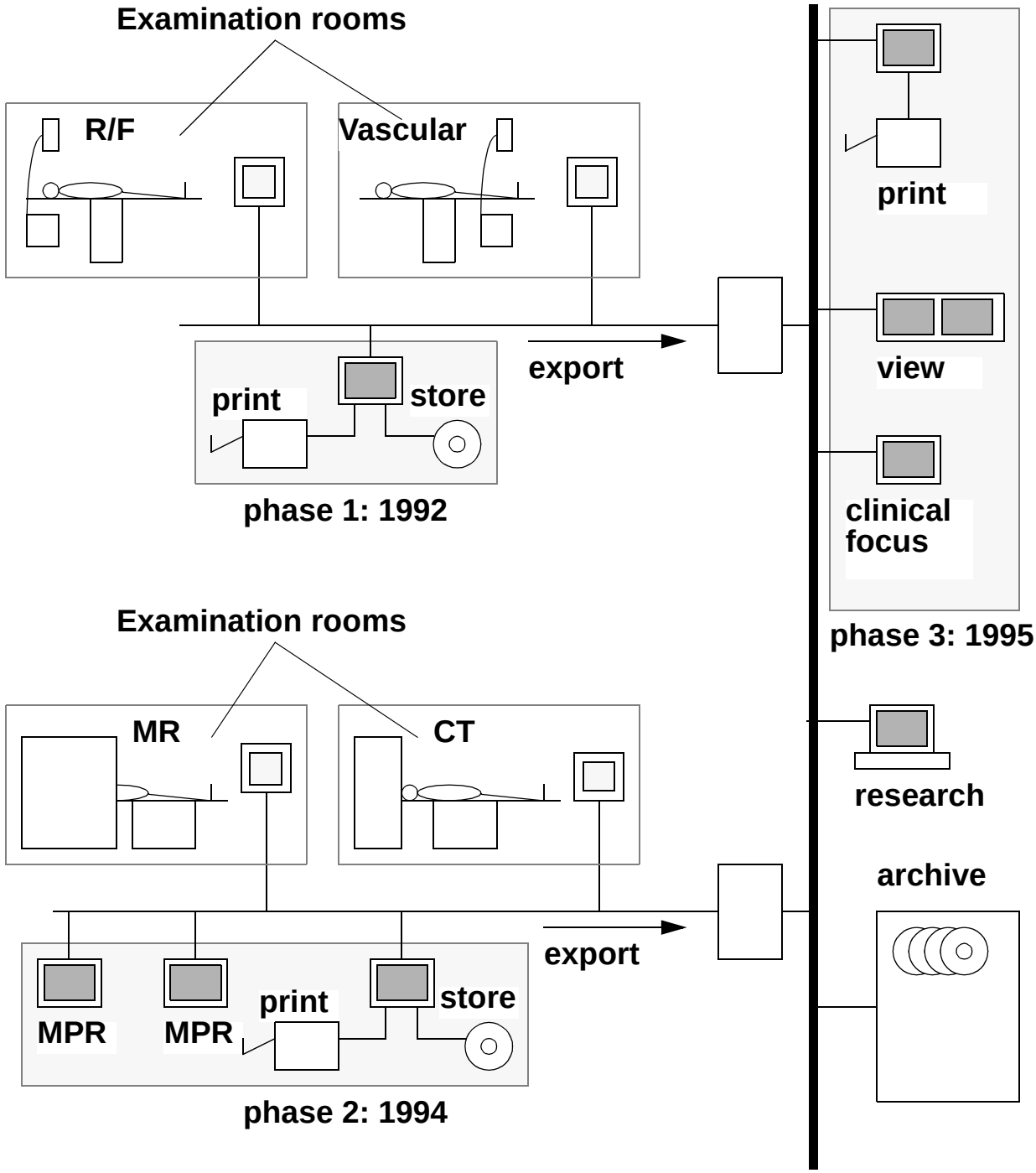
EasyVision family of products



Product types:

- Modality productivity enhancers:
  - + Easyvision R/F
  - + Easyvision RAD
  - + Easyvision CT/MR

street price ca 50 k$, high added clinical value; sales directly related to modality sales

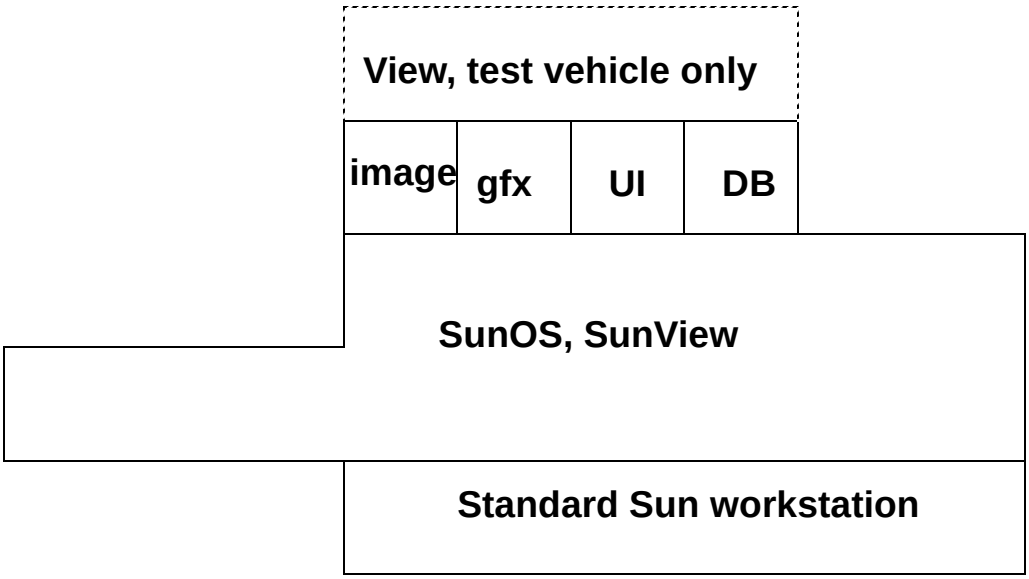
- Clinical Focus:
  - + Neurovision
  - + Image Guided Surgery

street price ca 100 k$, very high added clinical value; sales limited to specialist areas

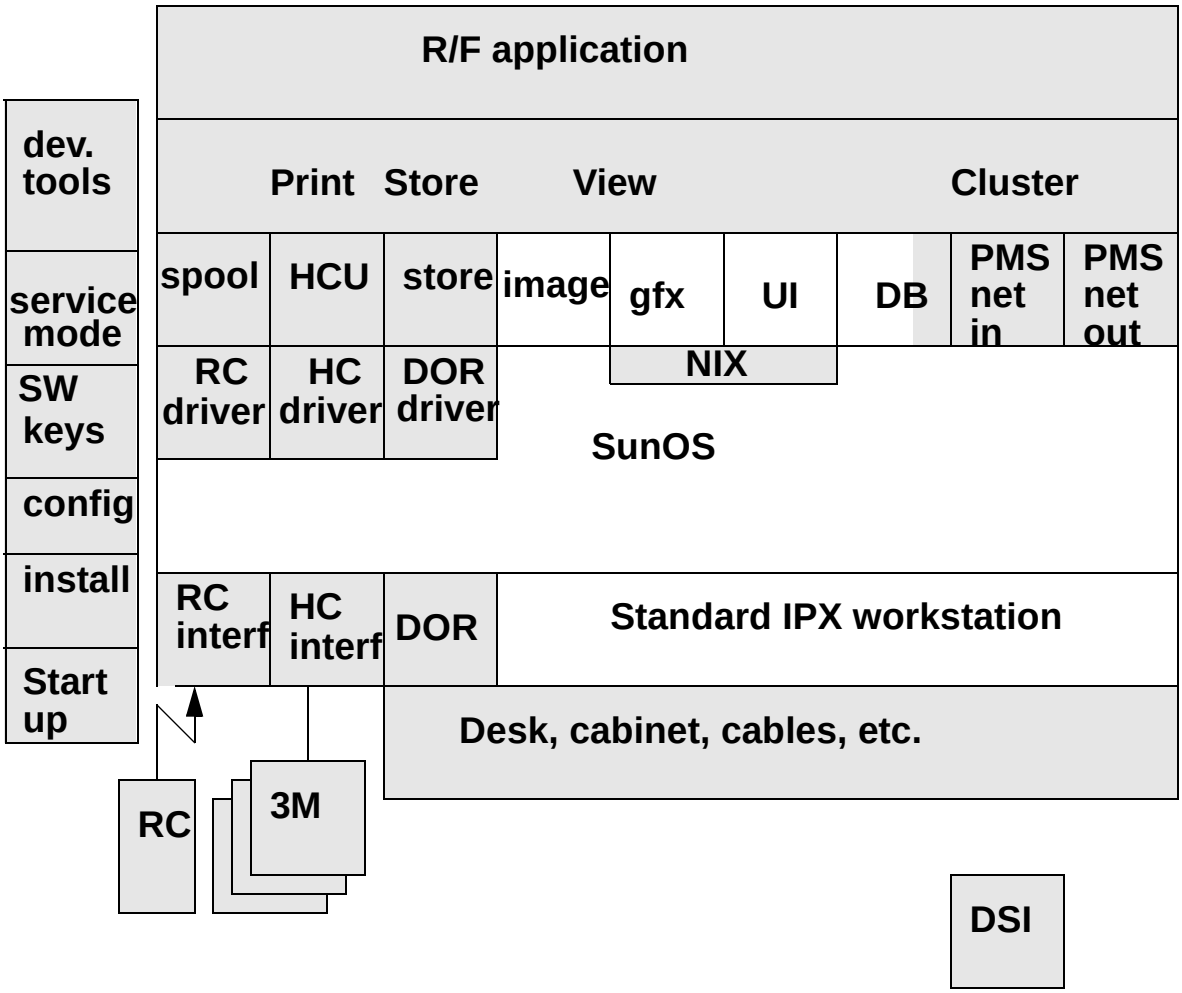
- “PACS” workstations
  - + Teleradiology Workstation
  - + Critical Care Workstation
  - + Multi modality review station

street price ca 25 k$, low added value, low margin; sales potentially very high

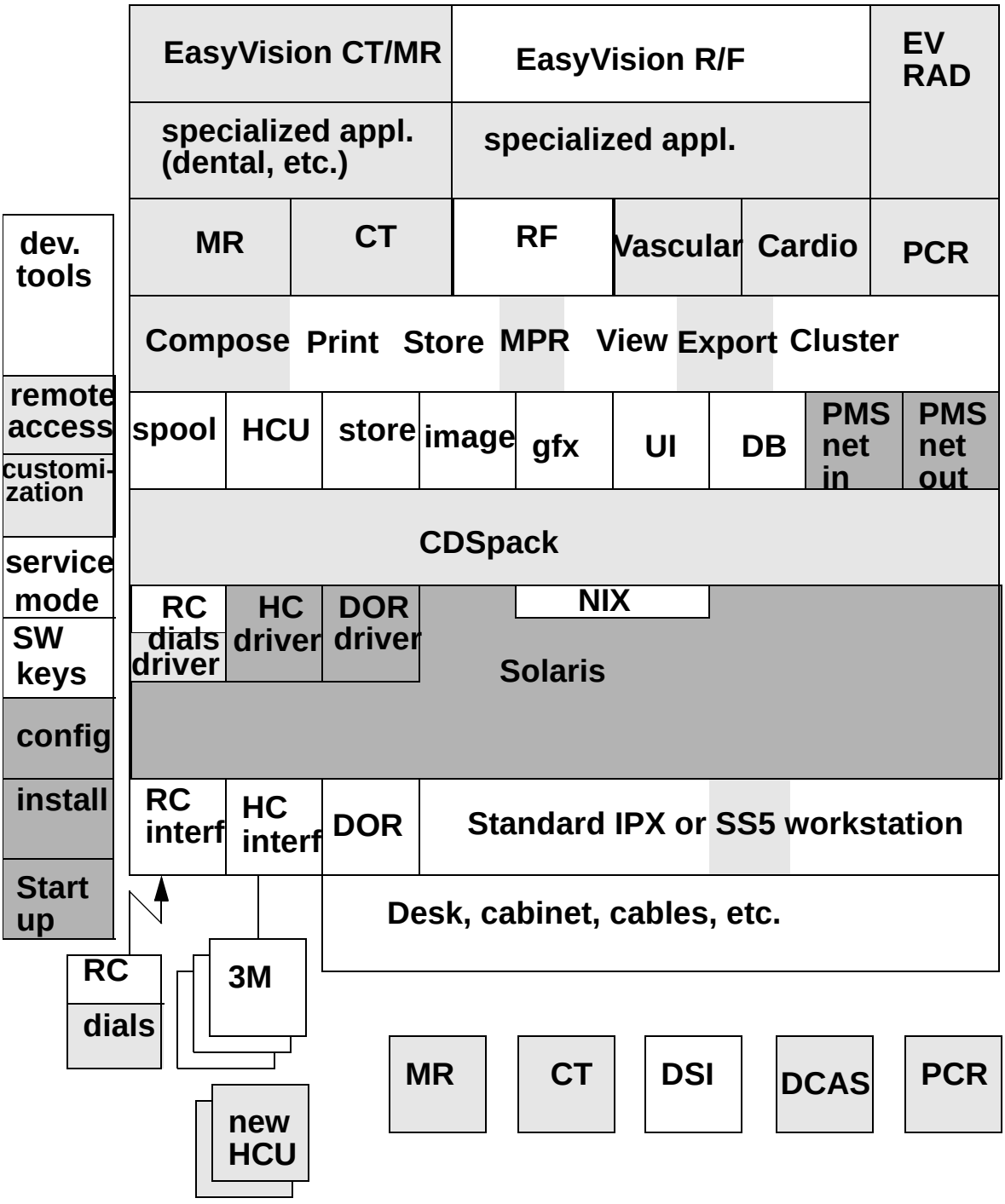
september 1991



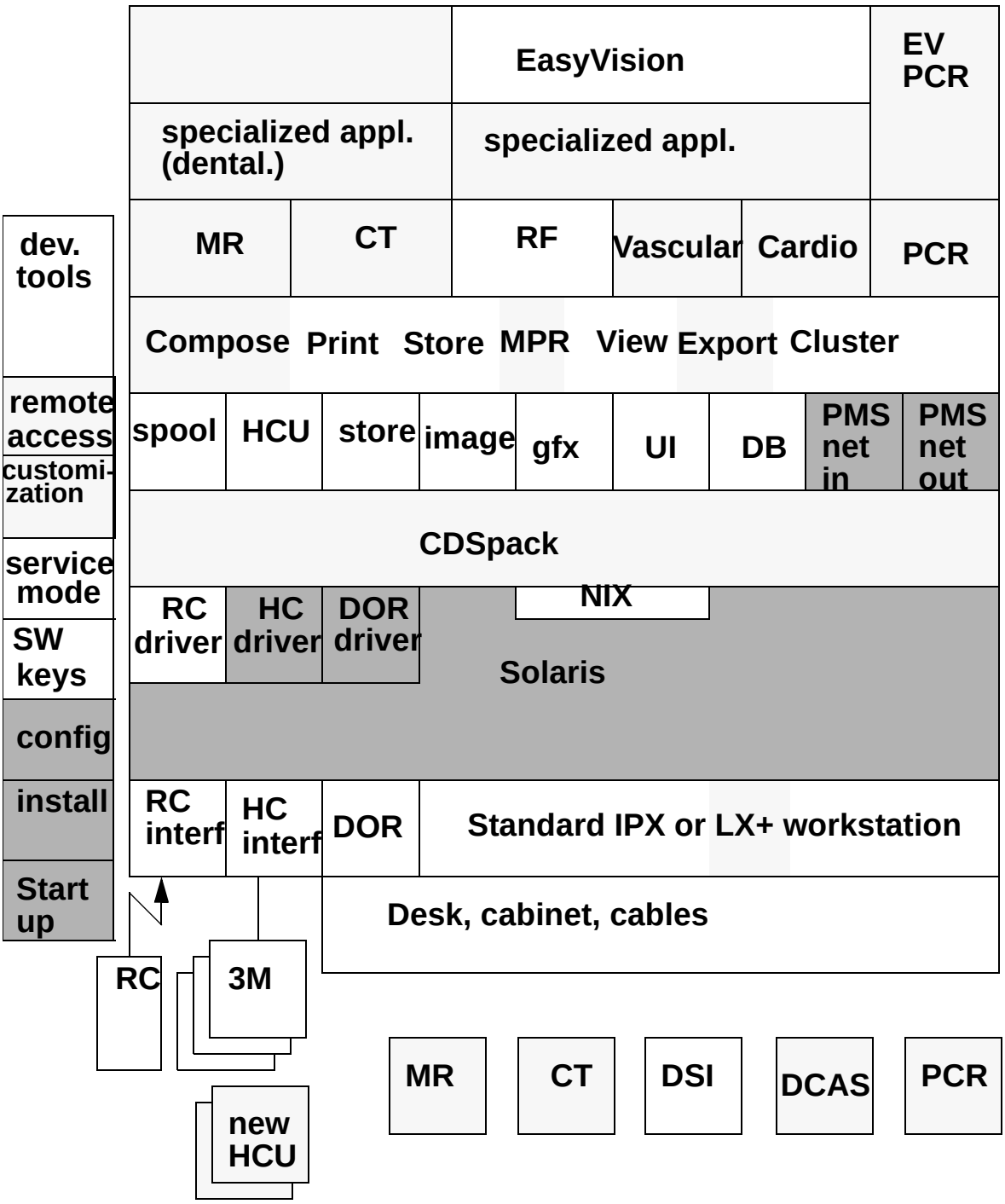
september 1992



june 1994


EasyVision CT/MR
EasyVision R/F
EV RAD
specialized appl. (dental, etc.)
specialized appl.
dev. tools
MR
CT
RF
Vascular
Cardio
PCR
Compose
Print
Store
MPR
View
Export
Cluster
remote access
customi-zation
service mode
SW keys
config
install
Start up
spool
HCU
store
image
gfx
UI
DB
PMS net in
PMS net out
CDSpack
RC dials driver
HC driver
DOR driver
NIX
Solaris
RC interf
HC interf
DOR
Standard IPX or SS5 workstation
Desk, cabinet, cables, etc.
RC dials
3M
new HCU
MR
CT
DSI
DCAS
PCR

june 1994


EasyVision
EV PCR
specialized appl. (dental.)
specialized appl.
dev. tools
MR
CT
RF
Vascular
Cardio
PCR
Compose
Print
Store
MPR
View
Export
Cluster
remote access
spool
HCU
store
image
gfx
UI
DB
PMS net in
PMS net out
customi-zation
CDSpack
service mode
NIX
RC driver
HC driver
DOR driver
SW keys
Solaris
config
install
RC interf
HC interf
DOR
Standard IPX or LX+ workstation
Start up
Desk, cabinet, cables
RC
3M
new HCU
MR
CT
DSI
DCAS
PCR

1995/1996

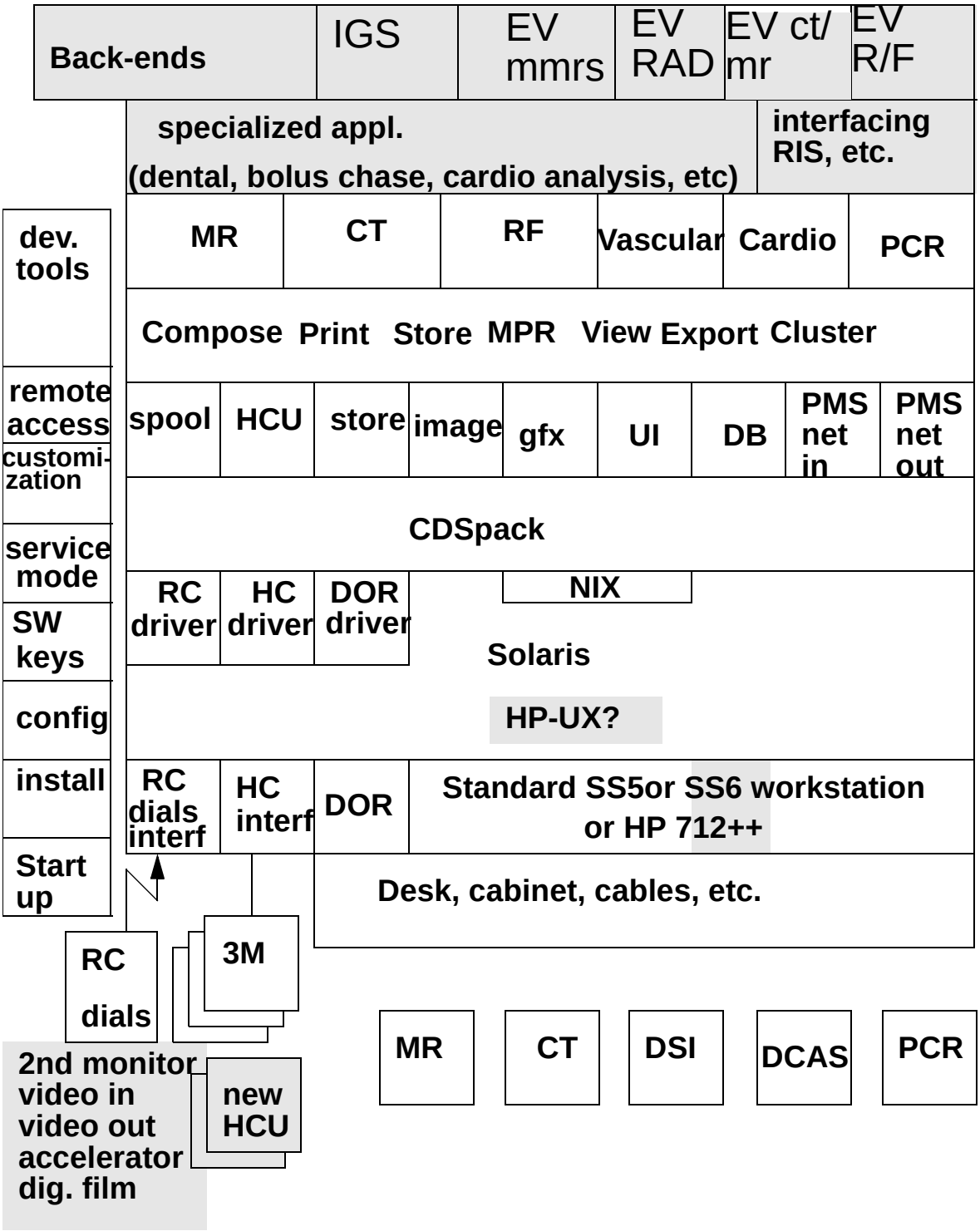

Back-ends
IGS
EV mmrs
EV RAD
EV ct/ mr
EV R/F
specialized appl.
(dental, bolus chase, cardio analysis, etc)
interfacing RIS, etc.
dev. tools
MR
CT
RF
Vascular
Cardio
PCR
Compose
Print
Store
MPR
View
Export
Cluster
remote access
customi-zation
service mode
SW keys
config
install
Start up
spool
HCU
store
image
gfx
UI
DB
PMS net in
PMS net out
CDSpack
RC driver
HC driver
DOR driver
NIX
Solaris
HP-UX?
RC dials interf
HC interf
DOR
Standard SS5or SS6 workstation
or HP 712++
Desk, cabinet, cables, etc.
RC dials
3M
2nd monitor
video in
video out
accelerator
dig. film
new HCU
MR
CT
DSI
DCAS
PCR

Table 1: Efficiency through re-use

	1992	1993	1994	1995	1996
number of products and applications					
products	1	3	5	9	13
inputs, a.o. modalities	1	5	10	15	
applications	1	4	8	16	32
people					
infrastructure			20+15	21+16	22+16
application			27	35	41
total		52	62	72	79
efficiency					
people per product		17	12	8	6

To OO or not to OO

Characteristics of the Easyvision application are:

- Large variety in input images
  - + 256^2, 480^2, 512^2, 1024^2, non square, etc.
  - + 8, 10, 12 bits
  - + CT, MR, X-ray Image Intensifier
- Large variety in application requirements
- Large variety in use

Easyvision is impossible without OO

Learning Curve

Phase 1:

Make something in the OO way

Result: We understand OO!

Learning Curve

Phase 2:

Modify the something of phase 1

How ugly, lets redesign

Result: Now we really understand OO

Learning curve

Phase 3:

Modify the something of phase 2

Jeeee, it is still ugly, lets redesign

Result: Now we finally understand OO

Learning curve

- Do it
- Plan for a long learning curve
  - + Do not sell (promise) re-use;

    If you are quite good you may see (controlled, reproducible) re-use after ca. 3 years
- Do not hesitate to throw away early implementations;

  Plan (budget) these redesigns

Method

Easyvision development method:

- prototype
- evaluate
- engineering

No formal analysis/design/ documentation method!

Formal methods:

- work for small projects only
- playground for academics :-)

C++ ??

Objective-C is:

- Much simpler
- More powerful

Conclusion: Use C++

- C++ is de facto standard
- all new tool developments are C++ based

To OO or not to OO, TWO (2).

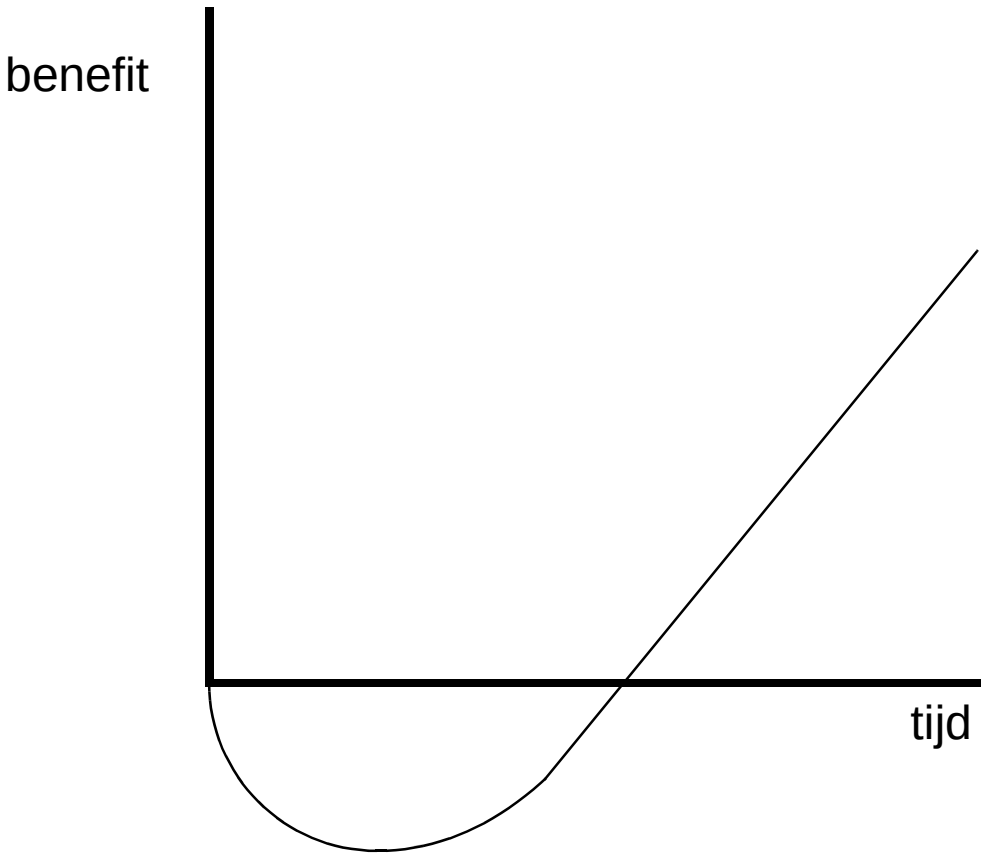
- It is not an easy transition
- The change will take years:
  - + don’t wait with the start
- BUT, you don’t have a choice:
  - + the projected growth of complexity in any system (TV or Numerical Control or medical imaging equipment) is too large for conventional methods

The same holds for Re-use!

(R)evolution in 25 years

	1980	1995	2005
#LOC	10^4-10^5	10^6	10^7?
technologie	96 K 0.1 MIPS	96 M 100 MIPS	? ?
time to market	2-5 jr	0.5-1 jr	0.5 jr
groep grootte waarvan SW	10-50 2-5	50-200 20-60	? ?
integratie complexiteit	generator/ statief	afdeling	health care?

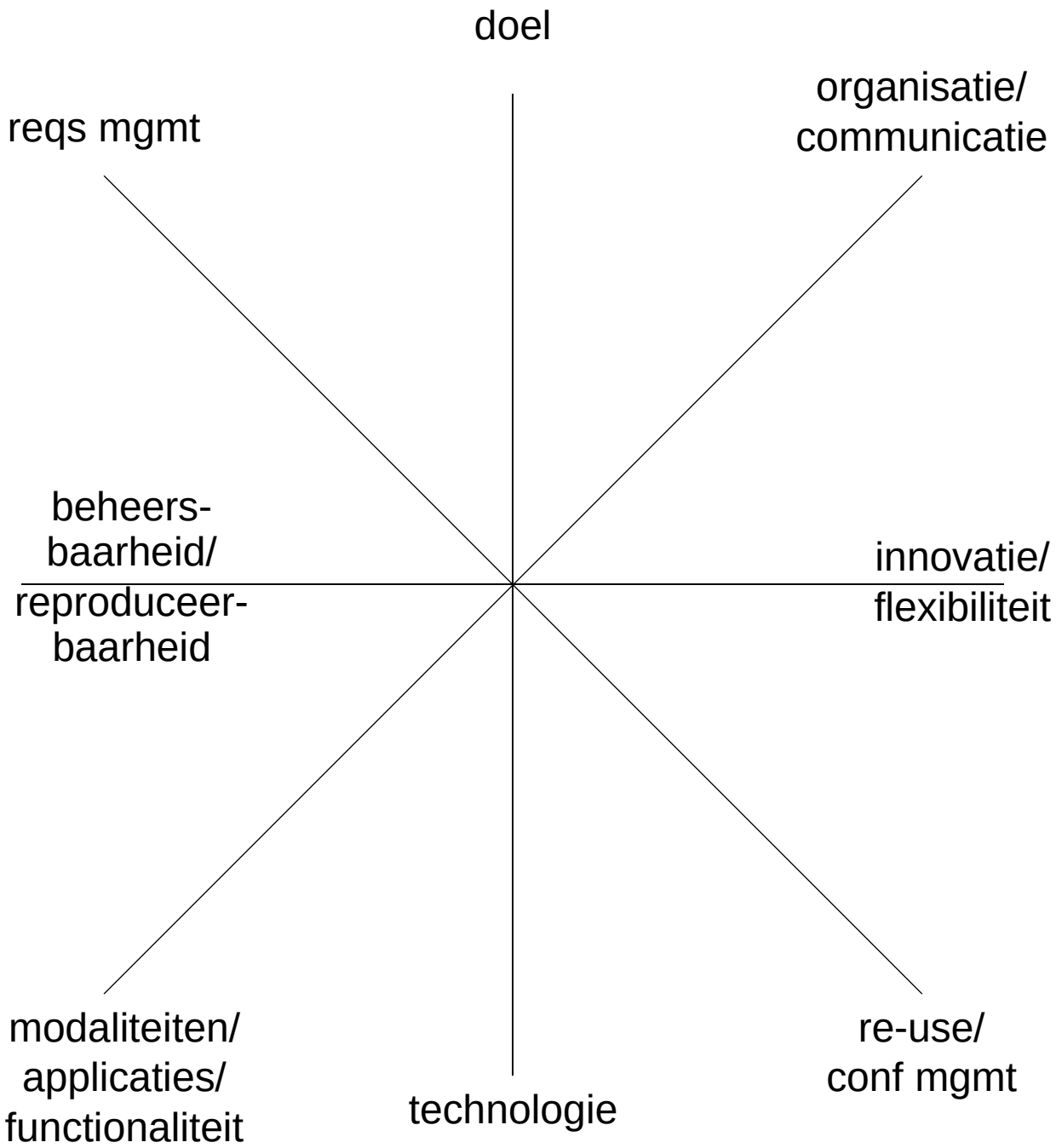
Re-use



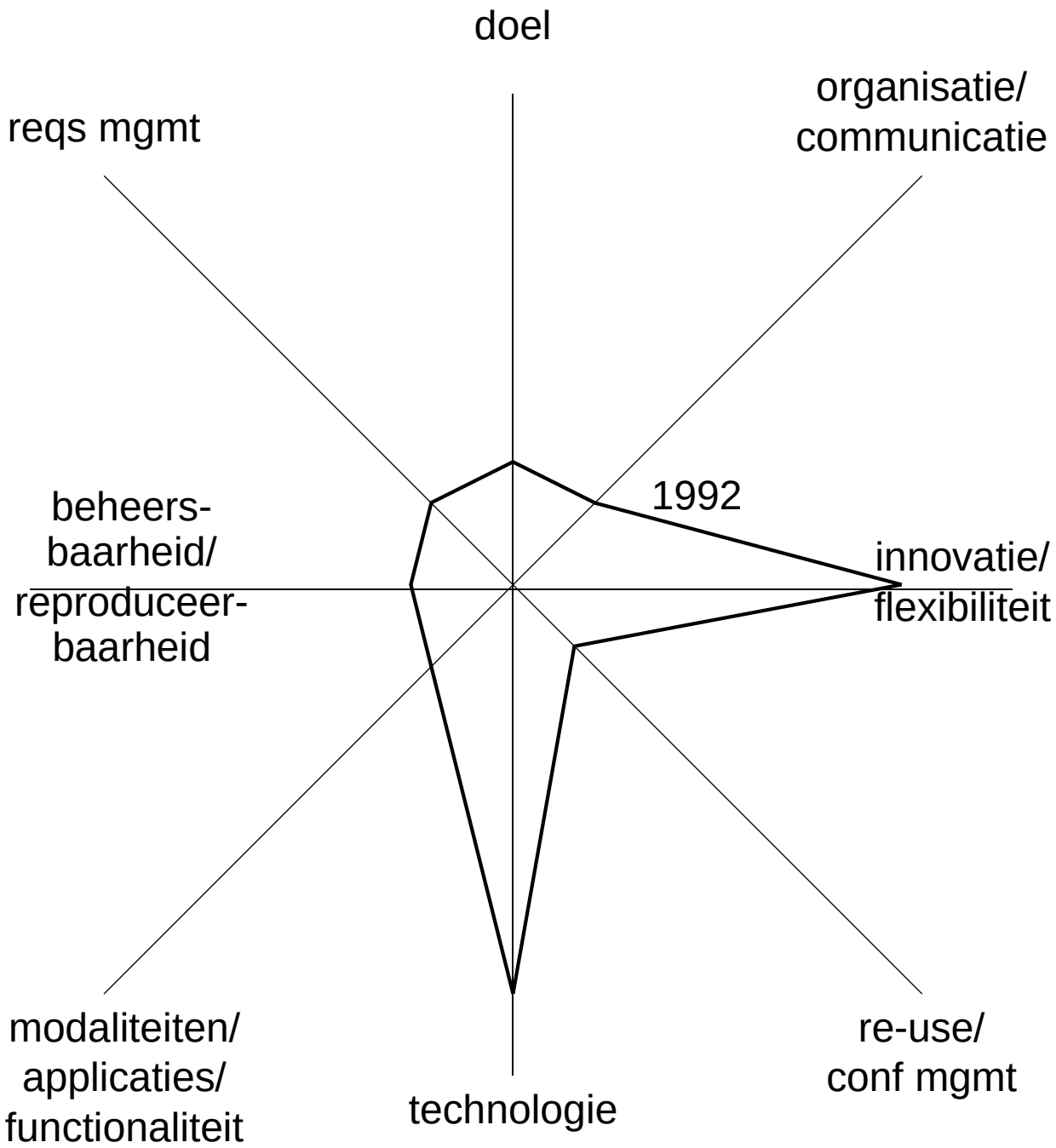
benefit:

- ontwikkelkosten
- kwaliteit
- time to market

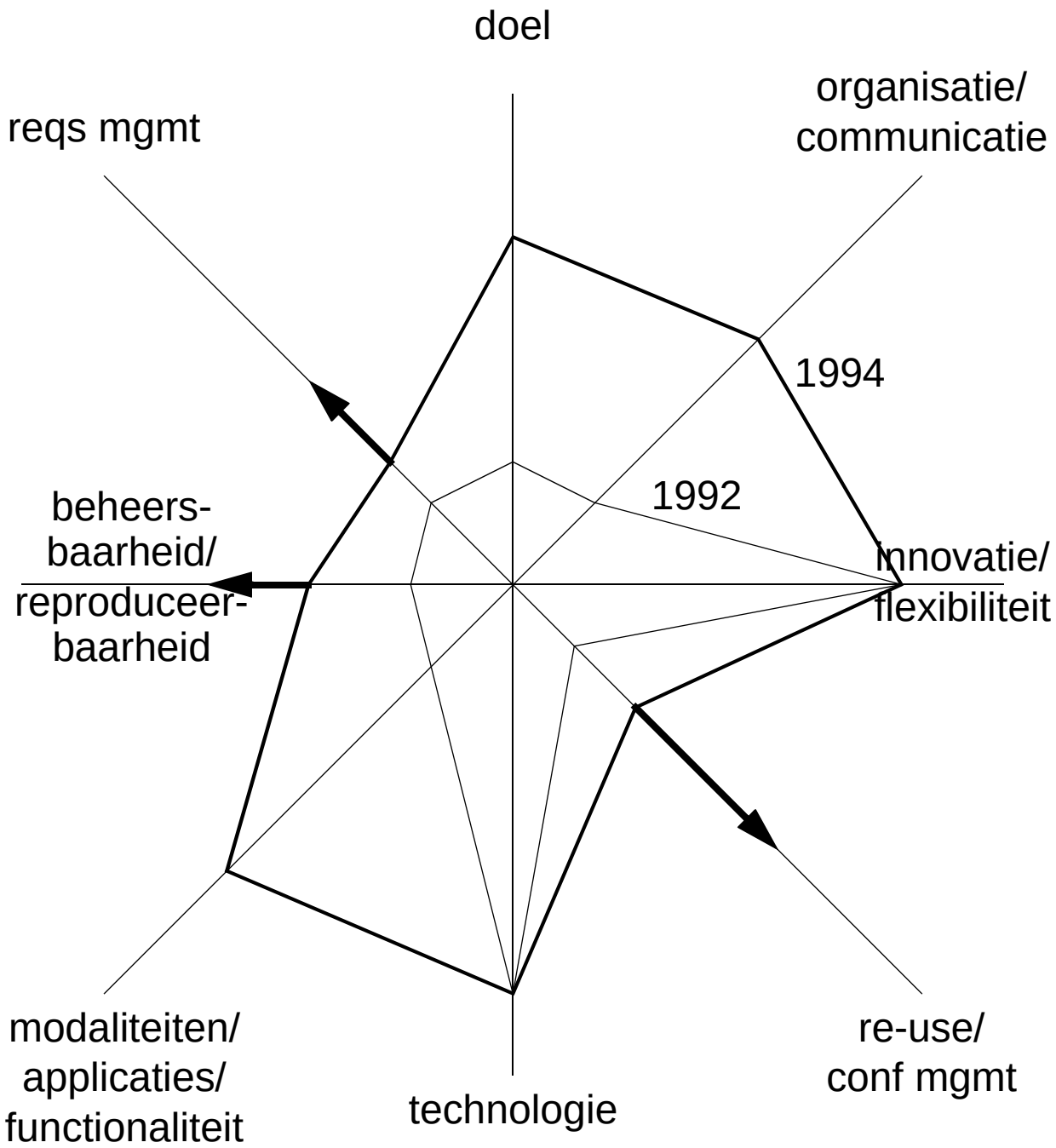
Waar staat CDS

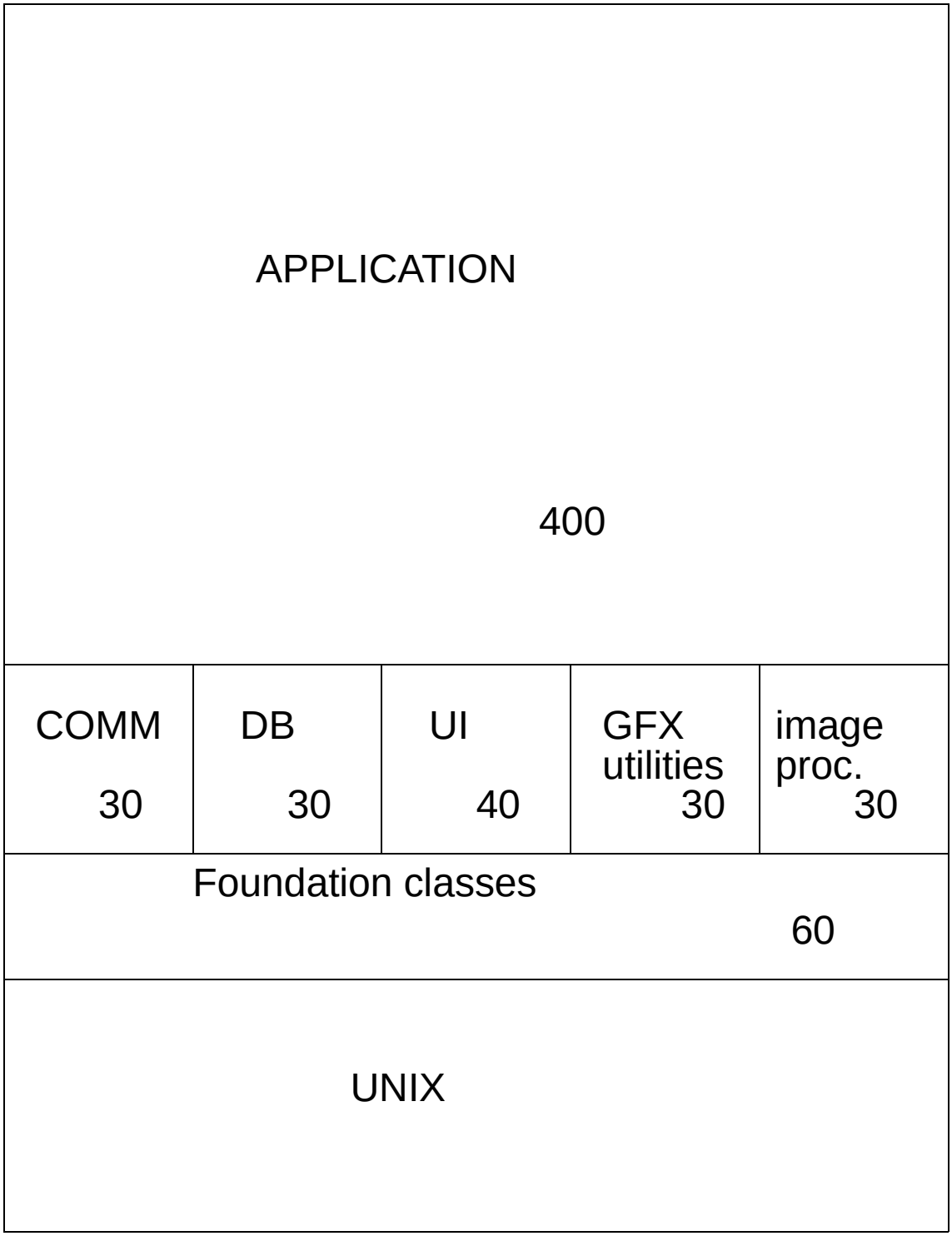

doel
organisatie/
communicatie
reqs mgmt
beheers-
baarheid/
reproduceer-
baarheid
innovatie/
flexibiliteit
modaliteiten/
applicaties/
functionaliteit
technologie
re-use/
conf mgmt

Waar stond CDS 1992


doel
organisatie/
communicatie
reqs mgmt
1992
beheers-
baarheid/
reproduceer-
baarheid
innovatie/
flexibiliteit
modaliteiten/
applicaties/
functionaliteit
technologie
re-use/
conf mgmt

Waar staat CDS 1994/1995


doel
organisatie/
communicatie
reqs mgmt
1994
1992
beheers-
baarheid/
reproduceer-
baarheid
innovatie/
flexibiliteit
modaliteiten/
applicaties/
functionaliteit
technologie
re-use/
conf mgmt


APPLICATION
400
COMM
30
DB
30
UI
40
GFX utilities
30
image proc.
30
Foundation classes
60
UNIX

Embedding

- Installation
- Configuration
- Customization
- Start up, shutdown
- Specifications:
  - + functional
  - + system design
  - + sw design
- Interface to application SW:
  - + add semantics level
  - + use of appropriate low level mechanisms
  - + match to high level mechanisms:
    - - notification, scheduling
    - - job requests, subscriptions

Embedding (continued)

- Exception handling:
  - + System monitor
  - + Error propagation
  - + Logging
- Resource allocation and monitoring provisions
  - + CPU
  - + Memory
  - + Disk
- Resource tuning, see above
- Safety design
- Security design

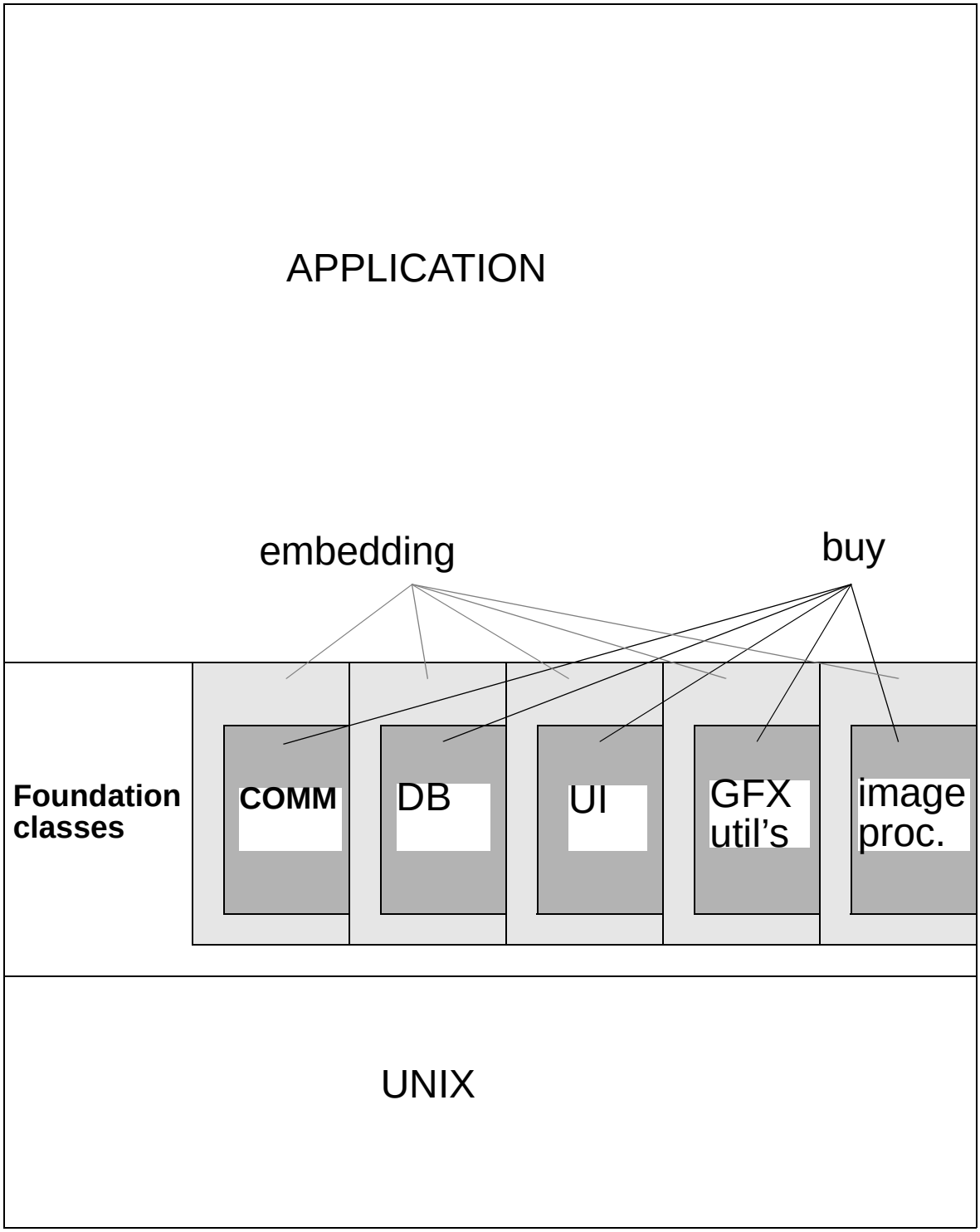
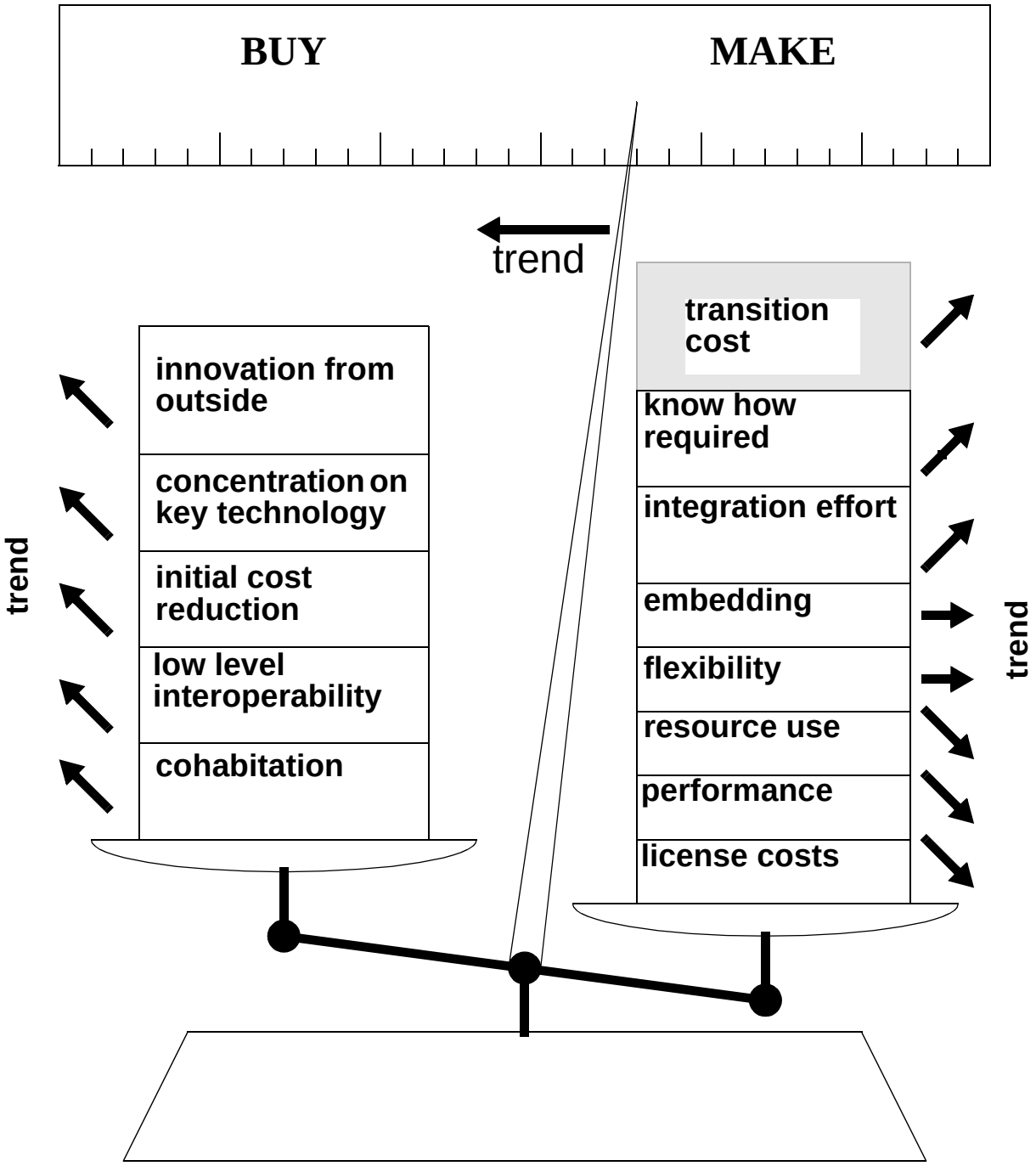
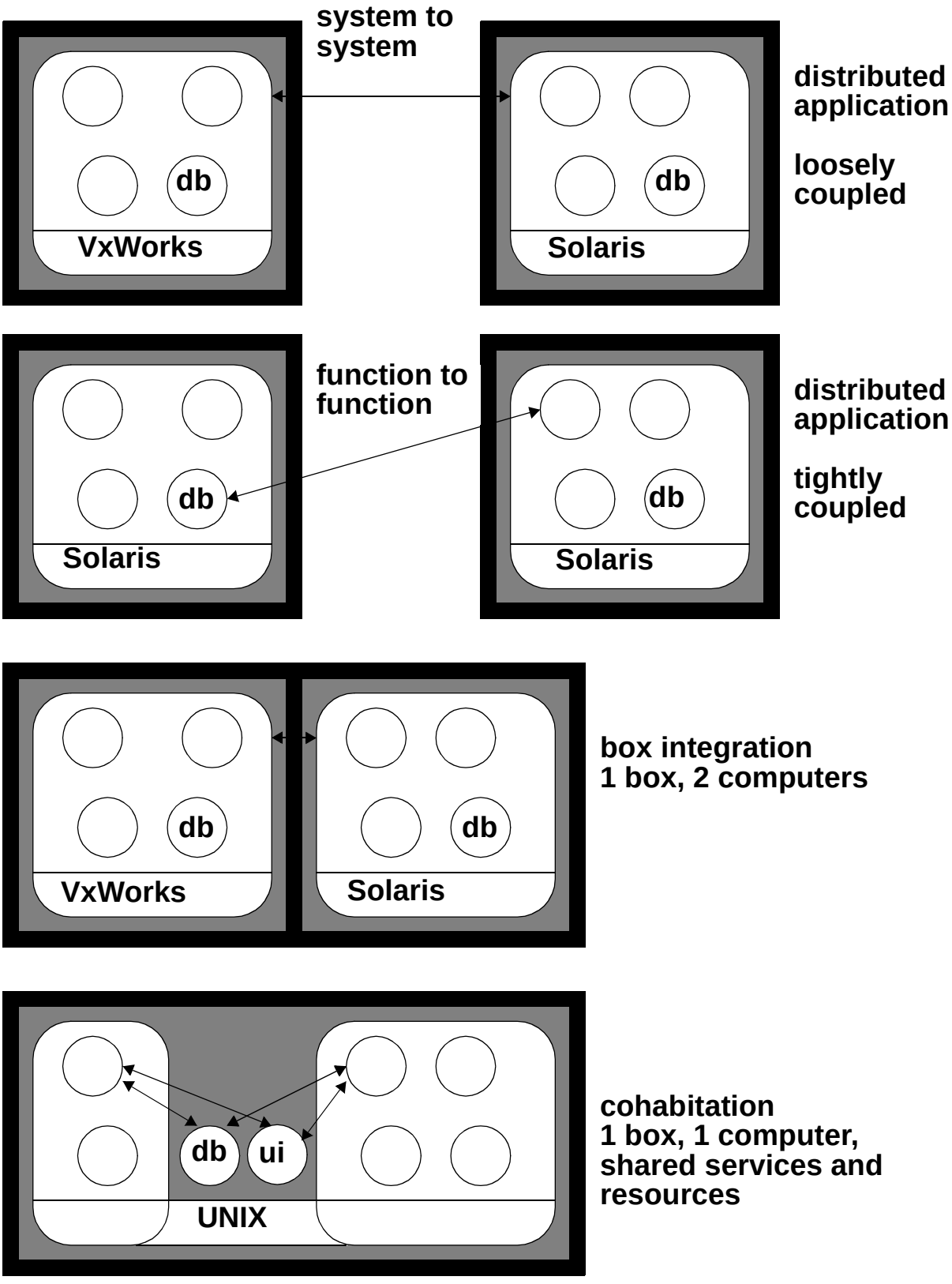

APPLICATION
embedding
buy
Foundation classes
COMM
DB
UI
GFX util's
image proc.
UNIX

Table 2: initial cost comparison

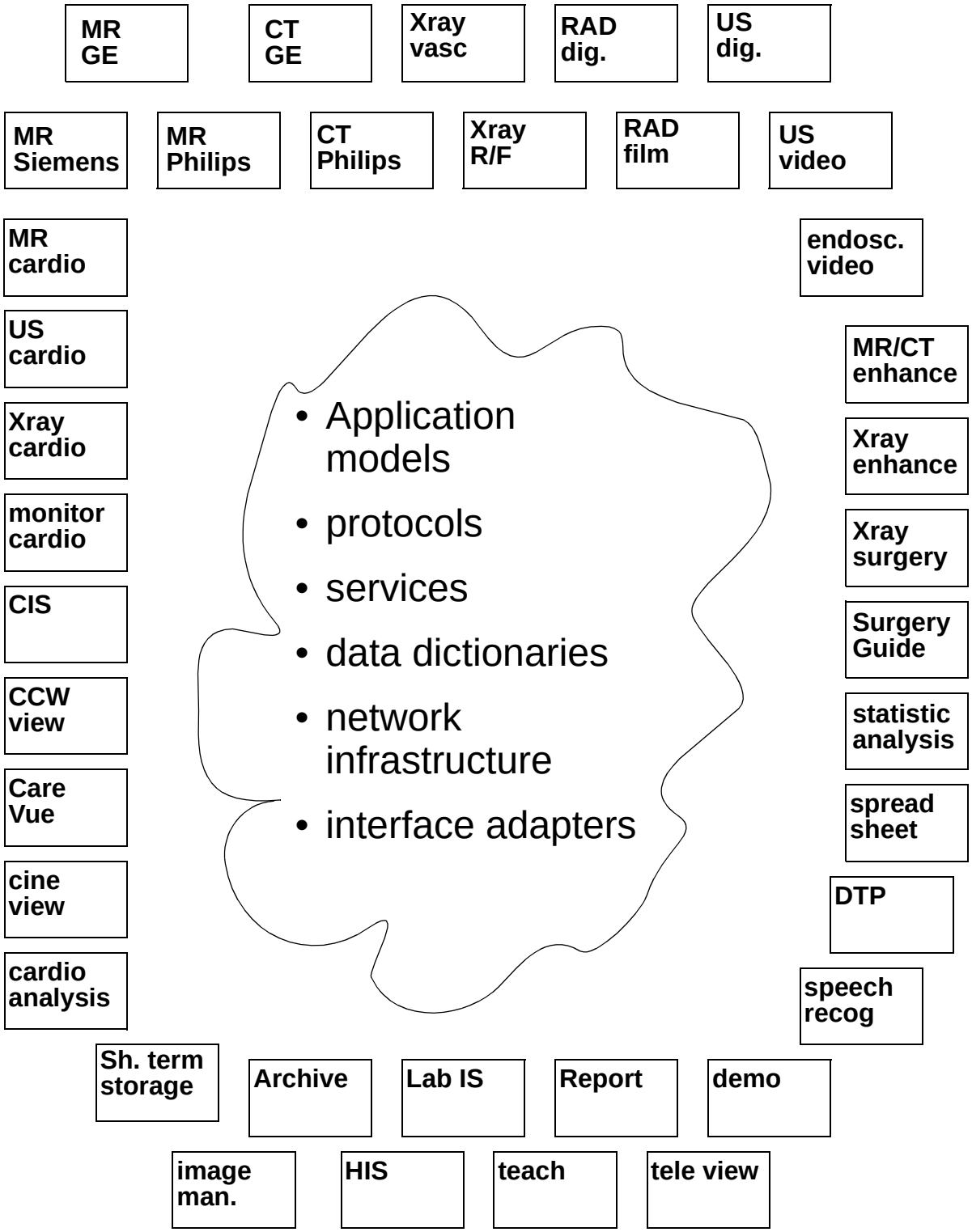
		1992	1994	1996
toolbox code	make	120	160	250
interface code	buy	90	100	110
total home made code	make	360	600	1100
	buy	330	540	960
initial cost from scratch (manyear)	make	5	8	12
	buy	9	10	11


BUY
MAKE
trend
transition cost
innovation from outside
concentration on key technology
initial cost reduction
low level interoperability
cohabitation
know how required
integration effort
embedding
flexibility
resource use
performance
license costs
trend
trend

Integration levels

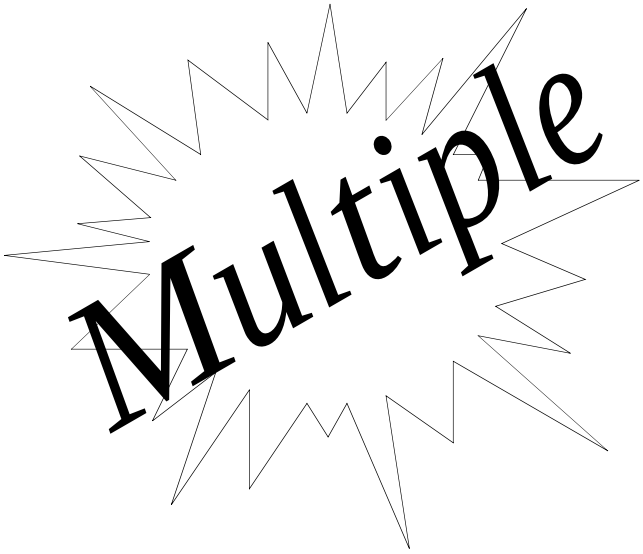


Distribution of applications



What is the problem we try to solve?

Efficient and cost-effective handling of



products

concurent projects

clinical applications

modalities

archives

product configurations

people

locations

platforms

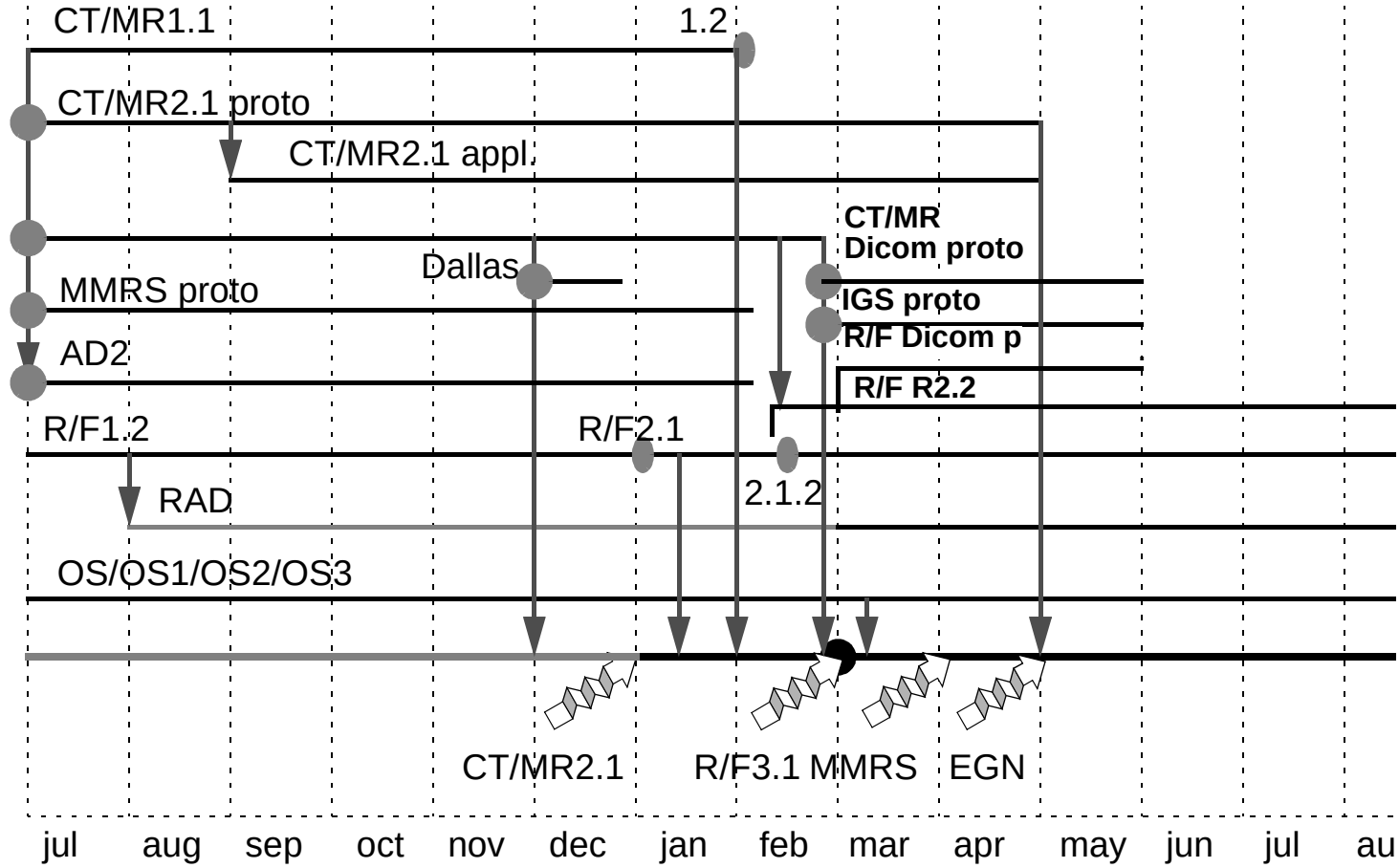
operating systems

vendor connections

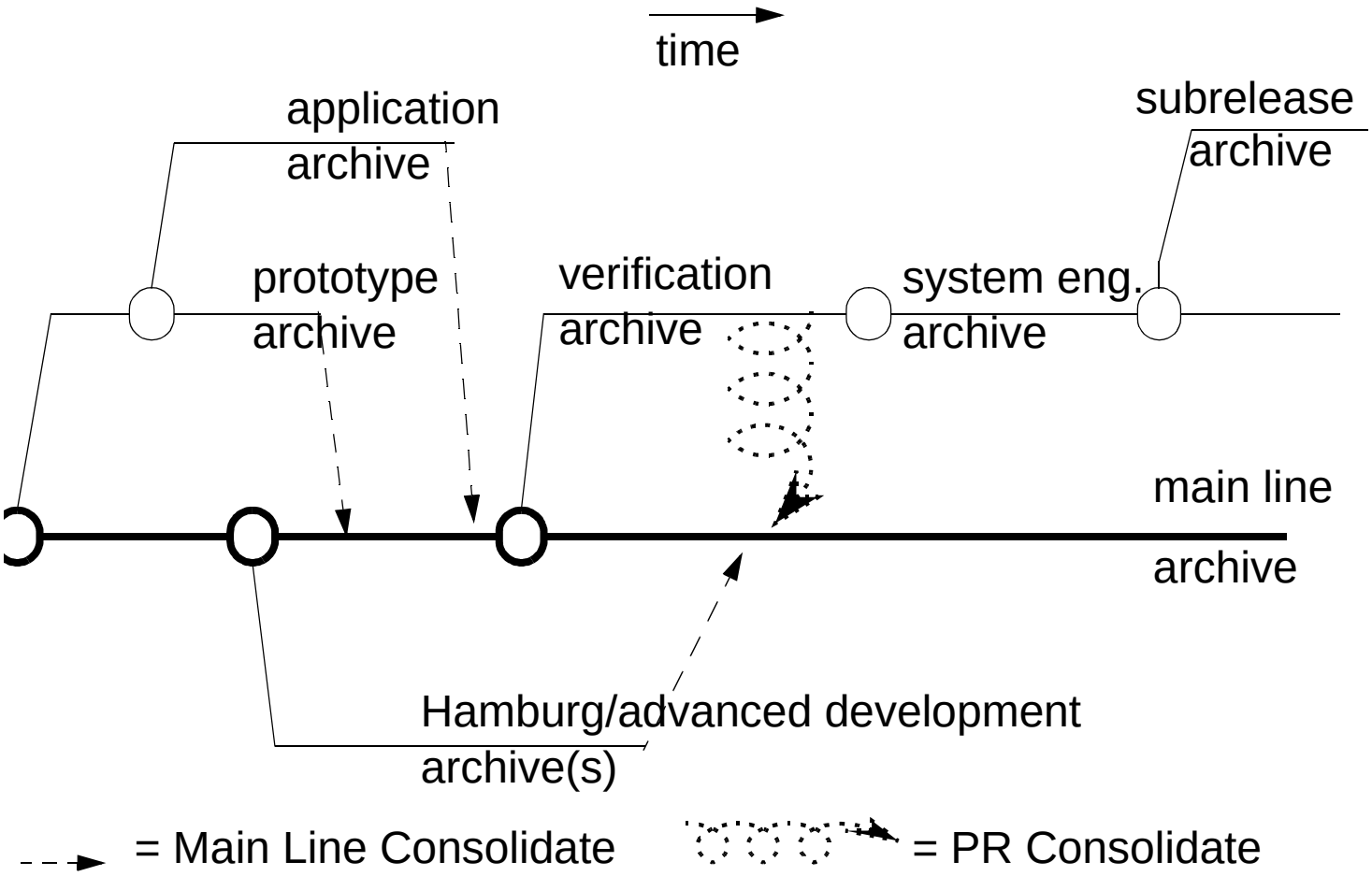
applications connections

Motivation for a main line archive

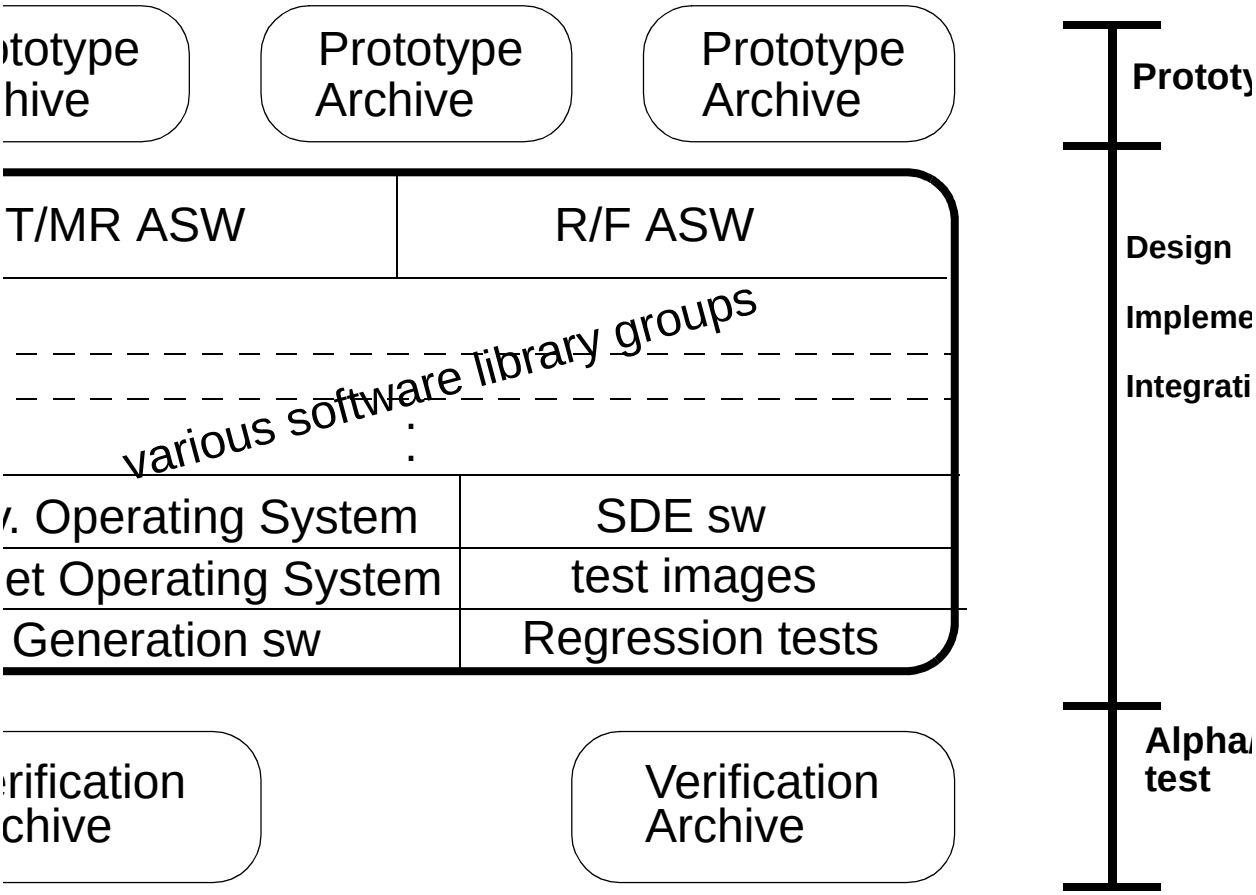
How to manage this situation?



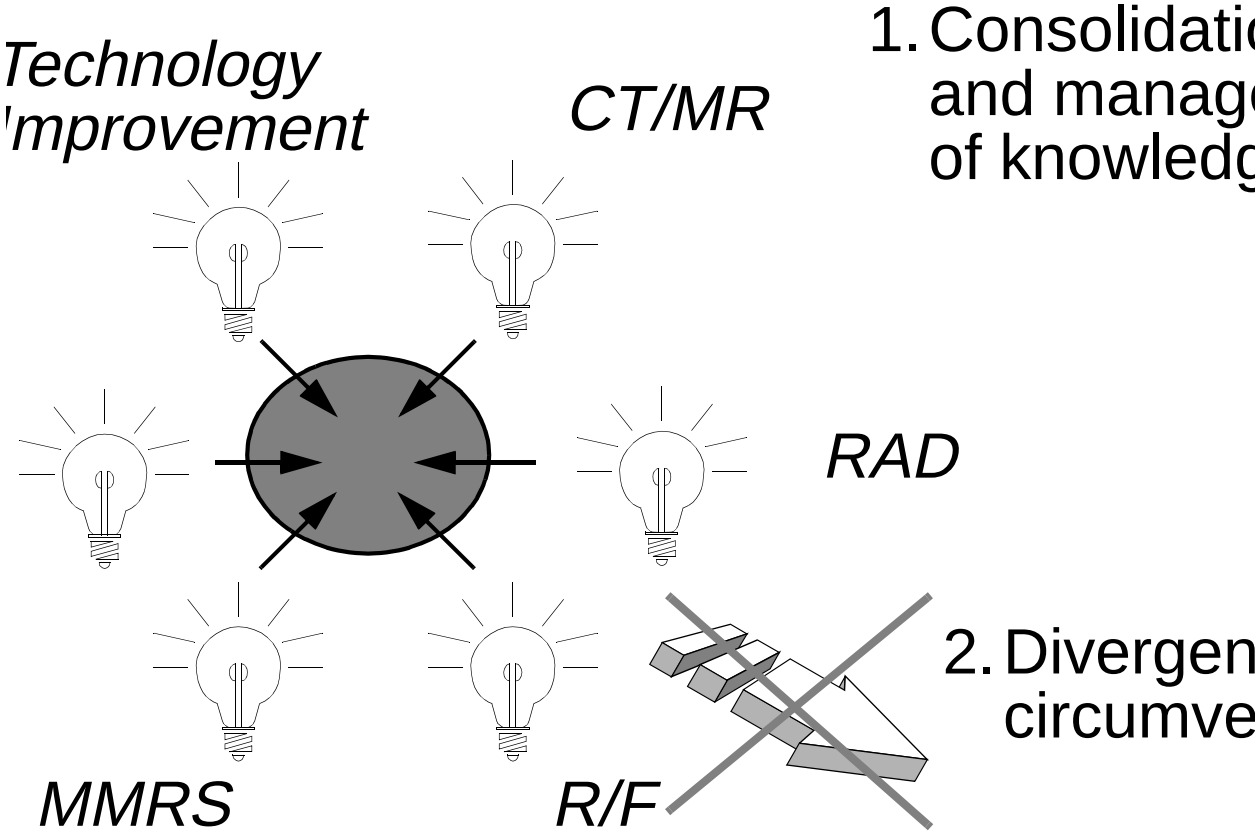
The various sorts of archives

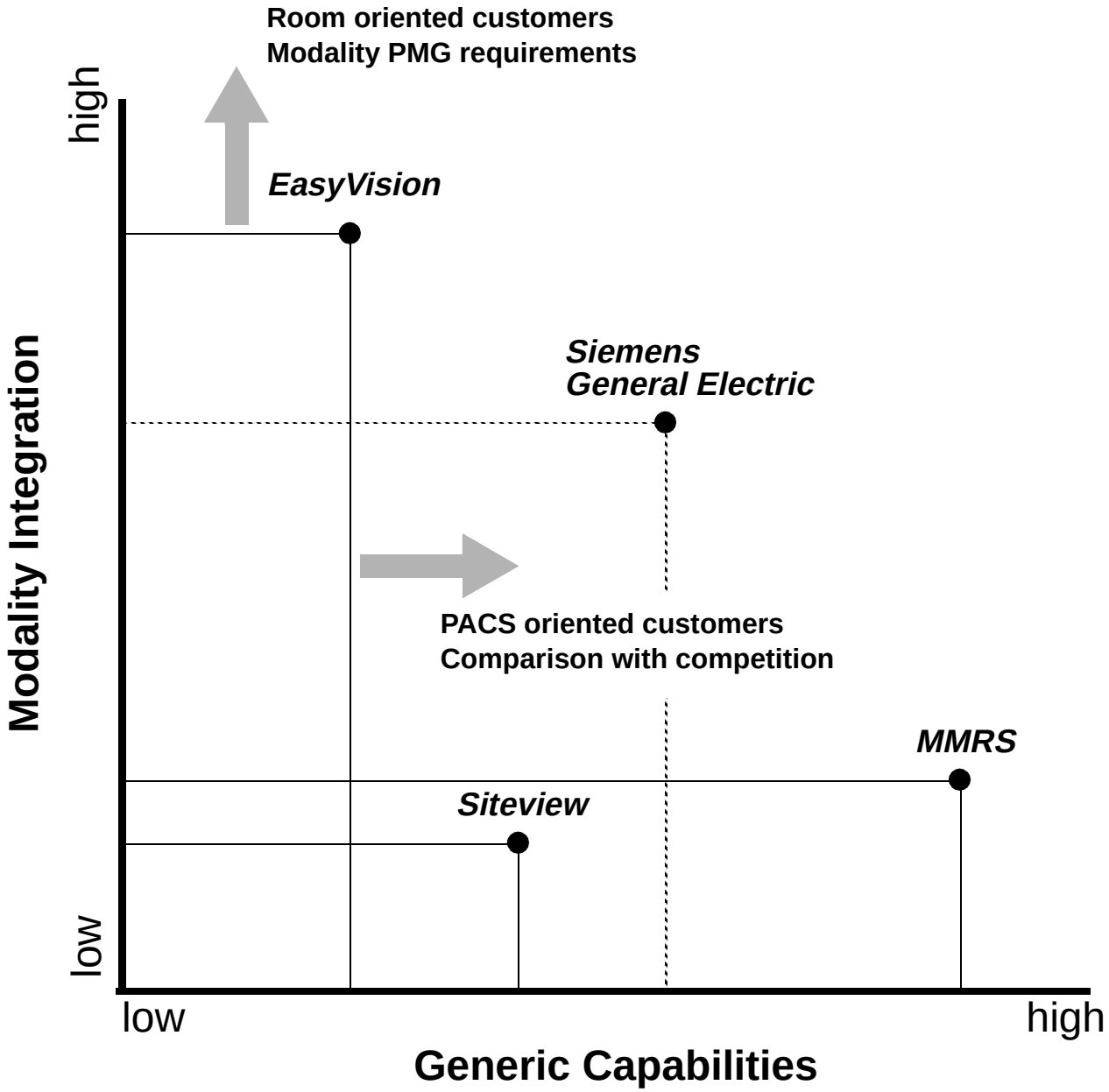


The various sorts of archives

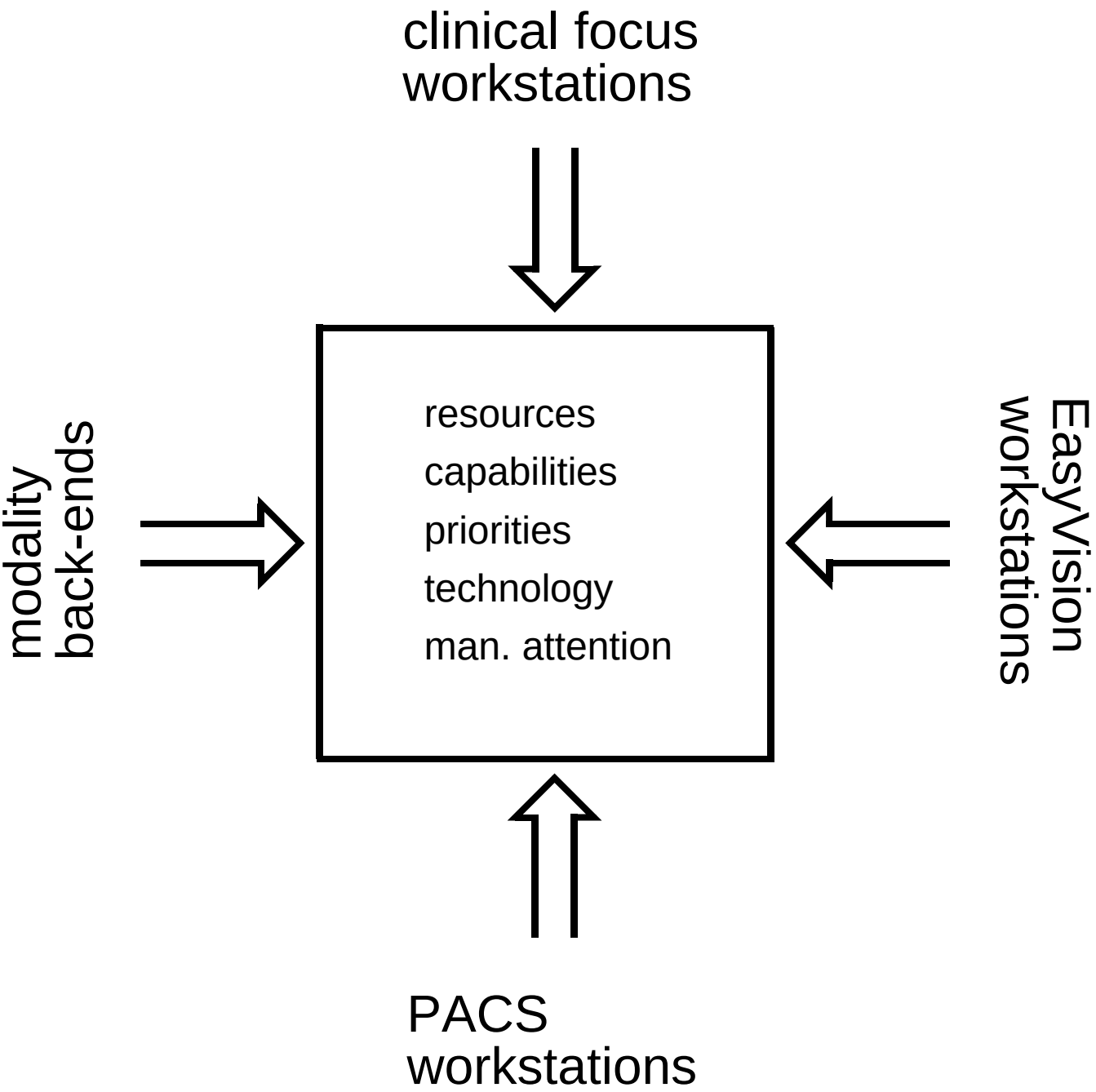


The main issue !

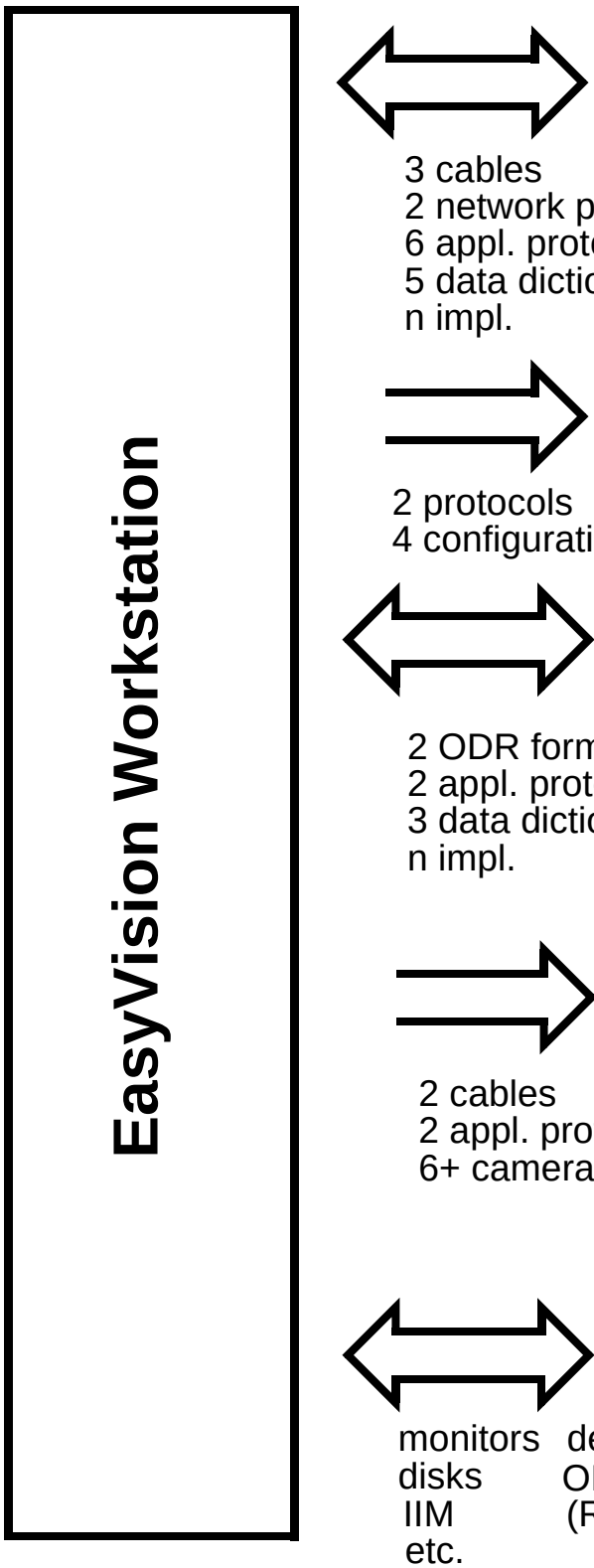



Room oriented customers
Modality PMG requirements
high
EasyVision
Siemens
General Electric
Modality Integration
PACS oriented customers
Comparison with competition
MMRS
Siteview
low
low
high
Generic Capabilities

....


clinical focus
workstations
modality
back-ends
resources
capabilities
priorities
technology
man. attention
EasyVision
workstations
PACS
workstations

Communication protocols & interfaces



modality interfacing

3 cables
2 network protocols
6 appl. protocols
5 data dictionaries
n impl.

export to outer world

2 protocols
4 configurations

storage/ optical medial

2 ODR formats
2 appl. protocols
3 data dictionaries
n impl.

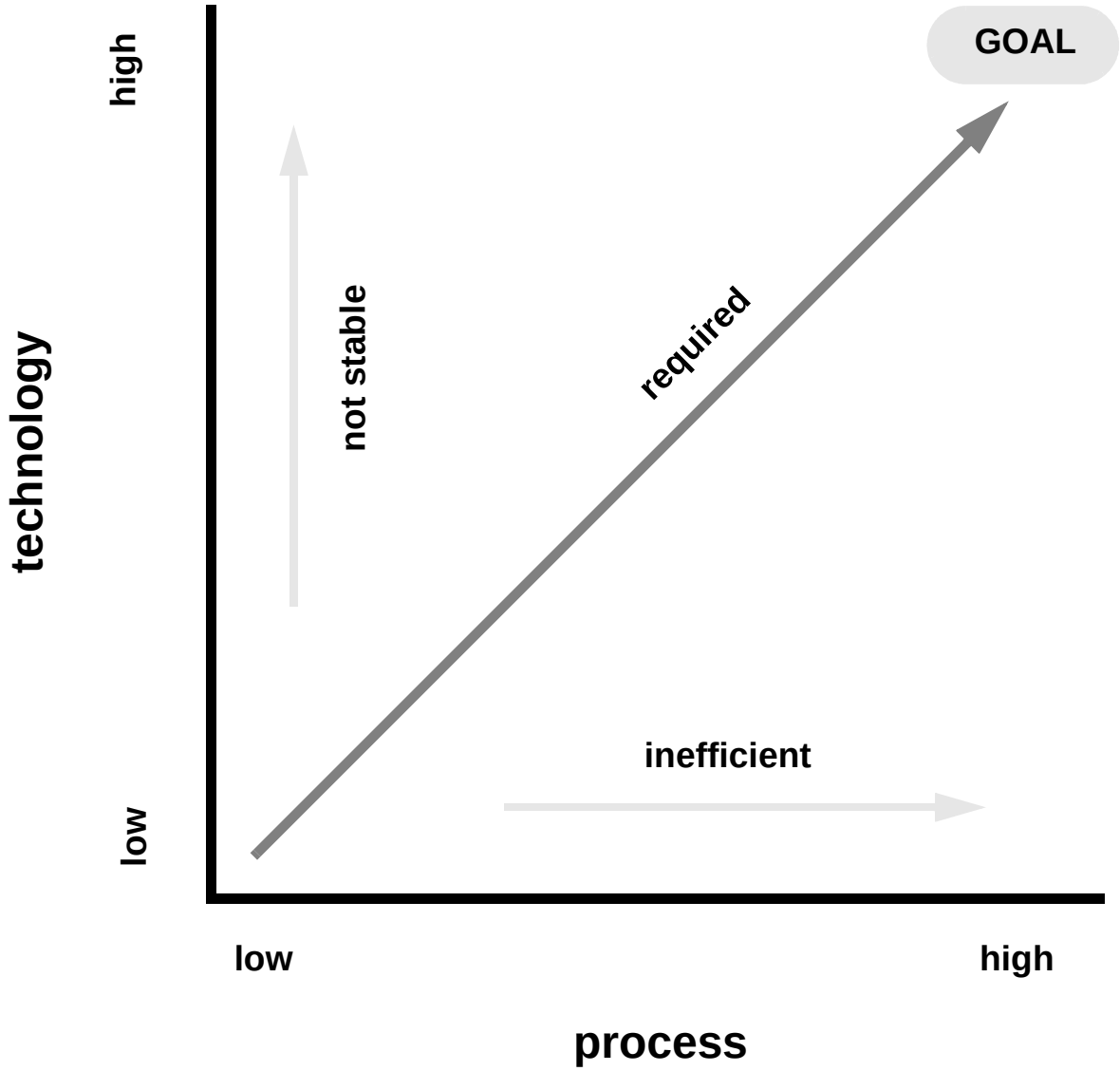
hardcopy/ printing

2 cables
2 appl. protocols
6+ camera protocols

external interfaces/ peripherals

monitors device I/F
disks ODR's
IIM (RIS)
etc.

Technology & process improvement ....



Innovation skills ....