Understanding And Validating Value

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

e-mail: gaudisite@gmail.com

www.gaudisite.nl

Abstract

Value of a system is determined by the value of the product for the customer. To create a valuable system we need to understand our customer. However, value is also impacted by the way we realize the system. Poor realizations degrade the value of a product, while ingenious realizations can boost the value. We use the CAFCR model to illustrate this for two cases: a video recorder and a health care system.

September 6, 2020
status: planned
version: 0

begin

1. Intro
C A F C R

2. Case
Video Recorder

3. Reflection on
Video Recorder Case

4. Case
Health Care

5. Reflection on
Health Care Case

end

Figure Of Contents™

begin

1. Intro

| C | A | F | C | R |

2. Case

Video Recorder

3. Reflection on

Video Recorder Case

4. Case

Health Care

5. Reflection on

Health Care Case

end

USN ESI

The "CAFCR" model

drives, justifies, needs →

← enables, supports

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

Customer **What**	Customer **How**	Product **What**	Product **How**	
Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization

USN   ESI

Integrating CAFCR

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

Customer **What**   Customer **How**   Product **What**

Product **How**

Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization
	context understanding	intention	objective driven	
	oppor-tunities	constraint awareness	knowledge based	

USN   ESI
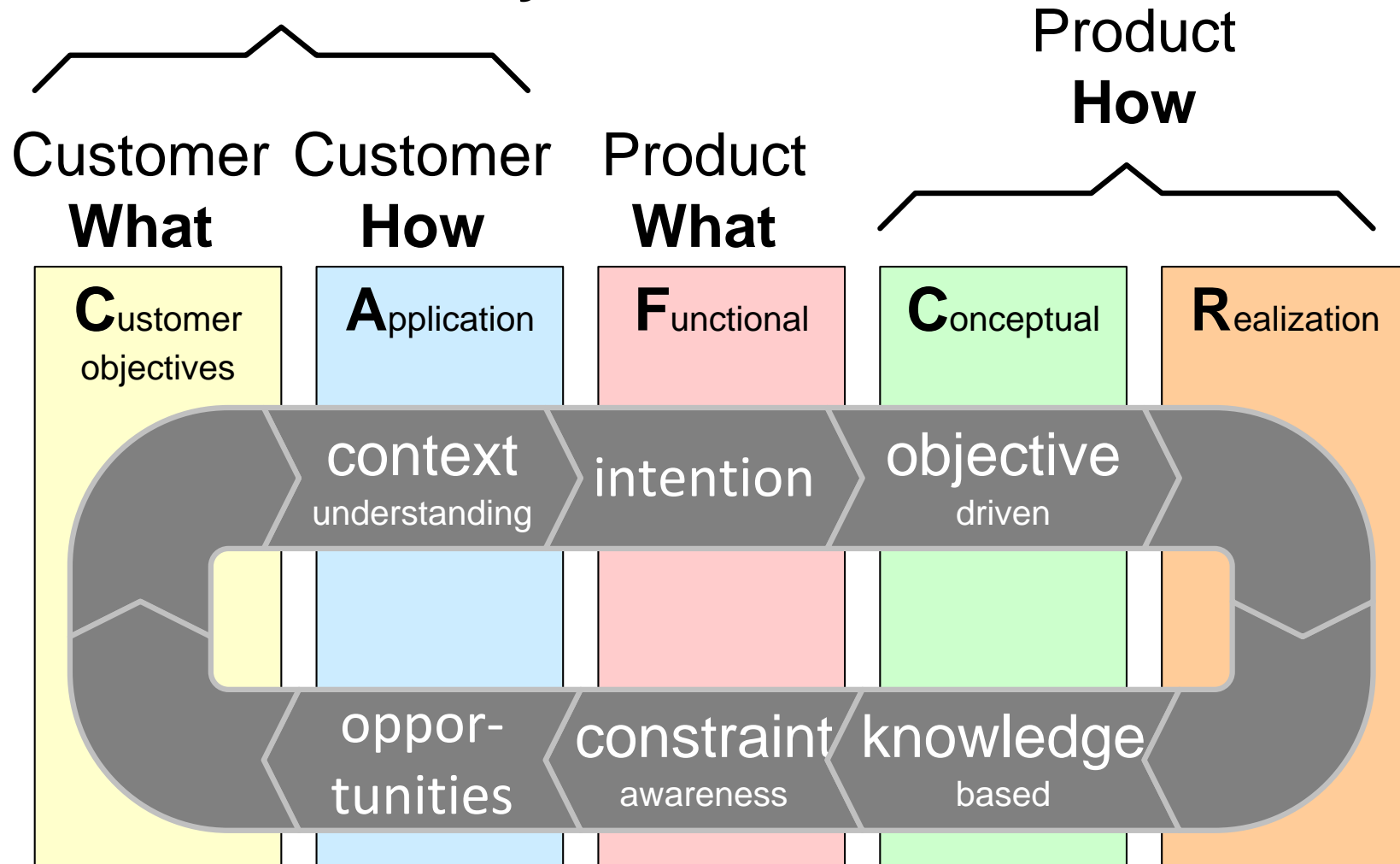
CAFCR can be applied recursively

Consumer

Drives

Enables

Customer's Customer Business

Drives

Enables

Customer Business

Drives

Enables

System (producer)

Value Chain
larger scope has smaller influence on architecture

USN   ESI
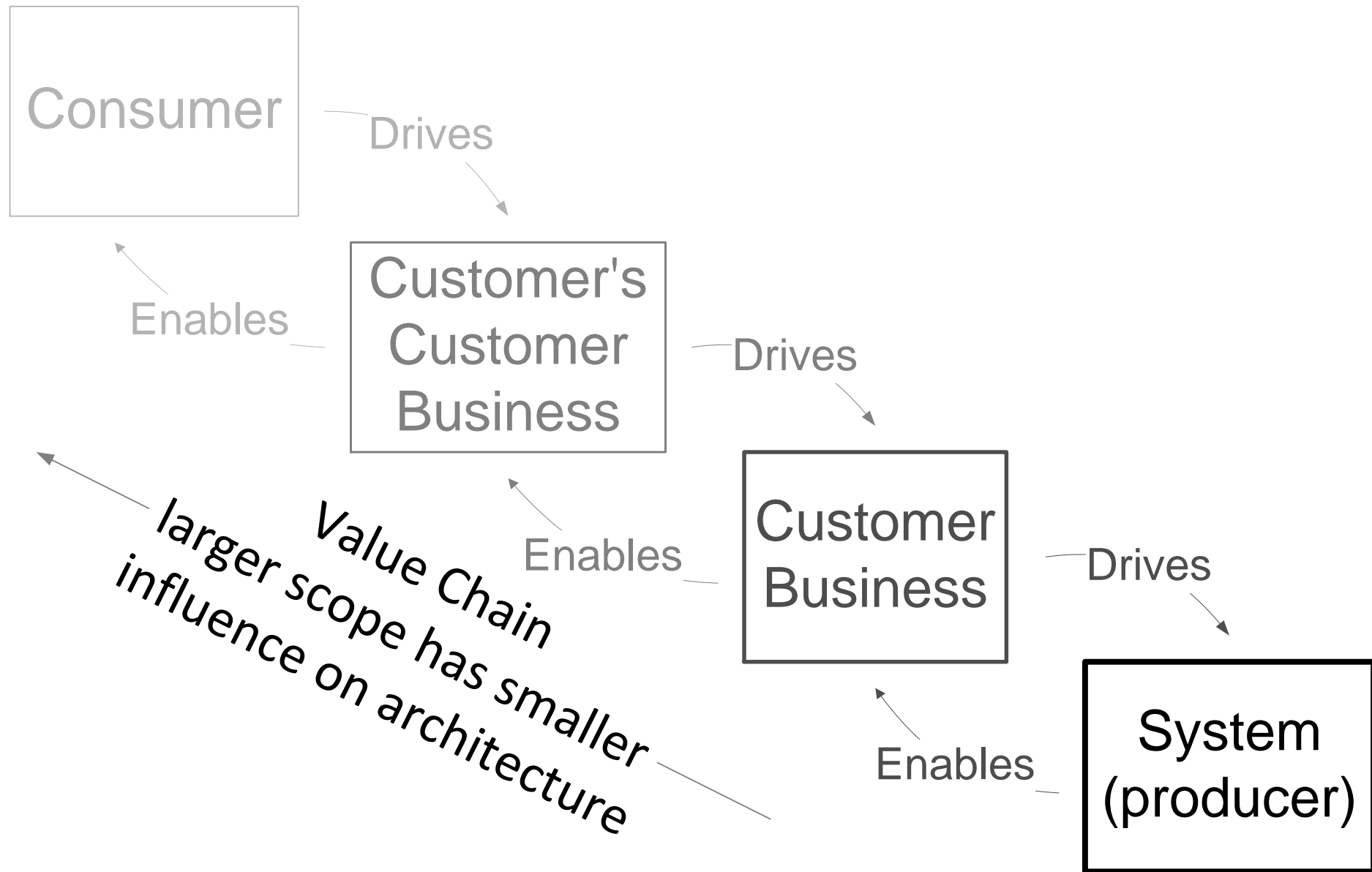
CAFCR+ model; Life Cycle View

Customer objectives

Application

Functional

Conceptual

Realization

operations
maintenance
upgrades

Life cycle

development
manufacturing
installation

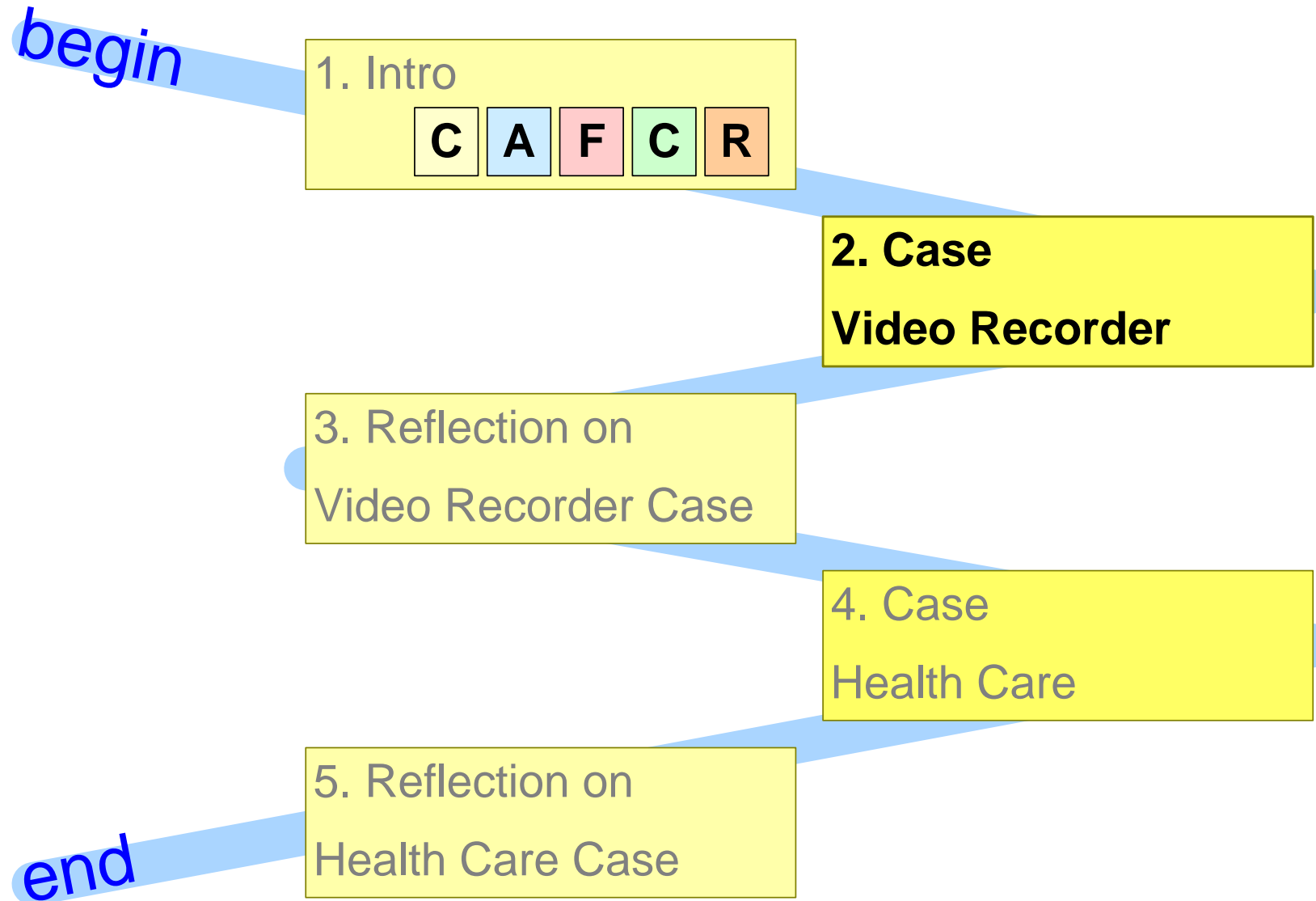sales, service, logistics, production, R&D

USN ESI
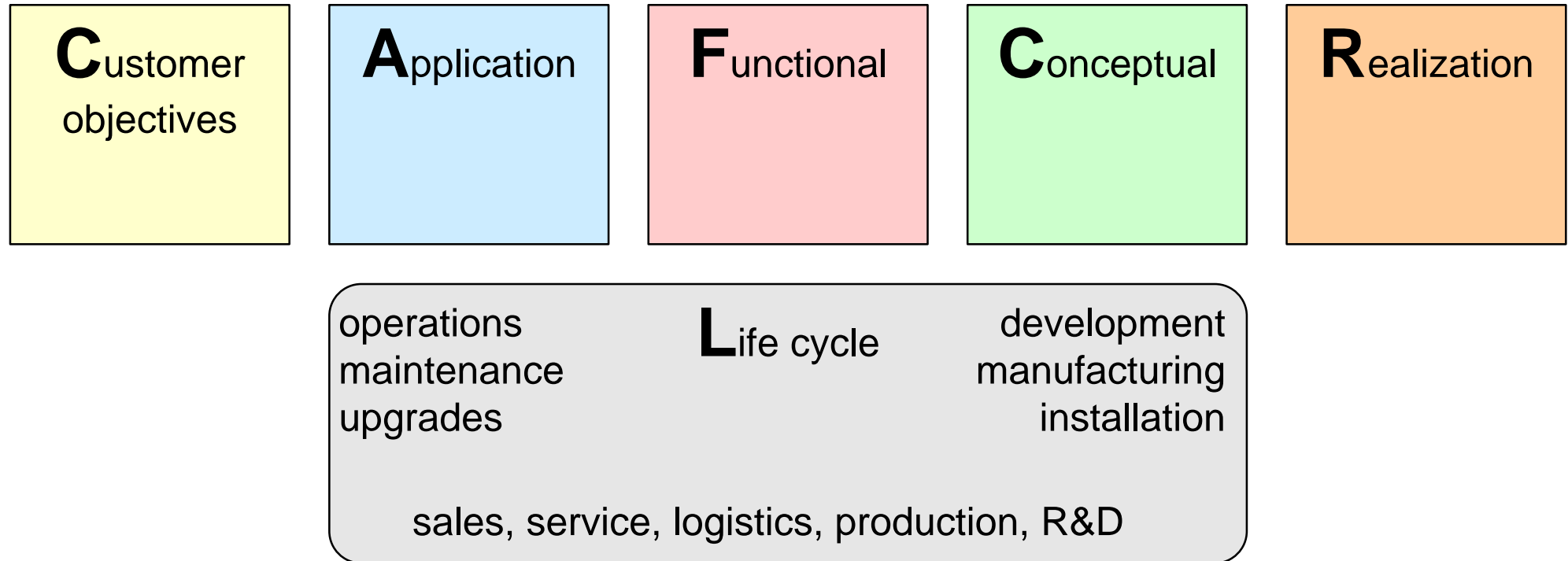
2001 Course Requirements Engineering

for OOTI

Post Master Education Technical Informatics

Group assignment for circa 16 students

Write a requirements specification for a hard-disk based video recorder

Video Recorder Case

begin

1. Intro

| C | A | F | C | R |

2. Case

Video Recorder

3. Reflection on

Video Recorder Case

4. Case

Health Care

5. Reflection on

Health Care Case

end

USN ESI

Late nineties

the question: "I want a hard disk based video recorder"

What are the actual needs?   What are the possible solutions?

What are the Needs
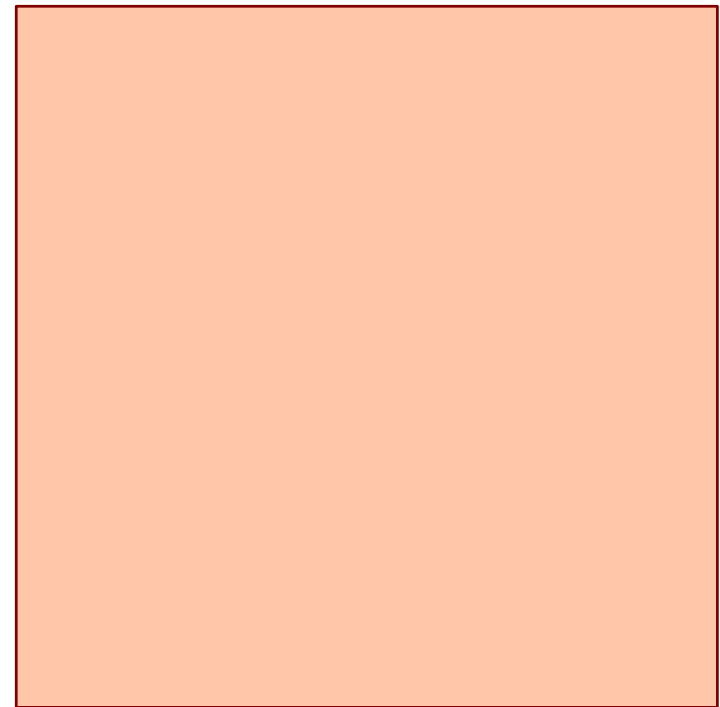
Late nineties

the question: <mark>"I want a hard disk based video recorder"</mark>

What are the actual needs?   *What are the possible solutions?*

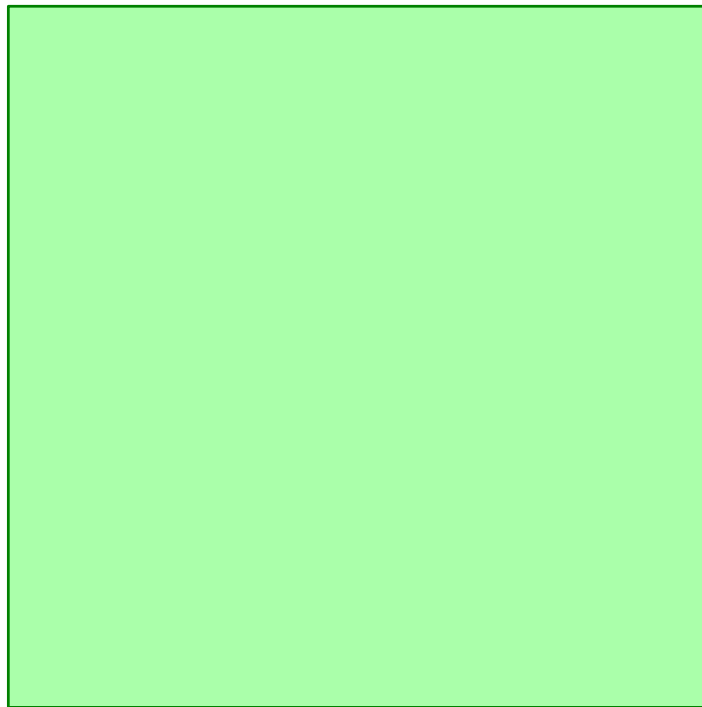|	
no hassle with tapes high reliability high capacity time shifting portable device skipping commercials ...	

USN ESI

What are Potential Solutions

Late nineties

the question: "I want a hard disk based video recorder"

What are the actual needs?   *What are the possible solutions?*

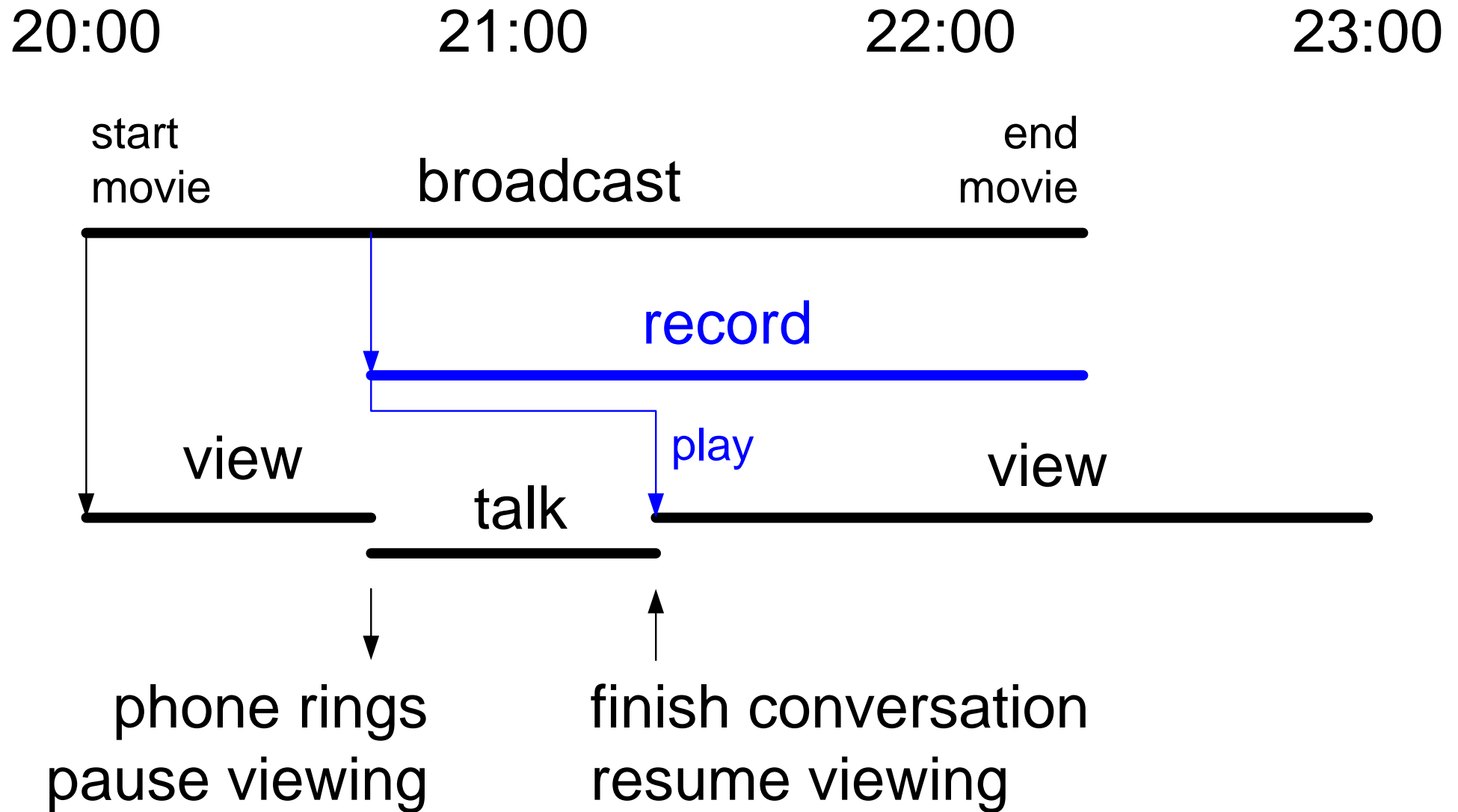|	
no hassle with tapes high reliability high capacity time shifting portable device skipping commercials ...	hard disk optical disc optical tape flash memory DRAM memory network ...

USN ESI

Did you ever program a VCR?

A ☐ depressed

B ☐ desparate

C ☐ hysteric

USN ESI

Example Time Shift recording

20:00   21:00   22:00   23:00

start   broadcast   end
movie   movie

record

view   play   view

talk

phone rings   finish conversation
pause viewing   resume viewing

USN   ESI

Black Box view on Video Recorder

channel selection

pause/resume/play

advanced controls

fast forward/backward
still

recording recipe

directory
channel number
menus

user information

broadband → videorecorder →

video

configuration

channel sources
channel names
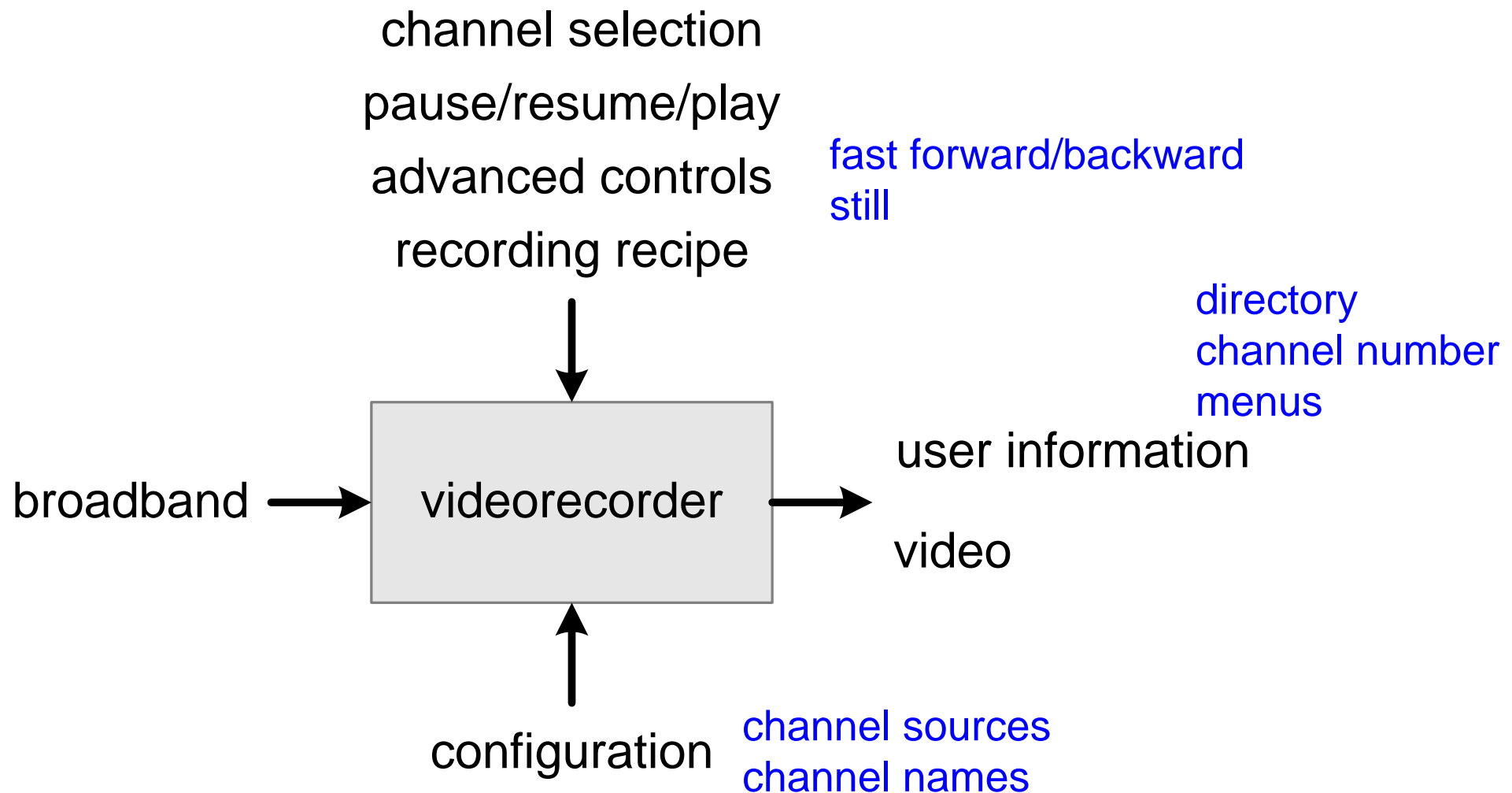
Functional Model of Video Recorder
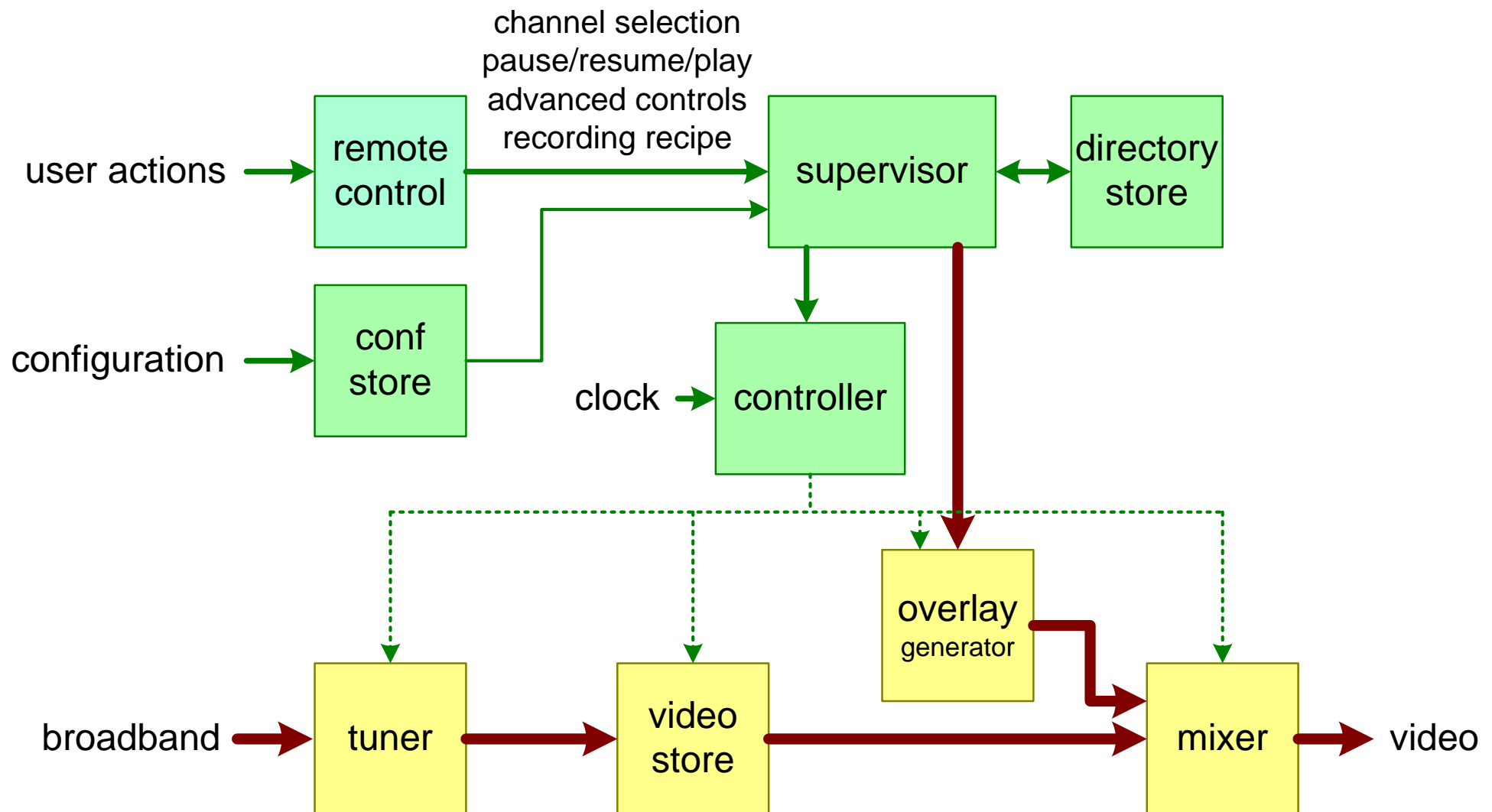
Video Recorder Mapped on CAFCR

Customer objectives

Application

Functional

Conceptual

Realization

Customer objectives	Application	Functional	Conceptual	Realization
portability	entertainment	*functionality*	storage	*comp chars:*
convenience	movie collection	record/play	storage man.	bandwidth
reliability	game analysis	program	concurrency	capacity
capacity	social exchange	timeshift	compression	lifetime
weight		manage		size
cost		configure		weight
family-individual				cost
		key perf pars:		*critical comp:*
		capacity		tuner
		weight		video store
		cost		control proc
		reliability		control sw
		image quality		

USN ESI

Construction limits intrude in User Experience

What if?

20:00   21:00   22:00   23:00

start
movie   broadcast   end
                                              movie

1. programmed recording of other station

record

view   talk   play   view   play

2. very long phone call

3. Dad zaps

phone rings
pause viewing

finish conversation
resume viewing
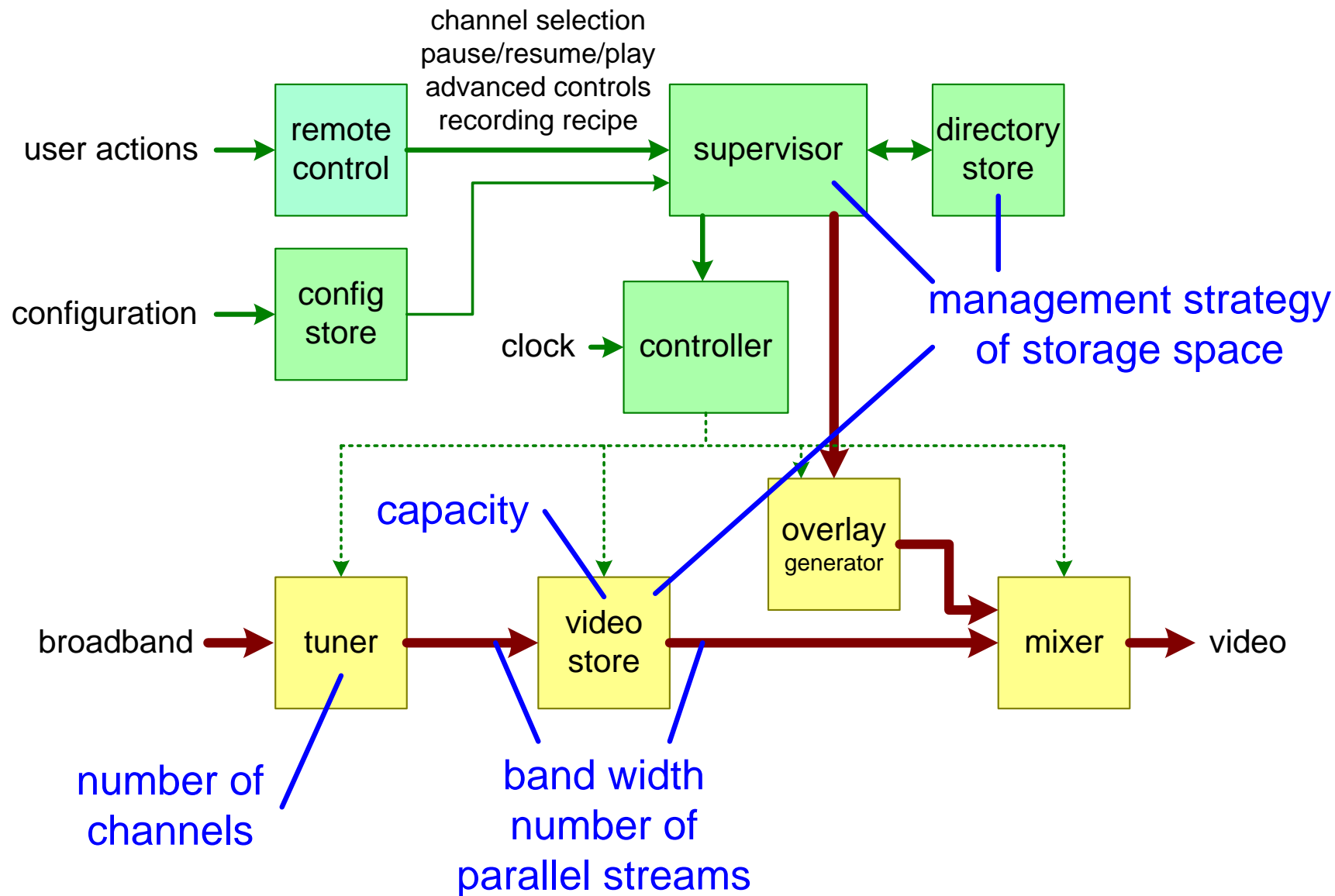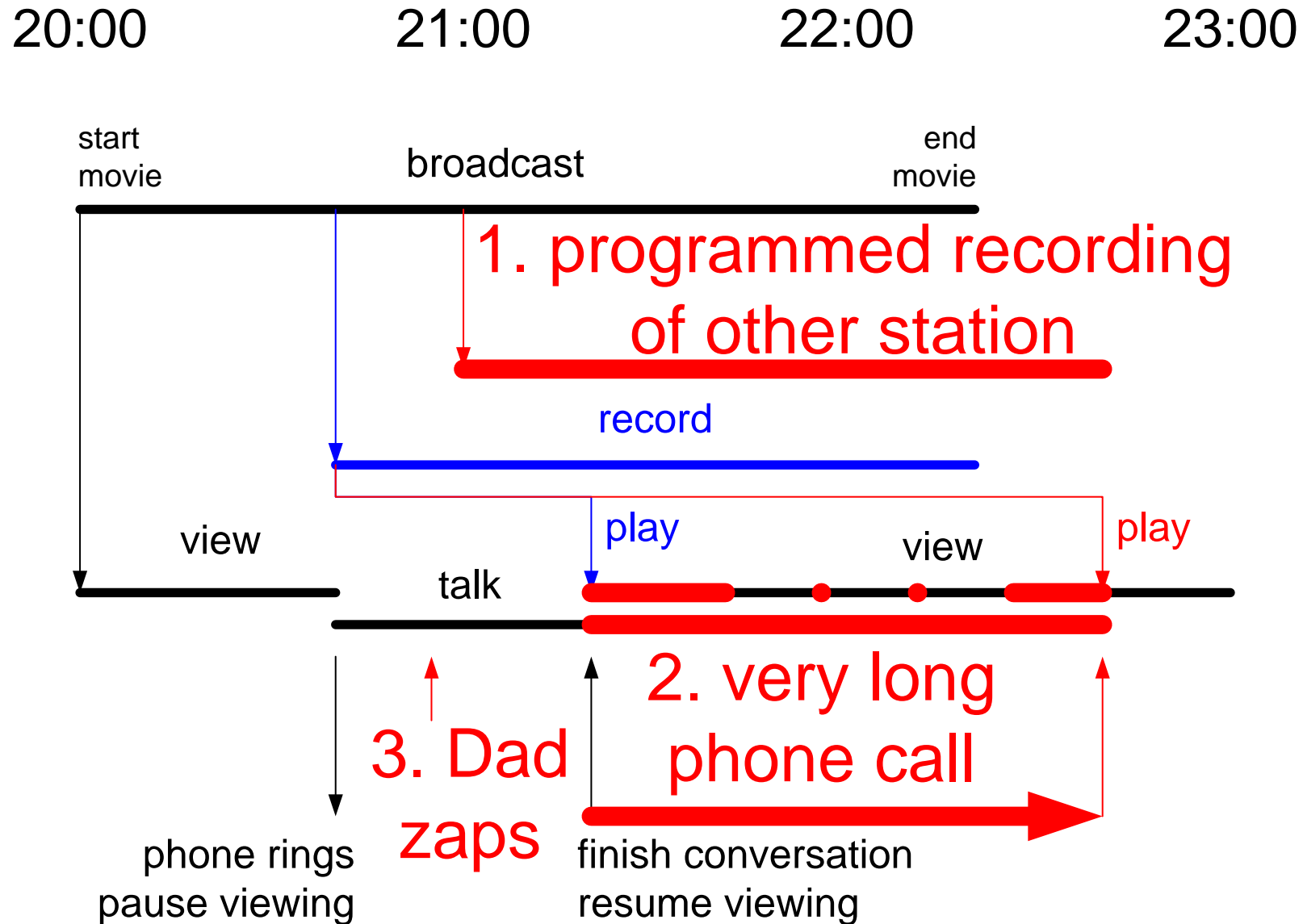
Visual Basic Prototype:

enables "experiencing"
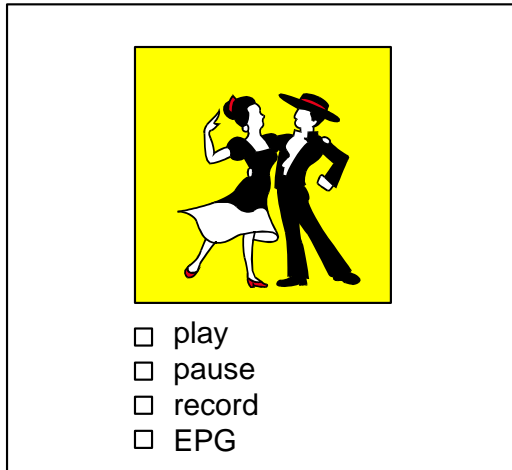
Requirements specification
Many tables, mostly addressing details

2.1.1 Real-time data requirements

2.1.2 Implementation detail

2.1.3 Non-real time data requirements

□ play
□ pause
□ record
□ EPG

1.1   Software Requirements

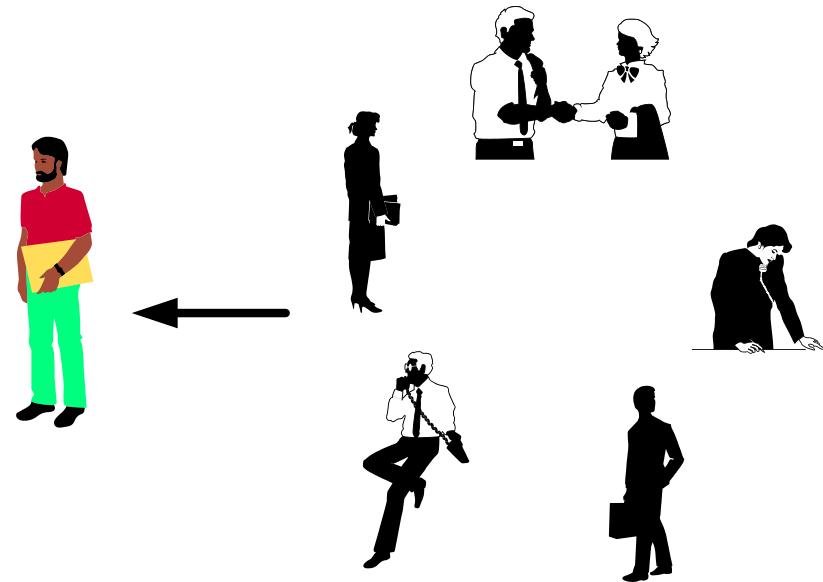| 1.1.1 | Real-time data requirements | 1.1.1.1 | Access to the non-real-time data must be done in such a way that it does not interfere with the real-time data |
		1.1.1.2	There must be no disruptions in output of video signal during the operation of VCR
		1.1.1.3	Responsiveness for non real-time data is less then 150ms (the time for writing a block on HDD) for 2KB of non-video data
1.1.2	Implementation detail	1.1.2.1	Management of HDD content must only be possible through the TOC in order to prevent unauthorized access to content of HDD
		1.1.2.2	Visual feedback is provided to the user via On-Screen Display
		1.1.2.3	User input is provided via the RC
1.1.3	Non-real time data requirements	1.1.3.1	User must be able to pause and unpause a title, played from HDD, while (s)he is watching it
		1.1.3.2	User can jump forward and backward in a title, from HDD, during watching of this title
		1.1.3.3	Names of titles should be derived from the information from the EPG (name of the program to be recorded, time and date of registration)

Key Success Factor: Feedback
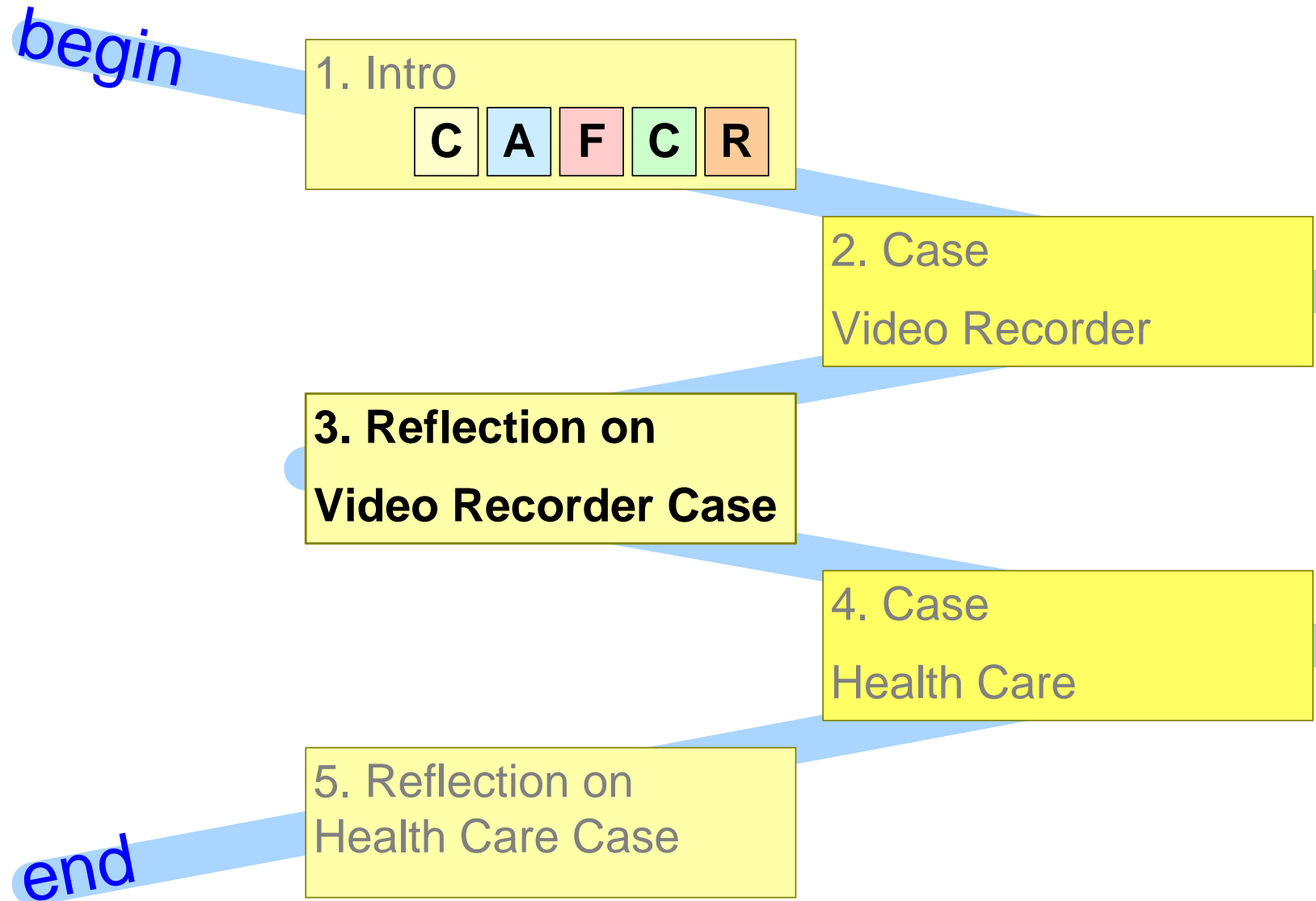

Obtain feedback from real users:

- Observe
- (Dare to) Listen

- Experiment
- Use short development cycles
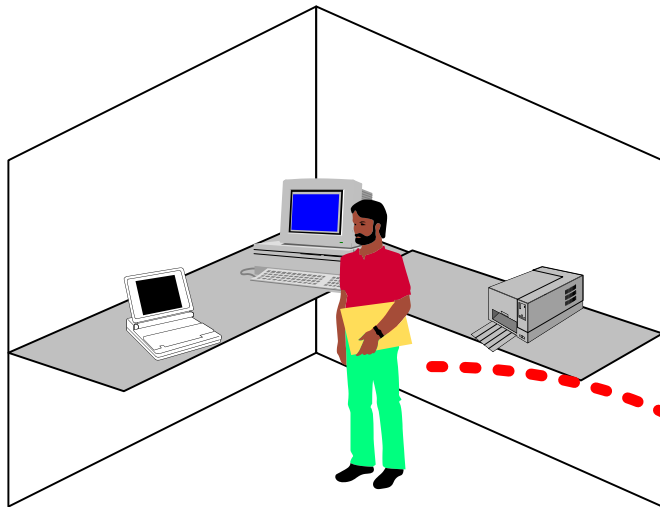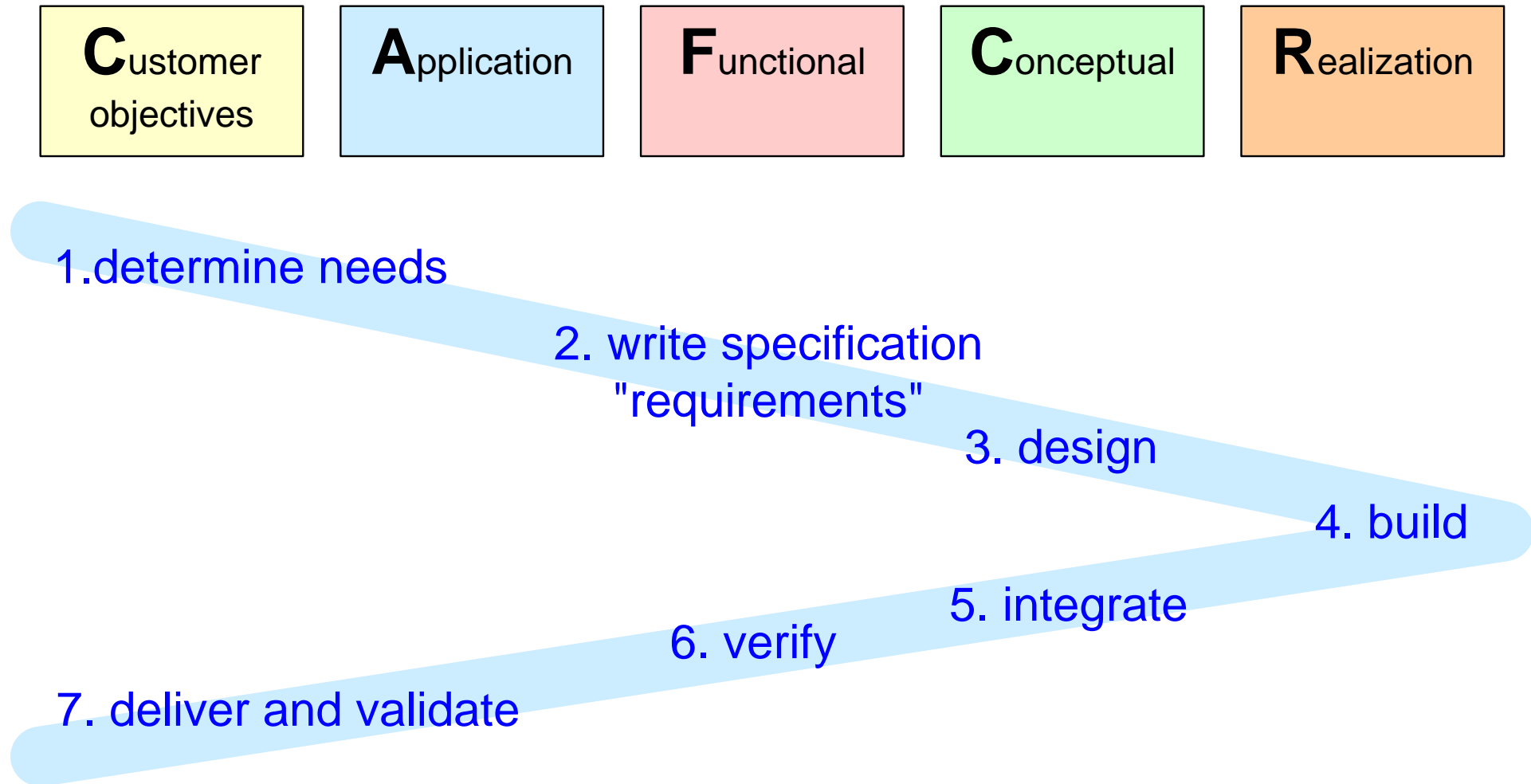
Don't stay in the development lab

Reflection on Video Recorder Case

begin

1. Intro

C A F C R

2. Case

Video Recorder

3. Reflection on

Video Recorder Case

4. Case

Health Care

5. Reflection on
Health Care Case

end

USN   ESI

The Conventional Waterfall Approach

Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization

1. determine needs

2. write specification "requirements"

3. design

4. build

5. integrate

6. verify

7. deliver and validate

USN   ESI

Iterative Approach Using CAFCR

Customer objectives

Application

Functional

Conceptual

Realization

ask needs

get solution as answer

reconstruct needs

why   why   why

explore solutions

explore use cases

draft spec

draft design

build proto

use proto

spec

design integrate

build

validate

verify

and iterate and evolve further....
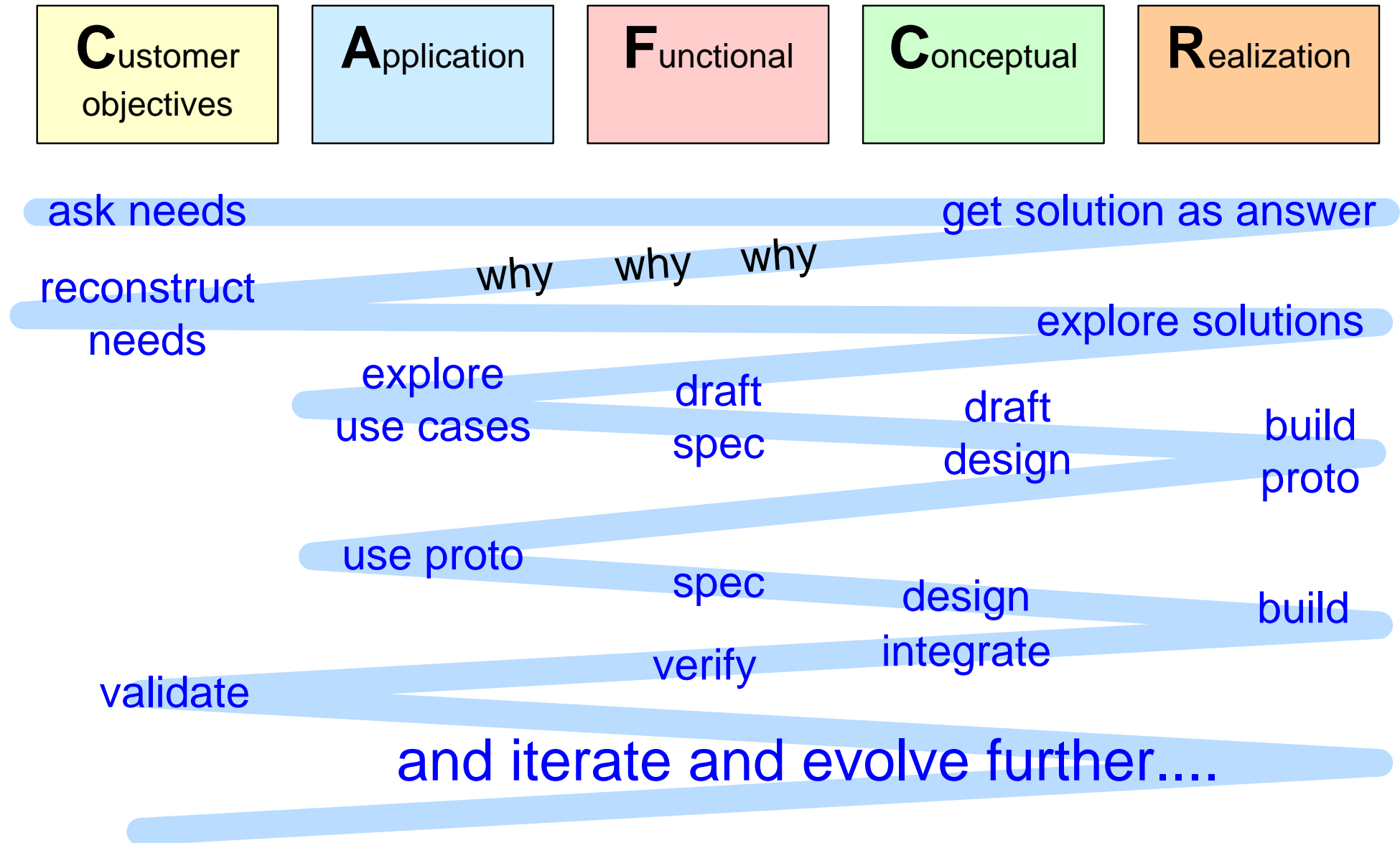
Reflection on CAFCR and Iteration

Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization

true needs

↓

true value ←———————————————— we have to reconstruct the needs

customers tend to pose solutions

multiple solutions satisfy the needs

unforeseen shortcomings degrade value
←————————————————
unforeseen opportunities increase value

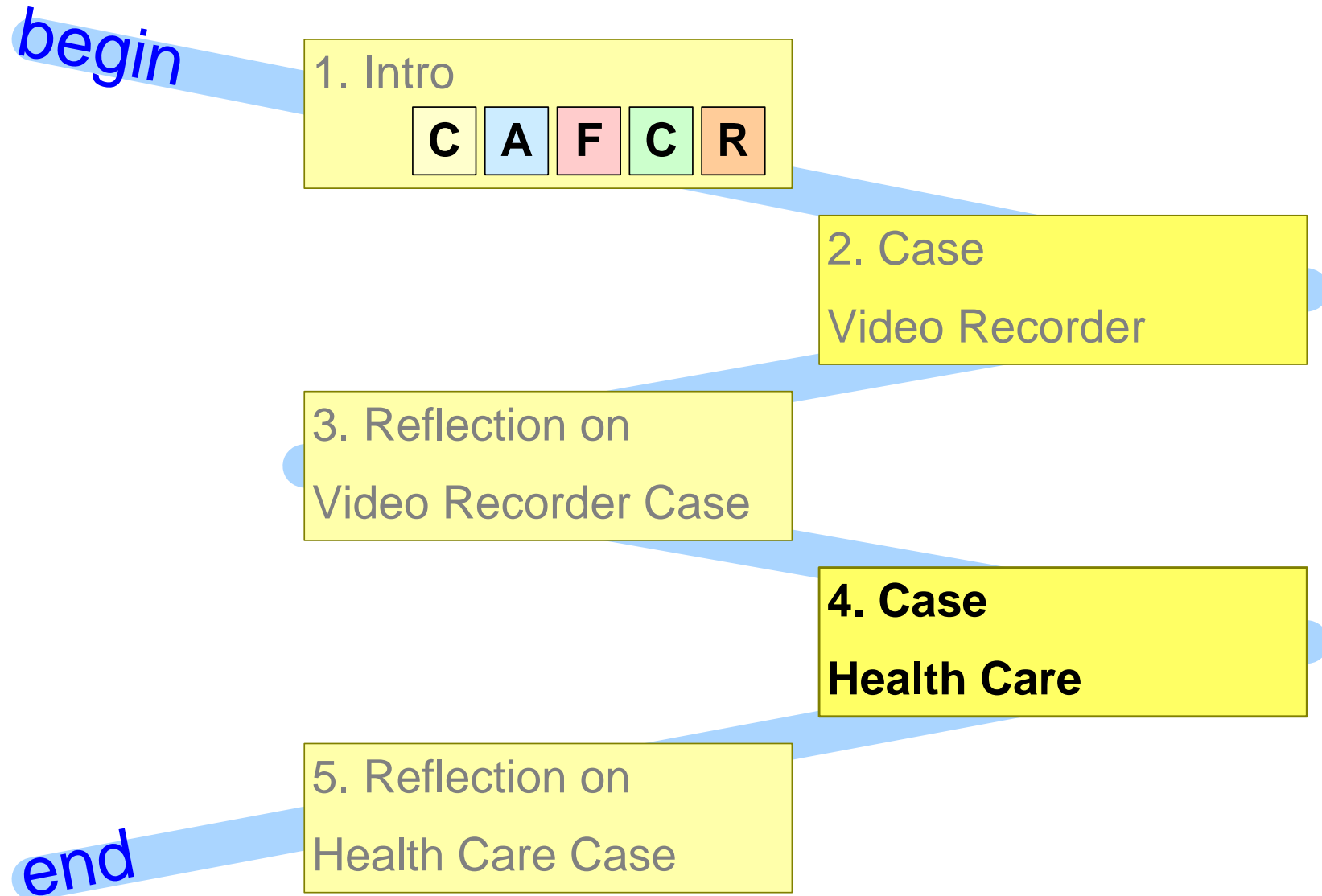constraints opportunities

the devil is in the detail
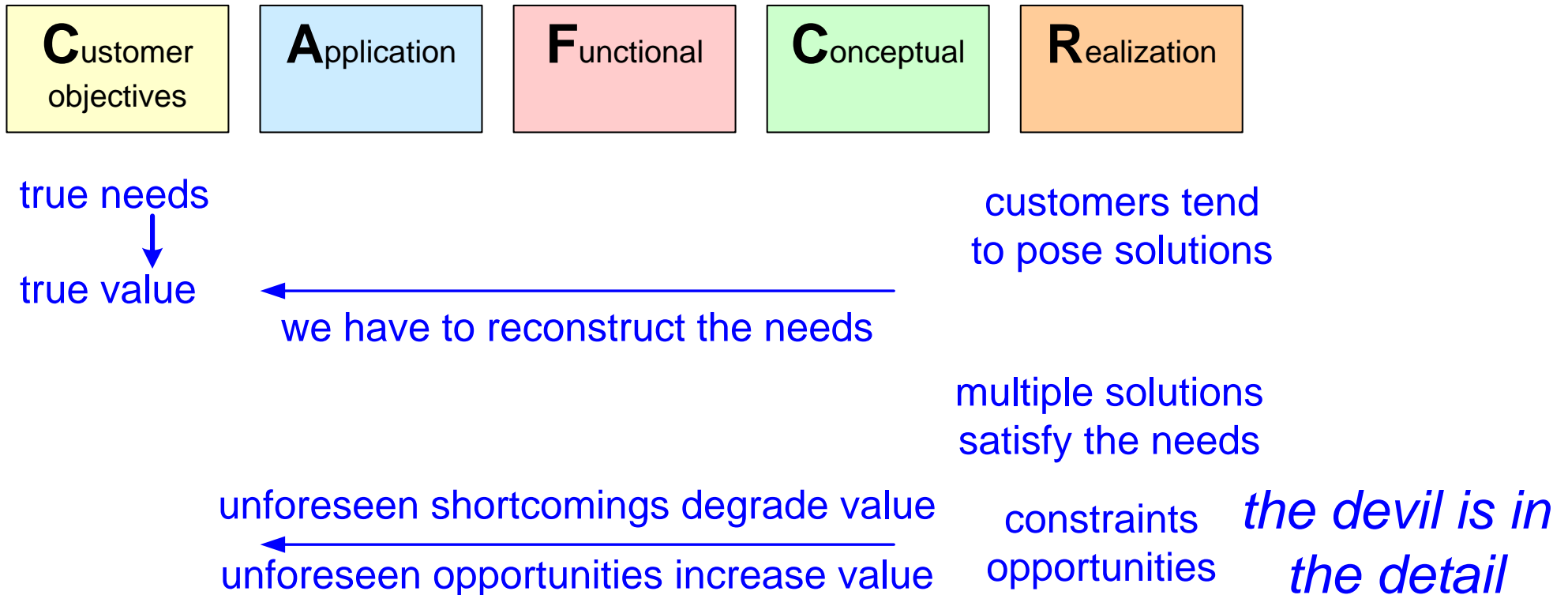
We learn faster when we iterate faster,

*but learning requires critical evaluation and reflection*
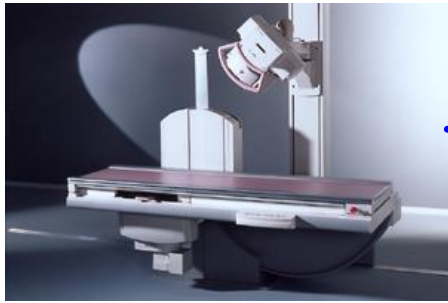
Stakeholders tend to respond on actual deliverables.
Prototypes are useful, but we have to switch to delivery in time to get feedback

USN ESI

Health Care Case

begin

1. Intro

C	A	F	C	R

2. Case

Video Recorder

3. Reflection on

Video Recorder Case

4. Case

Health Care

5. Reflection on

Health Care Case

end

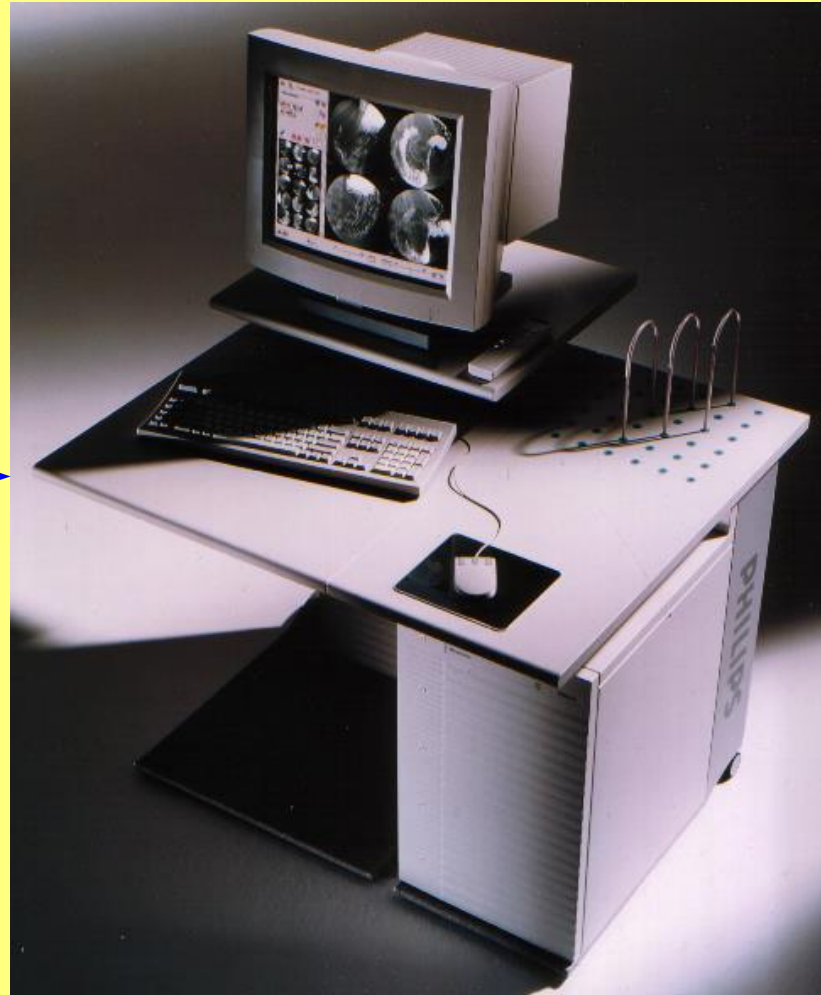USN ESI

Easyvision serving three URF examination rooms
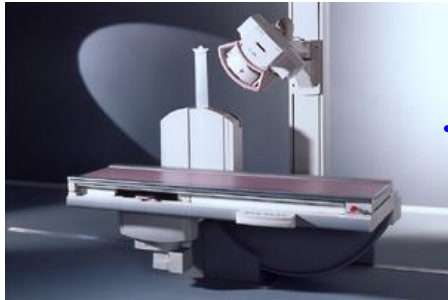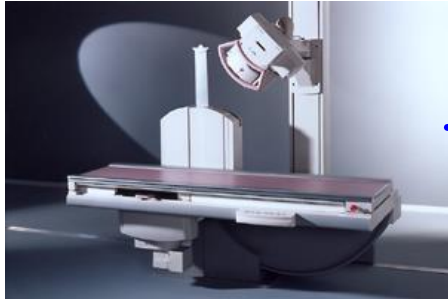
URF-systems

EasyVision: Medical Imaging Workstation

typical clinical image (intestines)

Time line of Viewing Products

| 1987 | | 1990 | | 1995 | | 2000 |

Advanced Development "Common Viewing" results in Basic Application and toolboxes

Development EasyVision RF

Development EasyVision CT/MR

Development EasyVision family and Work Flow products

Transformation in re-usable components

USN   ESI
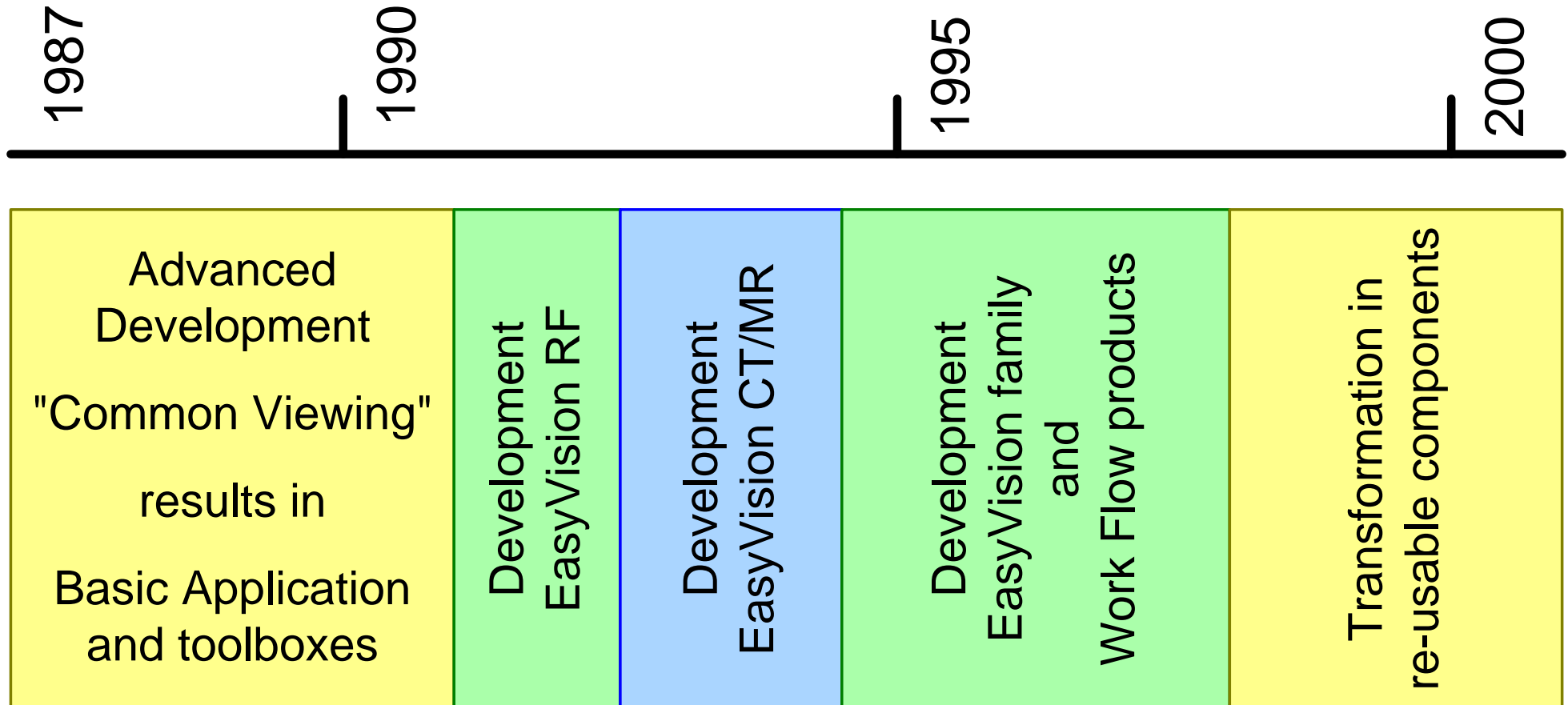
Chronology of Easyvision RF R1 development

1991   1992   1993

basic application
toolboxes
100 kloc

performance
problems

Easyvision RF
integrated product
360 kloc

interactive viewing

IQ
problems

print server +
communication +
interactive viewing

marketing opinion:
"All the functionality is available,
we only have to provide a clinical UI"
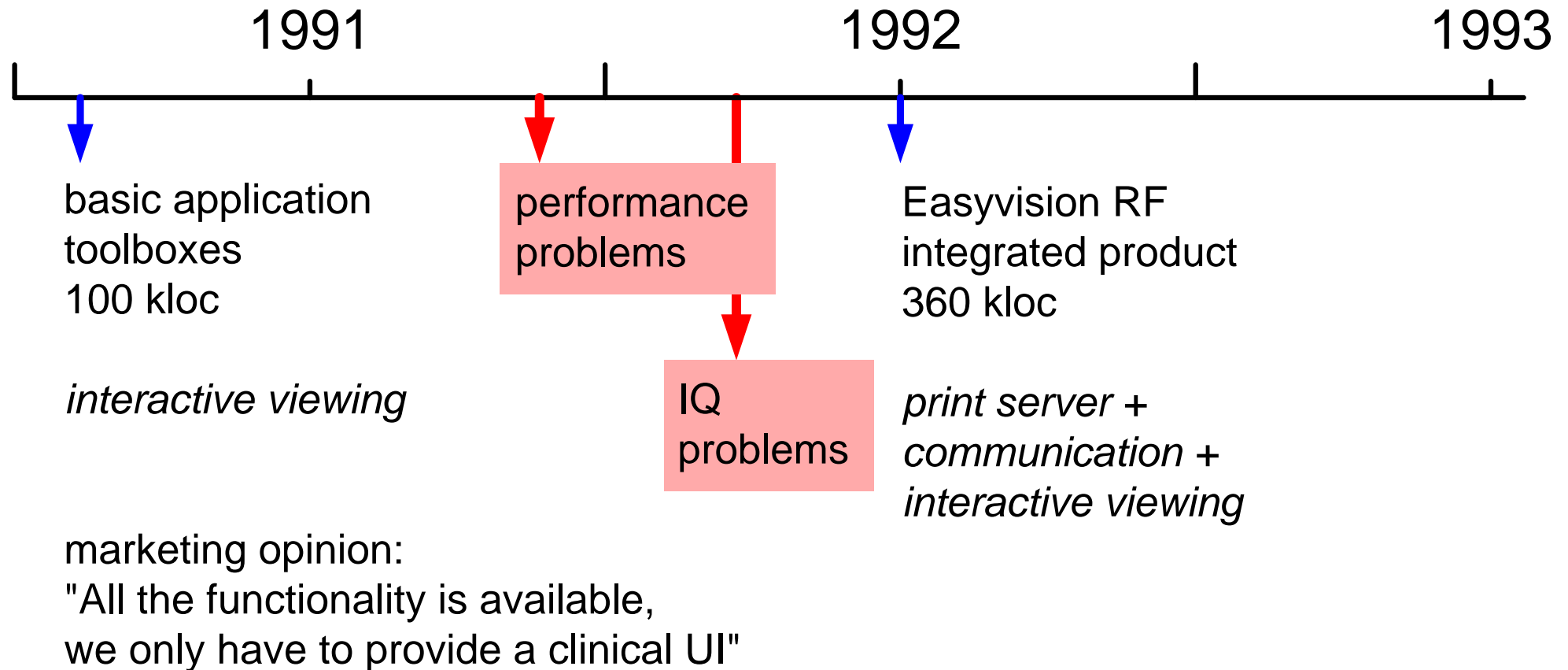
Thread of reasoning; introvert phase

Customer objectives

Application

Functional

Conceptual

Realization

useable

efficient

operational constraints

response time

purchase price

S — SW only

M — memory use

OO design

B — profit margin

Philips operational view
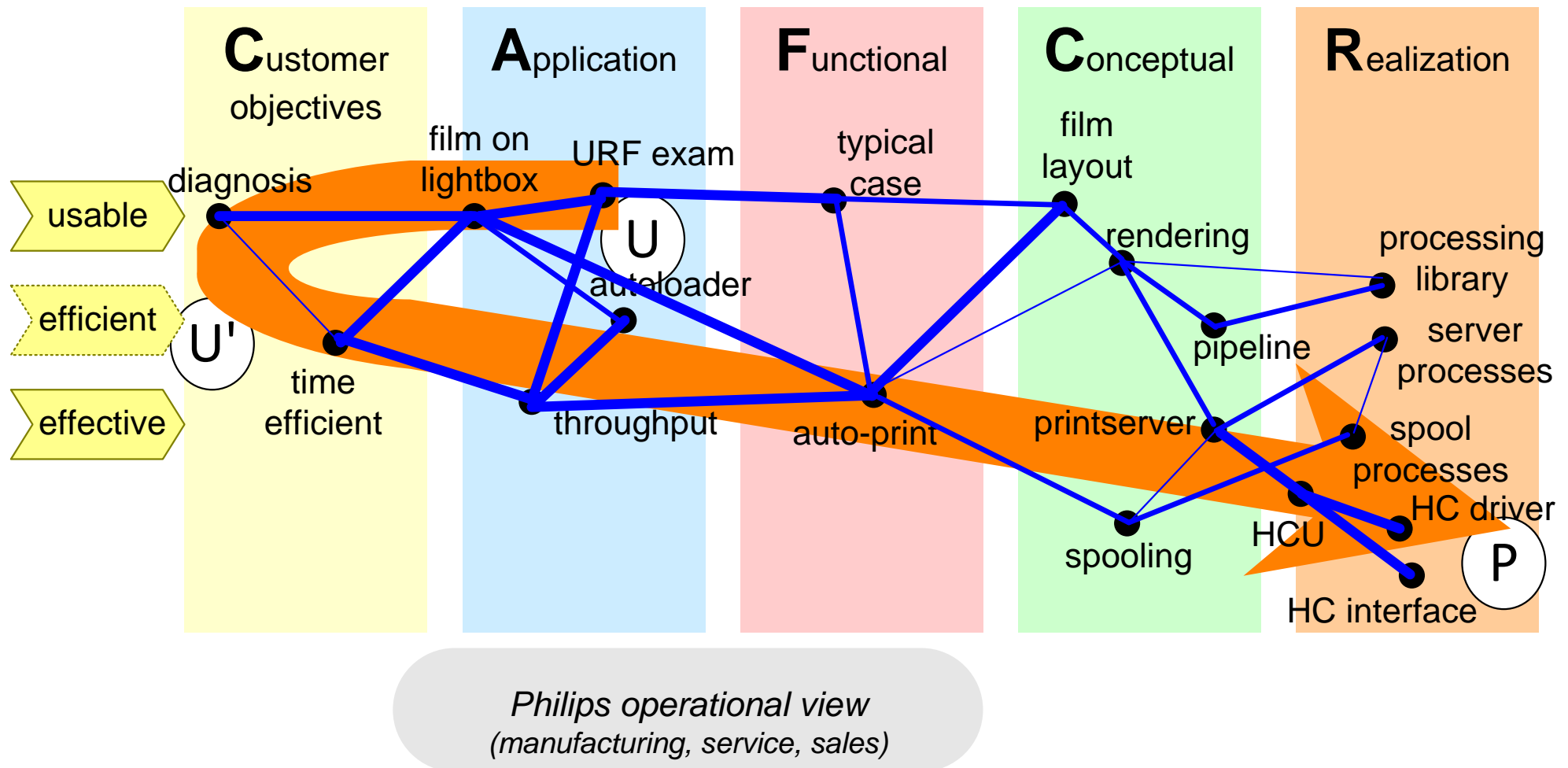*(manufacturing, service, sales)*
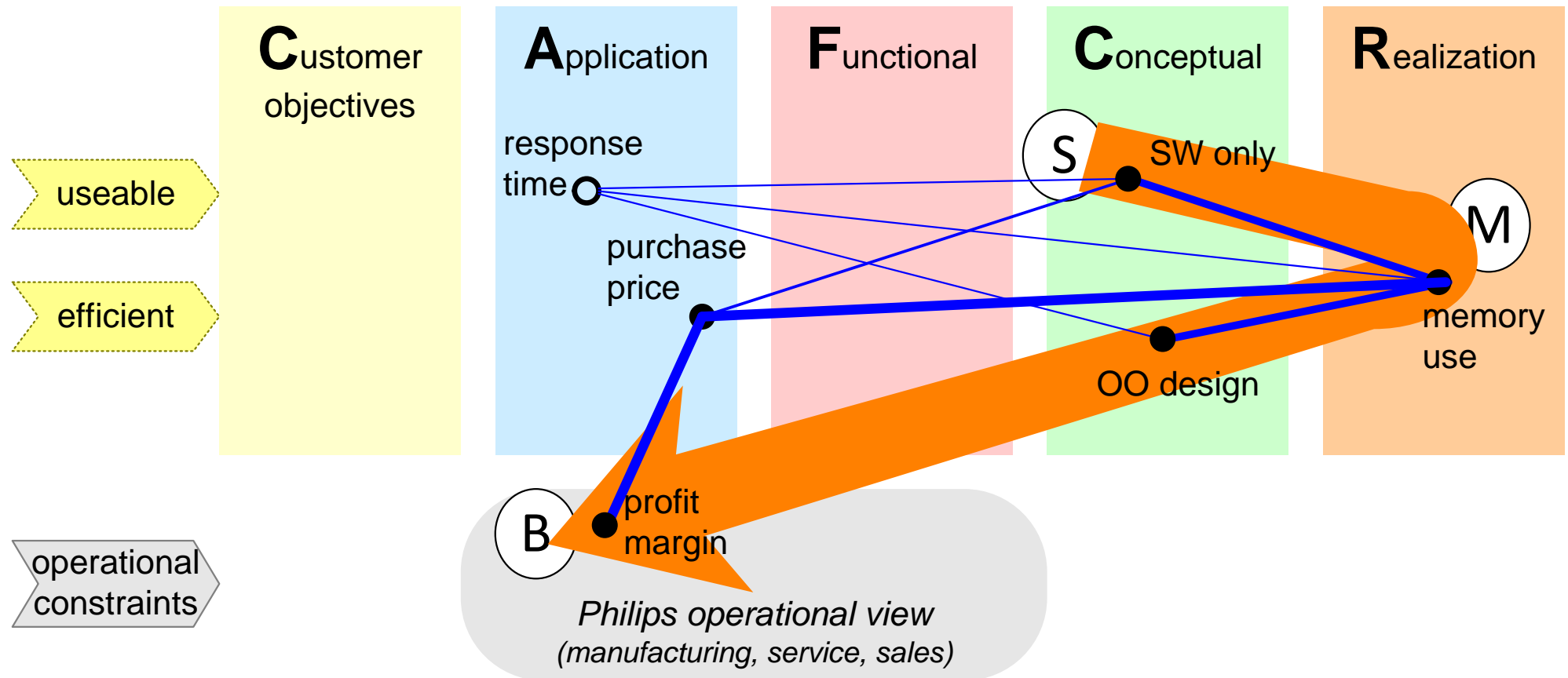
Introvert view: cost and impact of new technologies

USN   ESI

Thread of reasoning; phase 2
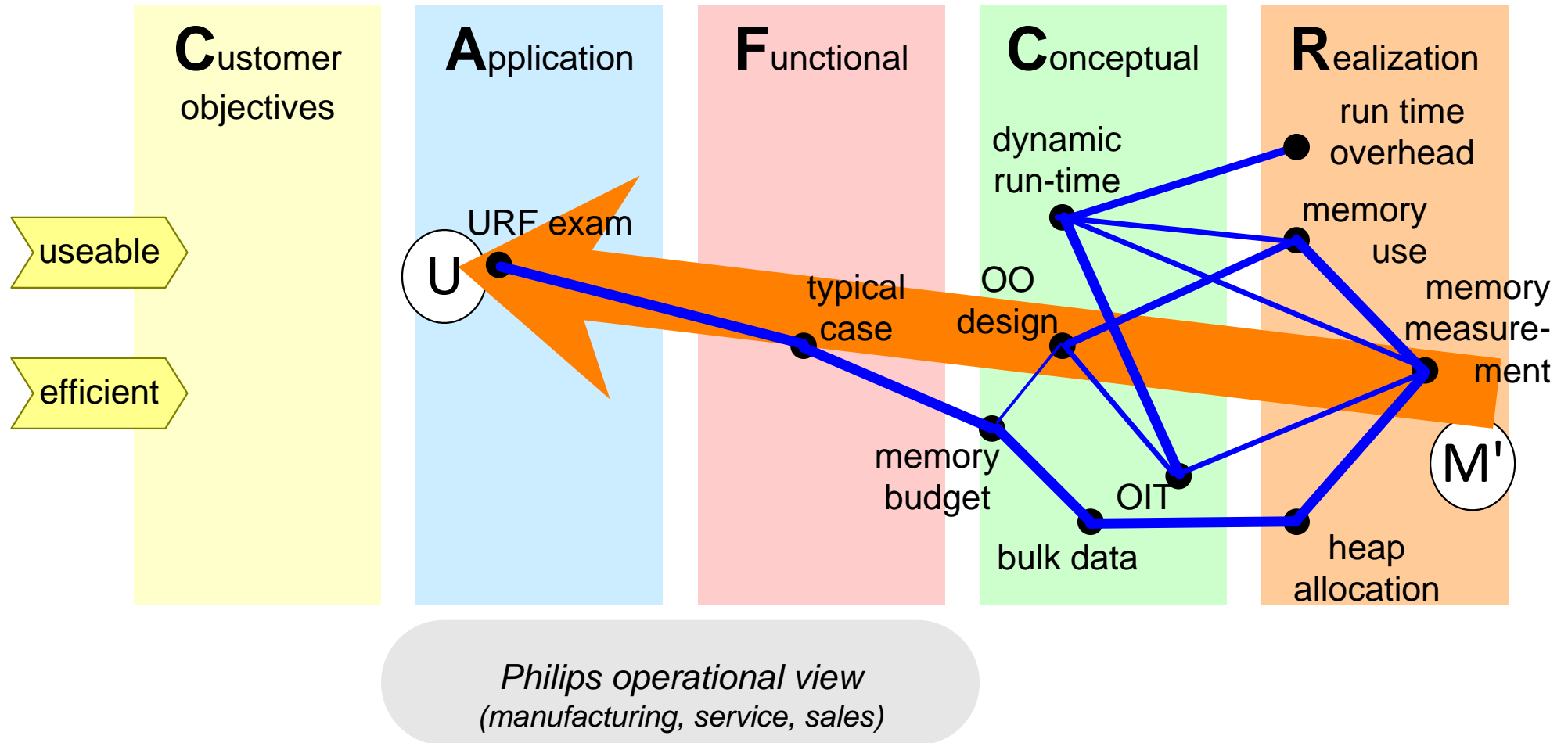
How to measure memory, how much is needed?
from introvert to extrovert

Thread of reasoning; phase 3

Customer objectives

Application

Functional

Conceptual

Realization

usable

efficient

effective

U'

U

P

diagnosis

film on lightbox

URF exam

typical case

film layout

rendering

processing library

autoloader

pipeline

server processes

time efficient

throughput

auto-print

printserver

spool processes

HC driver

spooling

HCU

HC interface

Philips operational view
(manufacturing, service, sales)

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

USN   ESI

Customer
objectives
useable
diagnosis
diagnostic quality
effective
time efficient
efficient

Application
URF exam
film on light-box
barium meal
image quality
throughput

Functional
contrast
dynamic range
resolution
typical case

Conceptual
film layout
rendering
pipeline
CPU budget
HCU

Realization
processing library
interpolation
pixel depth
HCU processing
HC interface

U''
T
P'

Philips operational view
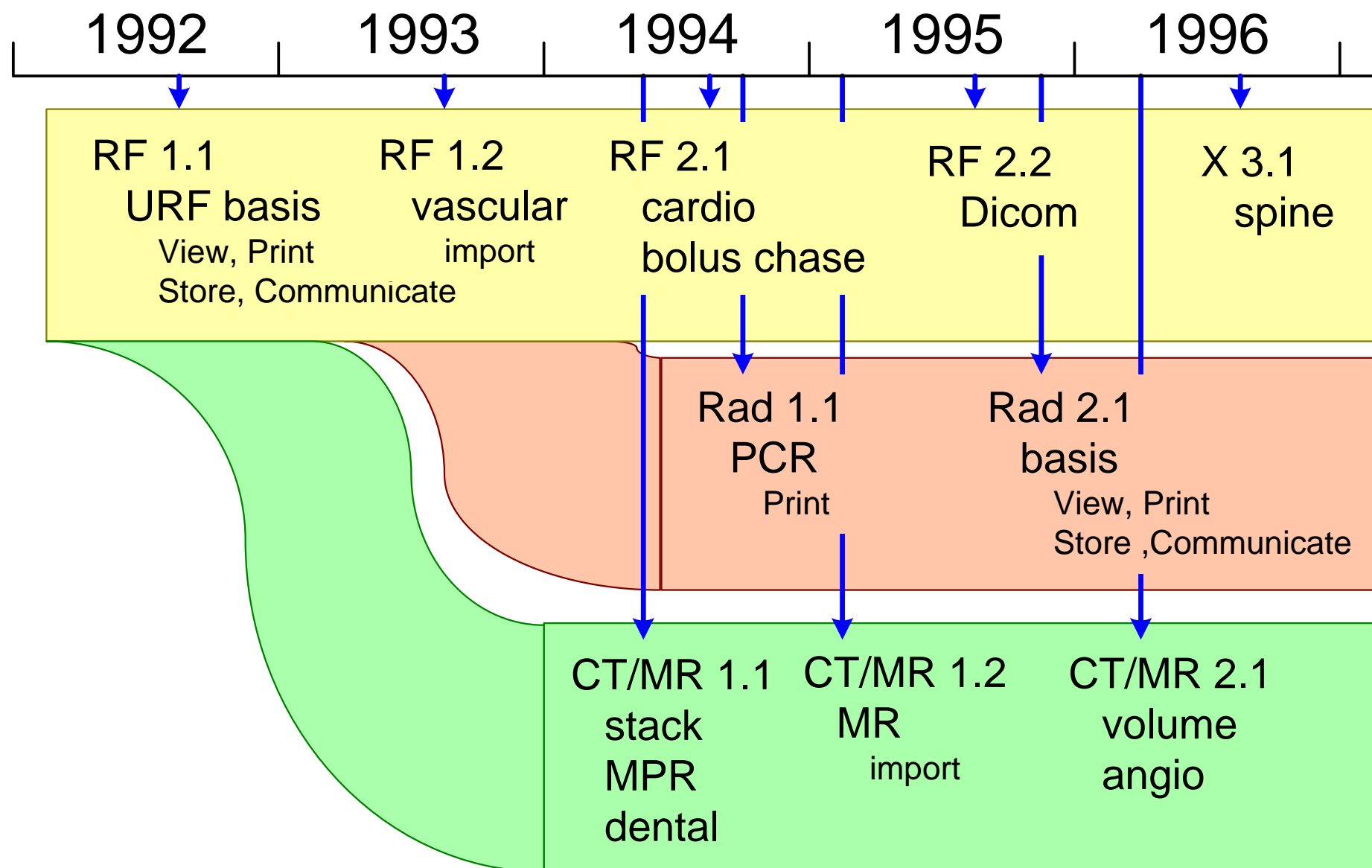*(manufacturing, service, sales)*

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

USN
ESI

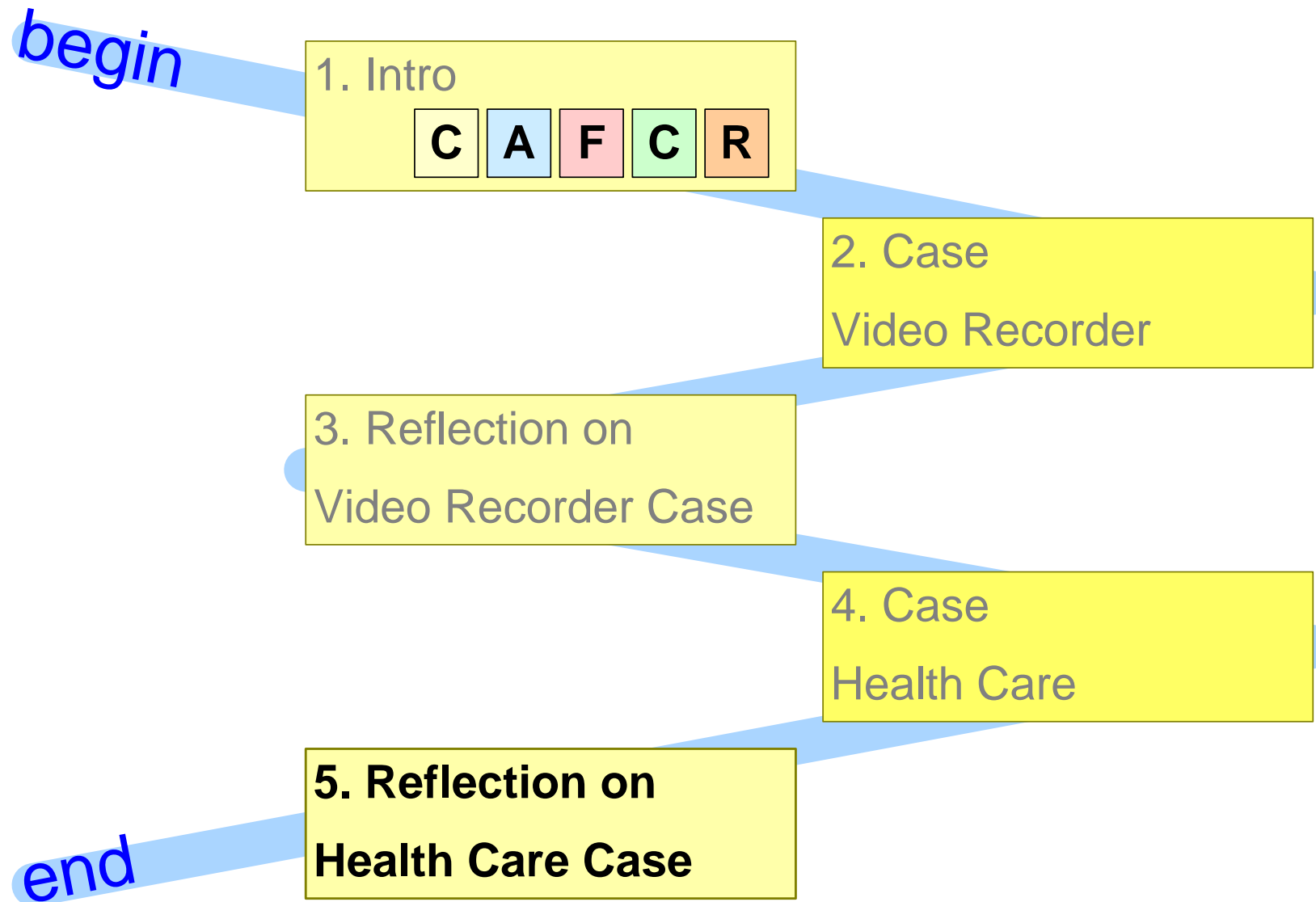# Thread of reasoning; phase 5
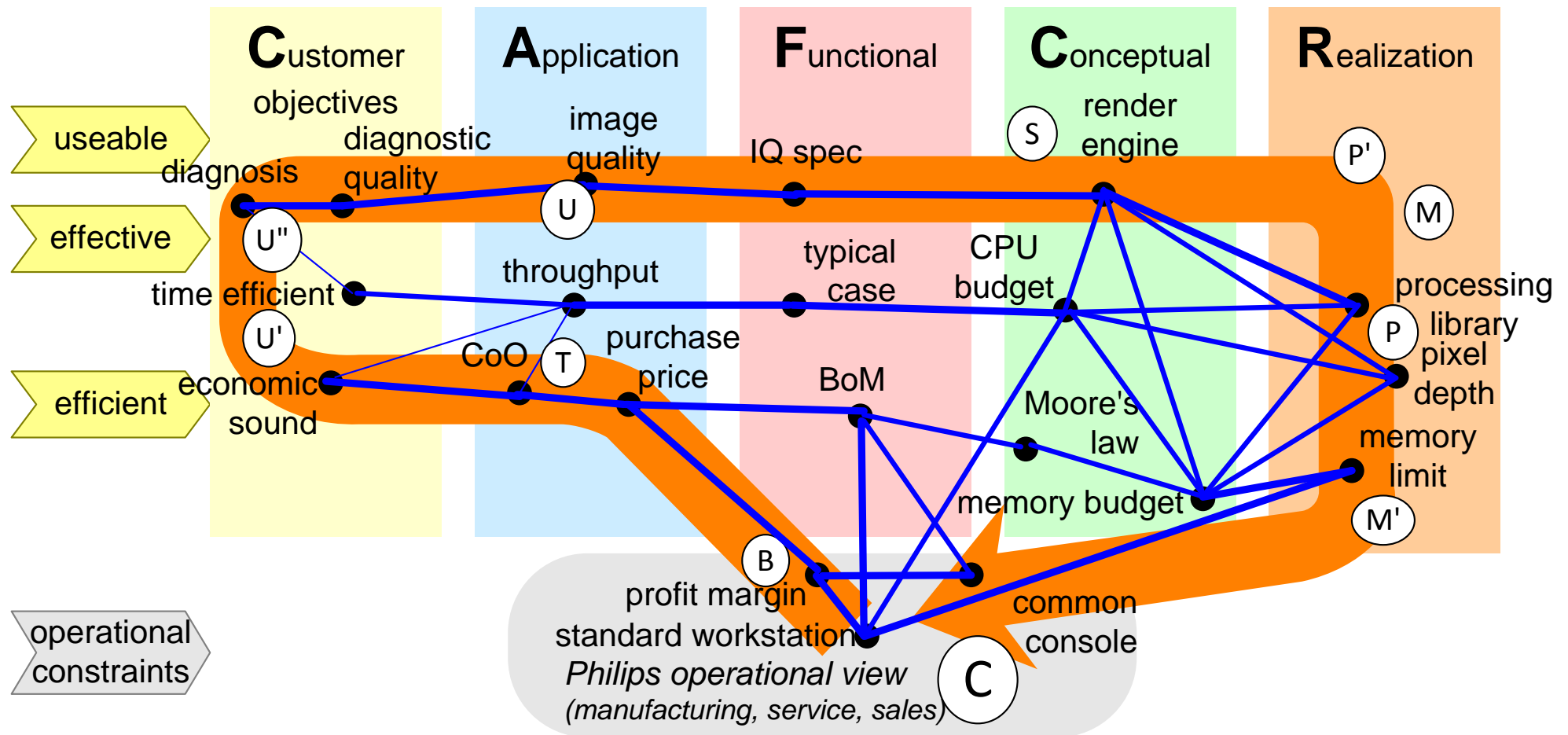
cost revisited in context of clinical needs and
realization constraints; note: original threads are significantly simplified

Retrospective functionality roadmap

| 1992 | 1993 | 1994 | 1995 | 1996 |

RF 1.1
URF basis
View, Print
Store, Communicate

RF 1.2
vascular
import

RF 2.1
cardio
bolus chase

RF 2.2
Dicom

X 3.1
spine

Rad 1.1
PCR
Print

Rad 2.1
basis
View, Print
Store ,Communicate

CT/MR 1.1
stack
MPR
dental

CT/MR 1.2
MR
import

CT/MR 2.1
volume
angio

USN ESI

Reflection on Health Care Case

begin

1. Intro

C	A	F	C	R

2. Case

Video Recorder

3. Reflection on

Video Recorder Case

4. Case

Health Care

5. Reflection on

Health Care Case

end

Reflecting on the Health Care Case

Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization
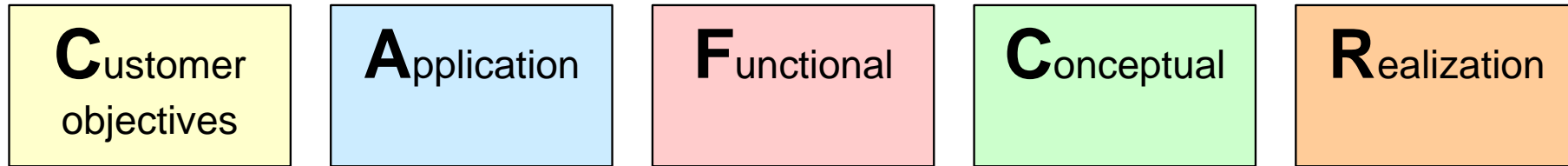
Many customers[1] are
conservative for valid reasons:
"Do not disturb our   Every delivery means change,
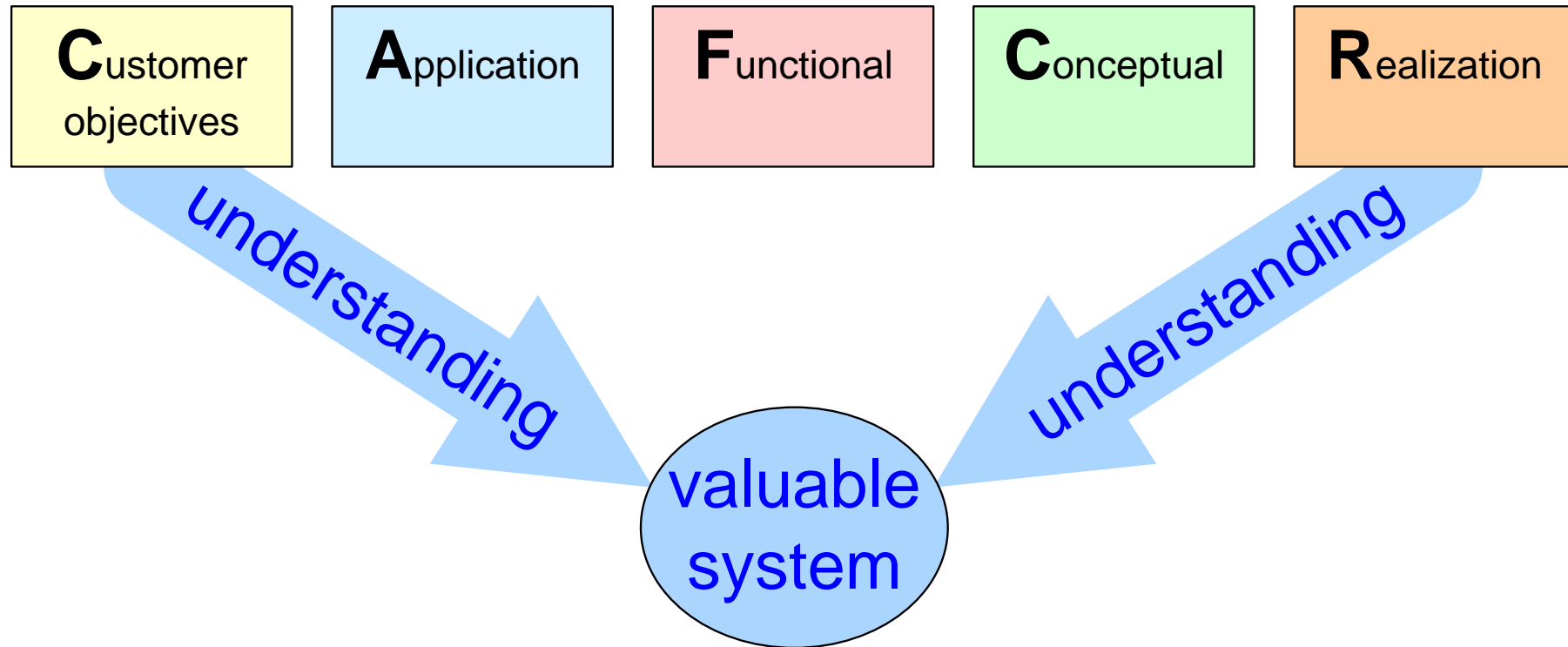*volume production"*   change means risk of disturbance

application models and prototypes
are *proxies* for deliveries

An active and close relation with
demanding customers is required to obtain timely feedback

[1]Not only in health care, but also in manufacturing, defense, oil and gas, ...

Summary

Customer objectives	**A**pplication	**F**unctional	**C**onceptual	**R**ealization

understanding

understanding

valuable system

Chicken and Egg:
Understanding is created by Delivering Value

USN ESI