Module Modeling and Analysis: Application and Life Cycle Modeling

by *Gerrit Muller* HSN-NISE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

Abstract

This module addresses Modeling and Analysis Fundamentals of Application.

March 27, 2021
status: planned
version: 0.3

Module Content

goal of this module

Tangible understanding of the customer enterprise and life cycle aspects

Provide useful views on customer application

Simplify and demystify customer concerns

content of this module

Example financial computations

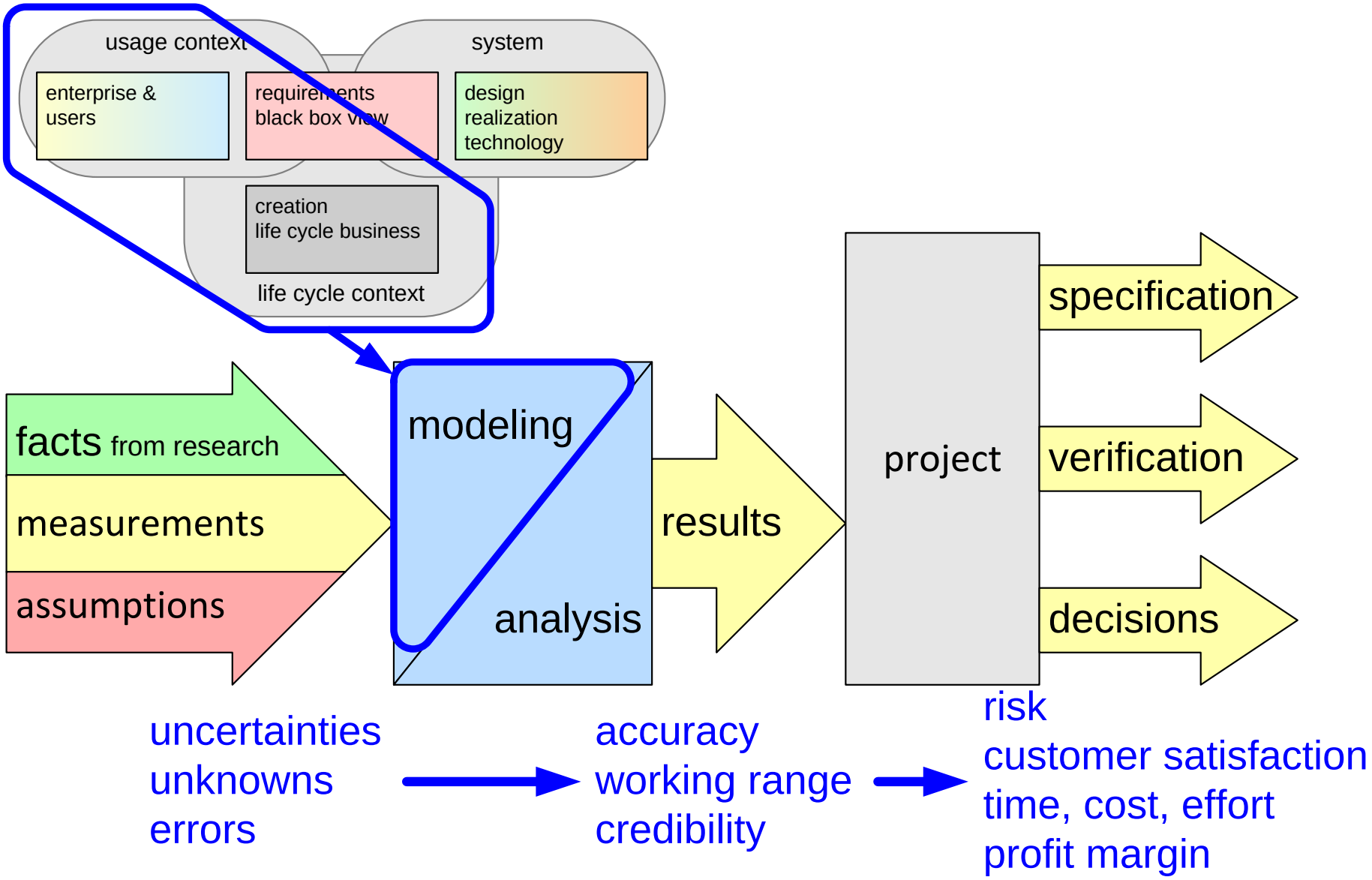
views on customer application:

- stakeholders and concerns
- simple cost models
- simple life cycle models

exercise

Make context and application models

Where are we in the Course?



Modeling and Analysis: Application Models

by *Gerrit Muller* University of South-Eastern Norway-NISE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

Abstract

The enterprise and its application is a complex system in itself. Specification and design decisions can have a significant impact on this system. We show a number of relevant application models with the purpose to be able to reason about specification and design in relation to the impact on the enterprise.

March 27, 2021
status: planned
version: 0.1

logo
TBD

Understanding Usage and Life Cycle Context

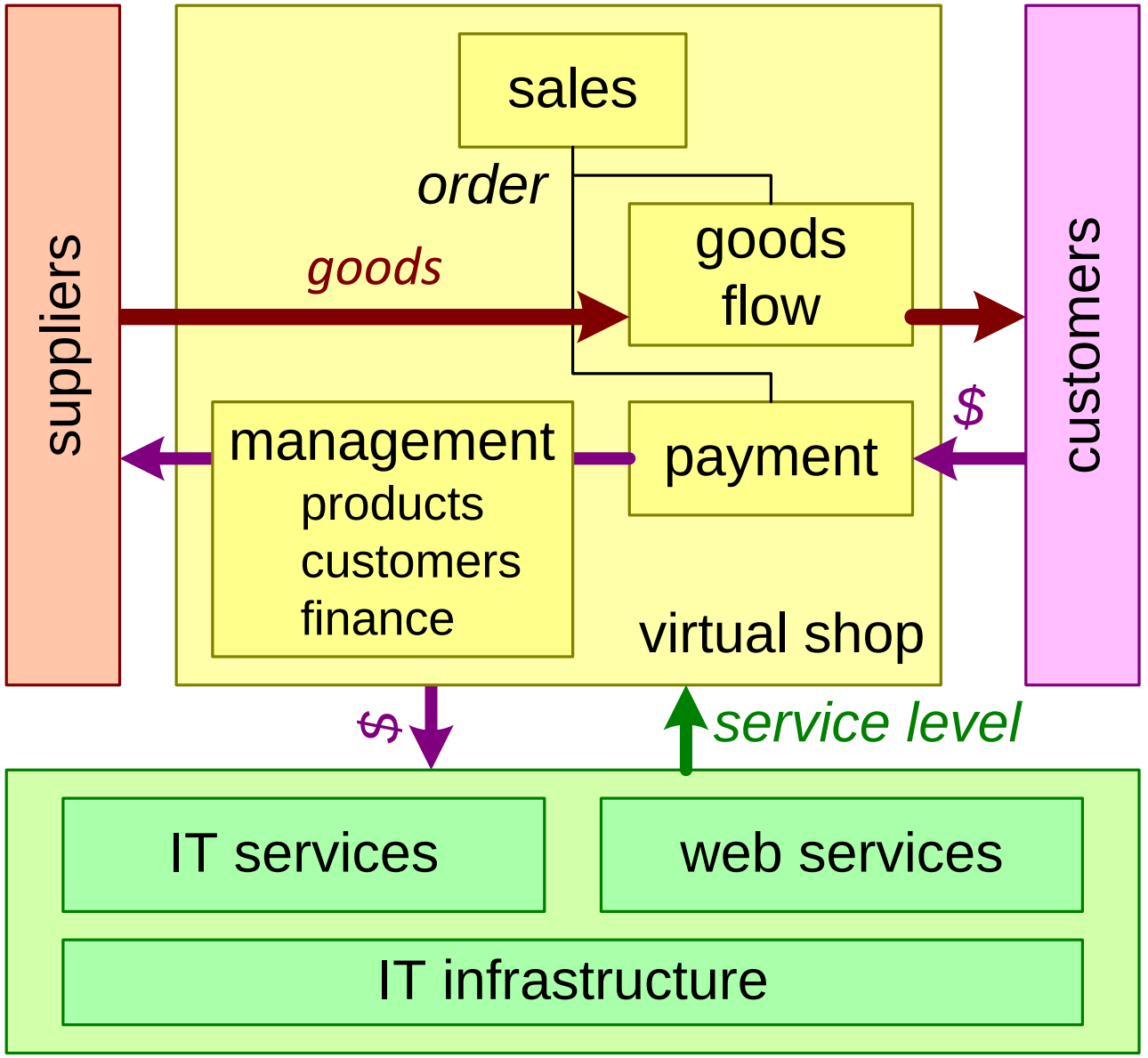
High Level Visual Models

+ value chain
+ map of competitors, partners, suppliers
+ context diagram
+ stakeholder diagram
+ infrastructure diagram
+ aspect diagrams e.g. security, data integrity, ..
+ customer key driver graph
+ life cycle key driver graph

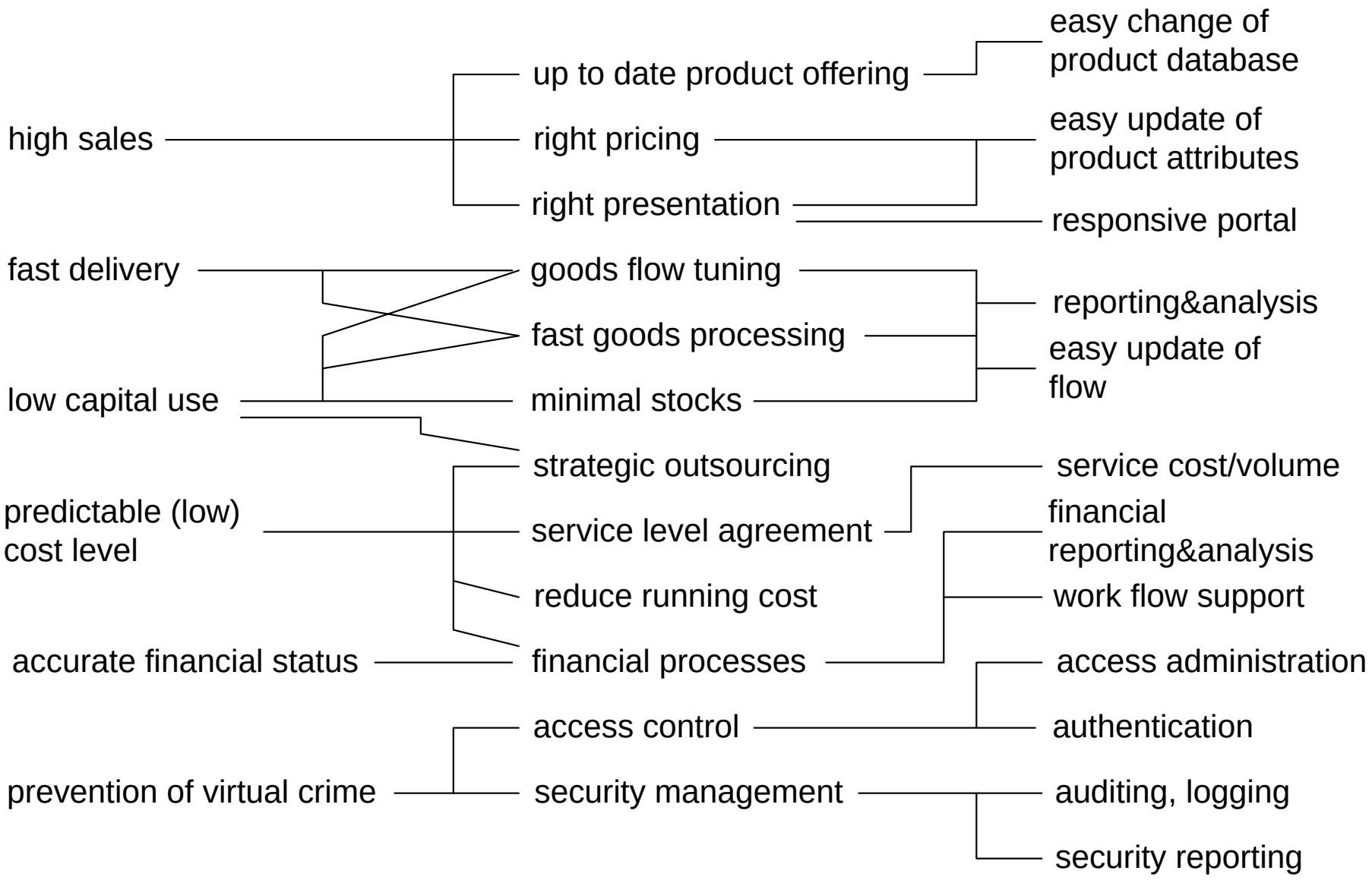
commercial
financial
legal
strategic
tactical
operational
social
technical

relations beyond actual system!

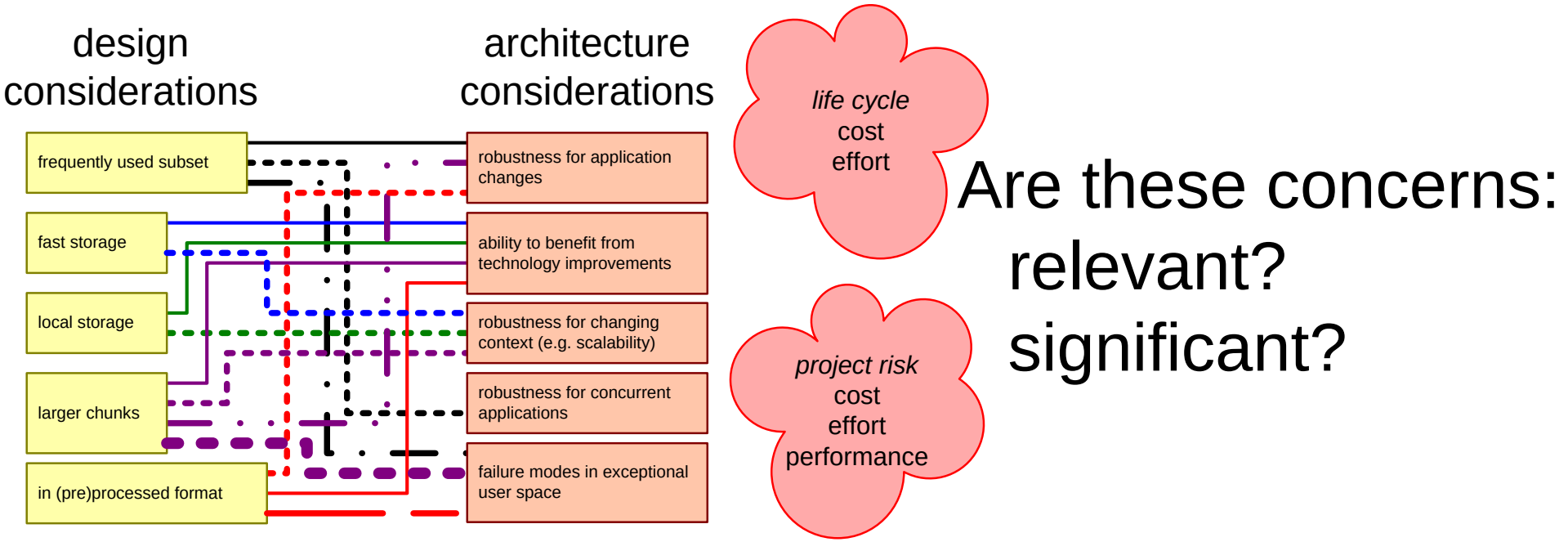
Simplified Web Shop Value Chain



Simplistic Customer Key Driver Graph



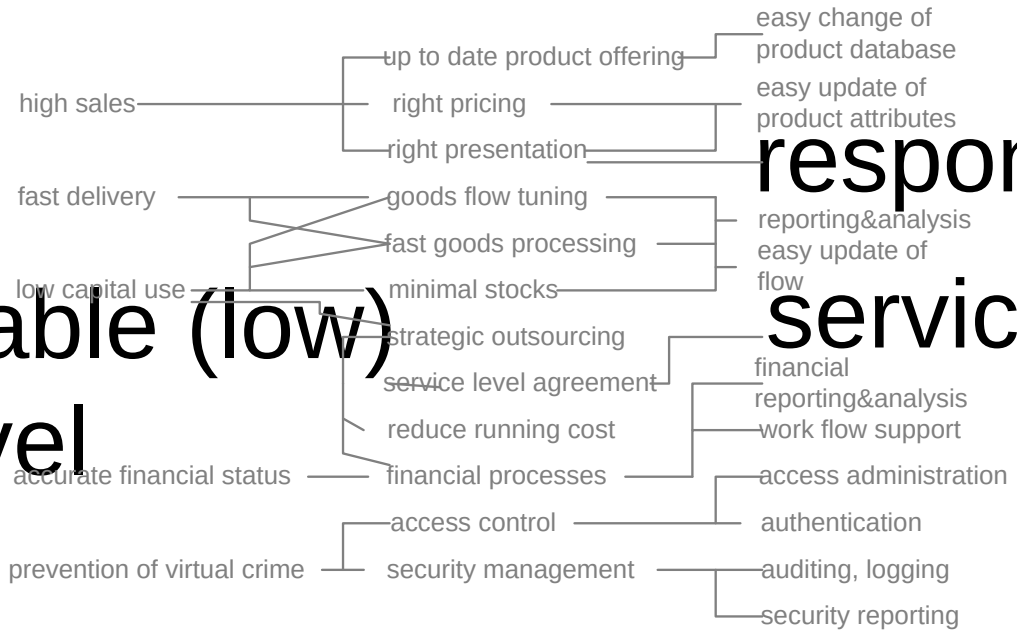
Example Assessment of Design Choices



What is the impact at enterprise level?

Example Zero Order Problem Statement

How does the
picture cache design
impact



responsive portal

service cost/volume

predictable (low) cost level

Zero Order Cost Model

total cost = f + s(v) + p * v + g * v

where

f = fixed base cost

s = service cost, see below

p = personnel cost including overheads

v = volume

g = goods flow handling

service cost s(v) = b + c * v

where

b = fixed base cost

c = cost / volume

v = volume

all including provider margin

Example Low Volume, Labor Intensive, Shop

low volume, labor intensive, shop

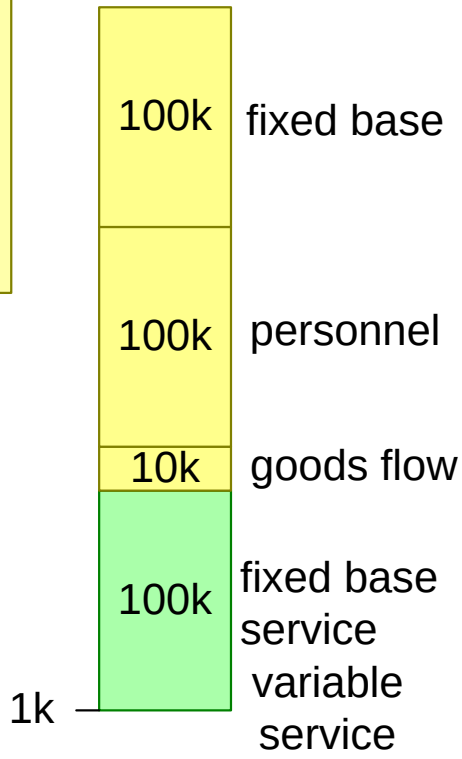
fixed costs and personnel cost dominate:
service cost changes have negligible impact on total cost!

total cost = f + s(v) + p * v + g * v
where
f = fixed base cost
s = service cost, see below
p = personnel cost including overheads
v = volume
g = goods flow handling

f =	100k
p =	1
v =	100k
g =	0.1
s(100k) =	101k

service cost s(v) = b + c * v
where
b = fixed base cost
c = cost / volume
v = volume
all including provider margin

b =	100k
c =	0.1



Example High Volume, Highly Automated, Shop

high volume, highly automated, shop

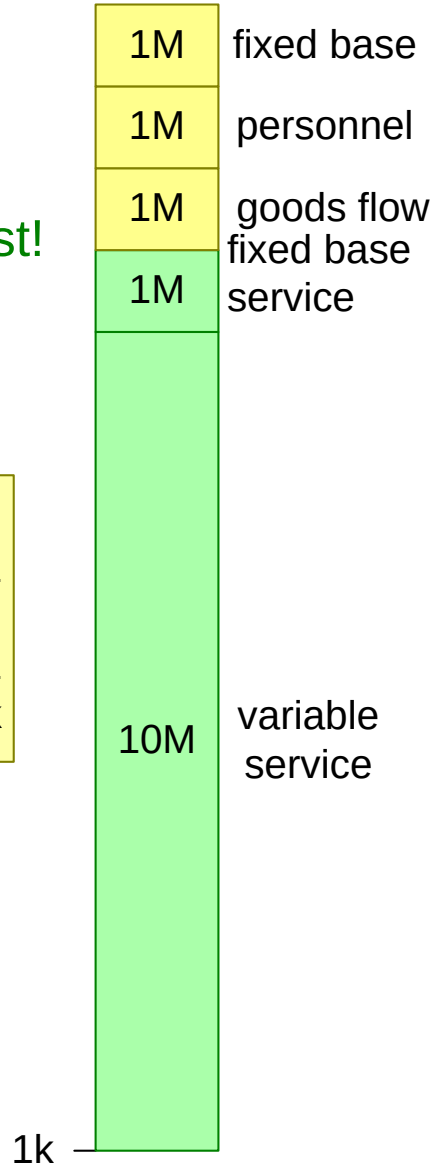
variable service costs dominate:
service cost changes have big impact on total cost!

total cost = f + s(v) + p * v + g * v
where
f = fixed base cost
s = service cost, see below
p = personnel cost including overheads
v = volume
g = goods flow handling

f =	1M
p =	0.01
v =	100M
g =	0.01
s(100k) =	101k

service cost s(v) = b + c * v
where
b = fixed base cost
c = cost / volume
v = volume
all including provider margin

b =	1M
c =	0.1



Conclusion Zero Order Models

Very simple, very coarse, zero order models

provide insight in relevance of

specification and design issues.

These models are used to identify relevant issues

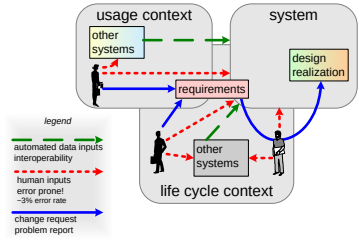
Modeling and Analysis: Life Cycle Models

by *Gerrit Muller* University of South-Eastern Norway-NISE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

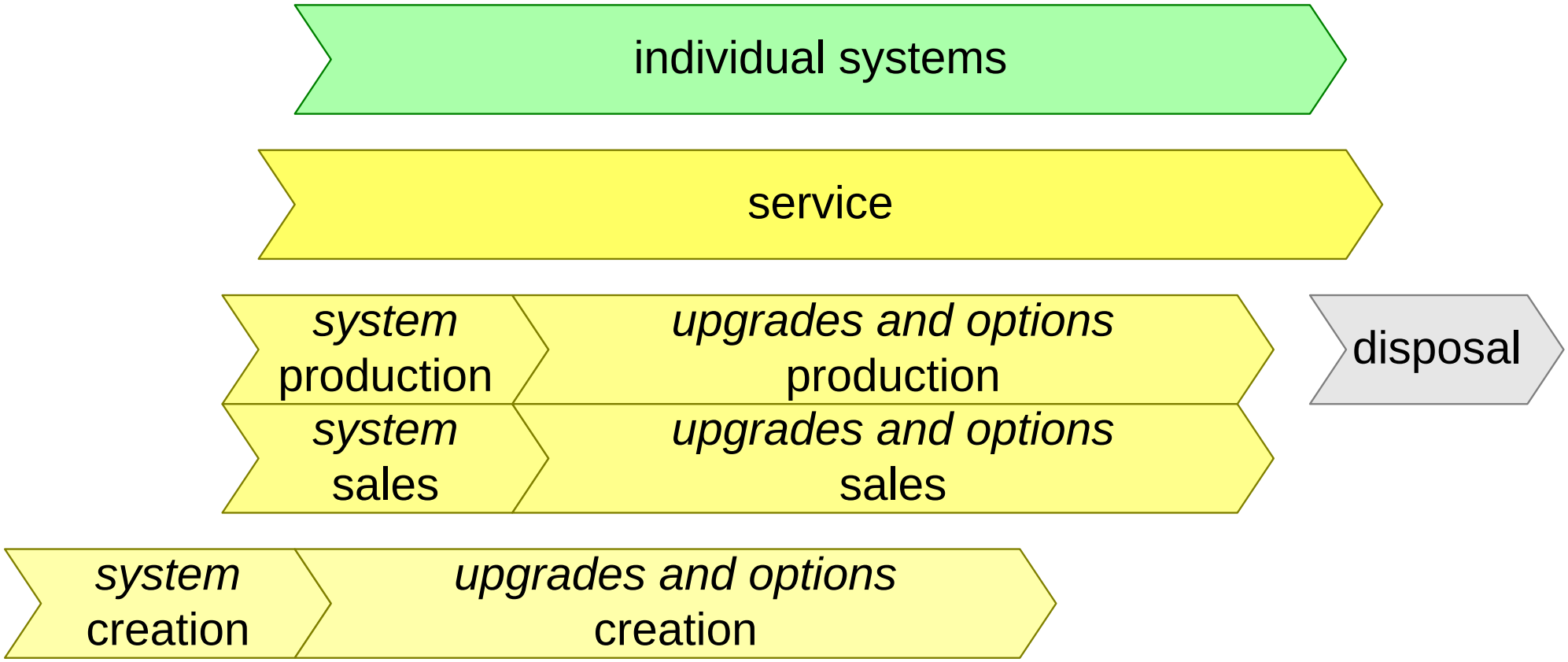
Abstract

Products and enterprises evolve over time. This presentation explores the impact of these changes on the system and on the business by making (small and simple) models of life cycle aspects.

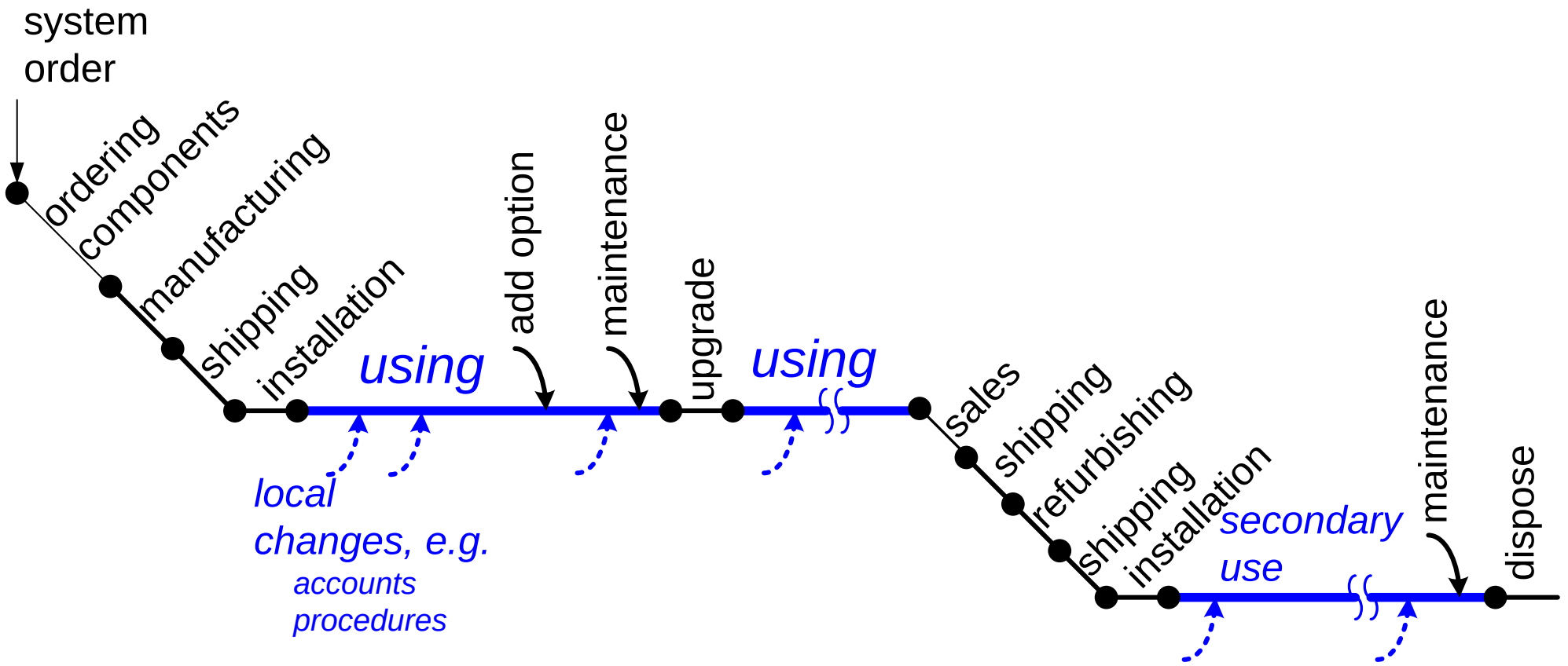
March 27, 2021
status: preliminary draft
version: 0.7



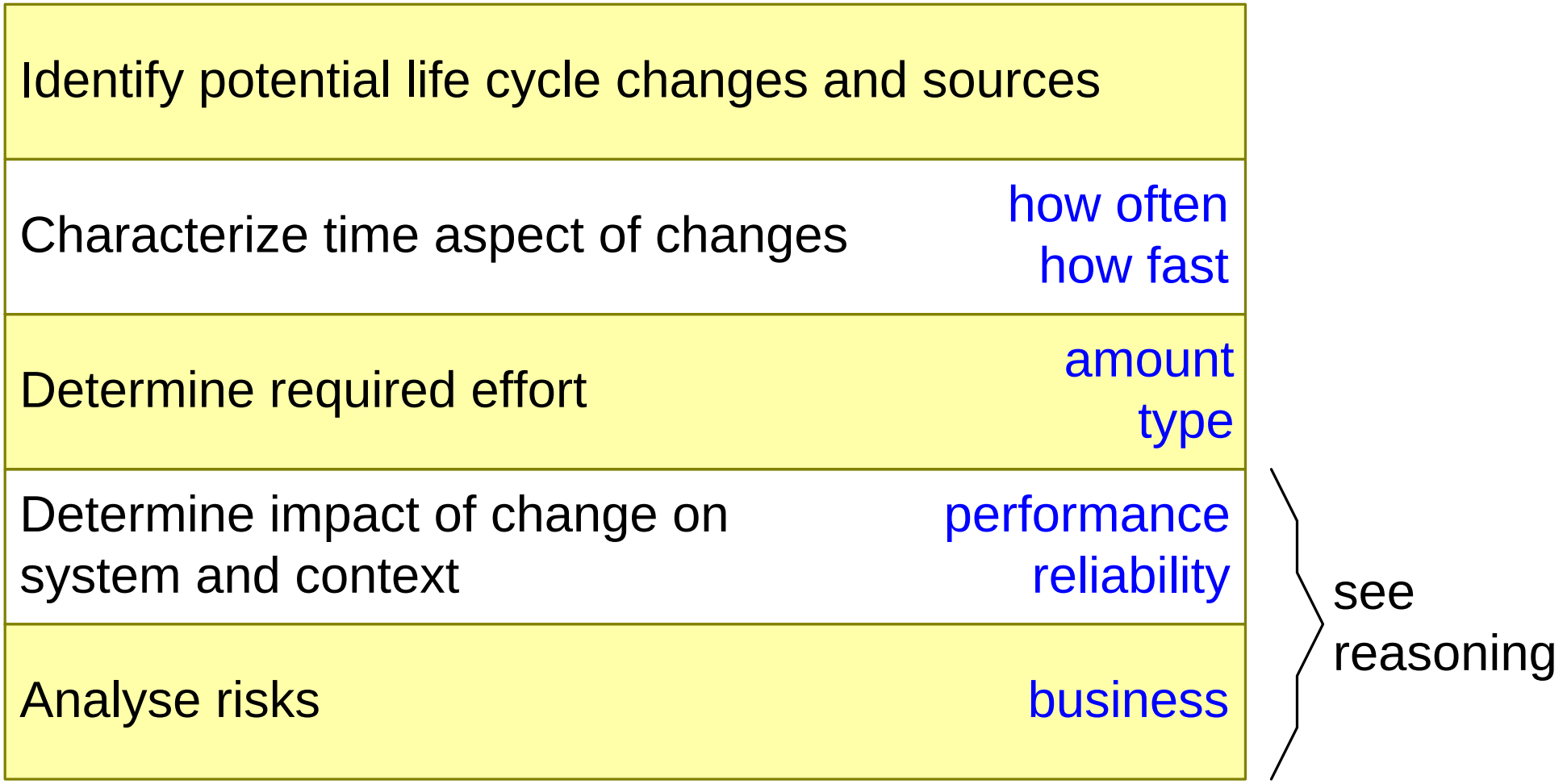
Product Related Life Cycles



System Life Cycle



Approach to Life Cycle Modeling



What May Change During the Life Cycle?

business volume

product mix

product portfolio

product attributes (e.g. price)

customers

personnel

suppliers

application, business processes

et cetera

www.homes4sale.com

www.apple.com/itunes/

www.amazon.com

www.ebay.com

www.shell.com

www.stevens.edu

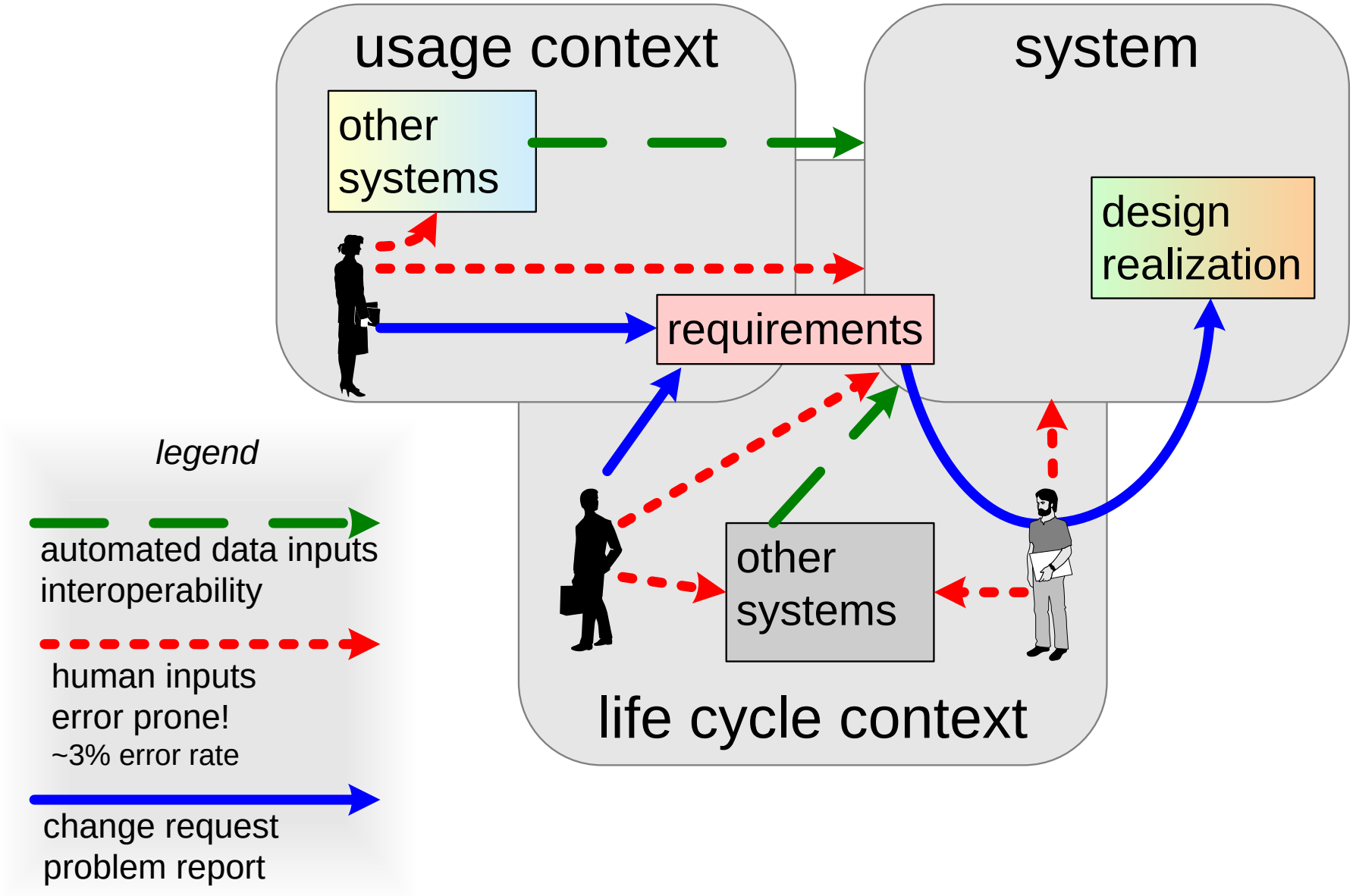
www.nokia.com

stock market

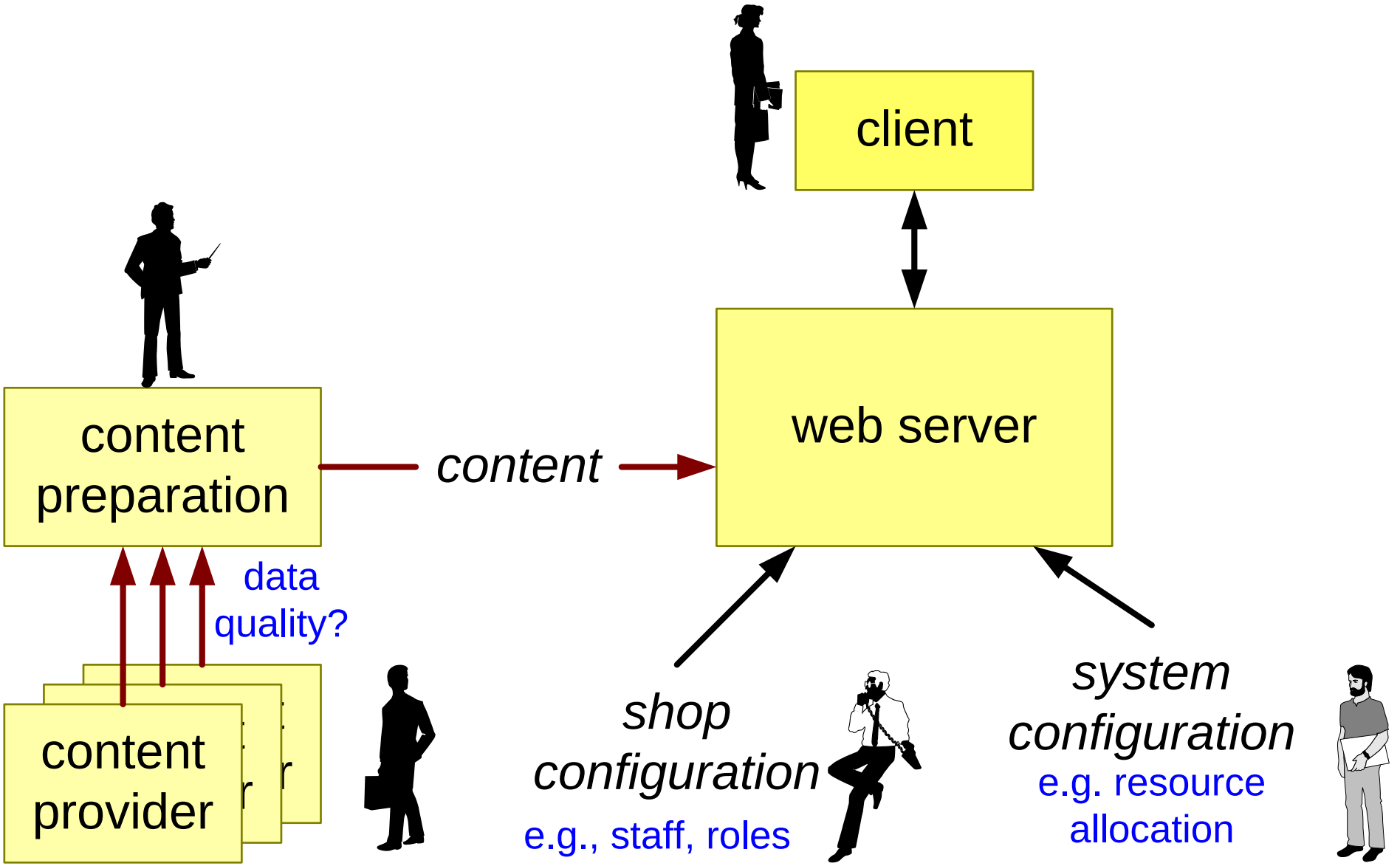
insurance company

local Dutch cheese shop

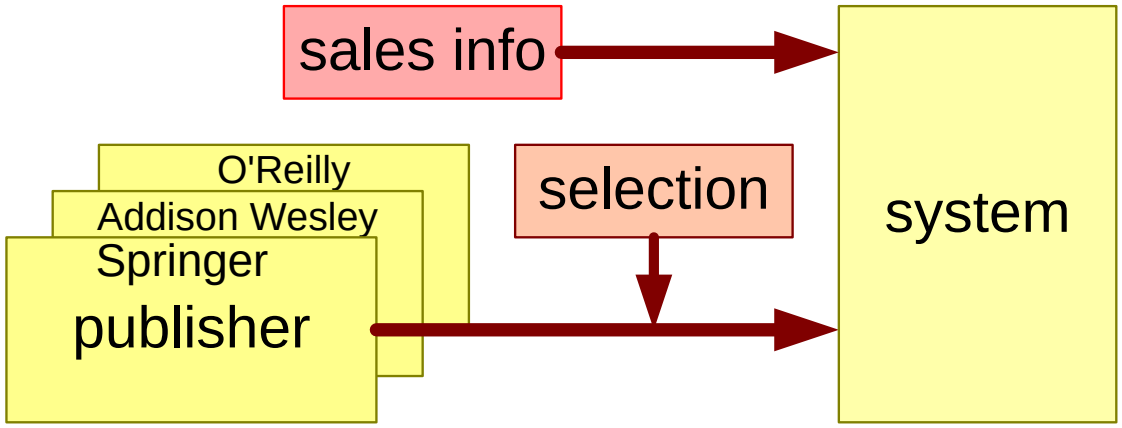
Simple Model of Data Sources of Changes



Data Sources of Web Server



Example Product Portfolio Change Books



product portfolio characteristics

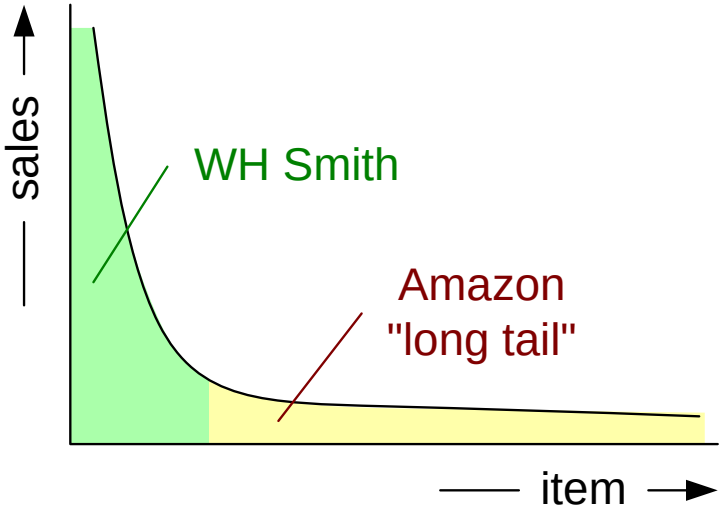
selection depends on business

life cycle changes determined by business characteristics

source: http://en.wikipedia.org/wiki/Long_tail

new books per year

UK (1)	206k (2005)	107k (1996)
USA(2)	172k (2005)	68k (1996)
China(3)		101k (1994)
India(21)		12k (1996)



source: http://en.wikipedia.org/wiki/Books_published_per_country_per_year

Example Customer Change

internet: broadband penetration

	Q1 '04	Q2 '04	growth in Q2 '04
Asia Pacific total	48M	54M	12.8%
China	15M	19M	26.1%
India	87k	189k	116.8%

http://www.apira.org/download/world_broadband_statistics_q2_2004.pdf

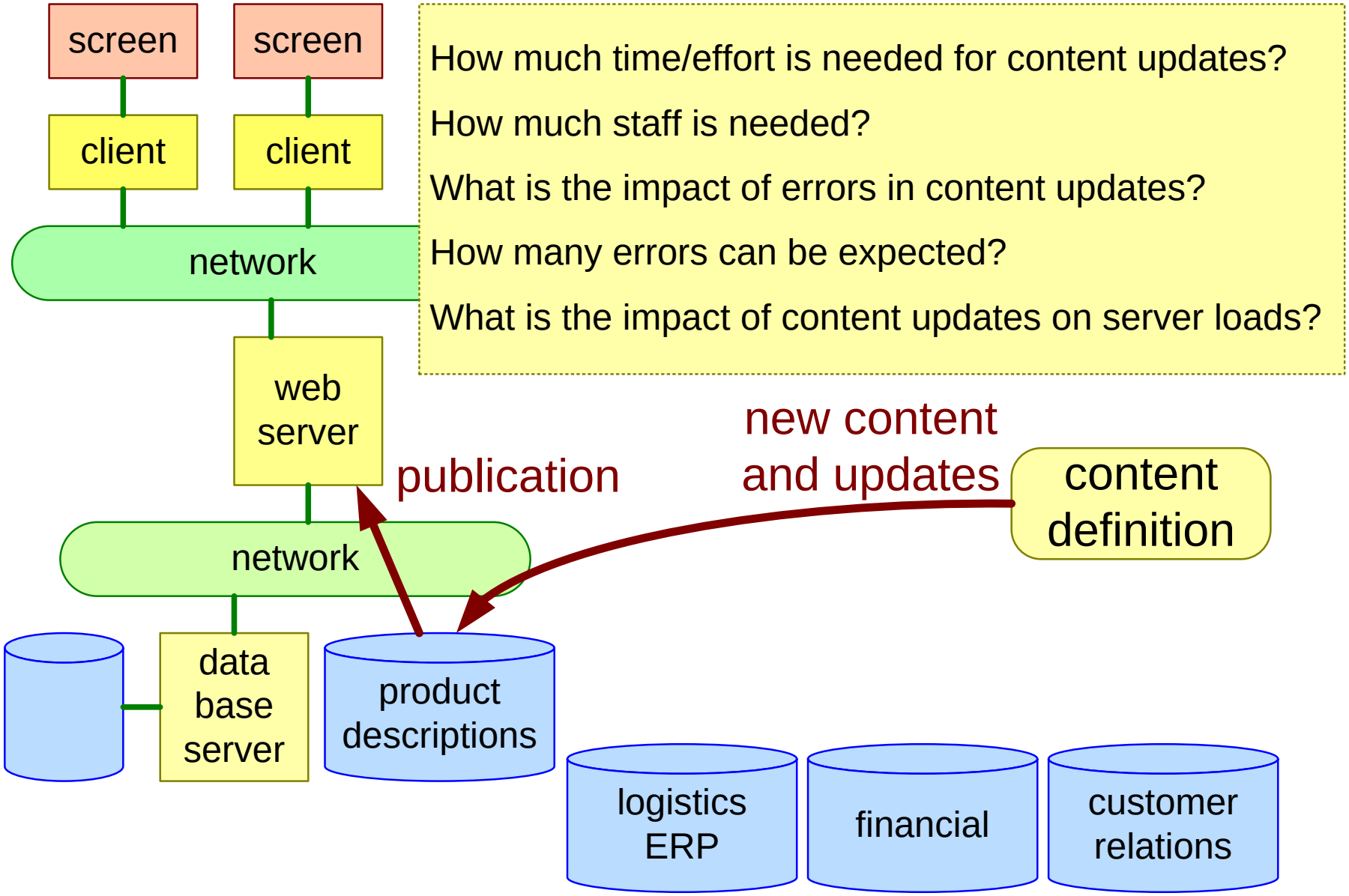
What is the expected growth of # customers?

What is the impact on system and infrastructure?

What is the impact on CRM (Customer Relation Management)?

What is the impact on customer, sales support staff?

Web Shop Content Update



Web Shop Content Change Effort

prepare change 1	prepare change 2		prepare change n

review input
select info
layout&cosmetics
check-in

verify change 1		verify change n

inspect source
inspect result

commit changes

$$effort_{changes} = n_{changes}*(t_{prepare} + t_{verify})+t_{commit}$$

$$\#fte = effort_{changes} / hours\ per\ day$$

$n_{changes}$ per day	10	100	1000
$effort_{changes}$	1 uur	10 uur	100 uur
#fte	0.1	1	12

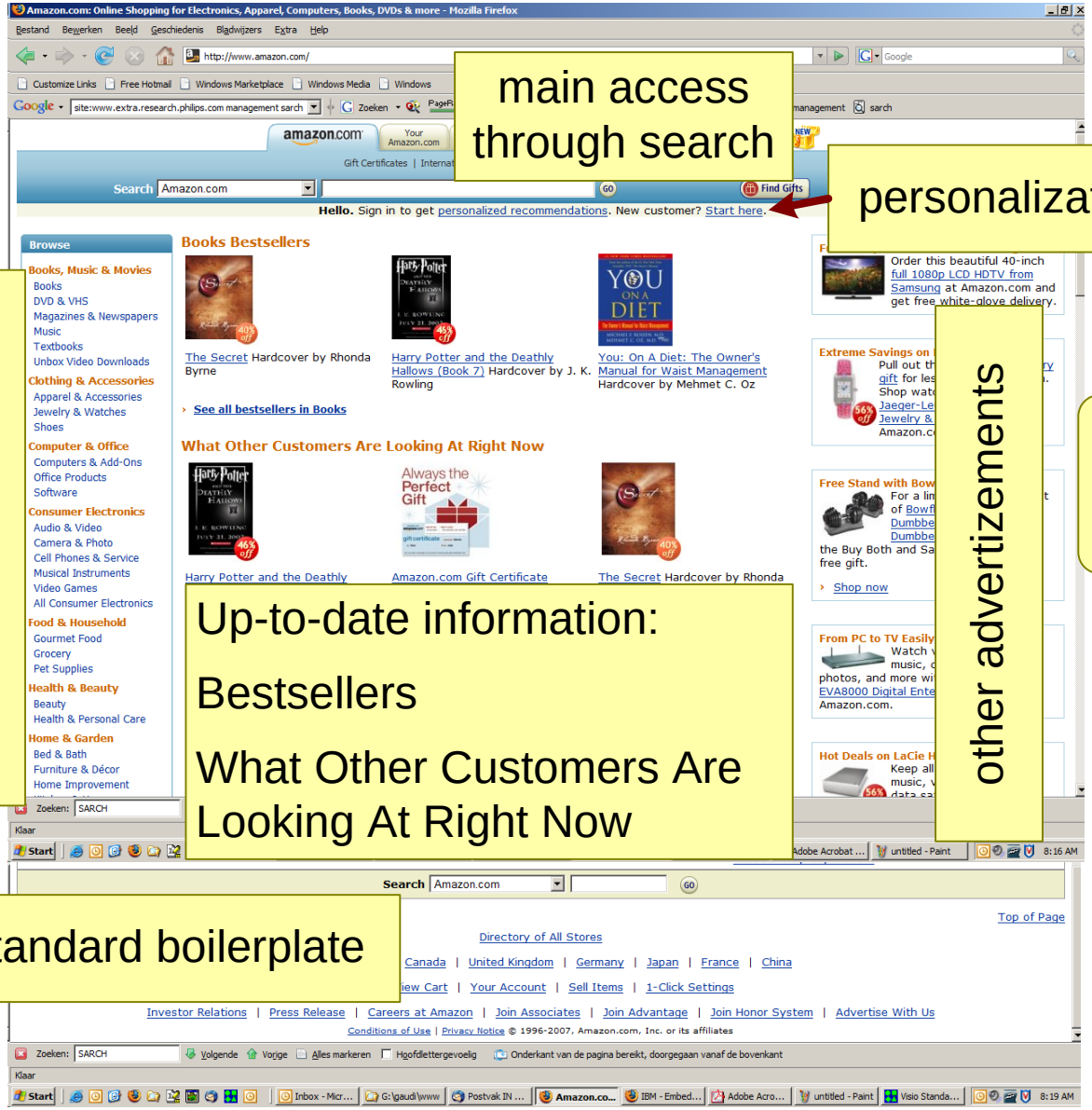
with $t_{prepare}$ = 4 min

t_{verify} = 2 min

t_{commit} = 1 min

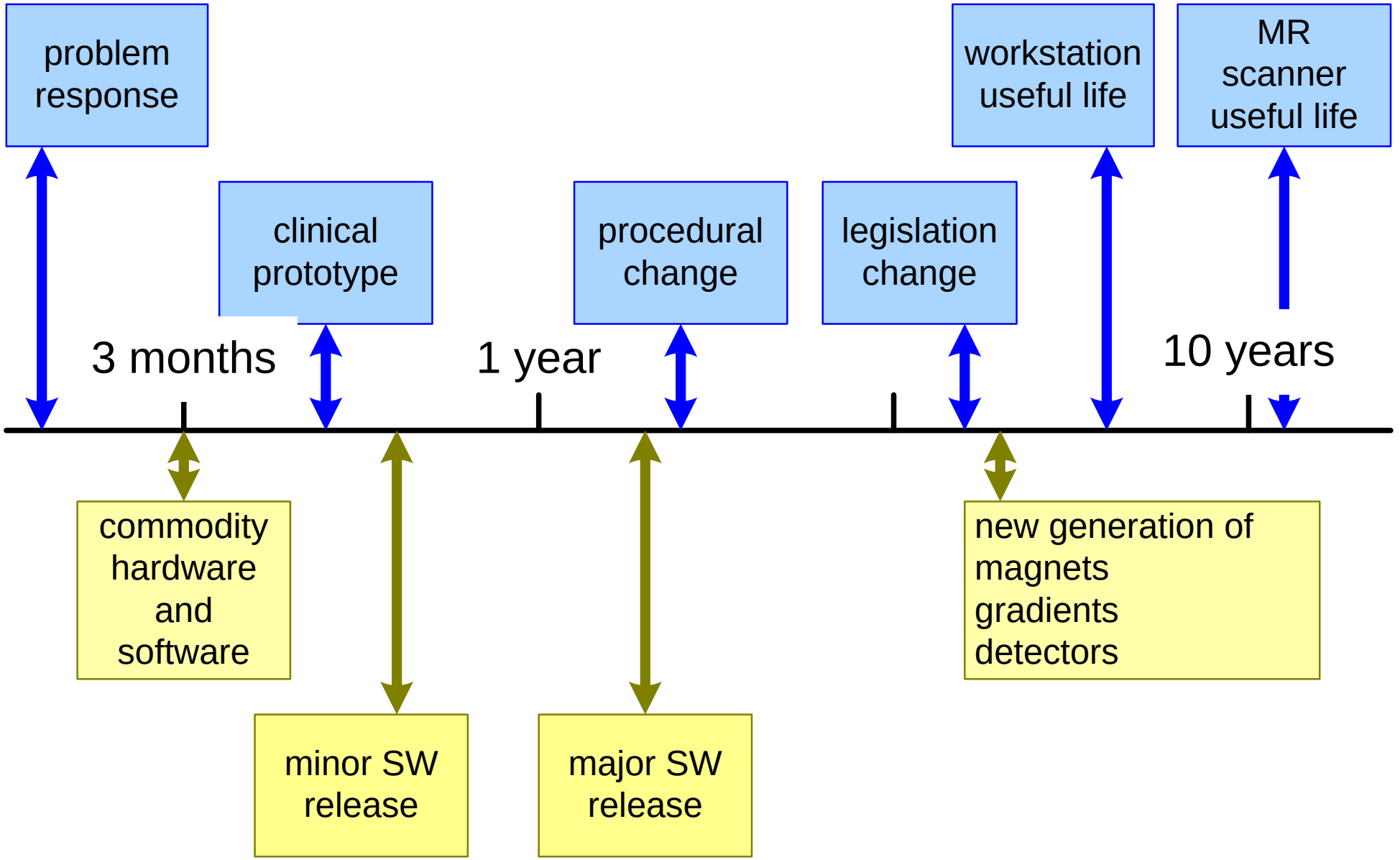
hours per day = 8 hours

Example of Client Level Changes

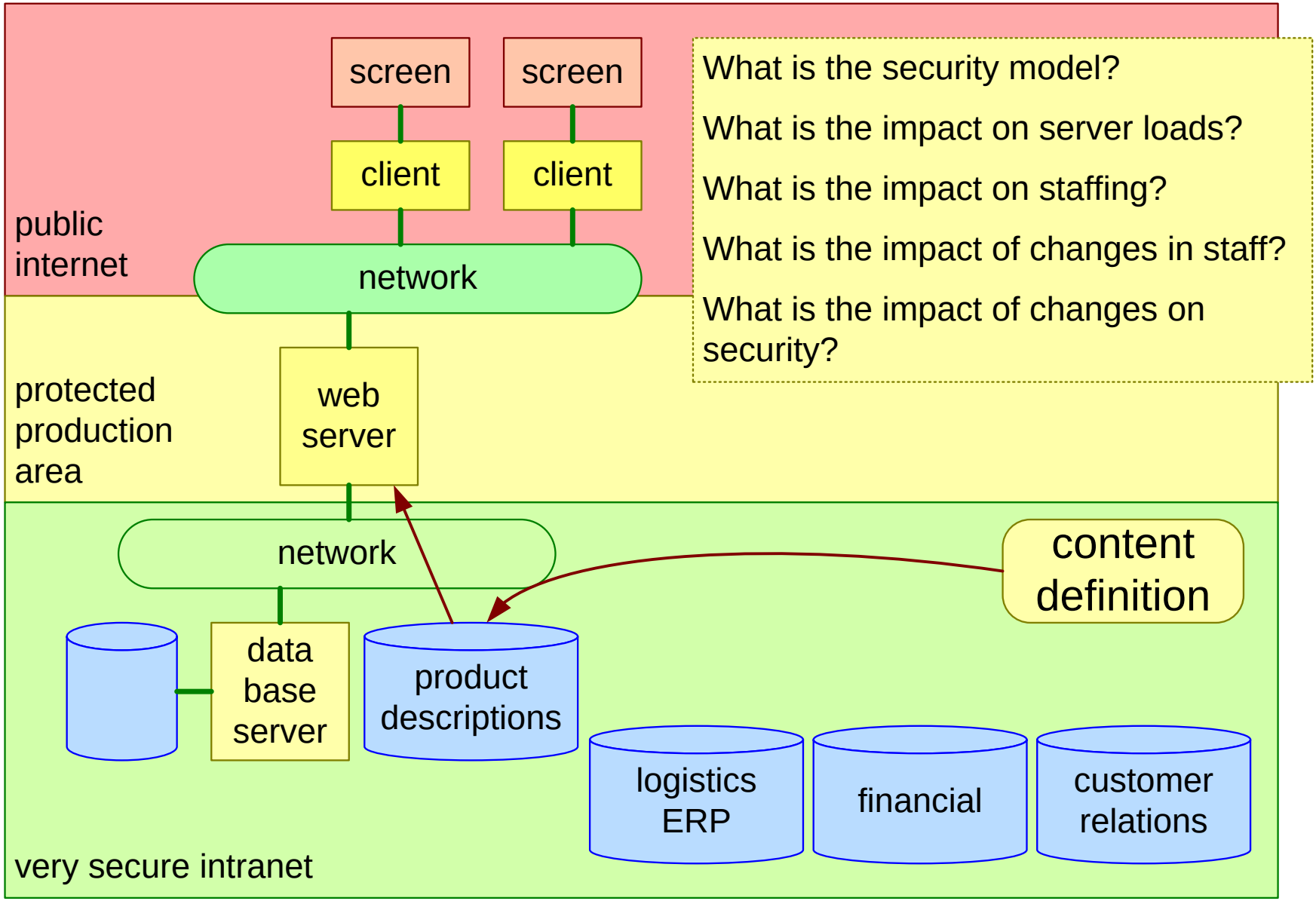


snapshot of www.amazon.com

Example of Time Scale Model for Changes



Web Shop Security and Changes



Web Shop Reliability and Changes

new faults = average fault density * #changes

$$\#\text{errors} = \sum_{\text{faults}} f(\text{severity}, \text{hit probability}, \text{detection probability})$$

	severity	hit probability	detection probability
Jansen iso *Janssen*	low	high	low
operator iso *sales repr*	high	high	medium

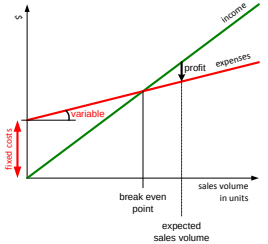
Simplistic Financial Computations for System Architects.

by *Gerrit Muller* USN-SE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

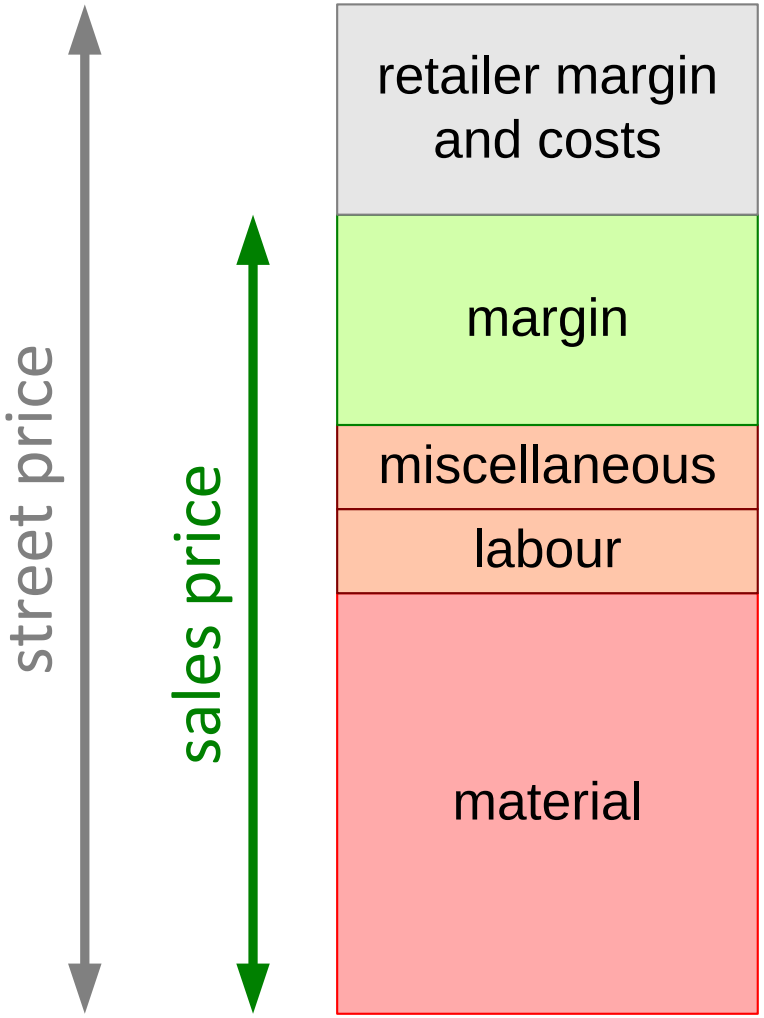
Abstract

This document explains how simple financial estimates can be made by system architects. These simplistic estimates are useful for an architect to perform sanity checks on proposals and to obtain understanding of the financial impact of proposals. Note that architects will never have full fledged financial controller know how and skills. These estimates are zero order models, but real business decisions will have to be founded on more substantial financial proposals.

March 27, 2021
status: preliminary draft
version: 1.3



Product Margin = Sales Price - Cost



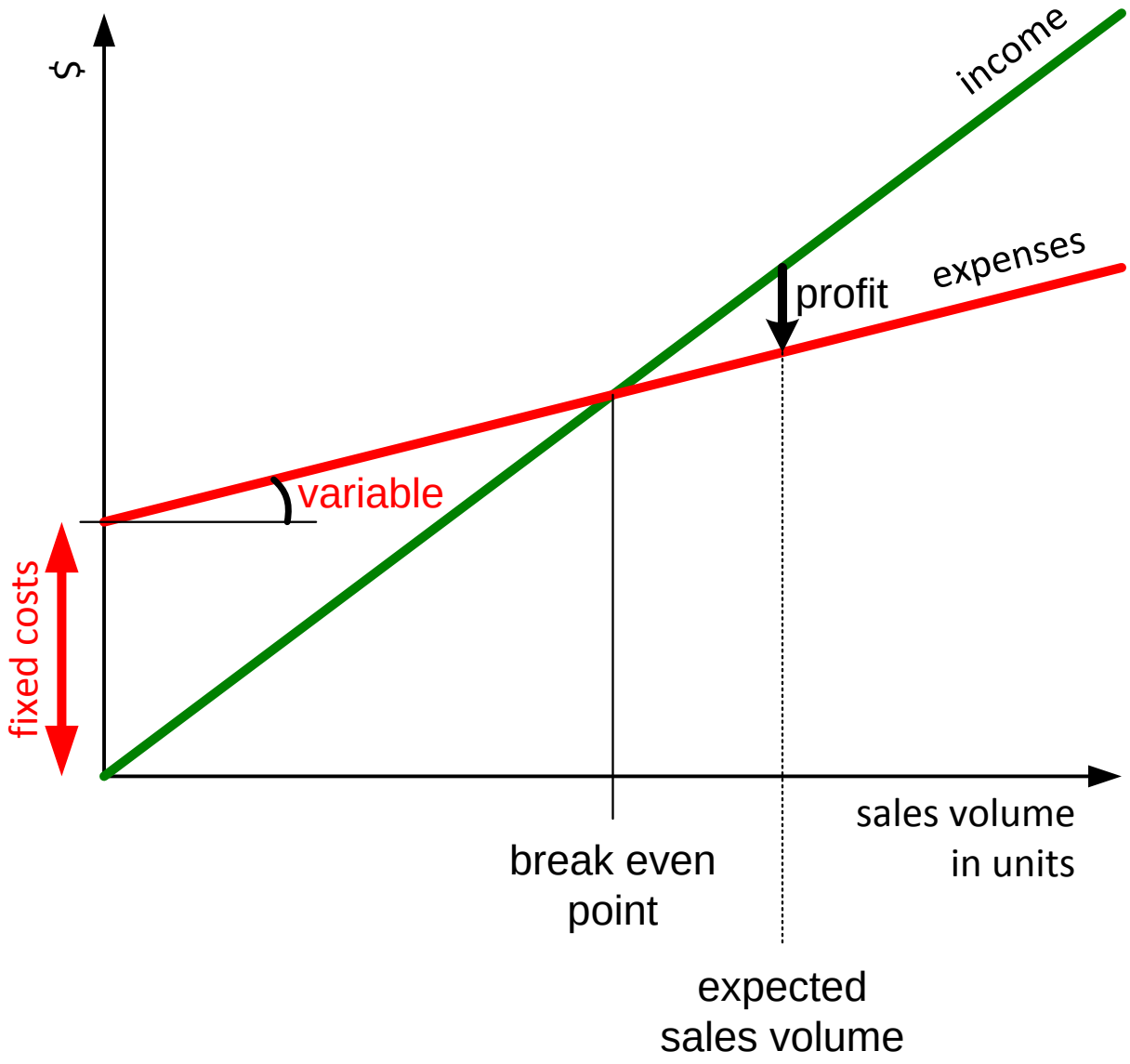
Margin per product.
The margin over the sales volume,
must cover the fixed costs, and generate profit

transportation, insurance,
royalties per product, ...

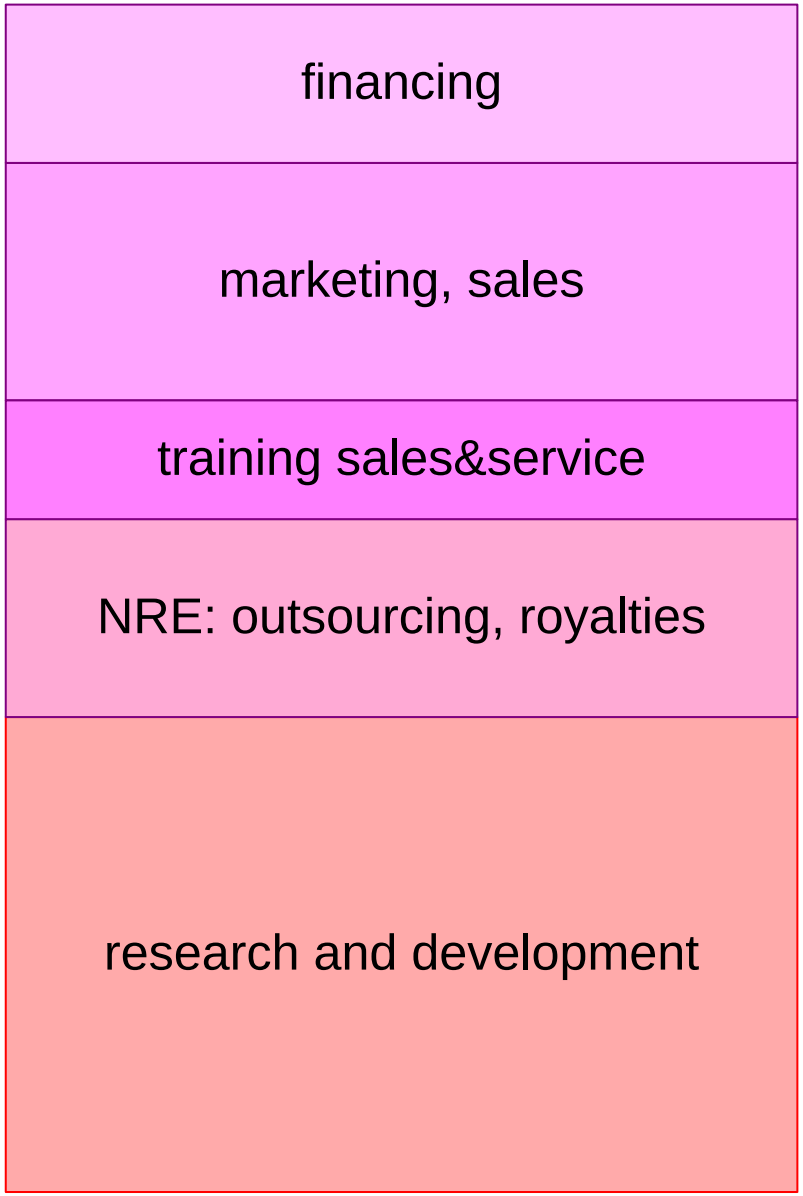
Cost per product,
excluding fixed costs

purchase price of components may cover
development cost of supplier

Profit as function of sales volume



Investments, more than R&D



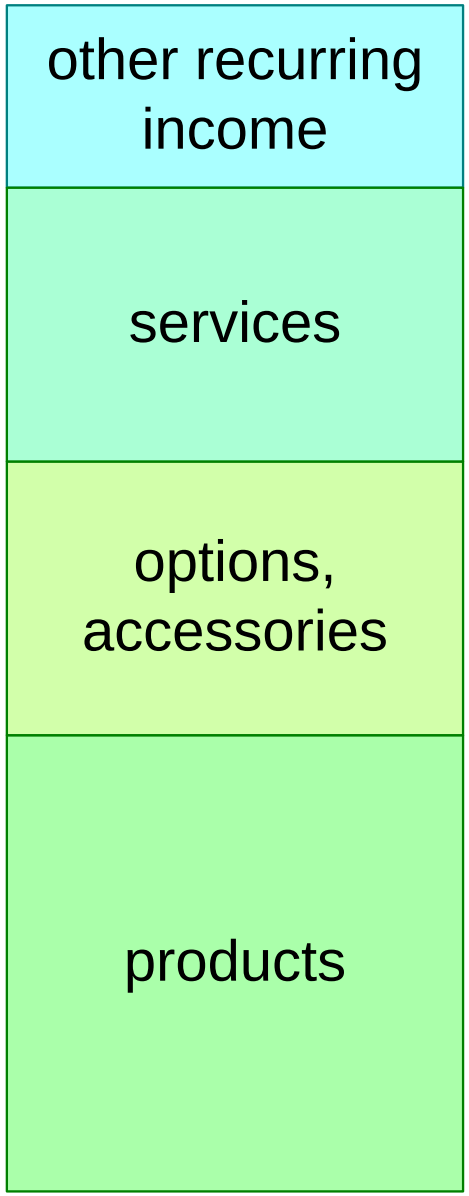
business dependent:
pharmaceutics industry
sales cost >> R&D cost

strategic choice:
NRE or per product

including:
- staff, training, tools, housing
- materials, prototypes
- overhead
- certification

often a standard staffing rate is used
that covers most costs above:
R&D investment = Effort * rate

Income, more than product sales only



$$\sum_{\text{services}} \text{income}_{\text{service}}$$

$$\sum_{\text{options}} \text{sales price}_{\text{option}} * \text{volume}_{\text{option}}$$

$$\text{sales price}_{\text{product}} * \text{volume}_{\text{product}}$$

license fees
pay per movie

content, portal
updates
maintenance

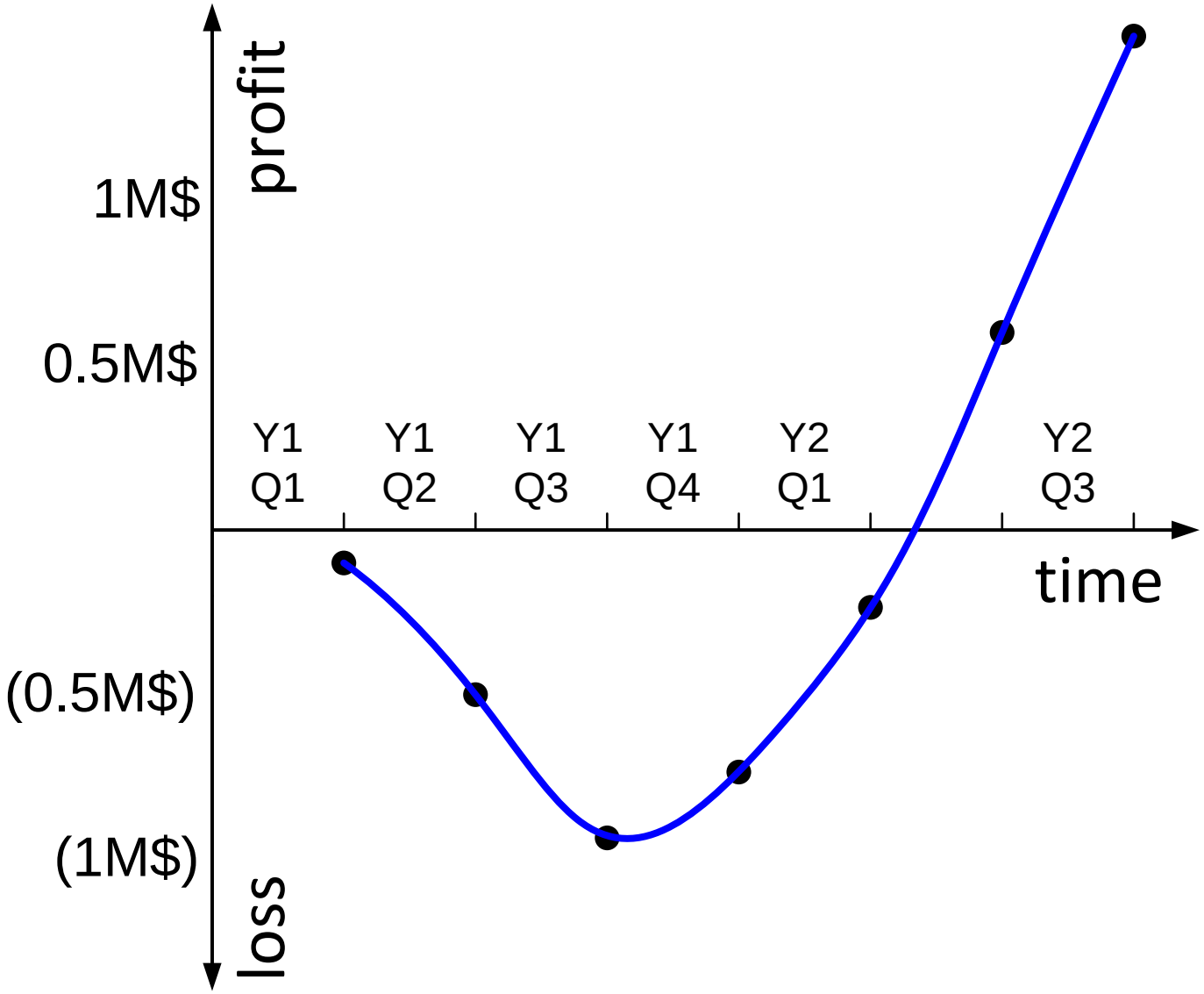
The Time Dimension

	Y1 Q1	Y1 Q2	Y1 Q3	Y1 Q4	Y2 Q1	Y2 Q2	Y2 Q3
investments	100k$	400k$	500k$	100k$	100k$	60k$	20k$
sales volume (units)	-	-	2	10	20	30	30
material & labour costs	-	-	40k$	200k$	400k$	600k$	600k$
income	-	-	100k$	500k$	1000k$	1500k$	1500k$
quarter profit (loss)	(100k$)	(400k$)	(440k$)	200k$	500k$	840k$	880k$
cumulative profit	(100k$)	(500k$)	(940k$)	(740k$)	(240k$)	600k$	1480k$

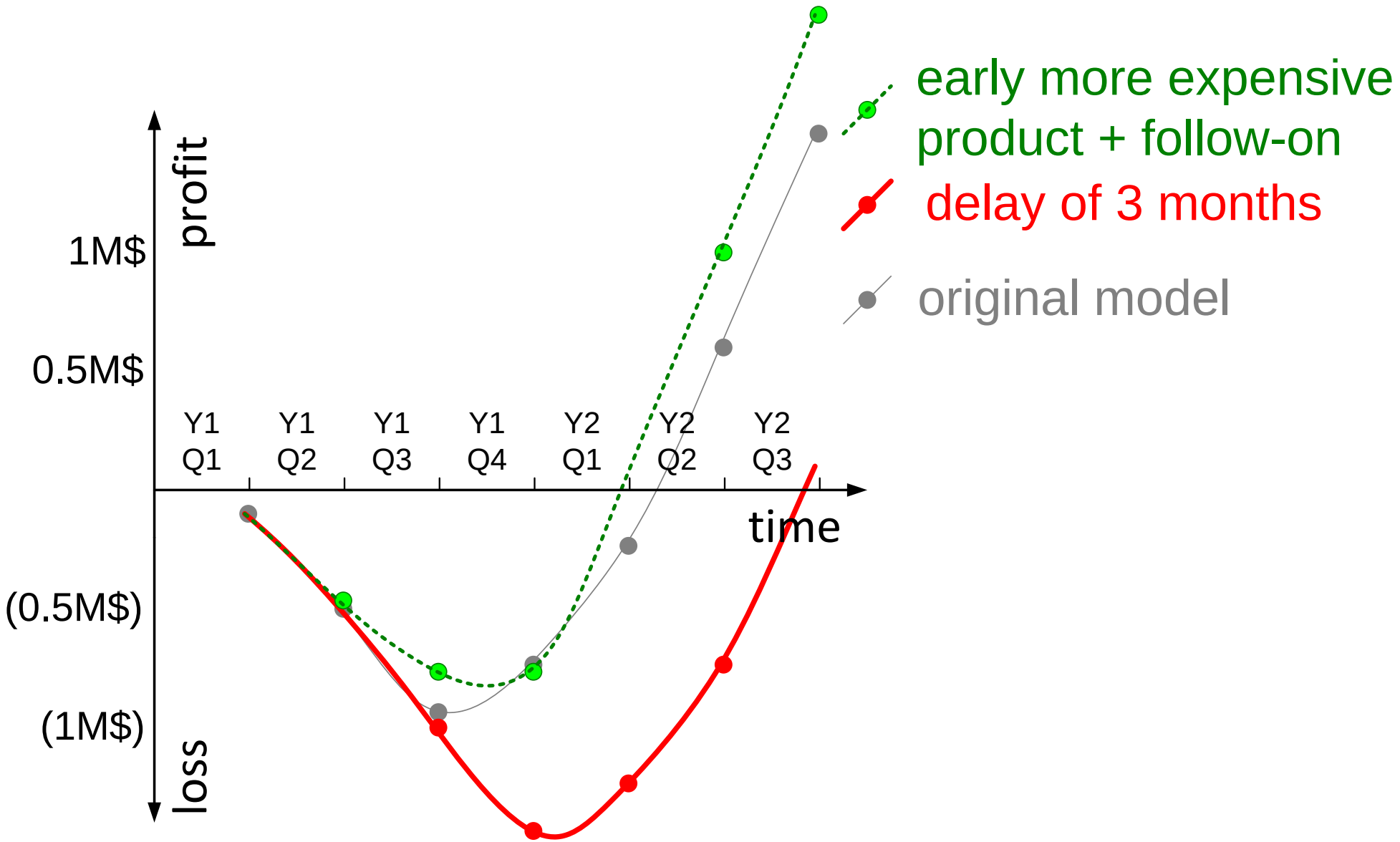
cost price / unit = 20k$
sales price / unit = 50k$

variable cost = sales volume * cost price / unit
income = sales volume * sales price / unit
quarter profit = income - (investments + variable costs)

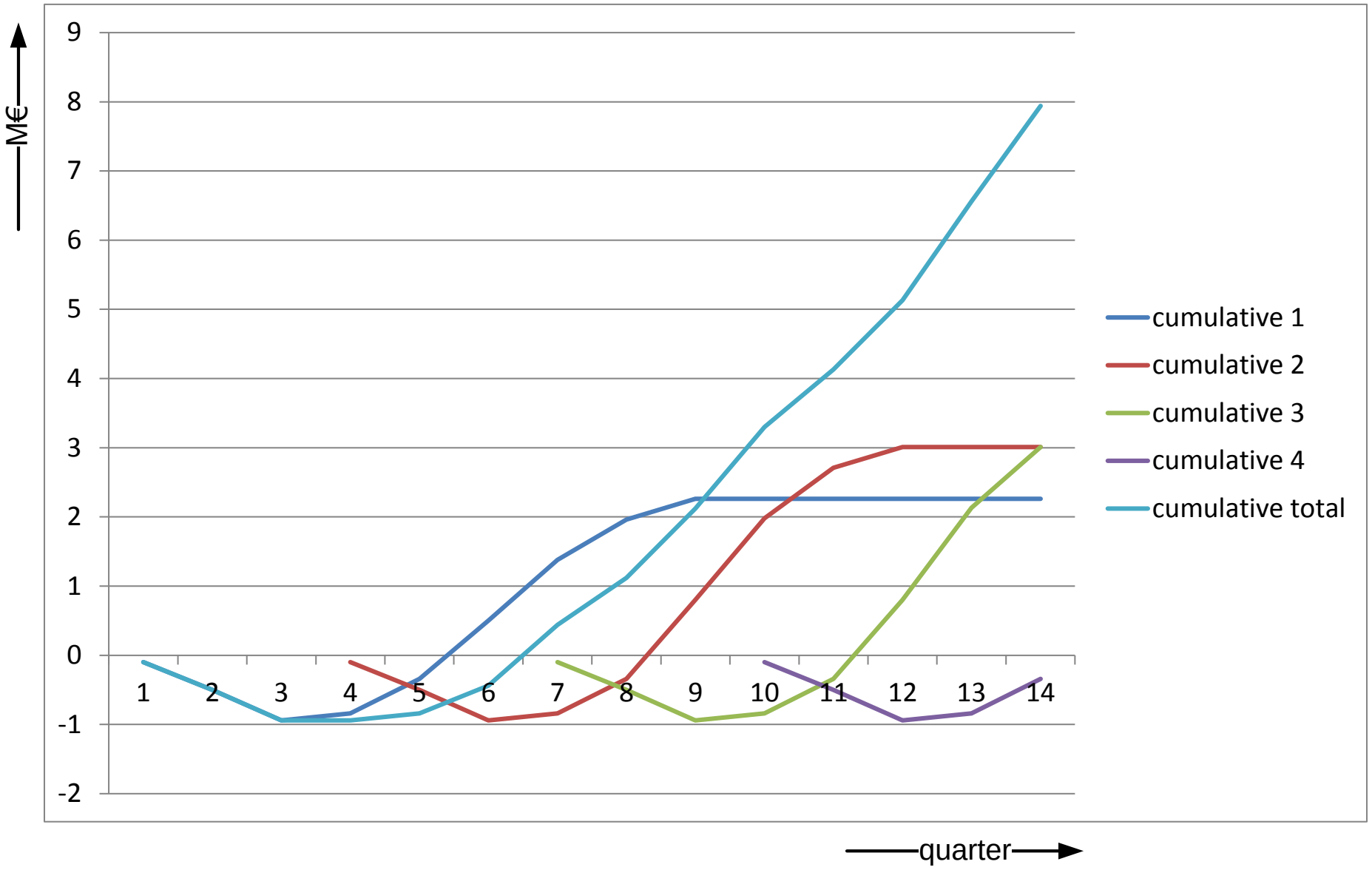
The “Hockey” Stick



What if ...?


profit
1M$
0.5M$
(0.5M$)
(1M$)
loss
Y1 Q1
Y1 Q2
Y1 Q3
Y1 Q4
Y2 Q1
Y2 Q2
Y2 Q3
time
early more expensive product + follow-on
delay of 3 months
original model

Stacking Multiple Developments



Fashionable financial yardsticks

Return On Investments (ROI)

Net Present Value

Return On Net Assets (RONA) leasing reduces assets, improves RONA

turnover / fte outsourcing reduces headcount, improves this ratio

market ranking (share, growth) "only numbers 1, 2 and 3 will be profitable"

R&D investment / sales in high tech segments 10% or more

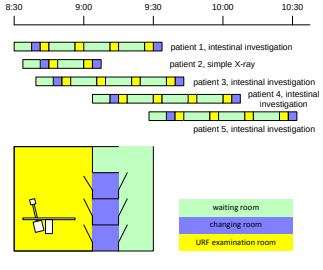
cash-flow fast growing companies combine profits with negative cash-flow, risk of bankruptcy

The application view

by *Gerrit Muller* University of South-Eastern Norway-NISE
e-mail: gaudisite@gmail.com
www.gaudisite.nl

Abstract

The purpose of the application view is described. A number of methods or models is given to use in this view: stakeholder and concerns, context diagram, static entity relationship models and dynamic flow models.

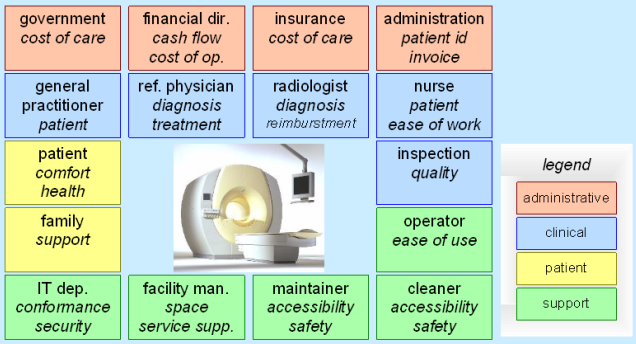


March 27, 2021
status: preliminary draft
version: 0.2

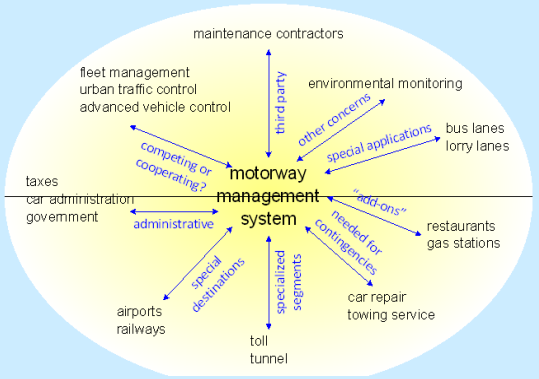
Application view overview

Customer objectives | **Application** | Functional | Conceptual | Realisation

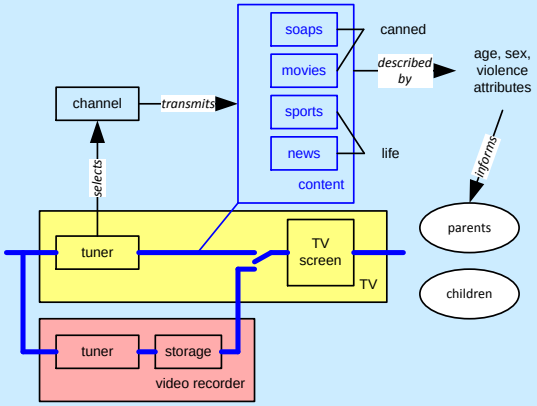
stakeholders and concerns



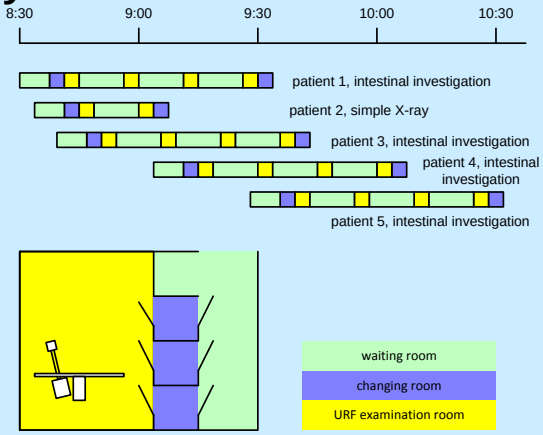
context diagrams



entity relationship models



dynamic models



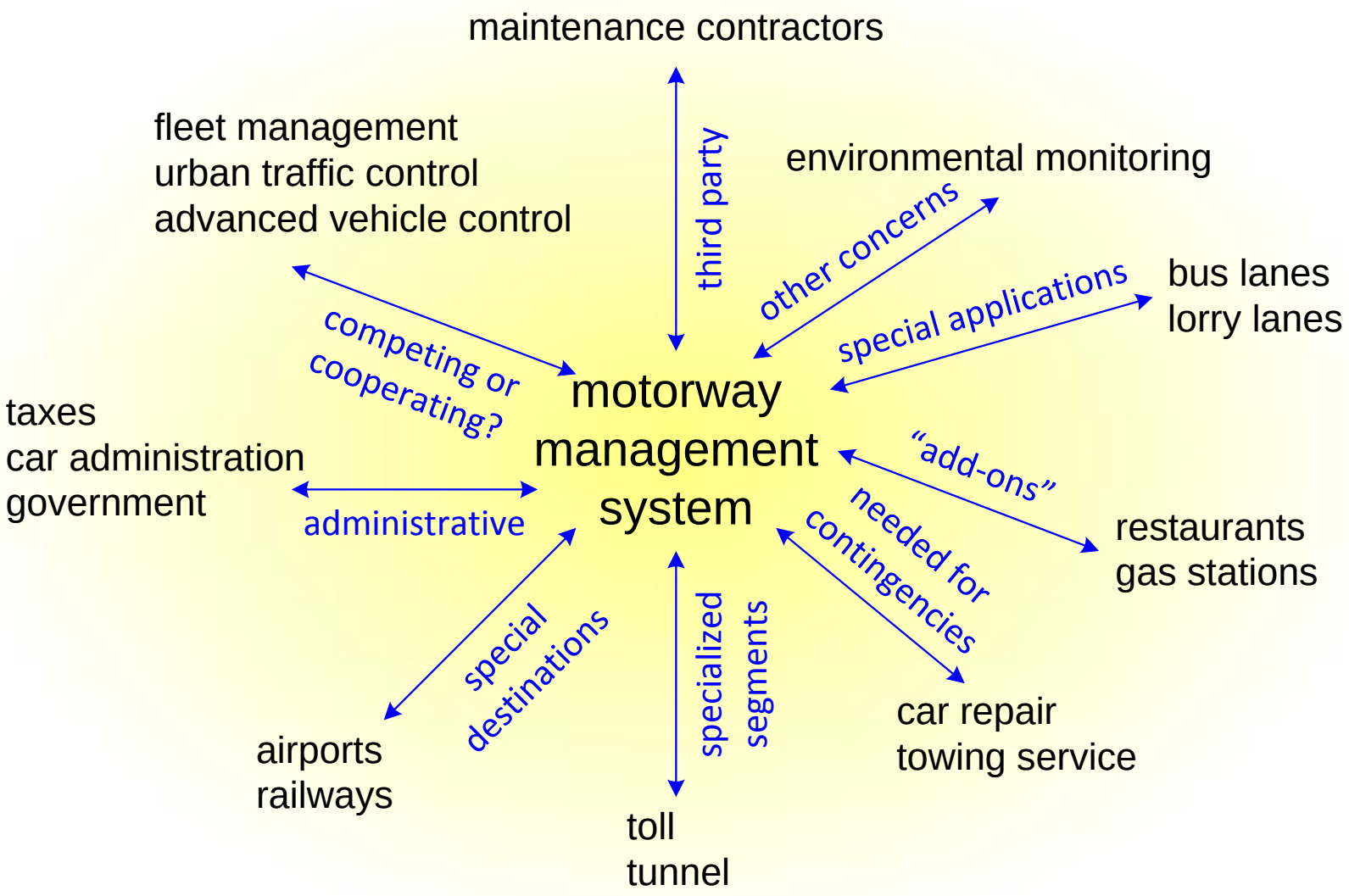
Stakeholders and concerns MRI scanner

government *cost of care*	financial dir. *cash flow cost of op.*	insurance *cost of care*	administration *patient id invoice*
general practitioner *patient*	ref. physician *diagnosis treatment*	radiologist *diagnosis reimburstment*	nurse *patient ease of work*
patient *comfort health*			inspection *quality*
family *support*			operator *ease of use*
IT dep. *conformance security*	facility man. *space service supp.*	maintainer *accessibility safety*	cleaner *accessibility safety*

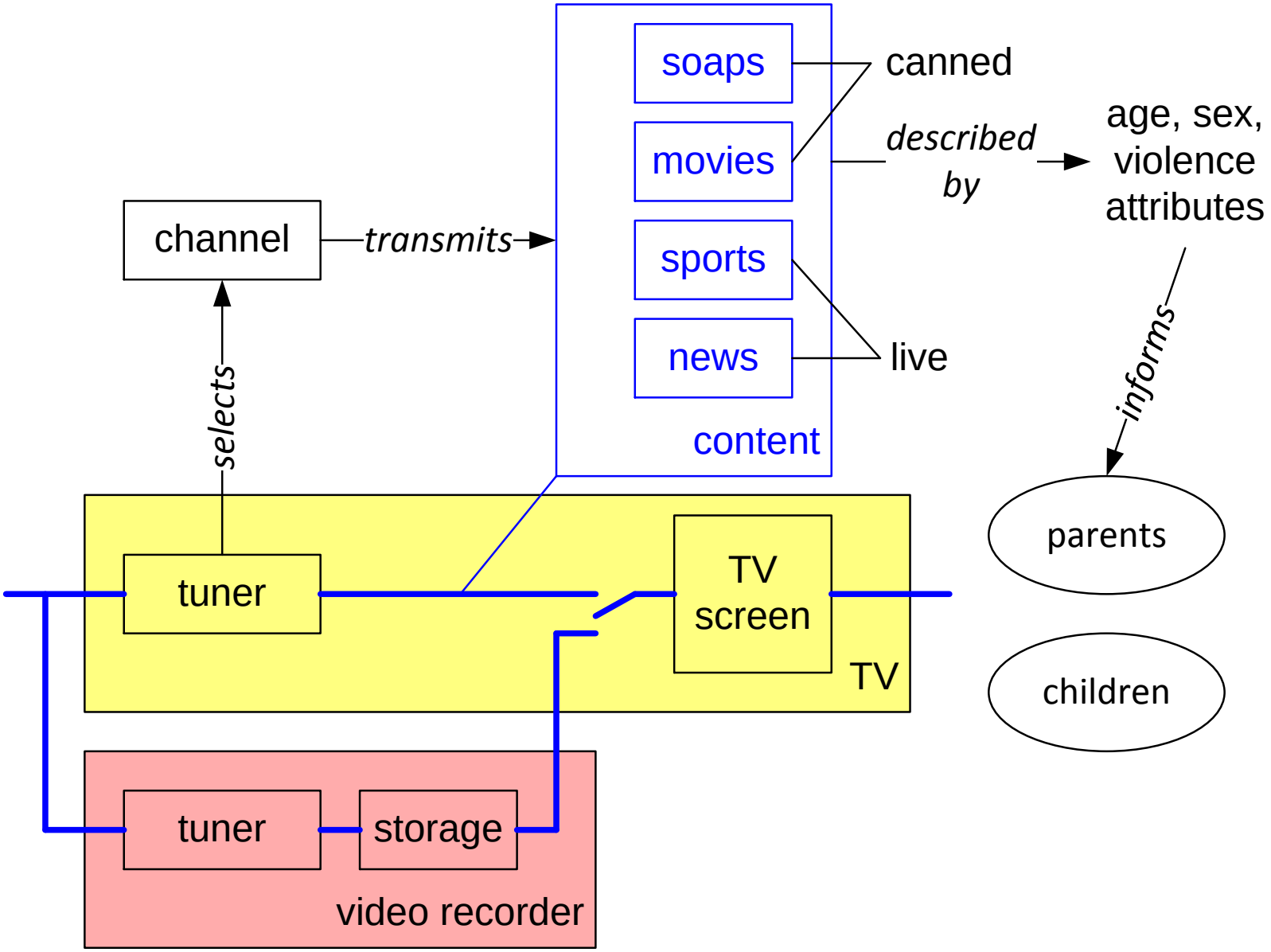
legend

- administrative
- clinical
- patient
- support

Context of motorway management system

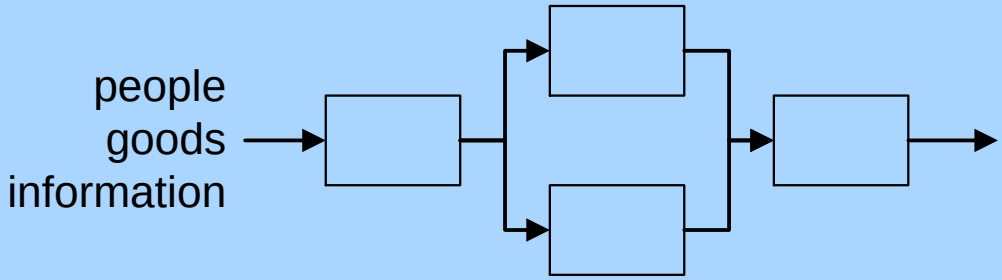


Example of simple TV application model

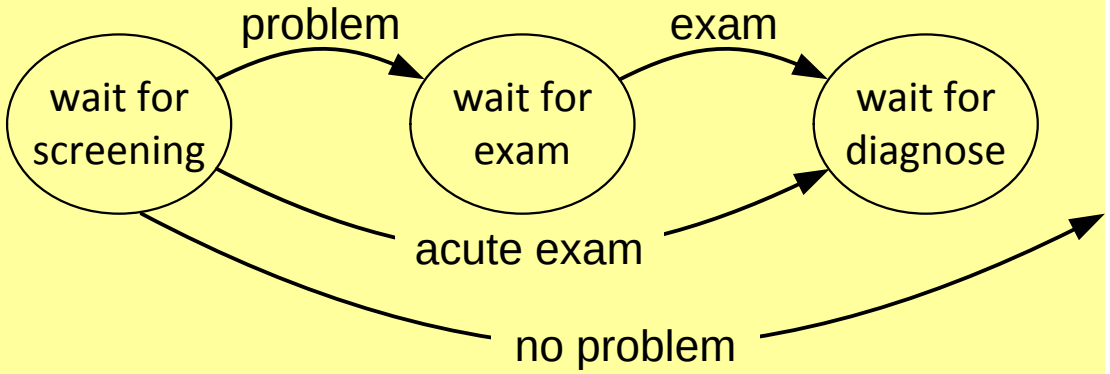


Examples of dynamic models

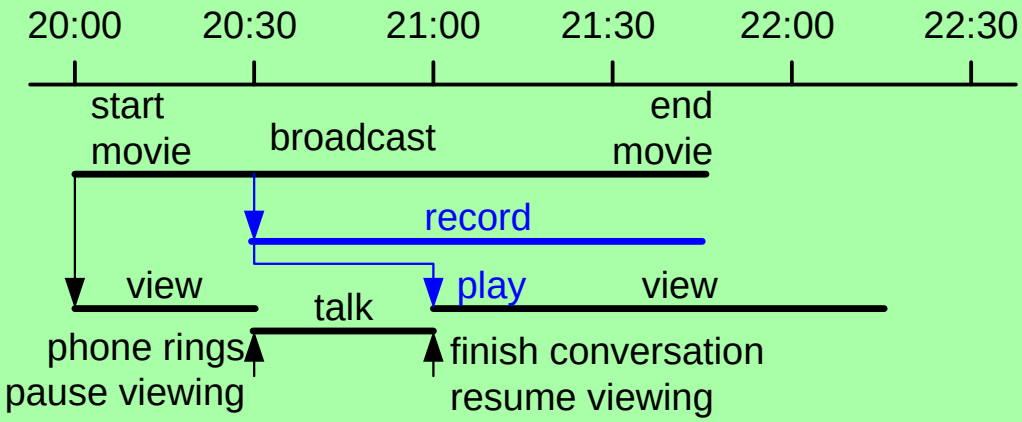
flow models



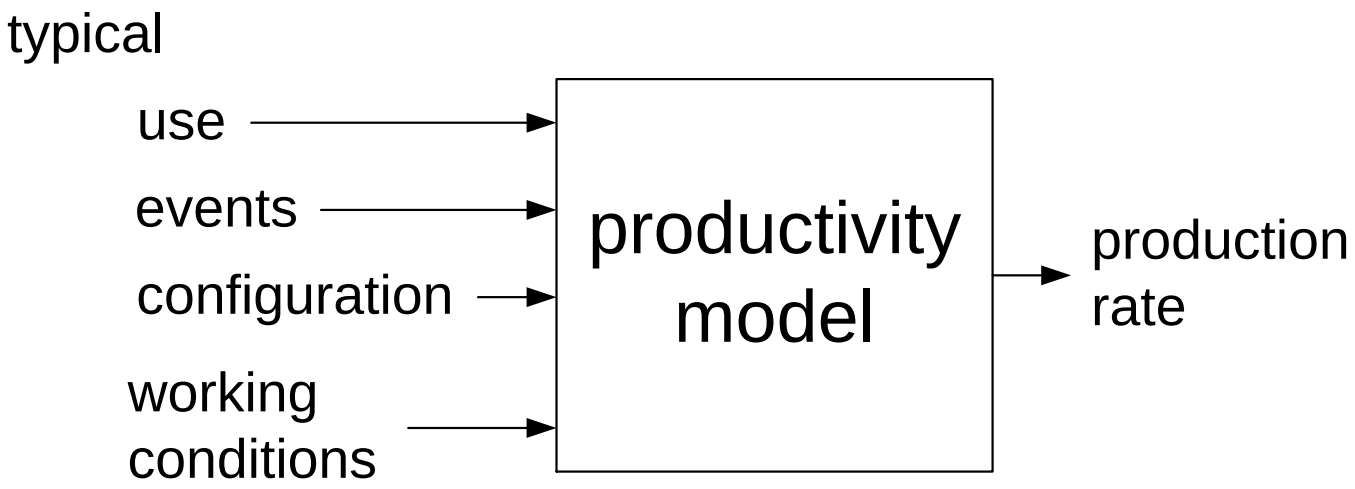
state diagrams



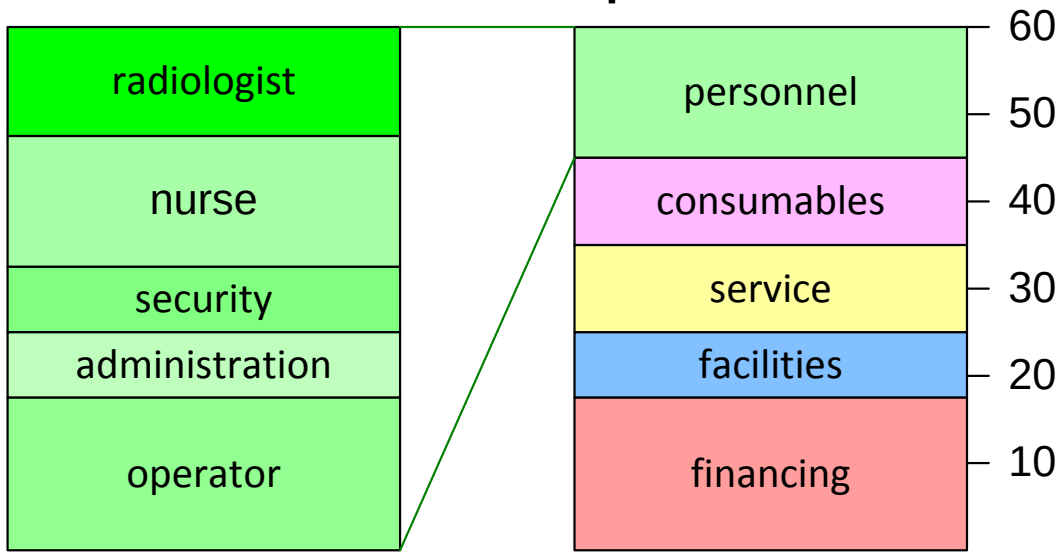
time line



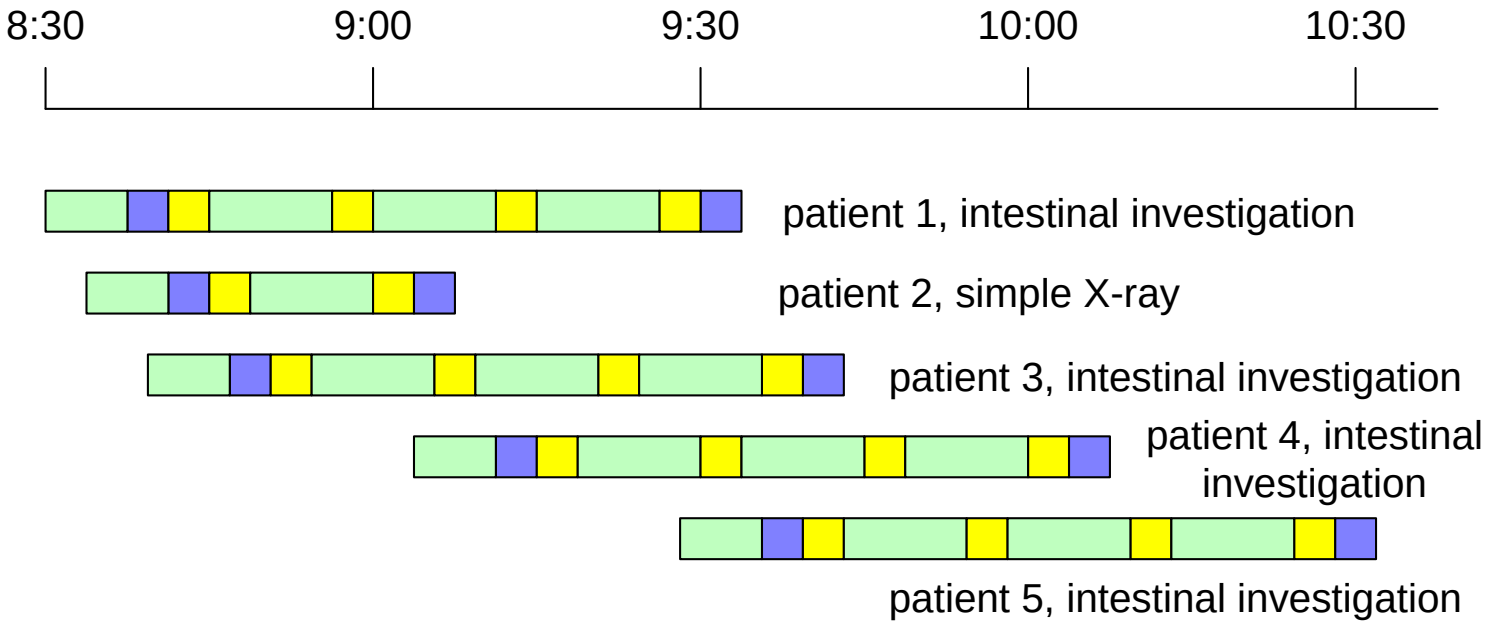
Productivity and Cost models

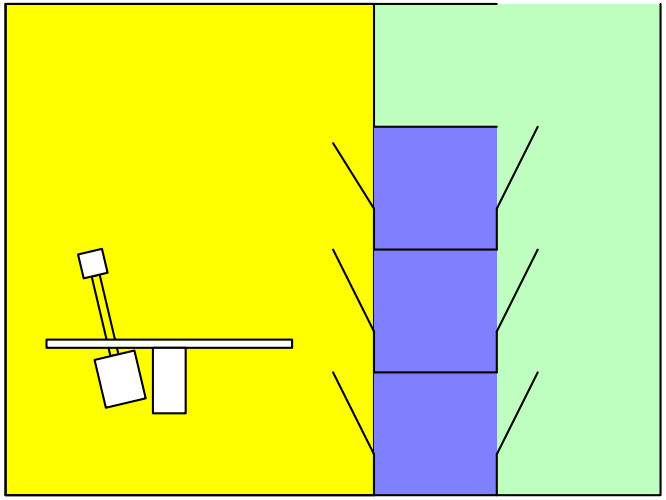


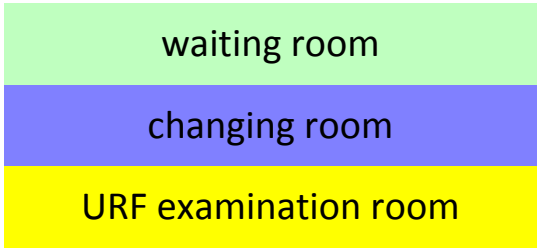
Cost Of Ownership model



Dynamics of an URF examination room







Exercise

Make a context diagram:

- What other related systems and applications are used?
- How do these relate with our system
- Visualize the context as diagram
- Make supporting diagrams for main application views

Reflection on Exercise

+ Context diagram lift insight to a higher level

~ Our system or application is only a fraction of the customers world

- Application models can become too generic or abstract

Summary Fundamentals of Application

Conclusions

Real requirements are driven by understanding of the customer's application

Complexity of finance is no excuse for ignoring all financial aspects; simplified models provide a lot of insight

Techniques, Models, Heuristics of this module

Simplistic financial models

TBD