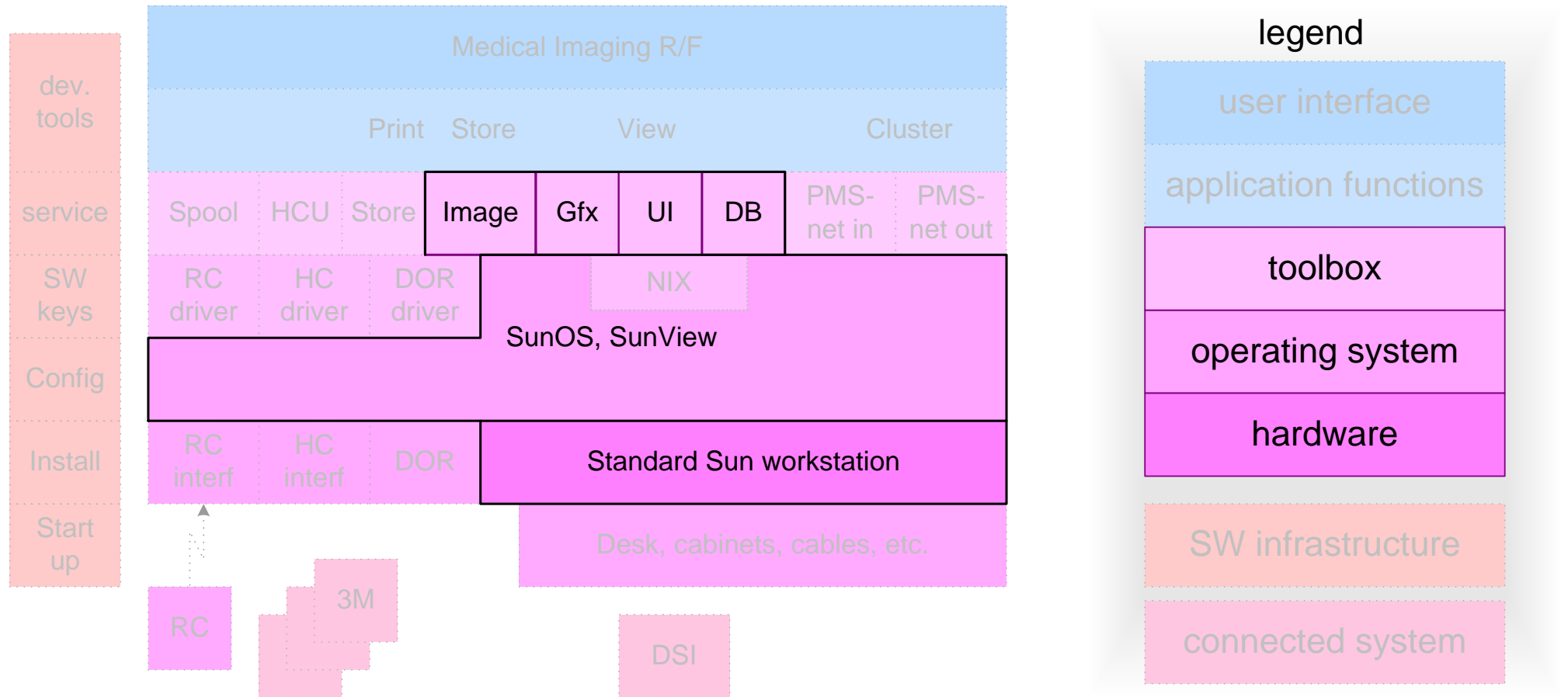
Network:
medium resolution
high throughput



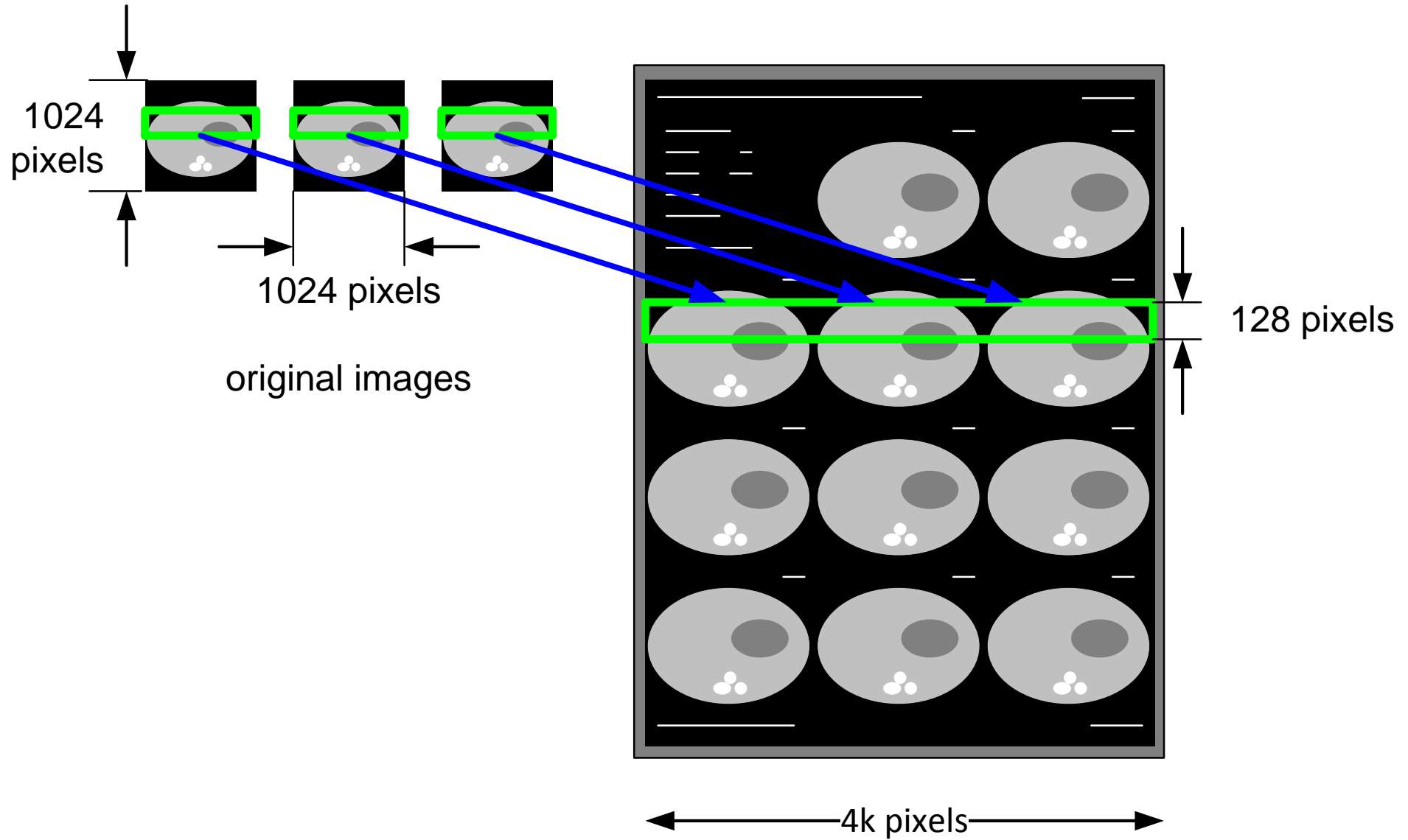
SW Process structure 1991



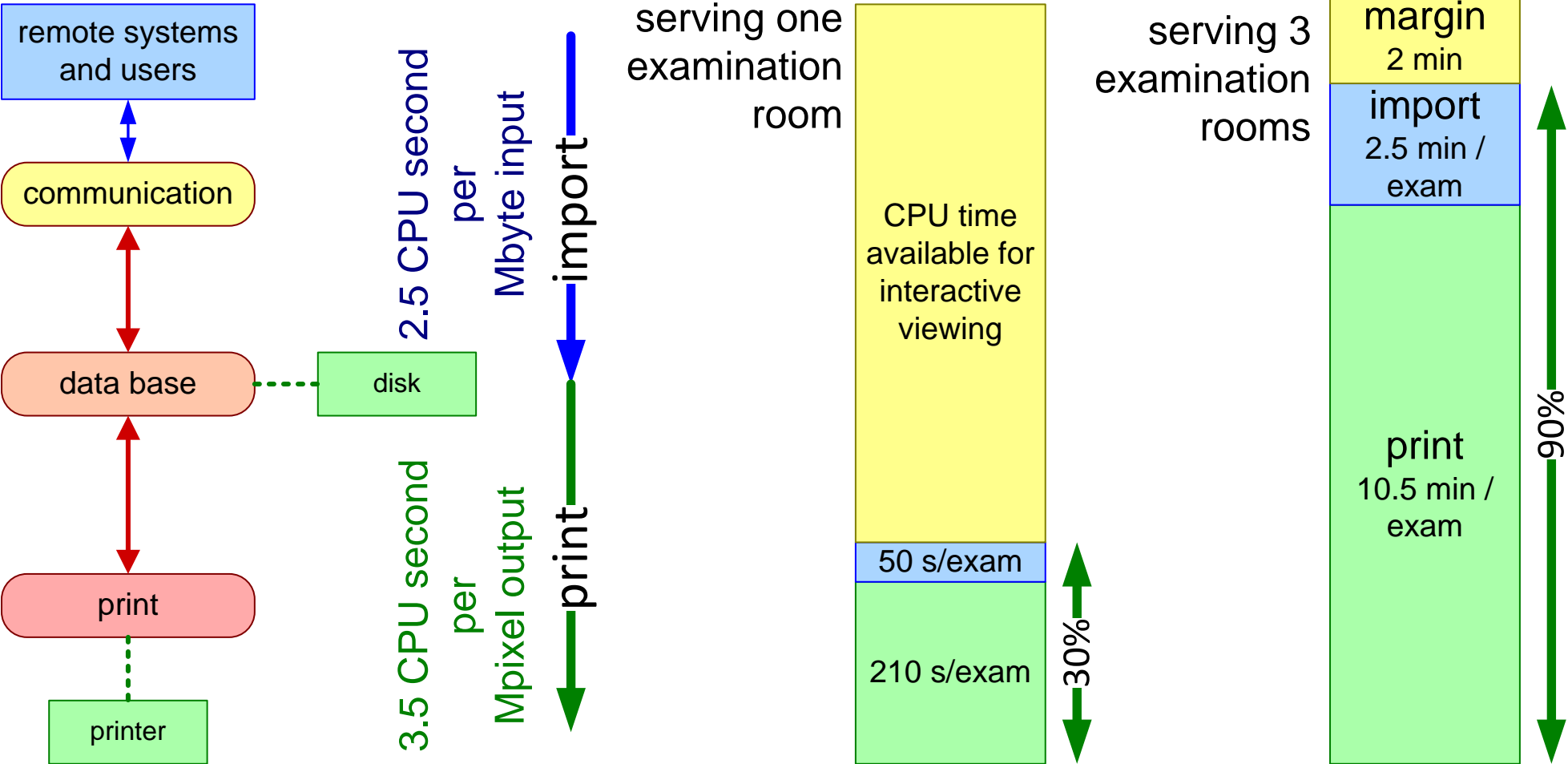
SW layers 1991



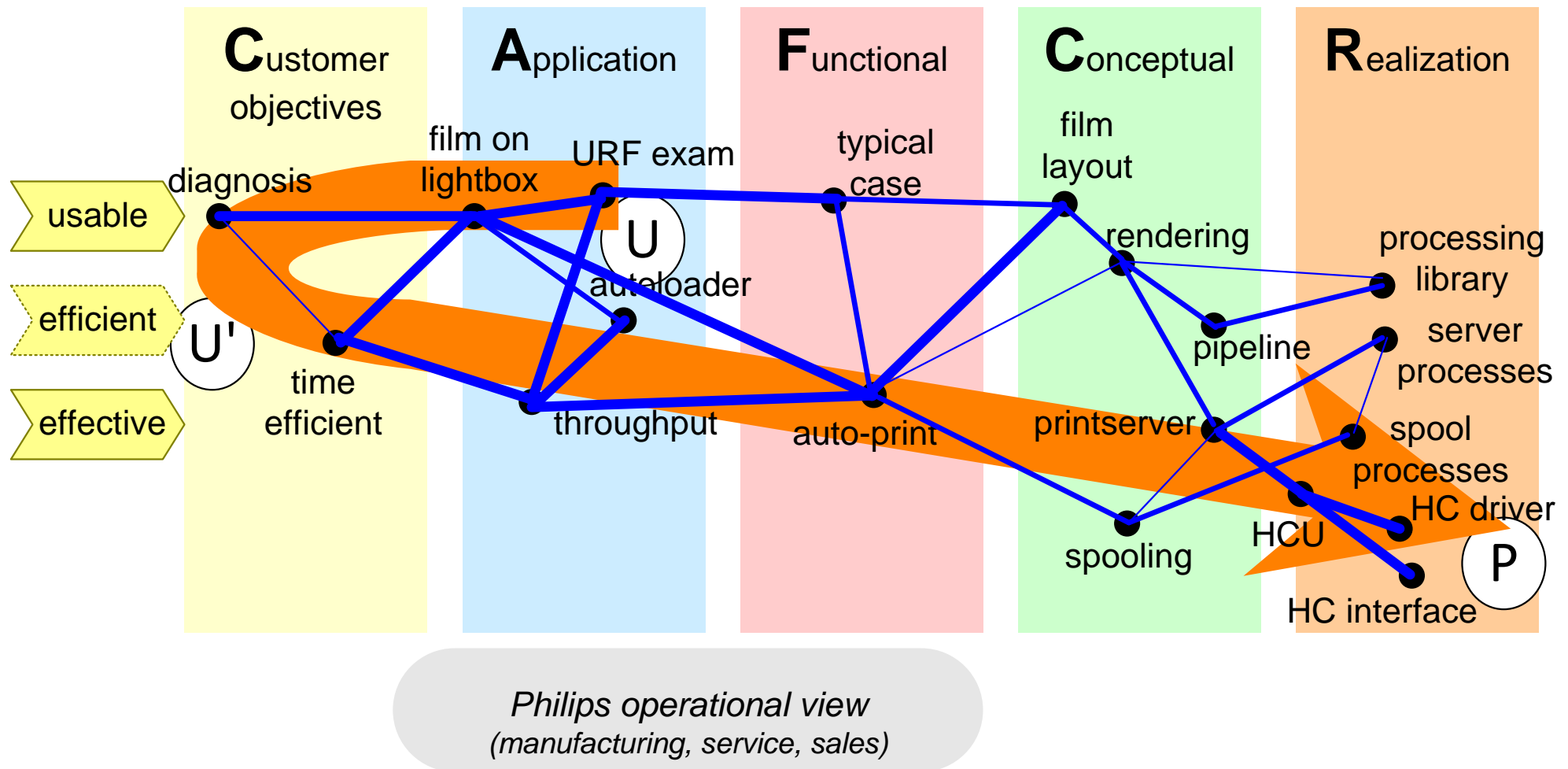
Print server is based on banding



Server CPU load

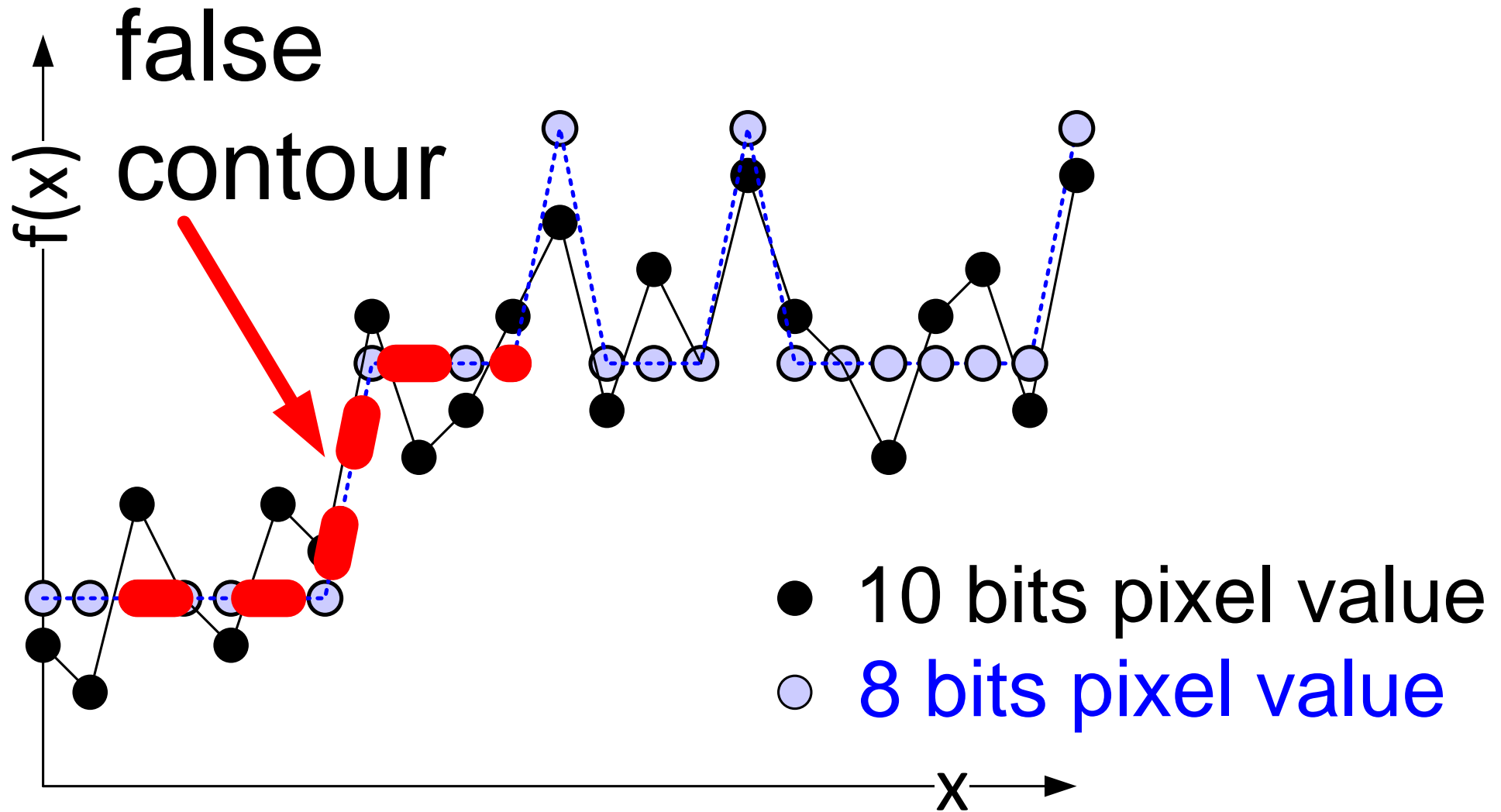


Thread of reasoning; phase 3



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

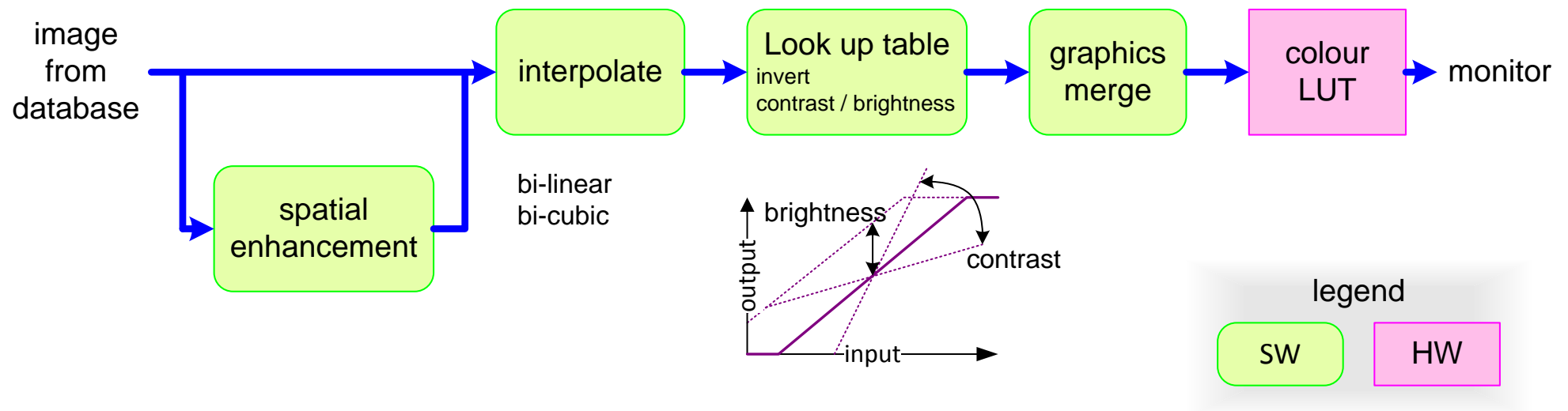
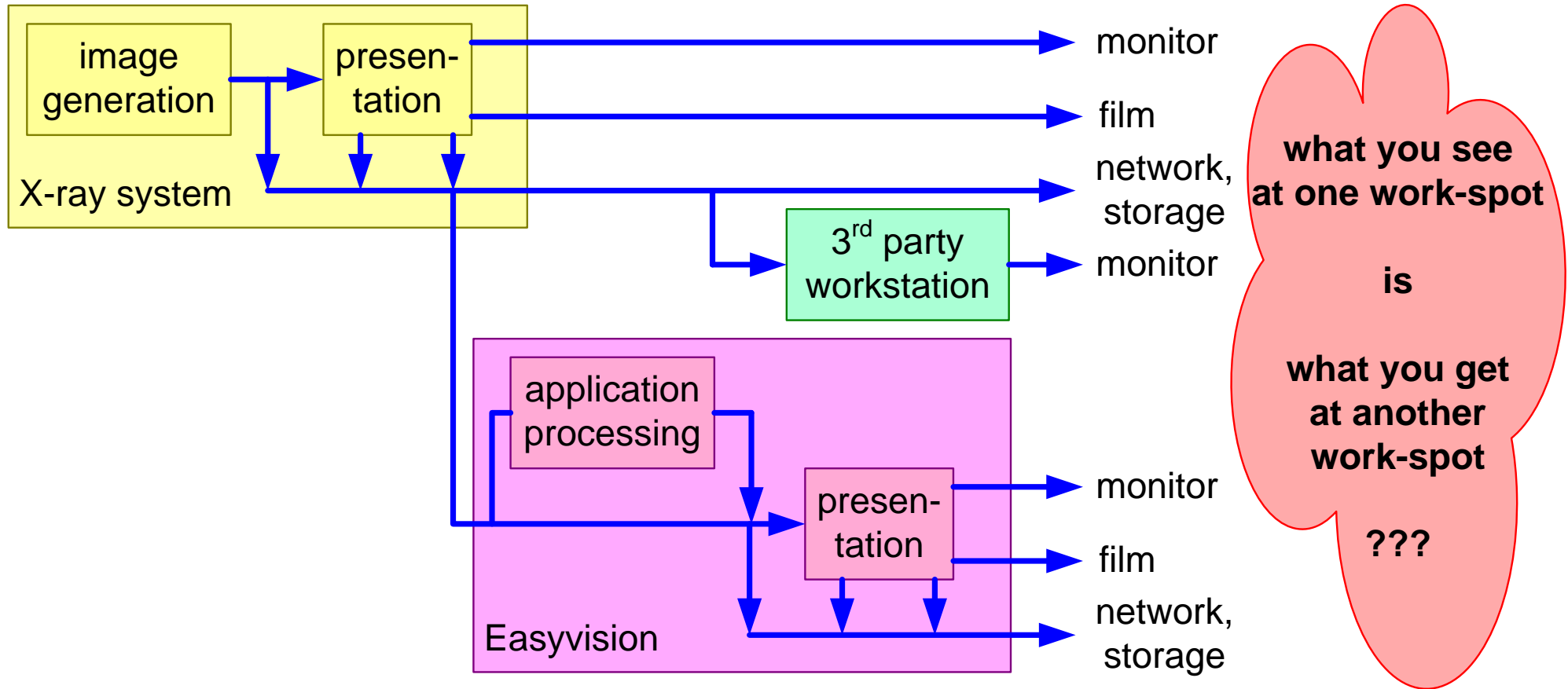
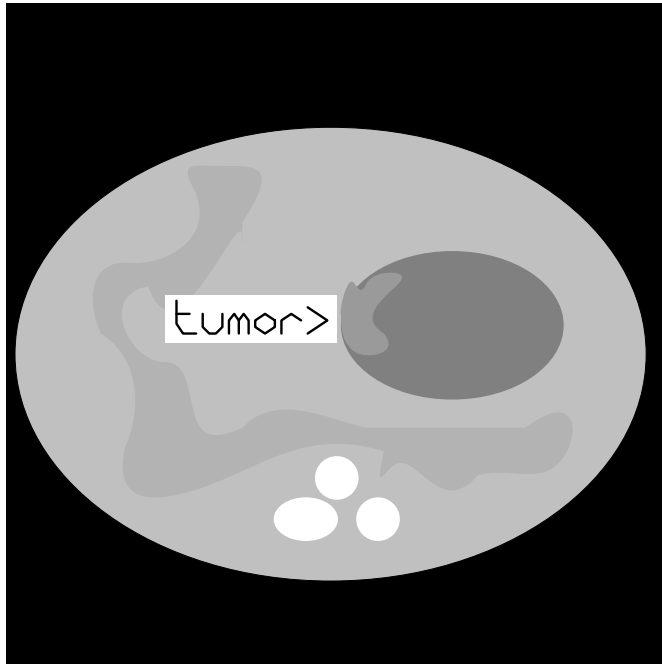


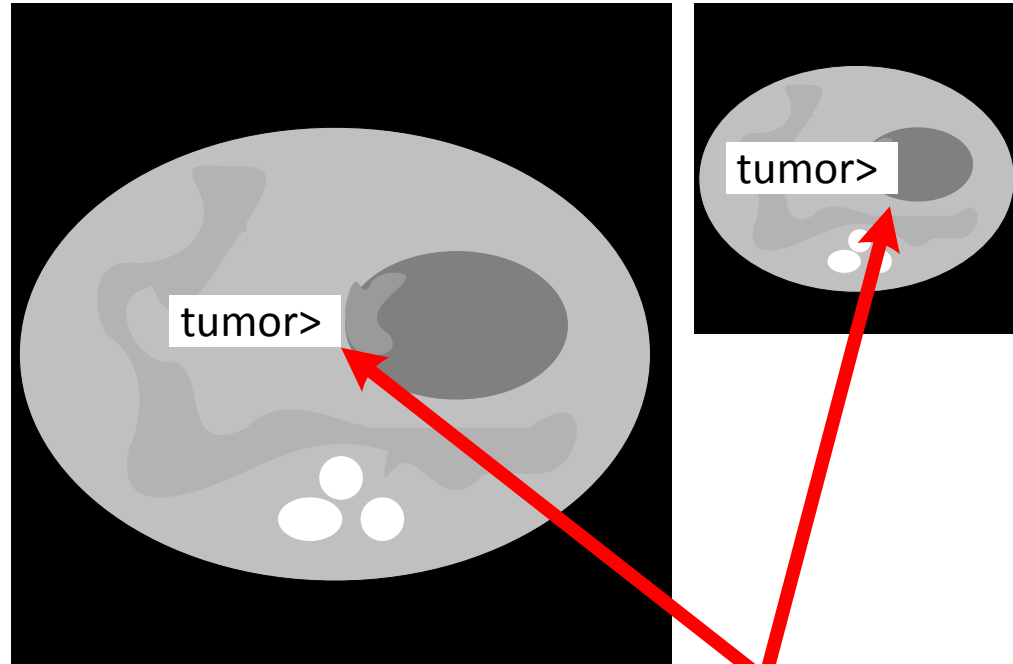
Image Quality expectation WYSIWYG



Safety problem



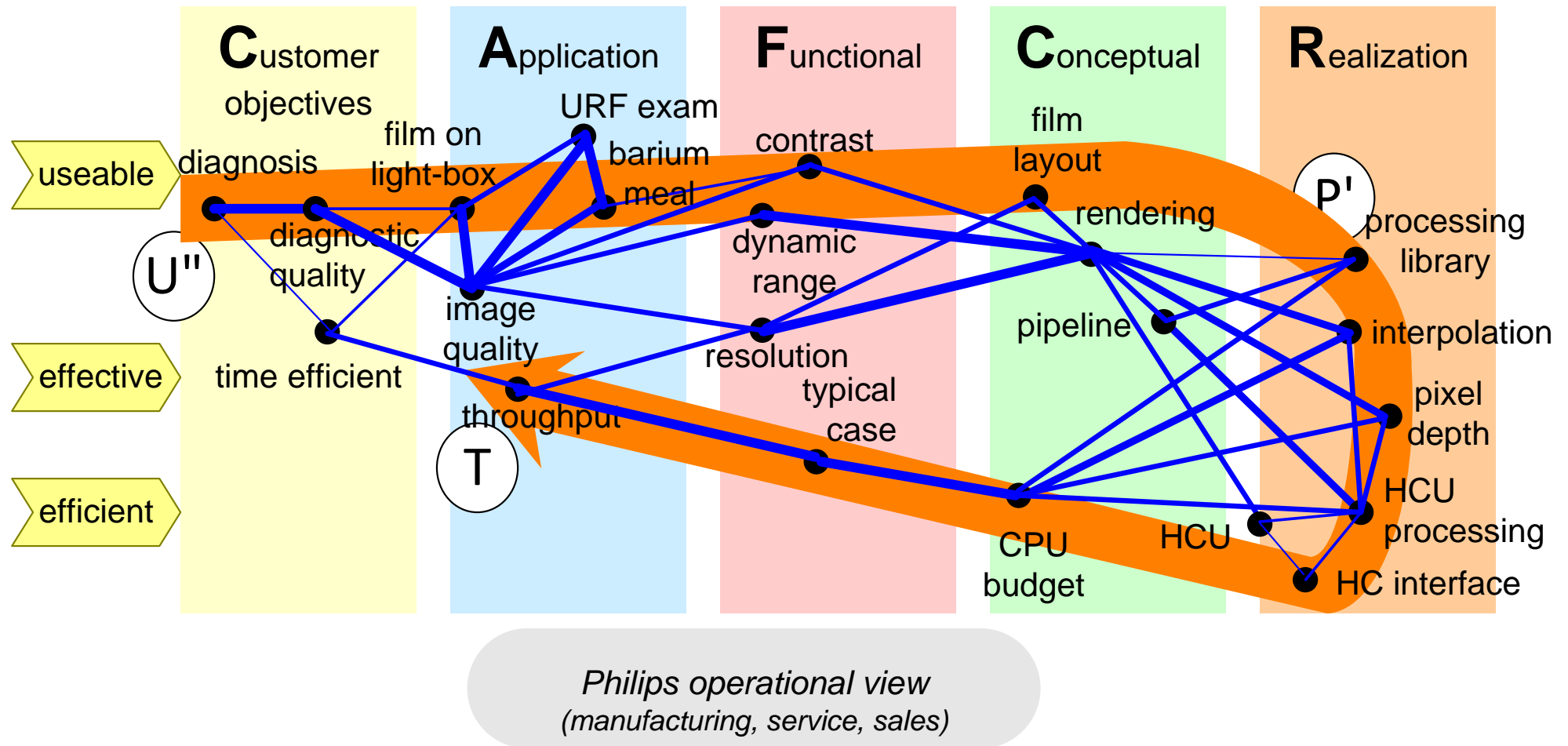
URF monitor output:
fixed size letters at fixed grid



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

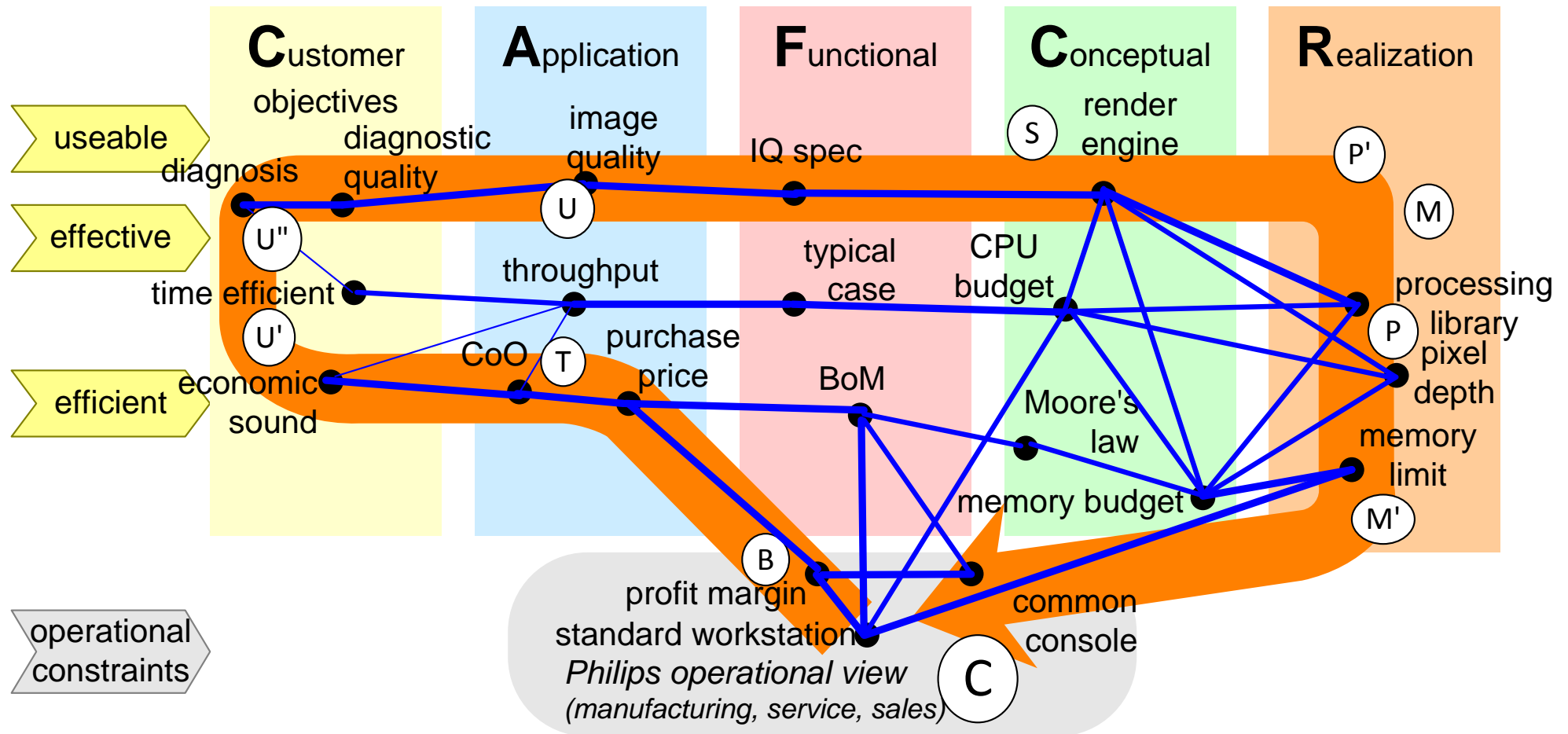
EV output: scaleable fonts in graphics overlay

Thread of reasoning; phase 4



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

Thread of reasoning; phase 5



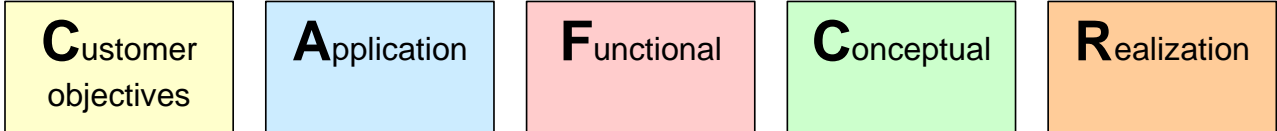
cost revisited in context of clinical needs and realization constraints; note: original threads are significantly simplified

Overview of architecting method

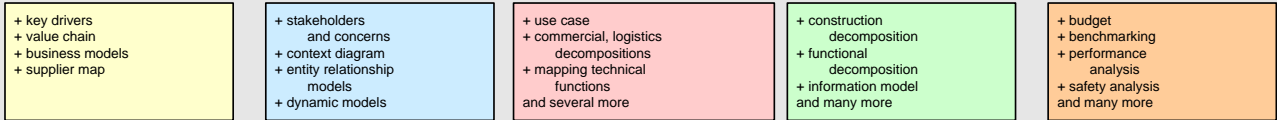
method outline

method visualization

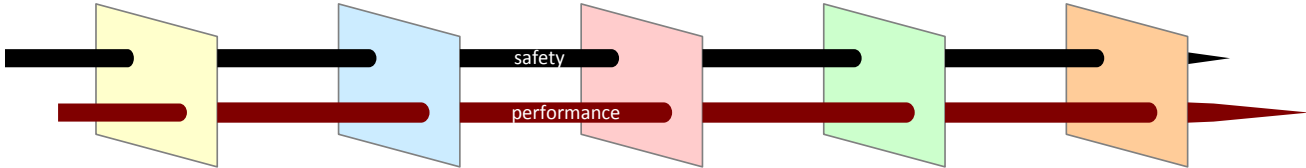
framework



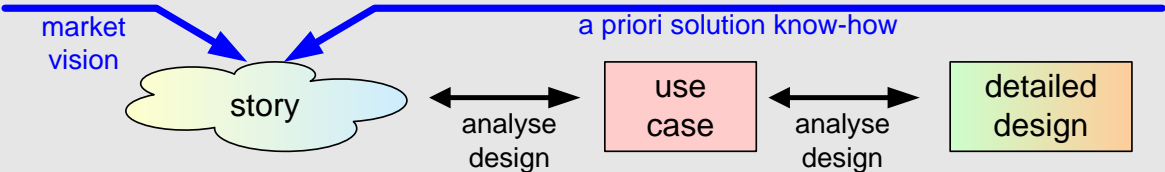
submethods



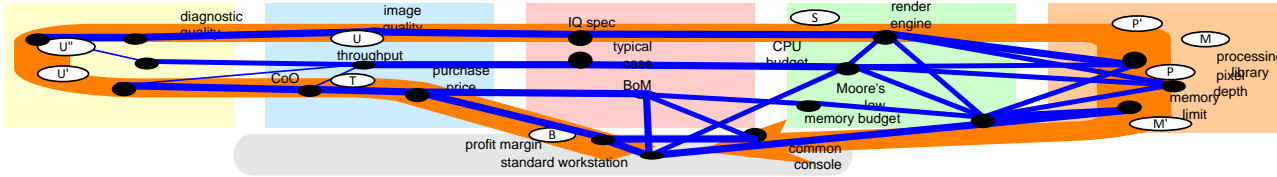
integration via qualities



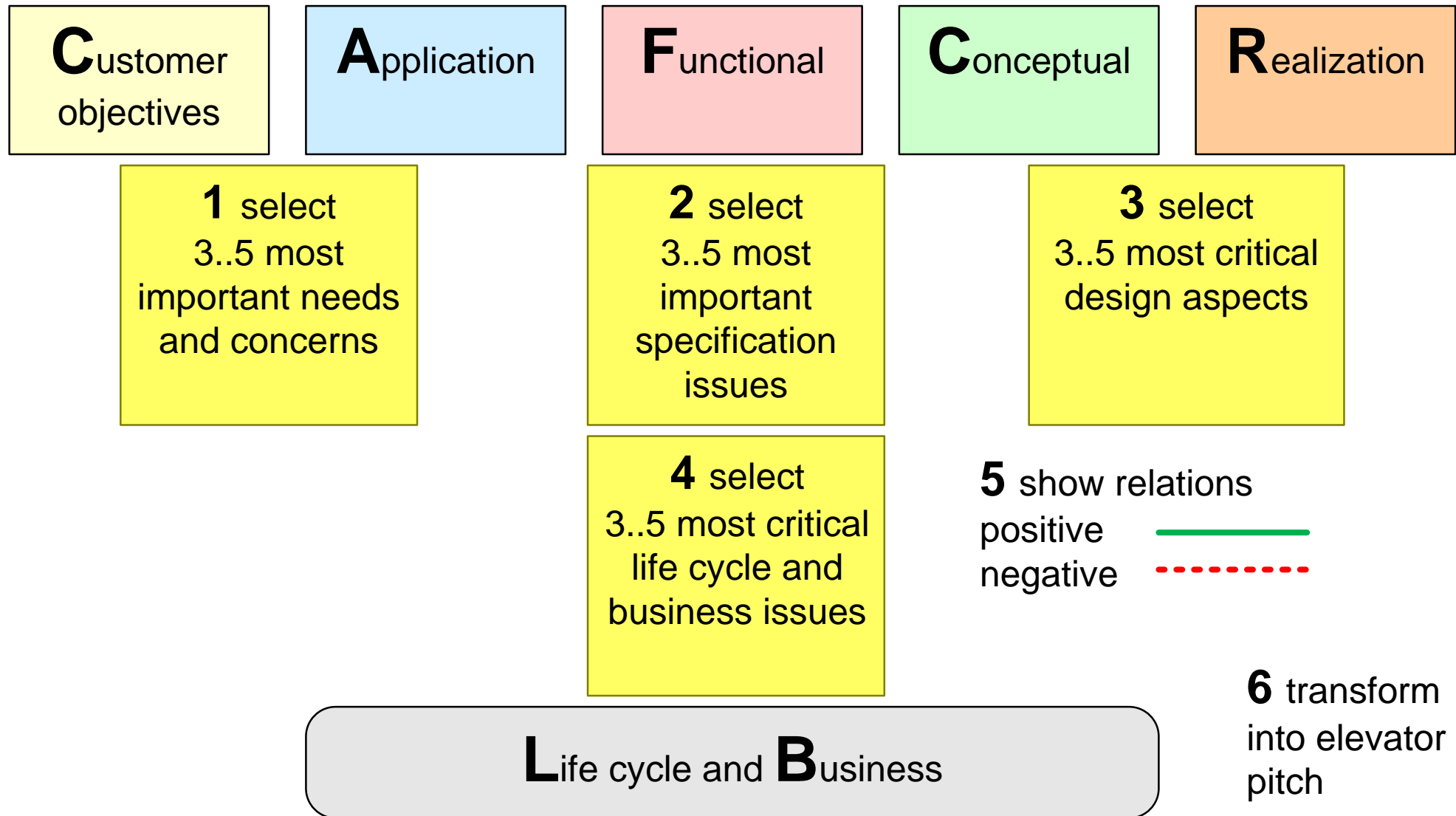
explore specific details



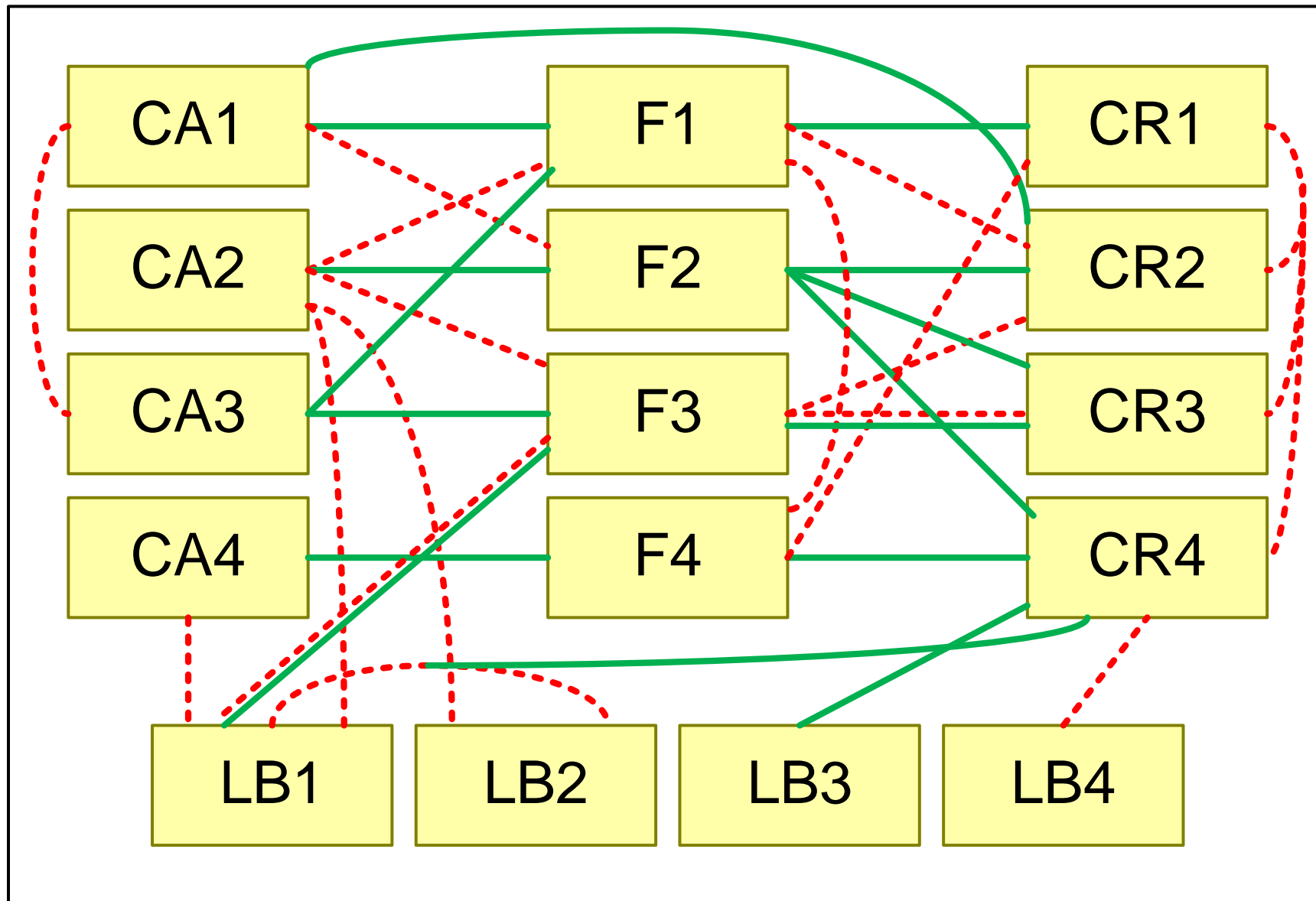
reasoning



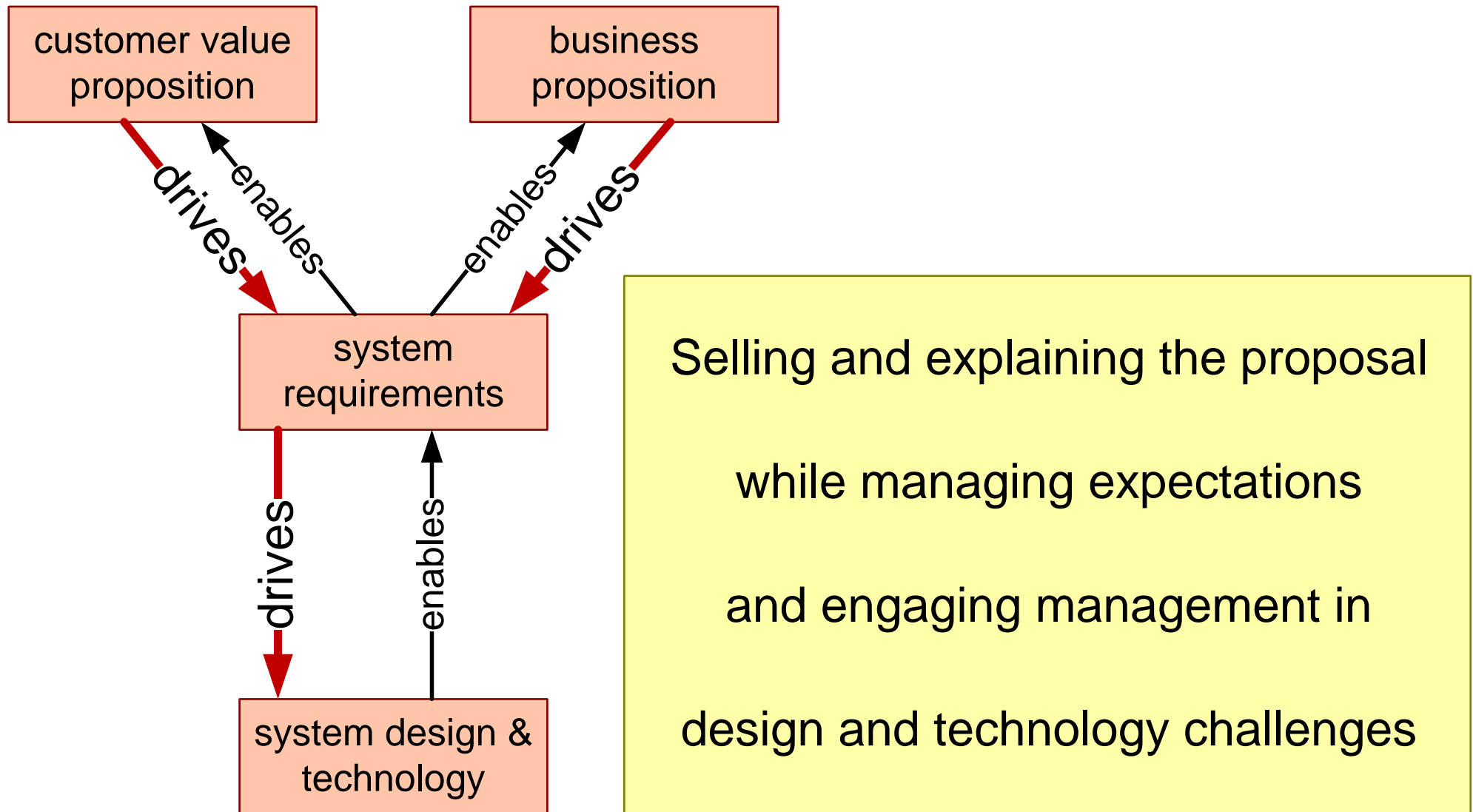
Exercise Threads of Reasoning



“Spaghetti” after Step 5

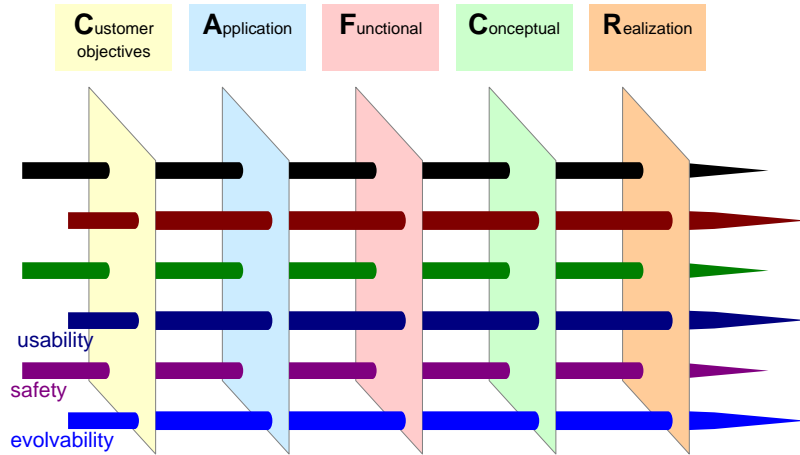


Elevator Pitch of about 90 seconds

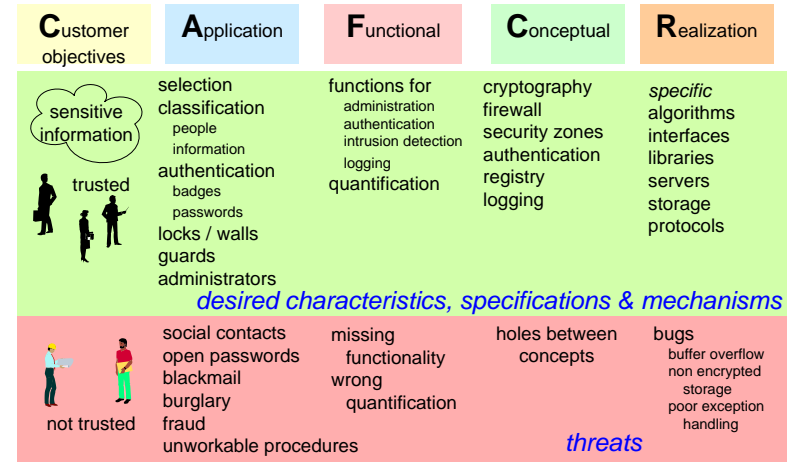


Integration via Qualities

Qualities Connect all Views



Look Positive and Negative



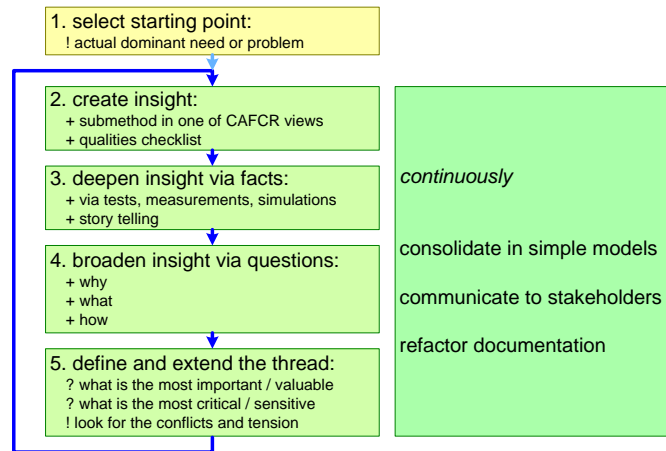
Many, Many Qualities

- usable
 - usability
 - attractiveness
 - responsiveness
 - image quality
 - wearability
 - storability
 - transportability
- interoperable
 - connectivity
 - 3rd party extendible
- serviceable
 - serviceability
 - configurability
 - installability
- ecological
 - ecological footprint
 - contamination
 - noise
 - disposability
- dependable
 - safety
 - security
 - reliability
 - robustness
 - integrity
 - availability
- liable
 - liability
 - testability
 - traceability
 - standards compliance
- future proof
 - evolvability
 - portability
 - upgradeability
 - extendibility
 - maintainability
- down to earth attributes
 - cost price
 - power consumption
 - consumption rate (water, air, chemicals, et cetera)
 - size, weight
 - accuracy
- efficient
 - resource utilization
 - cost of ownership
- consistent
 - reproducibility
 - predictability
- logistics friendly
 - manufacturability
 - logistics flexibility
 - lead time

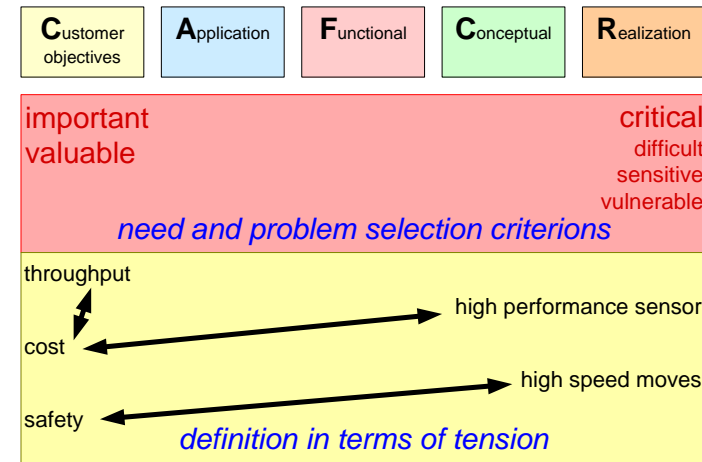
intentionally left blank

Threads of Reasoning

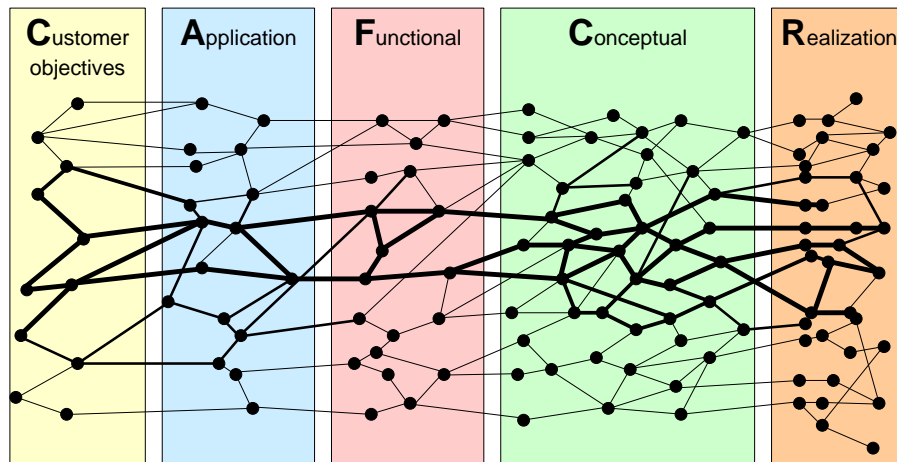
Diverge, Converge, Zoom-in, Zoom-out



Identify Most Relevant Issues



All Issues are Interrelated



Reconstruct the "Big Picture"

