

Module Modeling and Analysis: Application and Life Cycle Modeling

by *Gerrit Muller* HSN-NISE

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Abstract

This module addresses Modeling and Analysis Fundamentals of Application.

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

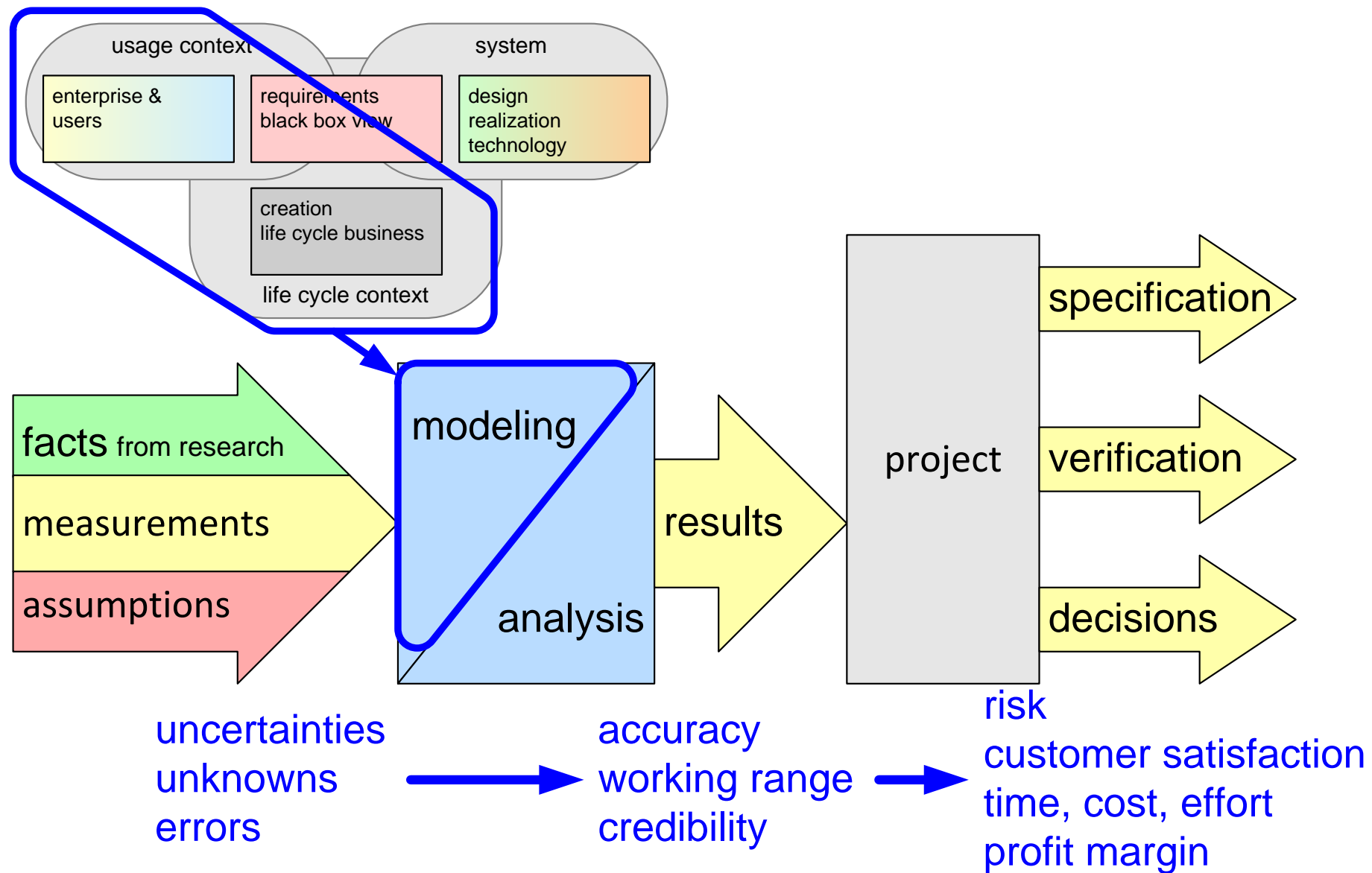
- simple cost models

- 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

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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.

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August 16, 2025
status: planned
version: 0.1

logo
TBD

Understanding Usage and Life Cycle Context

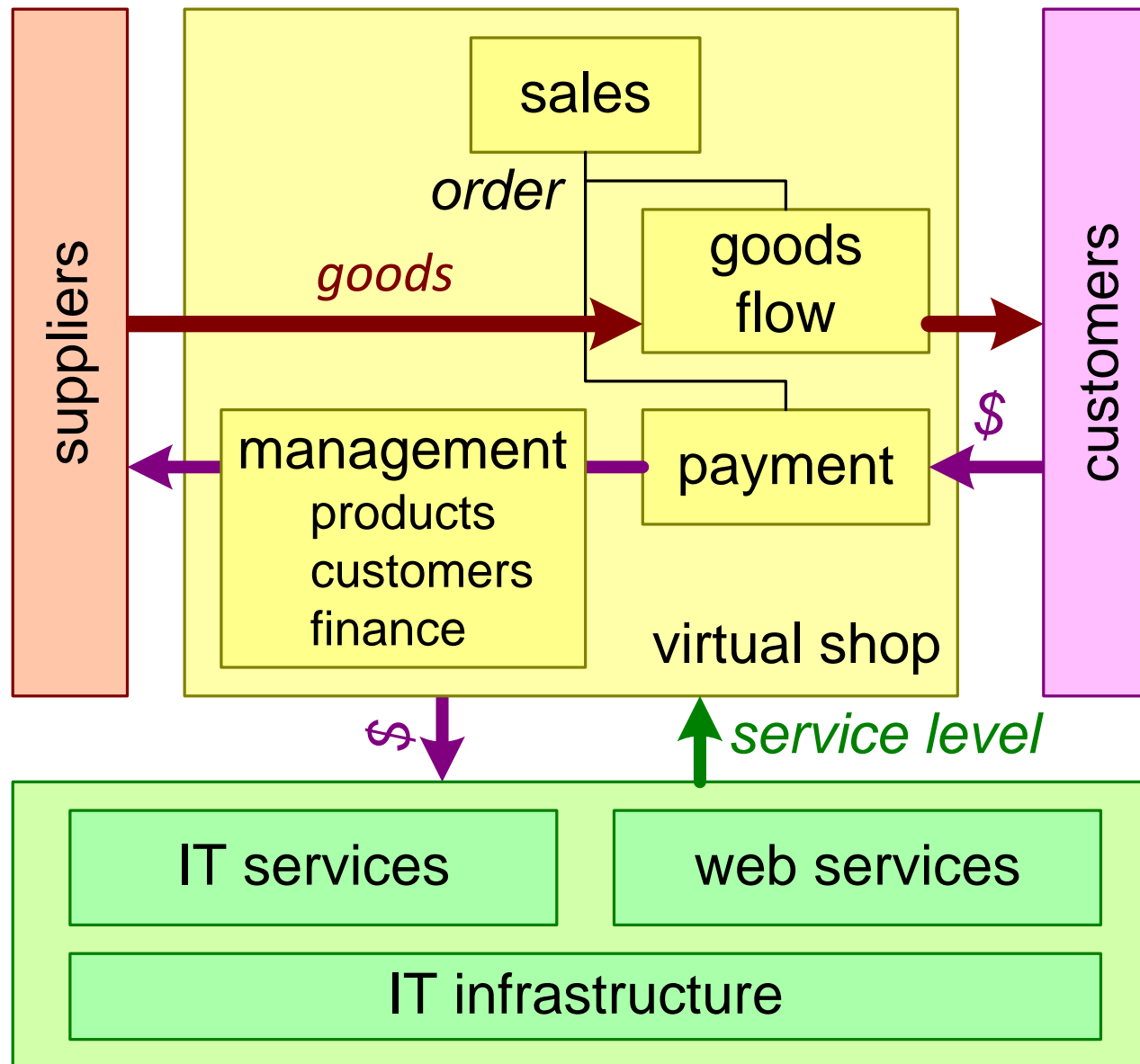
High Level Visual Models

- + 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

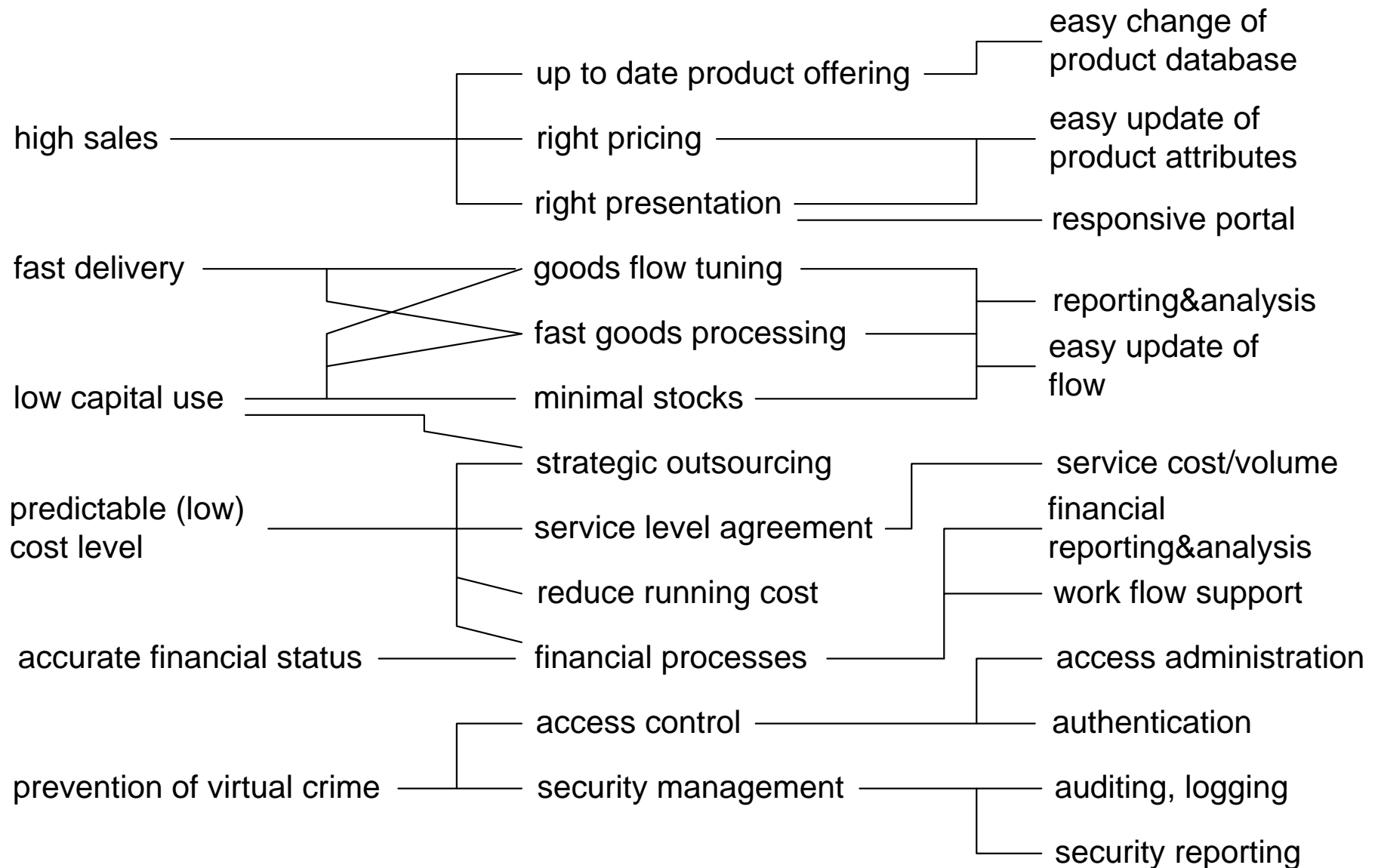
commercial
financial
legal
strategic
tactical
operational
social
technical

} relations beyond actual system!

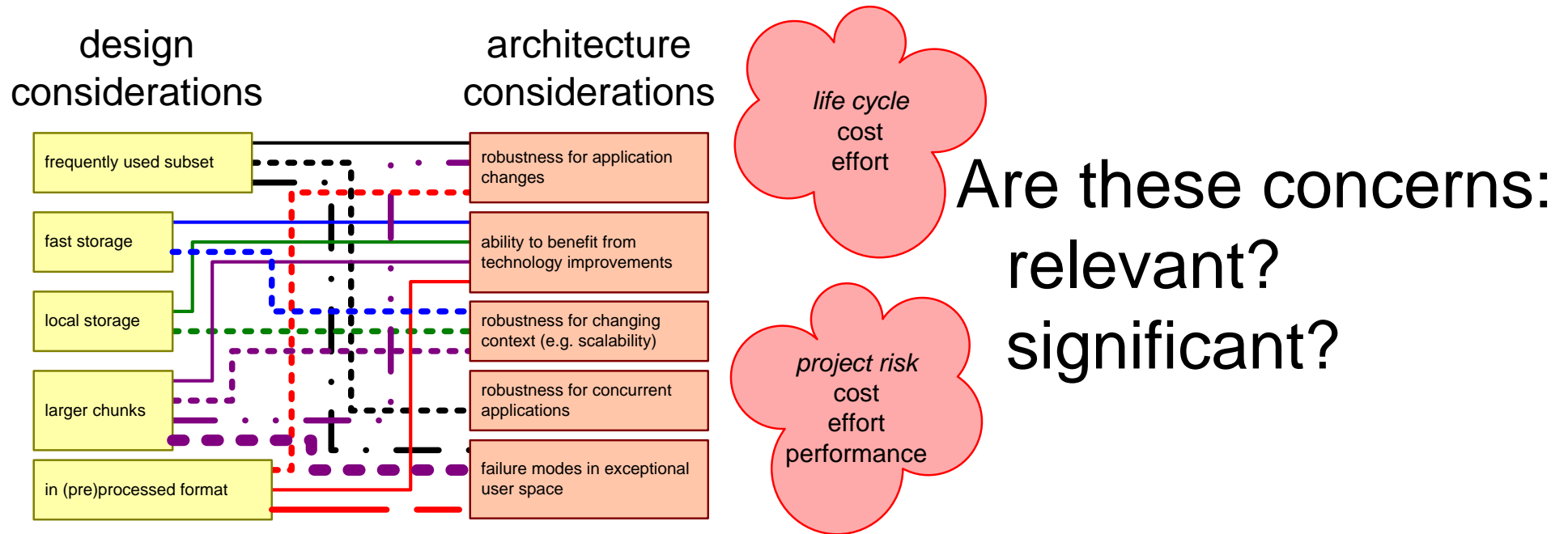
Simplified Web Shop Value Chain



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*



Zero Order Cost Model

$$\text{total cost} = f + s(v) + p * v + g * v$$

where

f = fixed base cost

s = service cost, see below

p = personnel cost including overheads

v = volume

g = goods flow handling

$$\text{service cost } s(v) = b + c * v$$

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!

$$\text{total cost} = f + s(v) + p * v + g * v$$

where

f = fixed base cost

s = service cost, see below

p = personnel cost including overheads

v = volume

g = goods flow handling

$$\begin{aligned} f &= 100k \\ p &= 1 \\ v &= 100k \\ g &= 0.1 \\ s(100k) &= 101k \end{aligned}$$

$$\text{service cost } s(v) = b + c * v$$

where

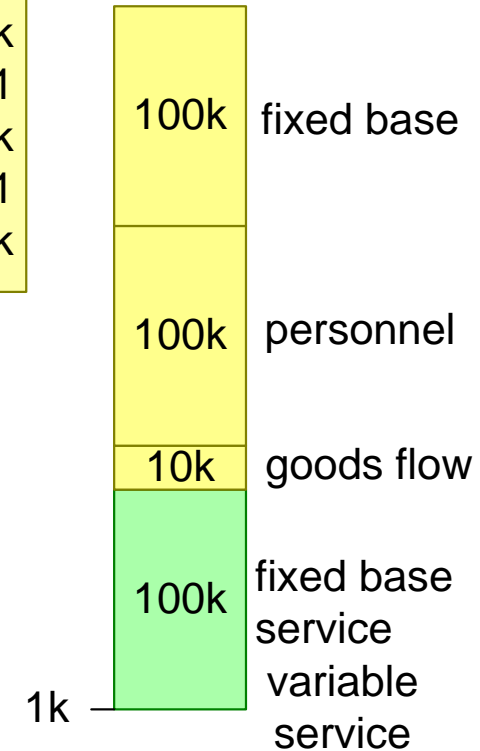
b = fixed base cost

c = cost / volume

v = volume

all including provider margin

$$\begin{aligned} b &= 100k \\ c &= 0.1 \end{aligned}$$



Example High Volume, Highly Automated, Shop

high volume, highly automated, shop

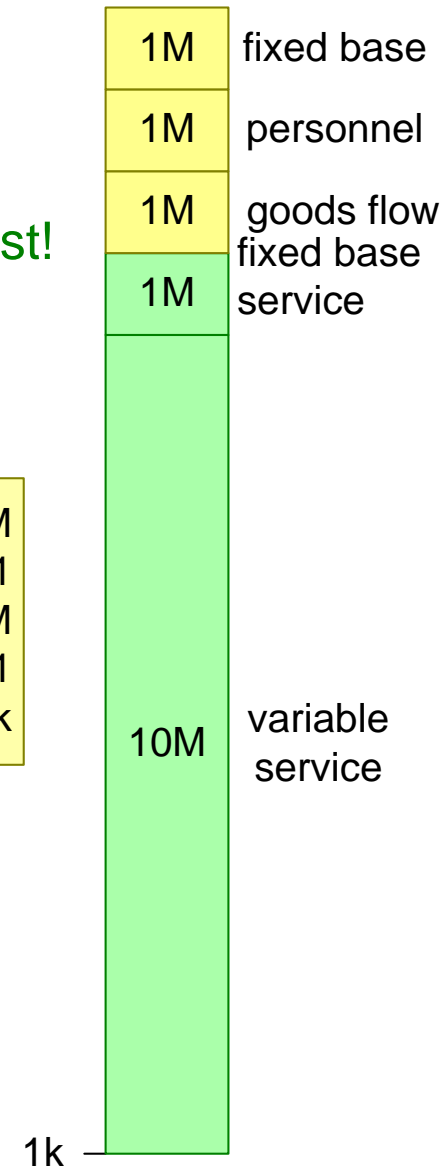
variable service costs dominate:
service cost changes have big impact on total cost!

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



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

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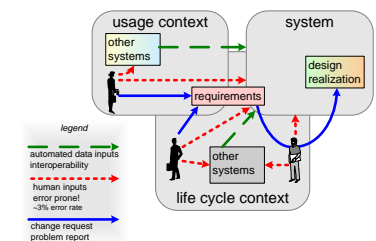
Abstract

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.

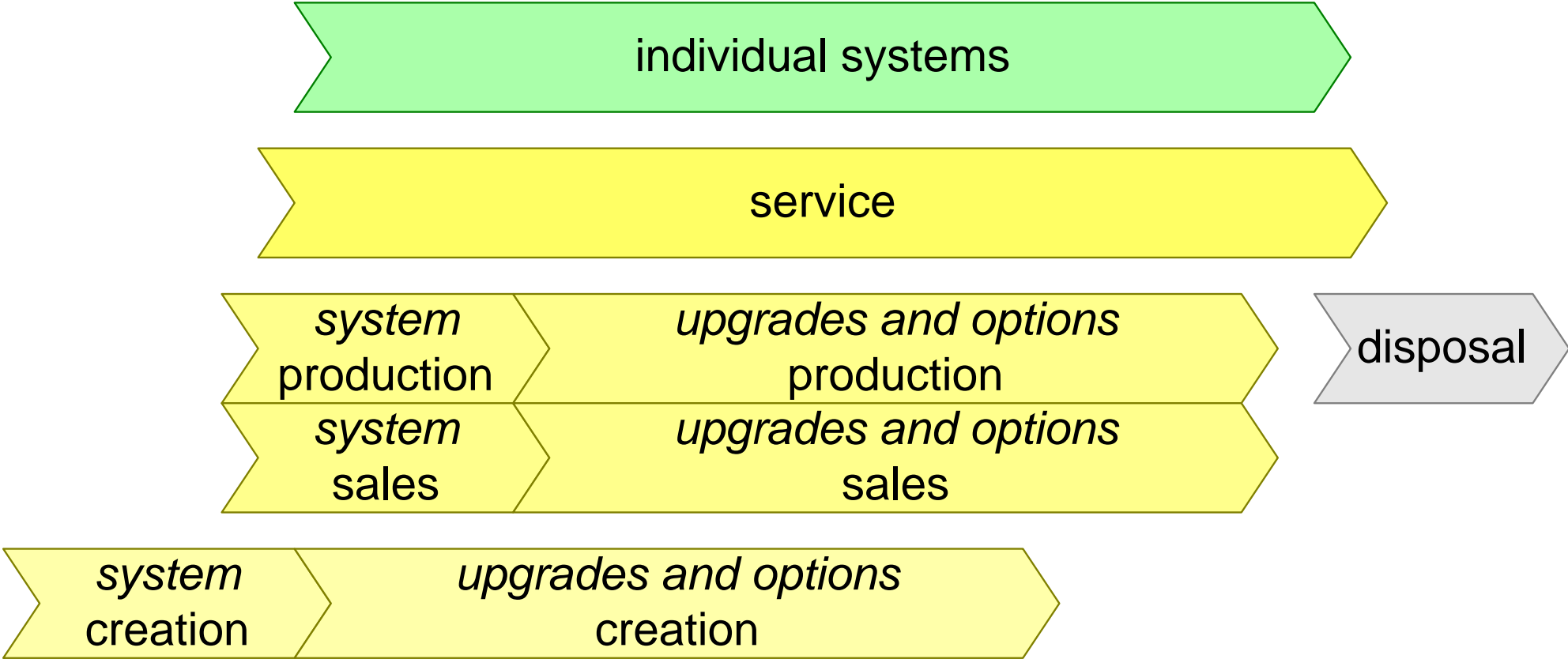
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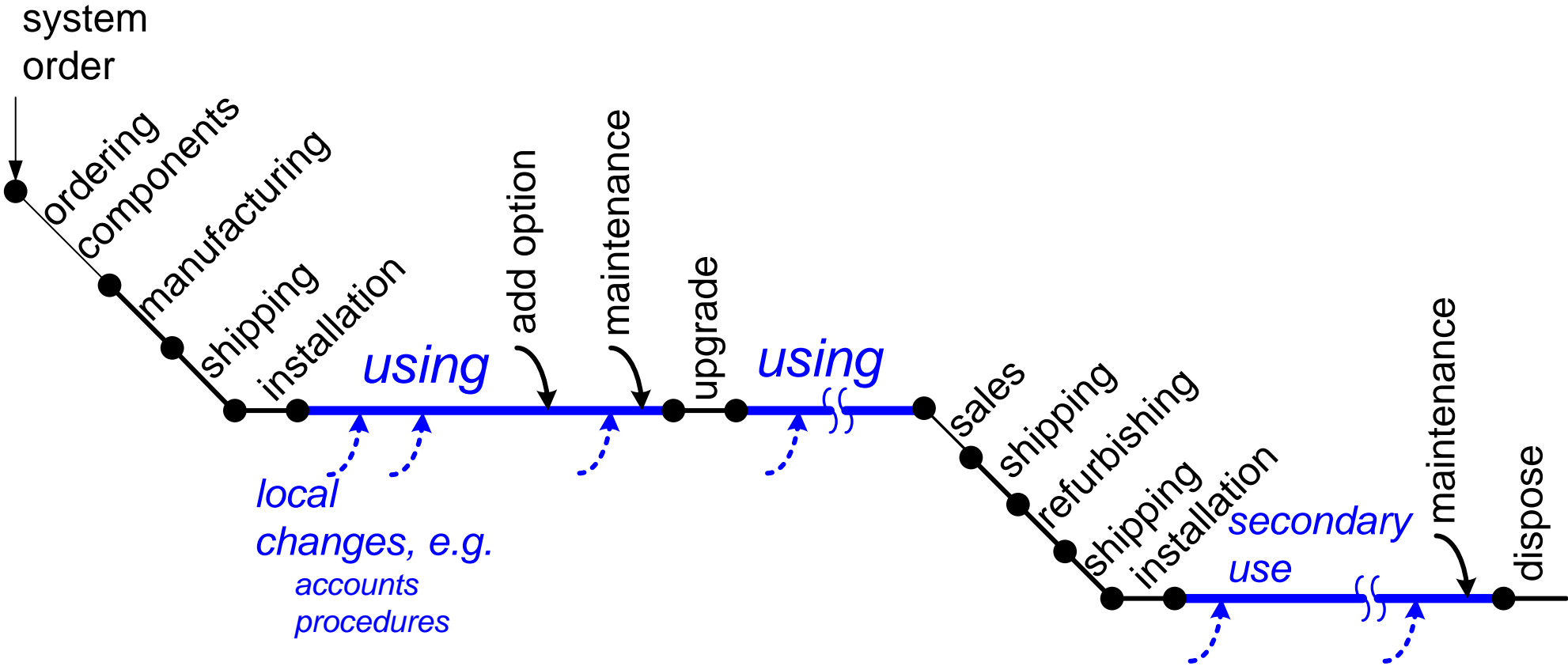
August 16, 2025
status: preliminary
draft
version: 0.7



Product Related Life Cycles



System Life Cycle



Approach to Life Cycle Modeling

Identify potential life cycle changes and sources	
Characterize time aspect of changes	how often how fast
Determine required effort	amount type
Determine impact of change on system and context	performance reliability
Analyse risks	business

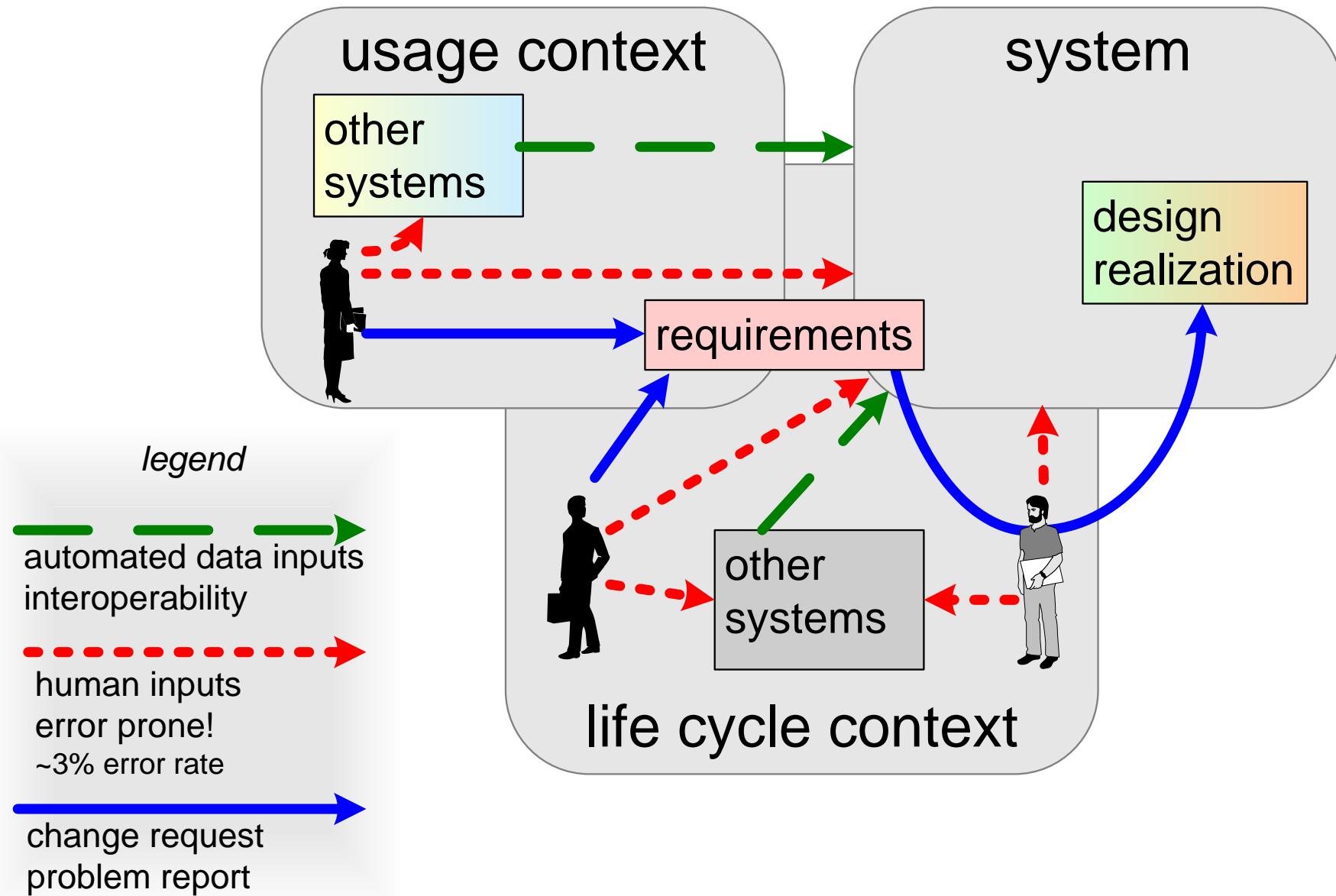
see reasoning

What May Change During the Life Cycle?

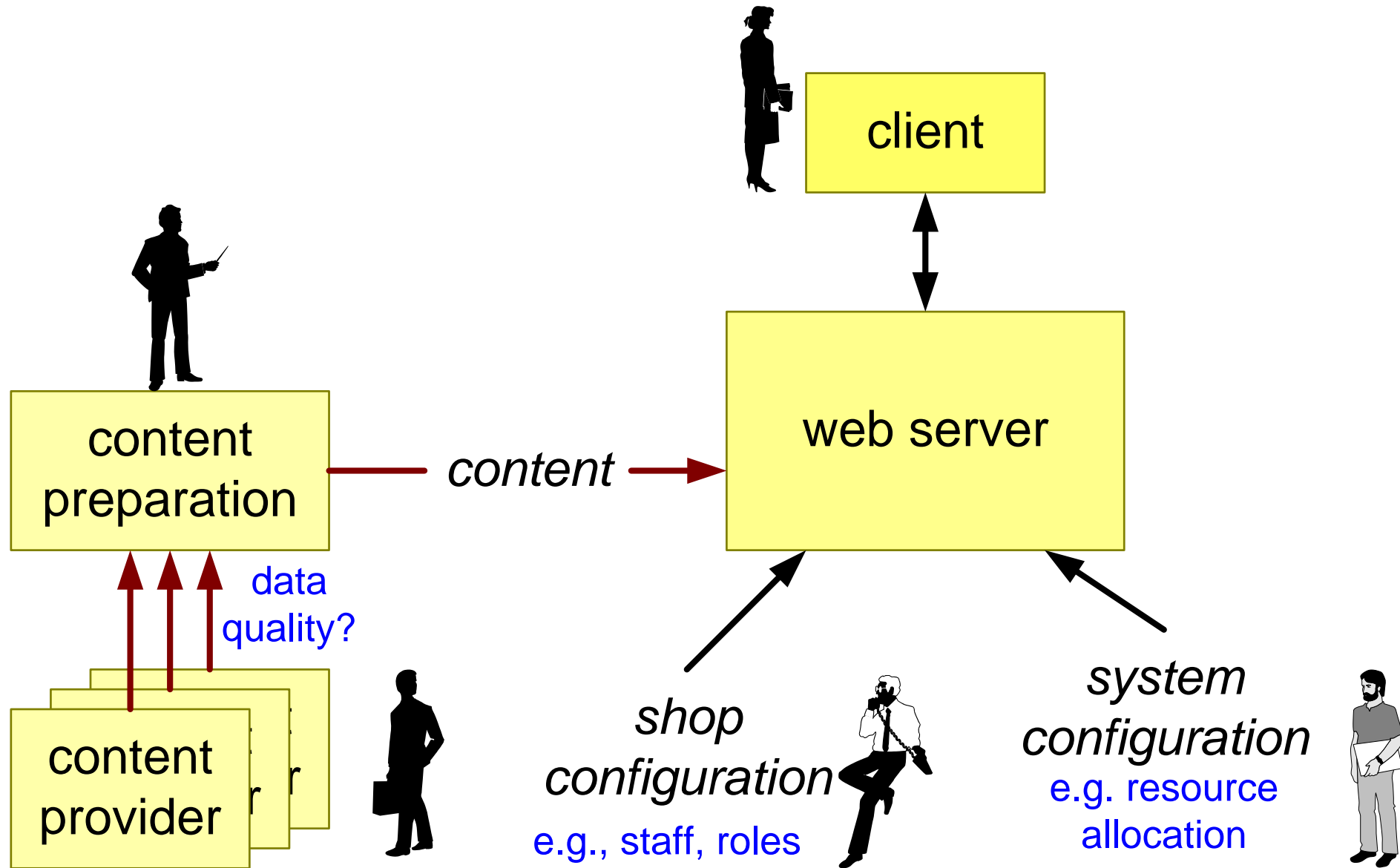
business volume
product mix
product portfolio
product attributes (e.g. price)
customers
personnel
suppliers
application, business processes
et cetera

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

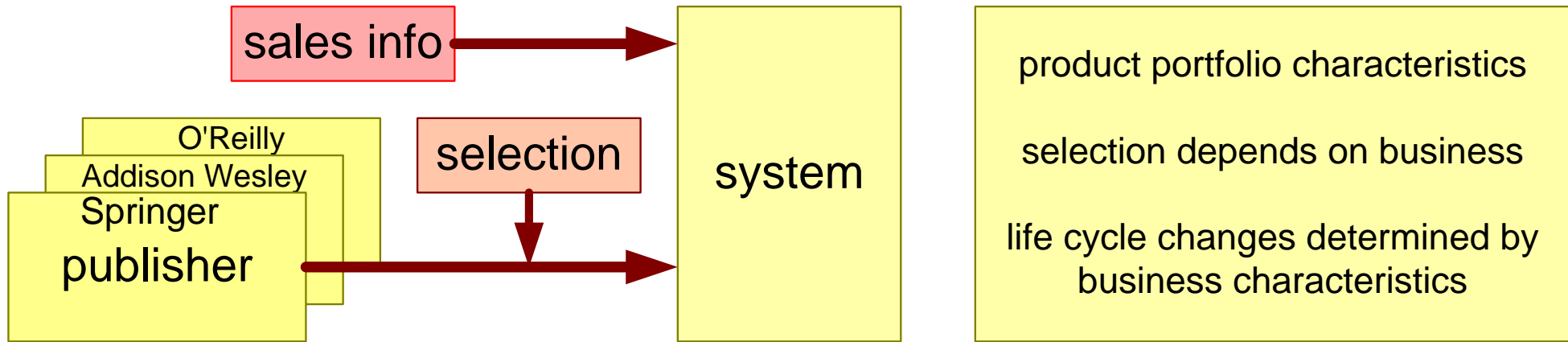
Simple Model of Data Sources of Changes



Data Sources of Web Server



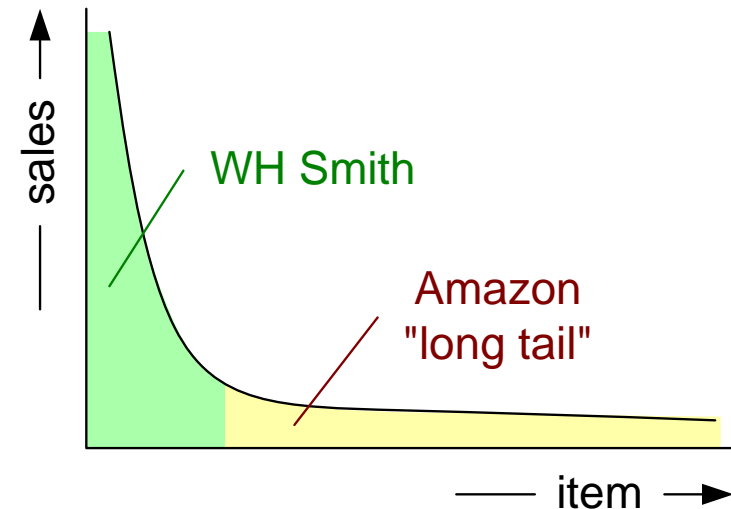
Example Product Portfolio Change Books



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/Long_tail



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

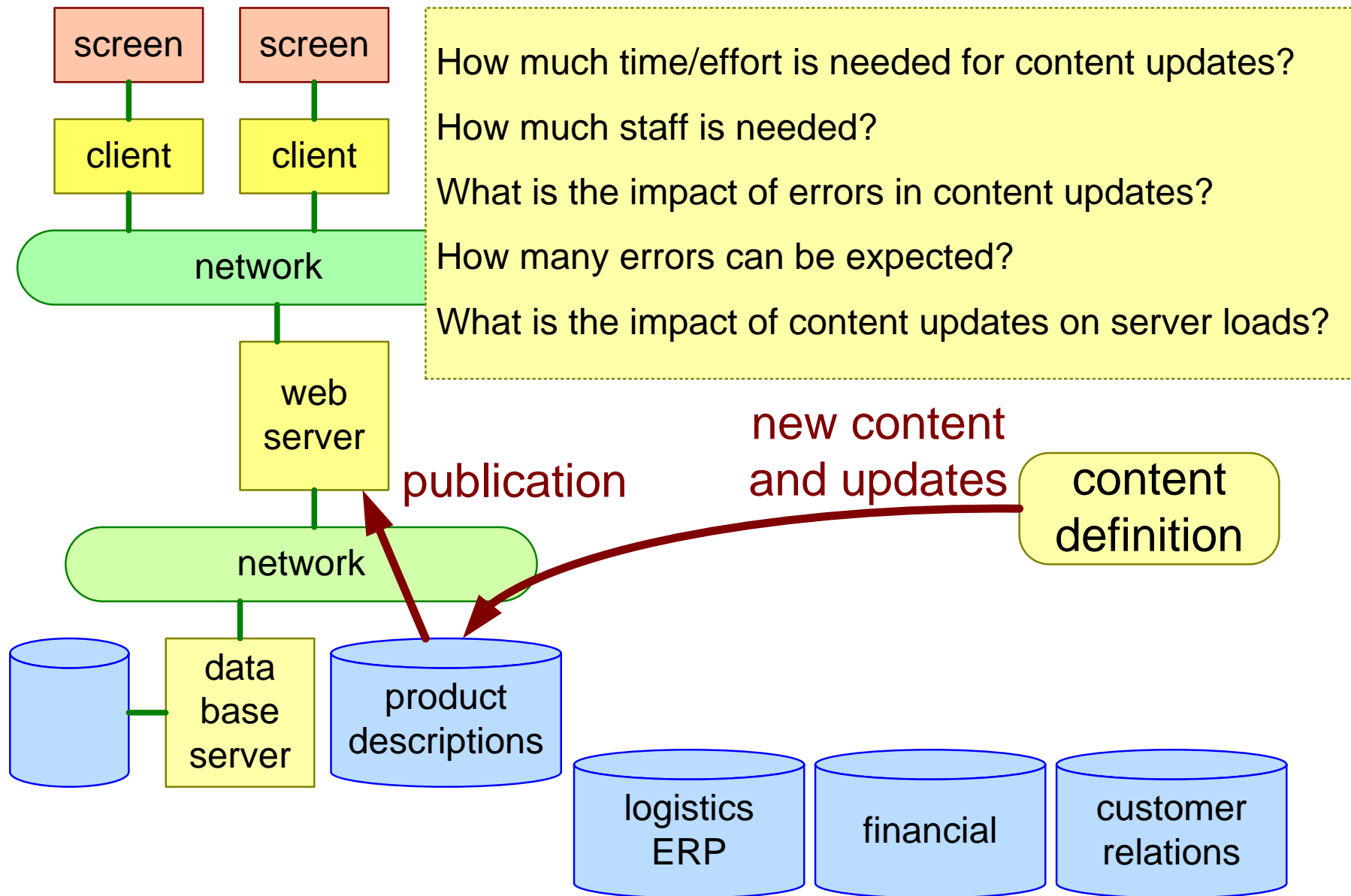
What is the expected growth of # customers?

What is the impact on system and infrastructure?

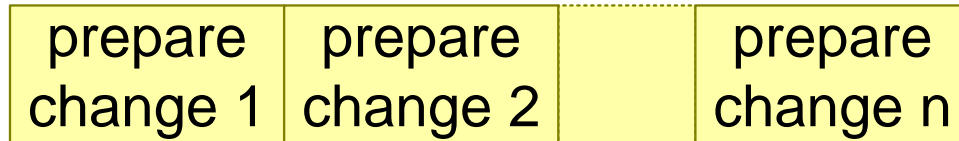
What is the impact on CRM (Customer Relation Management)?

What is the impact on customer, sales support staff?

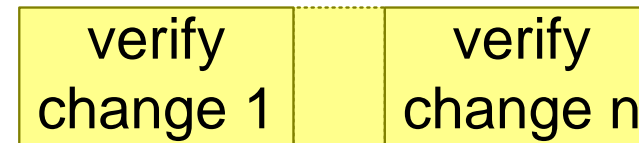
Web Shop Content Update



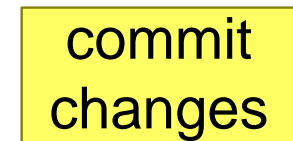
Web Shop Content Change Effort



review input
select info
layout&cosmetics
check-in



inspect source
inspect result



$$\text{effort}_{\text{changes}} = n_{\text{changes}} * (t_{\text{prepare}} + t_{\text{verify}}) + t_{\text{commit}}$$

$$\#fte = \text{effort}_{\text{changes}} / \text{hours per day}$$

with $t_{\text{prepare}} = 4 \text{ min}$

$t_{\text{verify}} = 2 \text{ min}$

$t_{\text{commit}} = 1 \text{ min}$

hours per day = 8 hours

n_{changes} per day	10	100	1000
$\text{effort}_{\text{changes}}$	1 uur	10 uur	100 uur
#fte	0.1	1	12

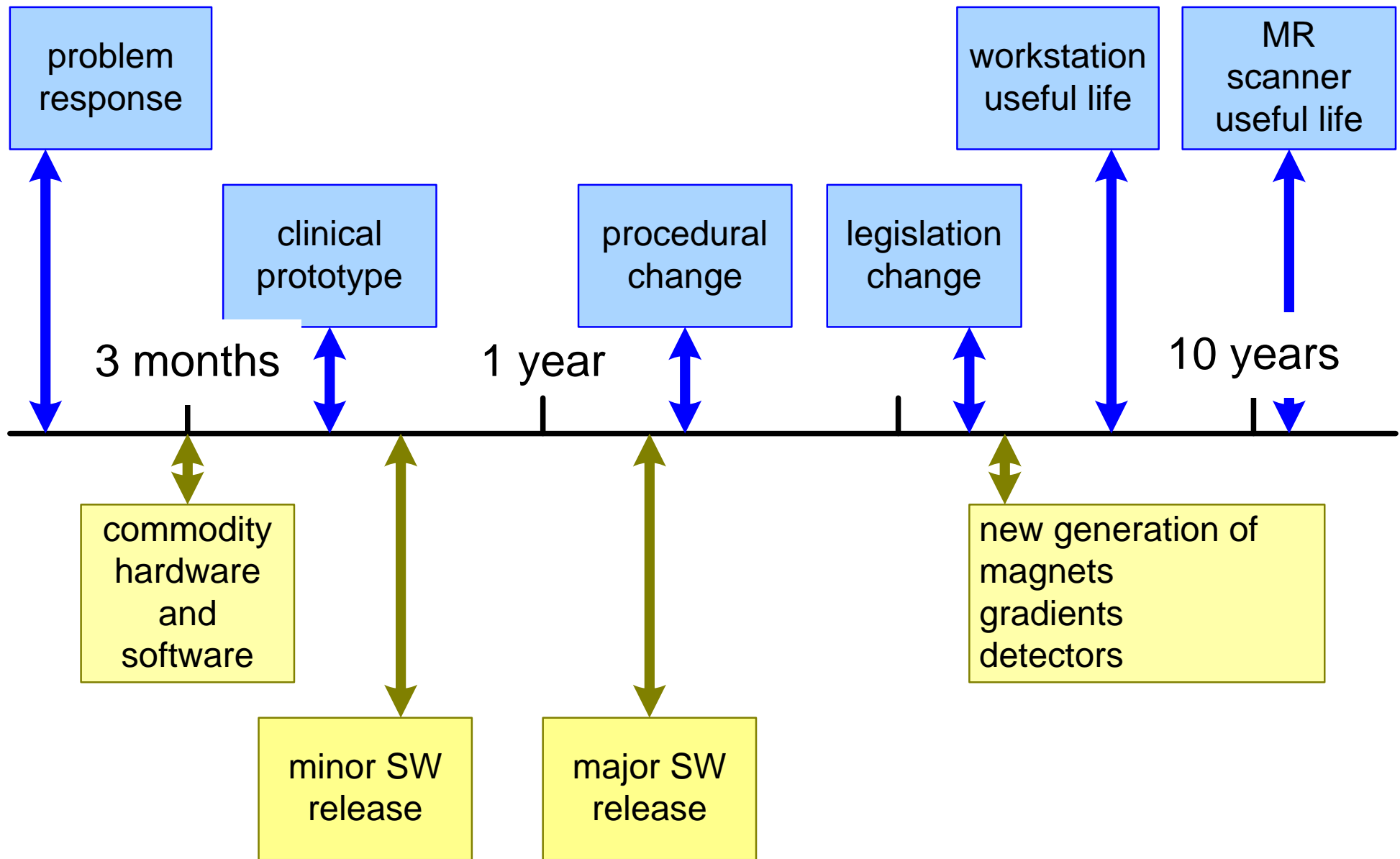
Example of Client Level Changes

The image shows a screenshot of the Amazon.com website in a Mozilla Firefox browser window. The browser's address bar shows 'http://www.amazon.com/'. The page content includes a search bar, a navigation menu on the left, and several product listings. The following callout boxes are overlaid on the image:

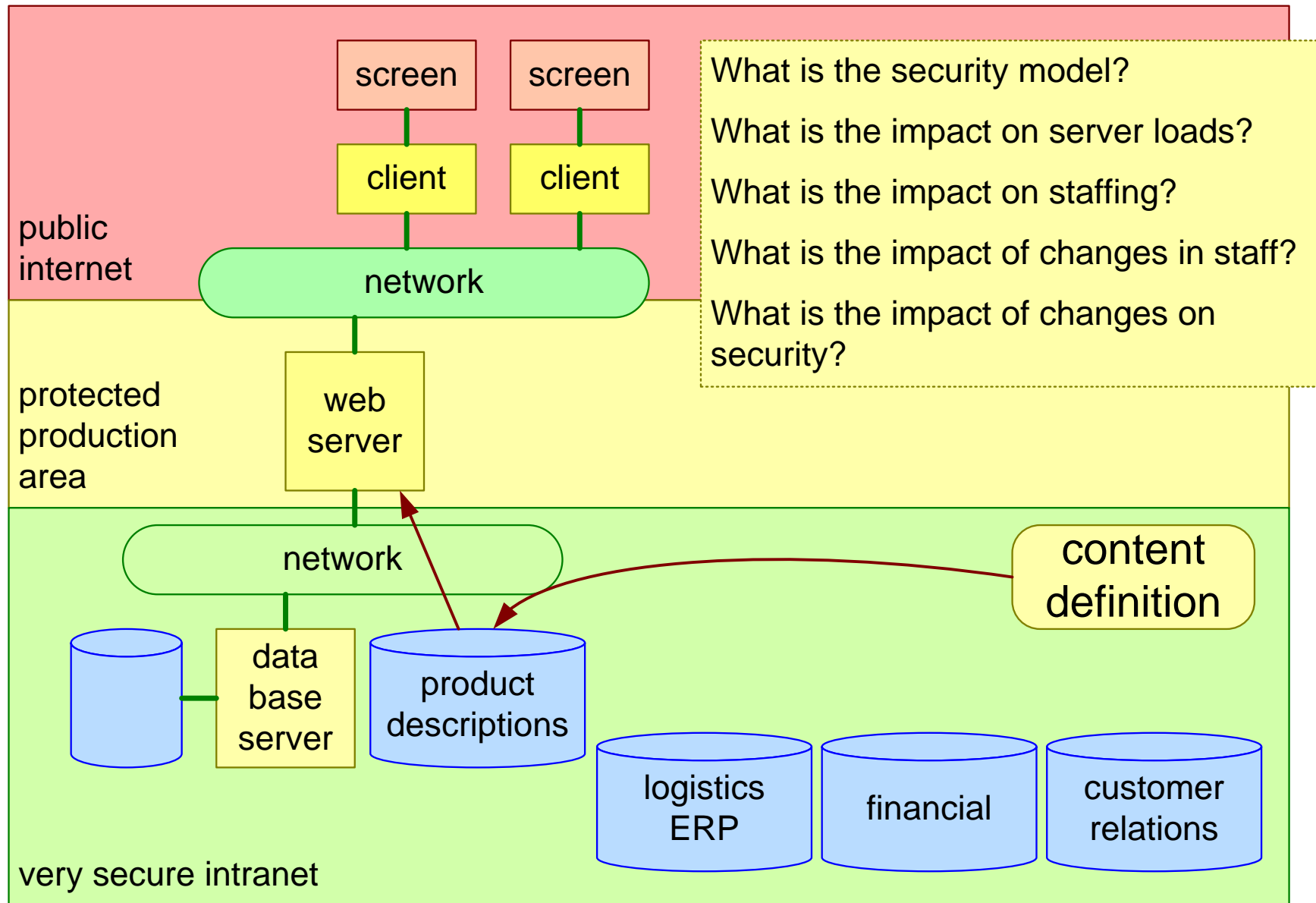
- main access through search**: Points to the search bar at the top of the page.
- personalization**: Points to the text 'Hello. Sign in to get personalized recommendations. New customer? Start here.'
- catalogue entries**: A vertical box on the left side of the page, pointing to the 'Browse' navigation menu.
- Up-to-date information: Bestsellers**: A box pointing to the 'Books Bestsellers' section.
- What Other Customers Are Looking At Right Now**: A box pointing to the 'What Other Customers Are Looking At Right Now' section.
- other advertisements**: A vertical box on the right side of the page, pointing to various promotional banners.
- styling: frequently updated, fashion!**: A box on the right side of the page, pointing to the overall layout and design.
- standard boilerplate**: A box at the bottom of the page, pointing to the footer area.

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

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

	severity	hit probability	detection probability
<i>Jansen iso Janssen</i>	low	high	low
<i>operator iso sales repr</i>	high	high	medium

Simplistic Financial Computations for System Architects.

by *Gerrit Muller* USN-SE

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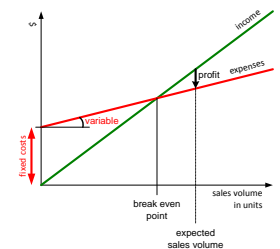
Abstract

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.

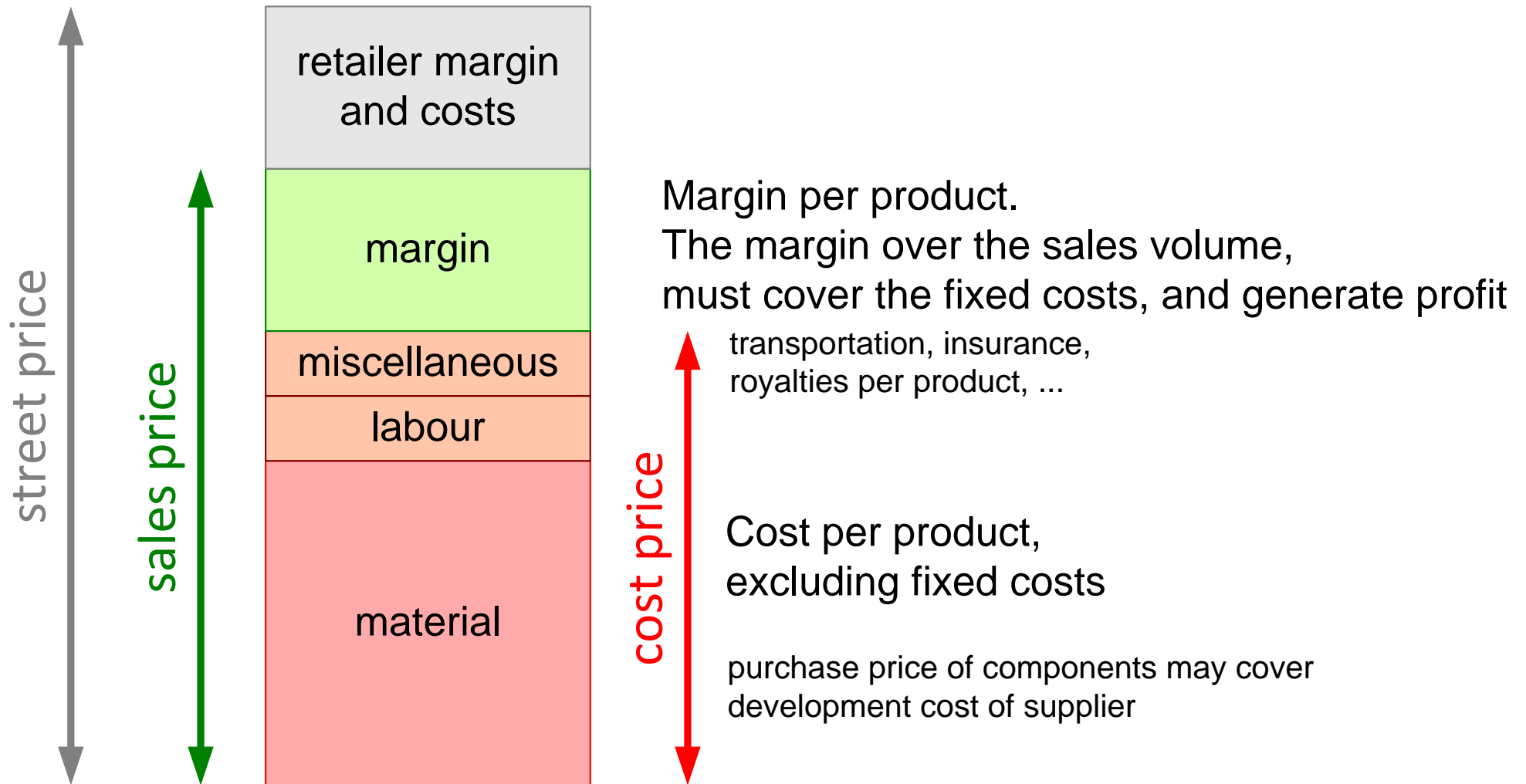
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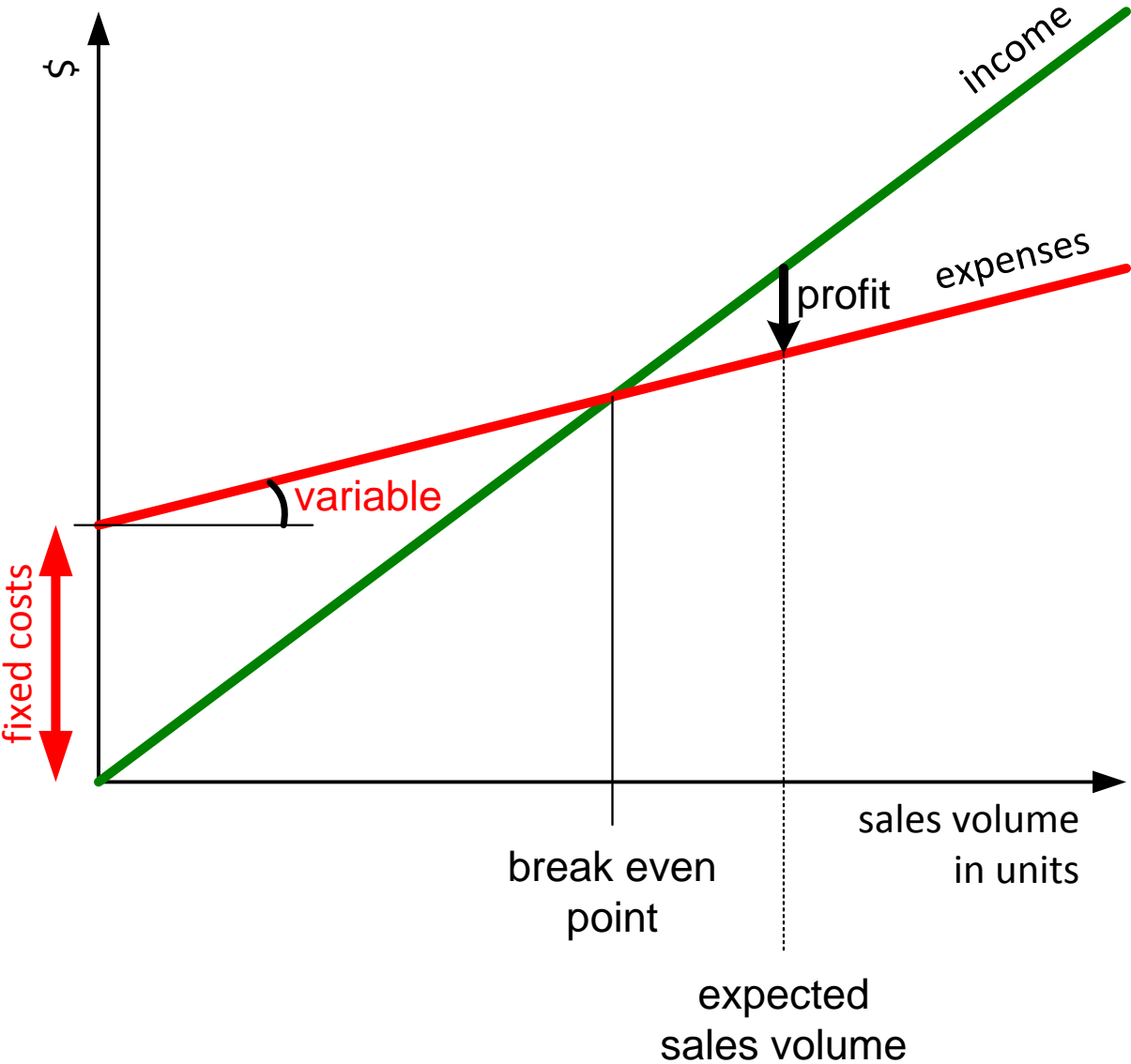
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draft
version: 1.3



Product Margin = Sales Price - Cost



Profit as function of sales volume



Investments, more than R&D



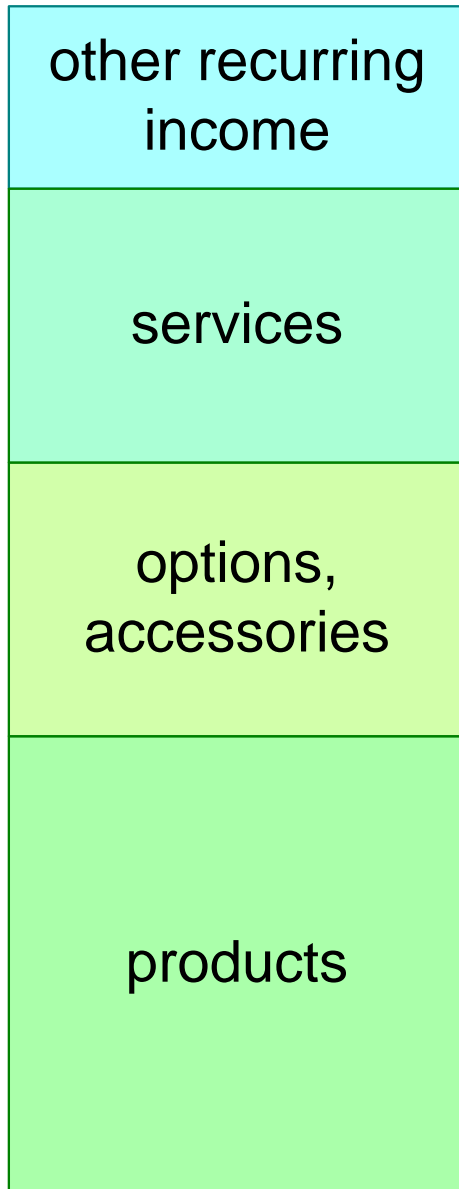
business dependent:
pharmaceuticals industry
sales cost >> R&D cost

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

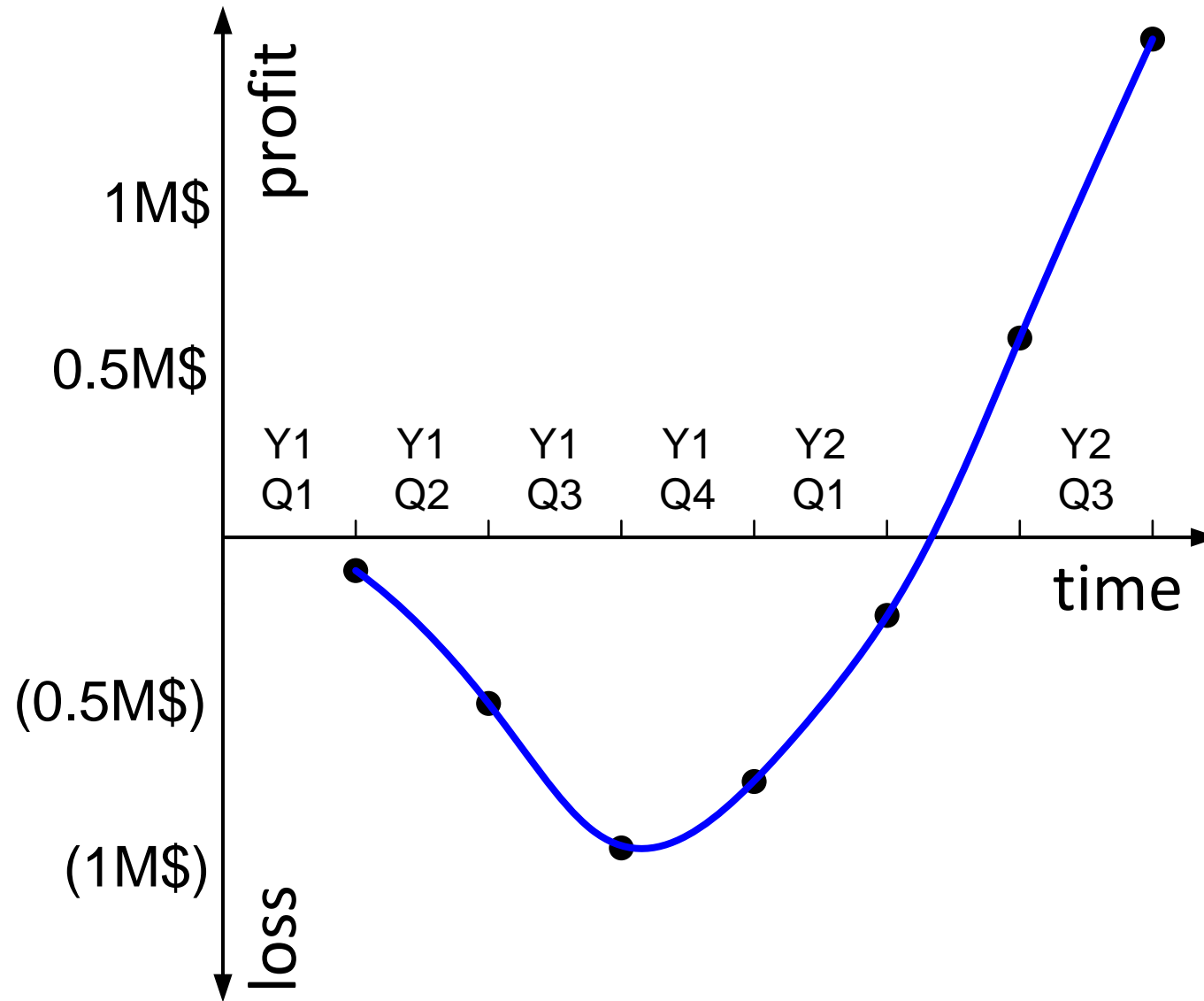
The Time Dimension

	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\$

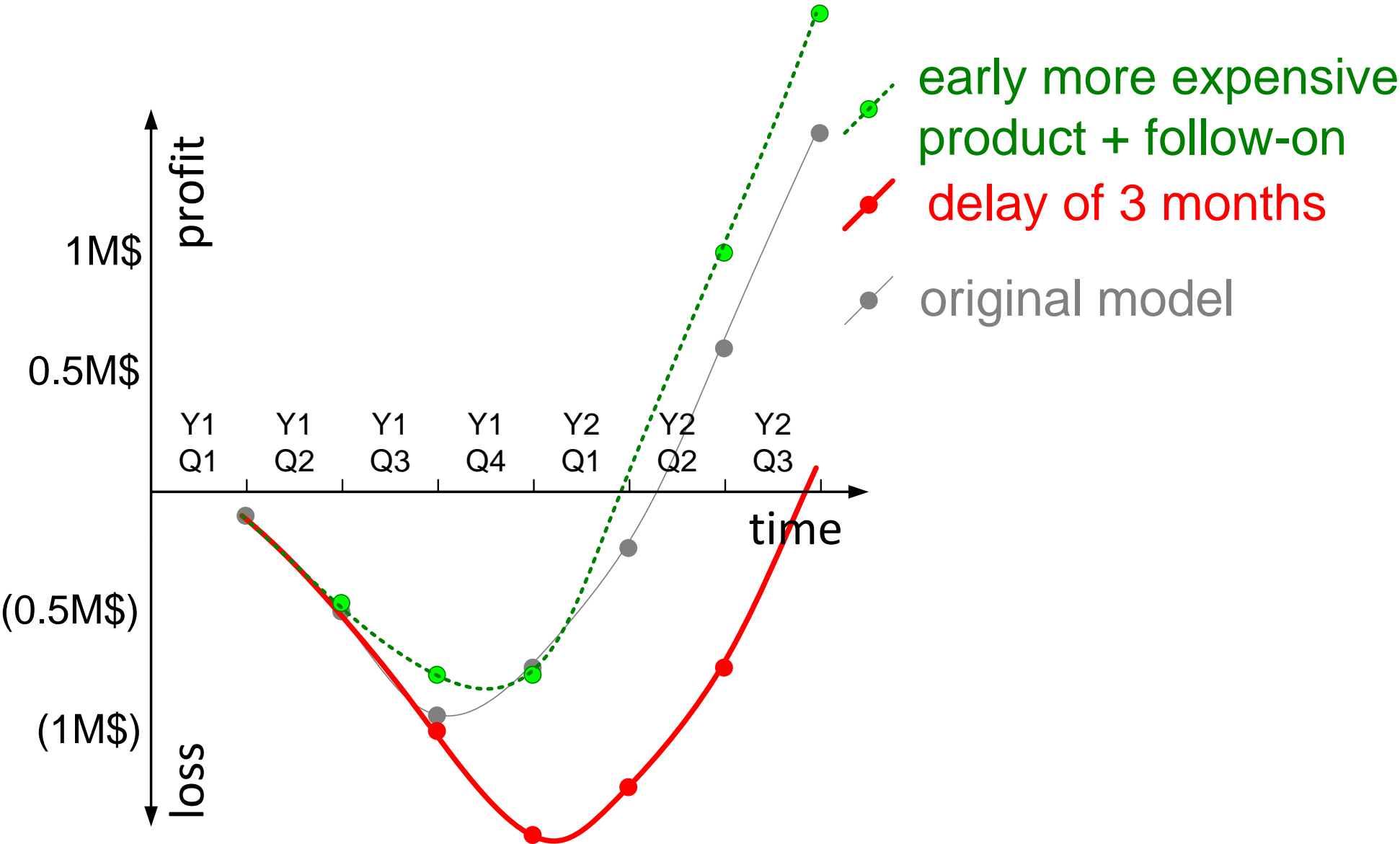
cost price / unit = 20k\$
sales price / unit = 50k\$

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

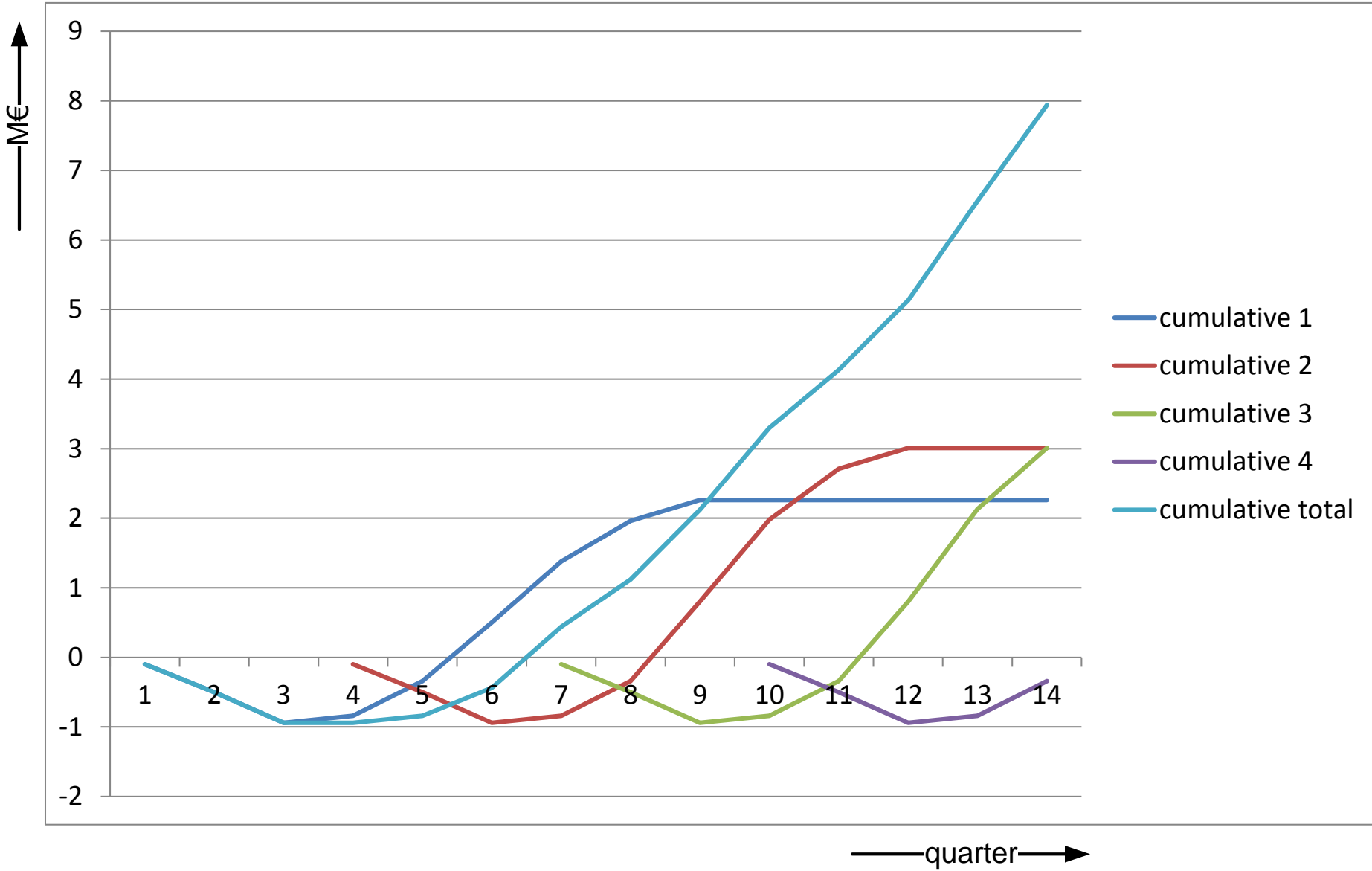
The "Hockey" Stick



What if ...?



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

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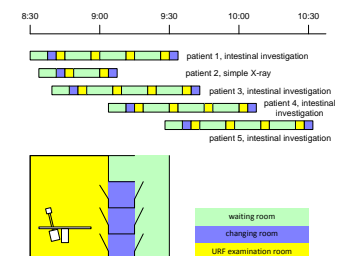
Abstract

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.

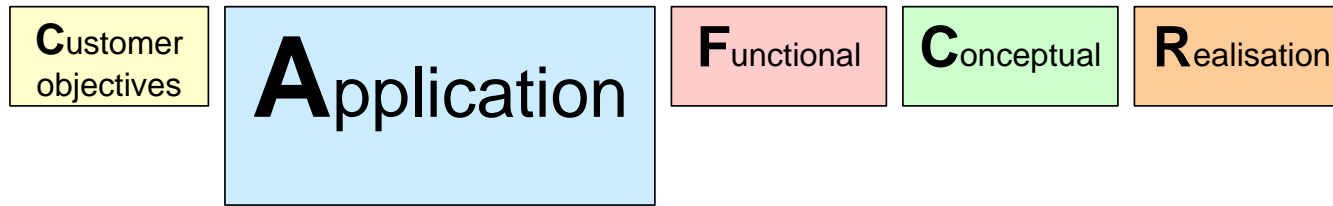
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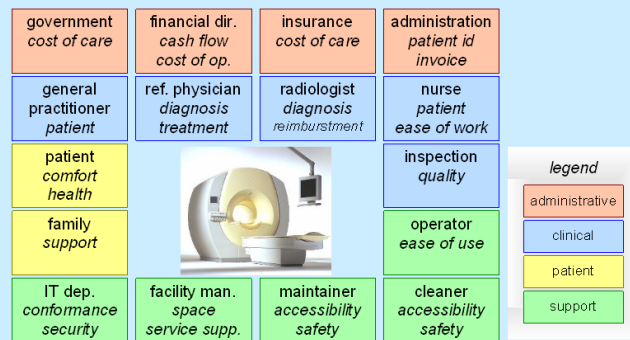
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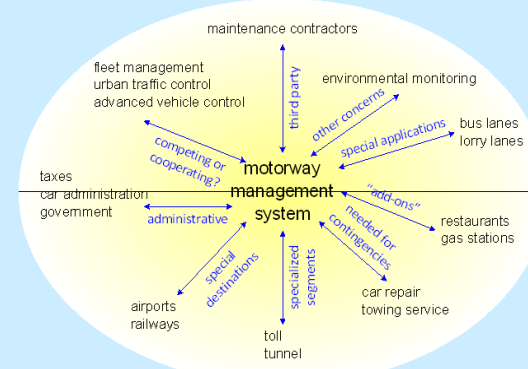
Application view overview



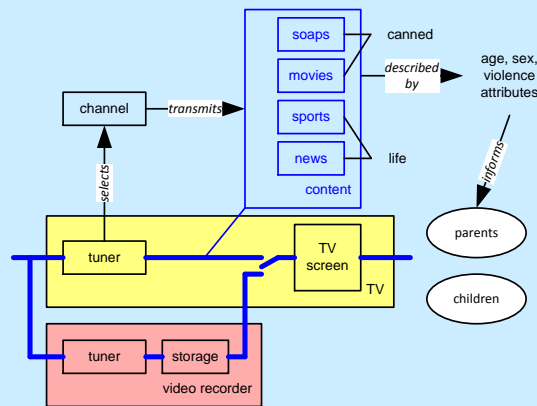
stakeholders and concerns



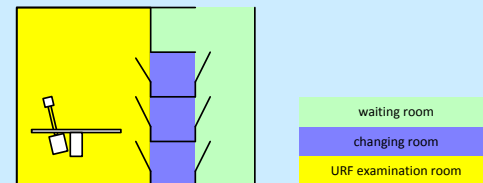
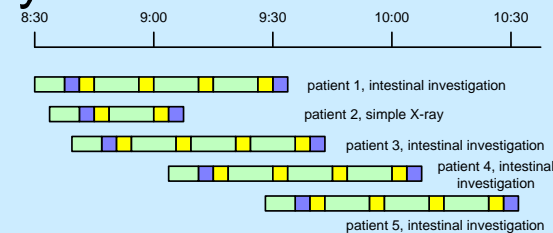
context diagrams



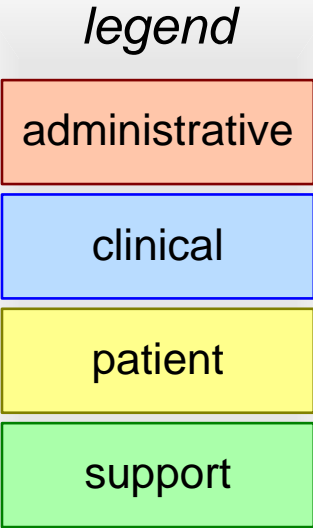
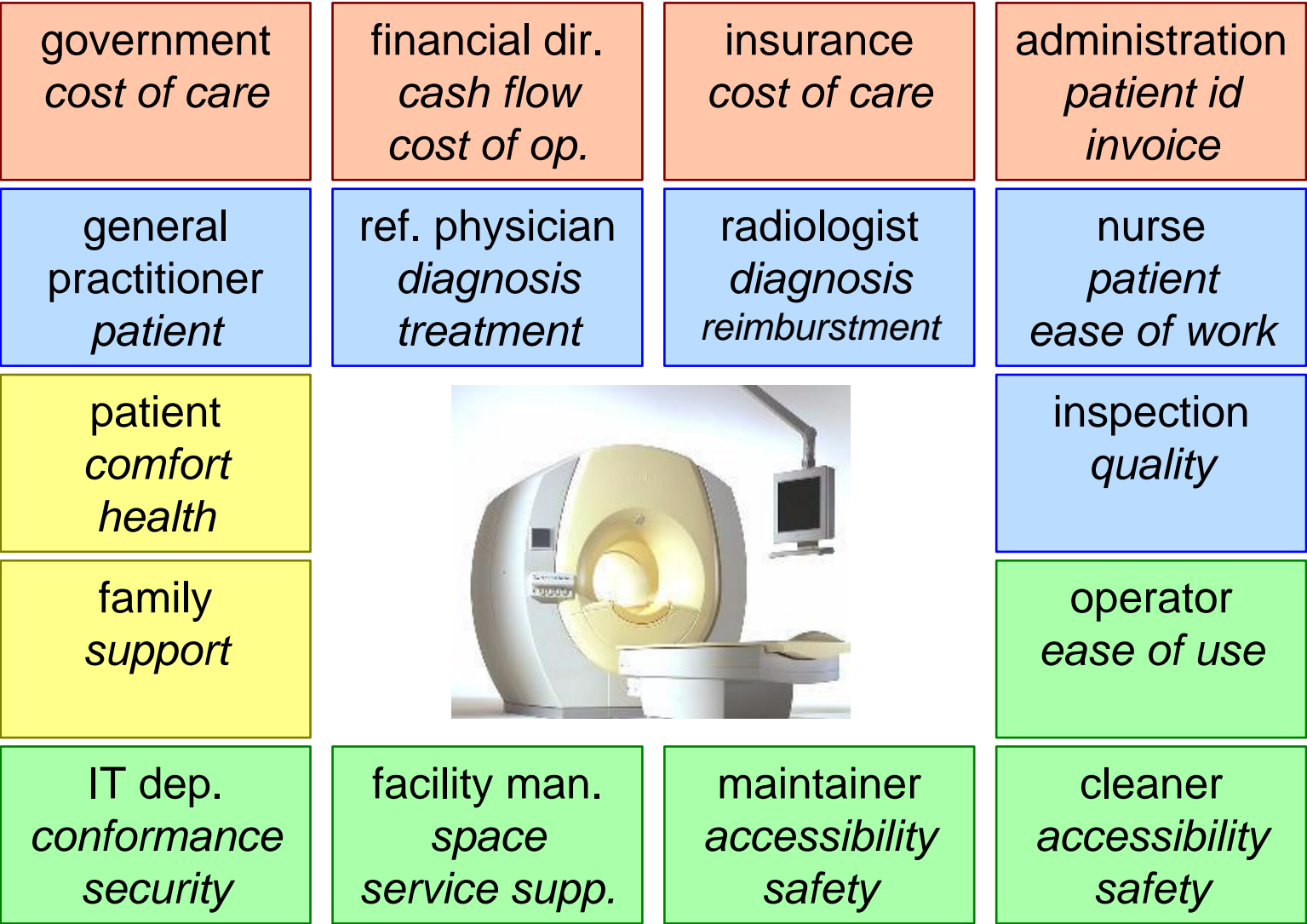
entity relationship models



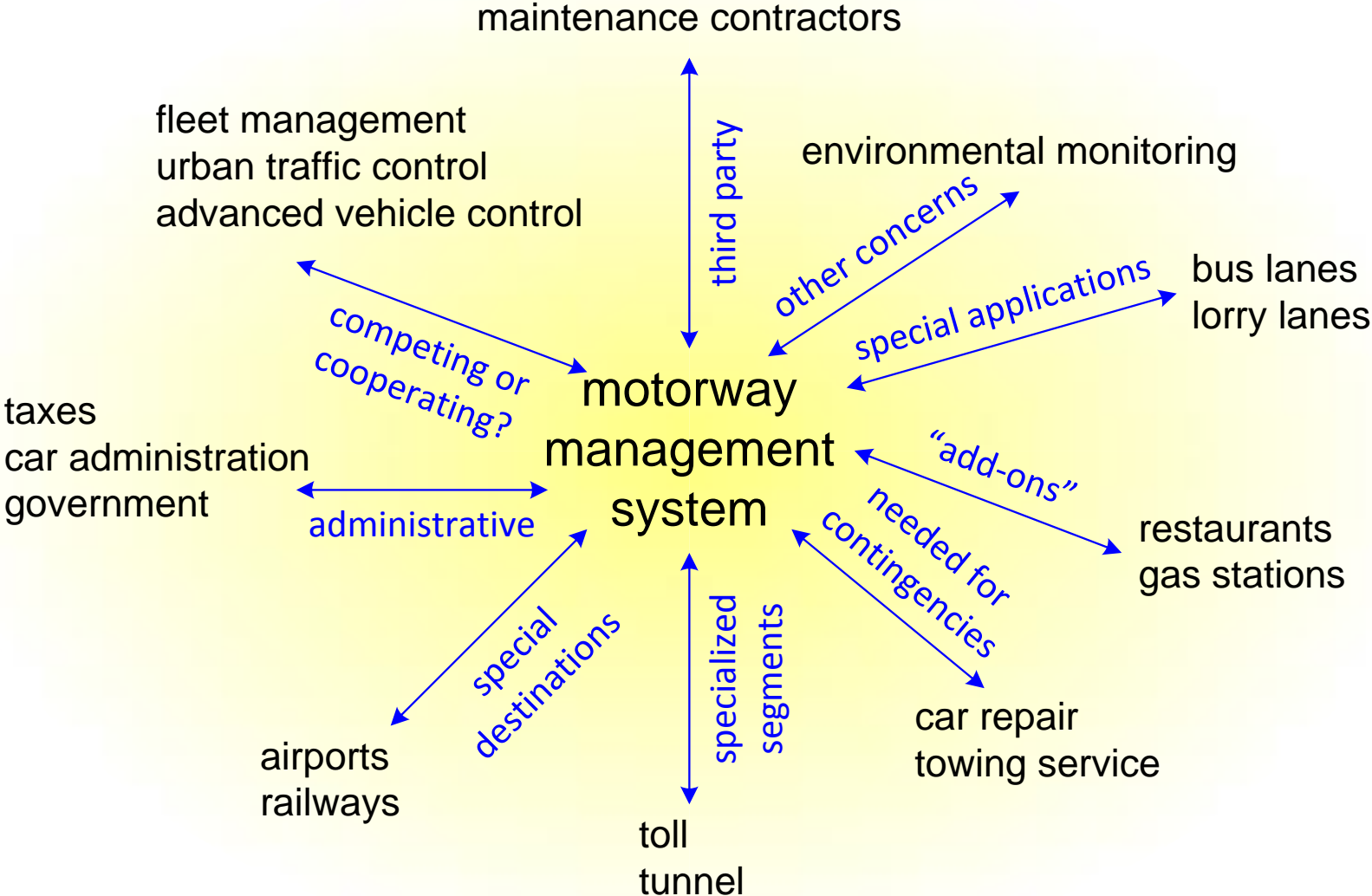
dynamic models



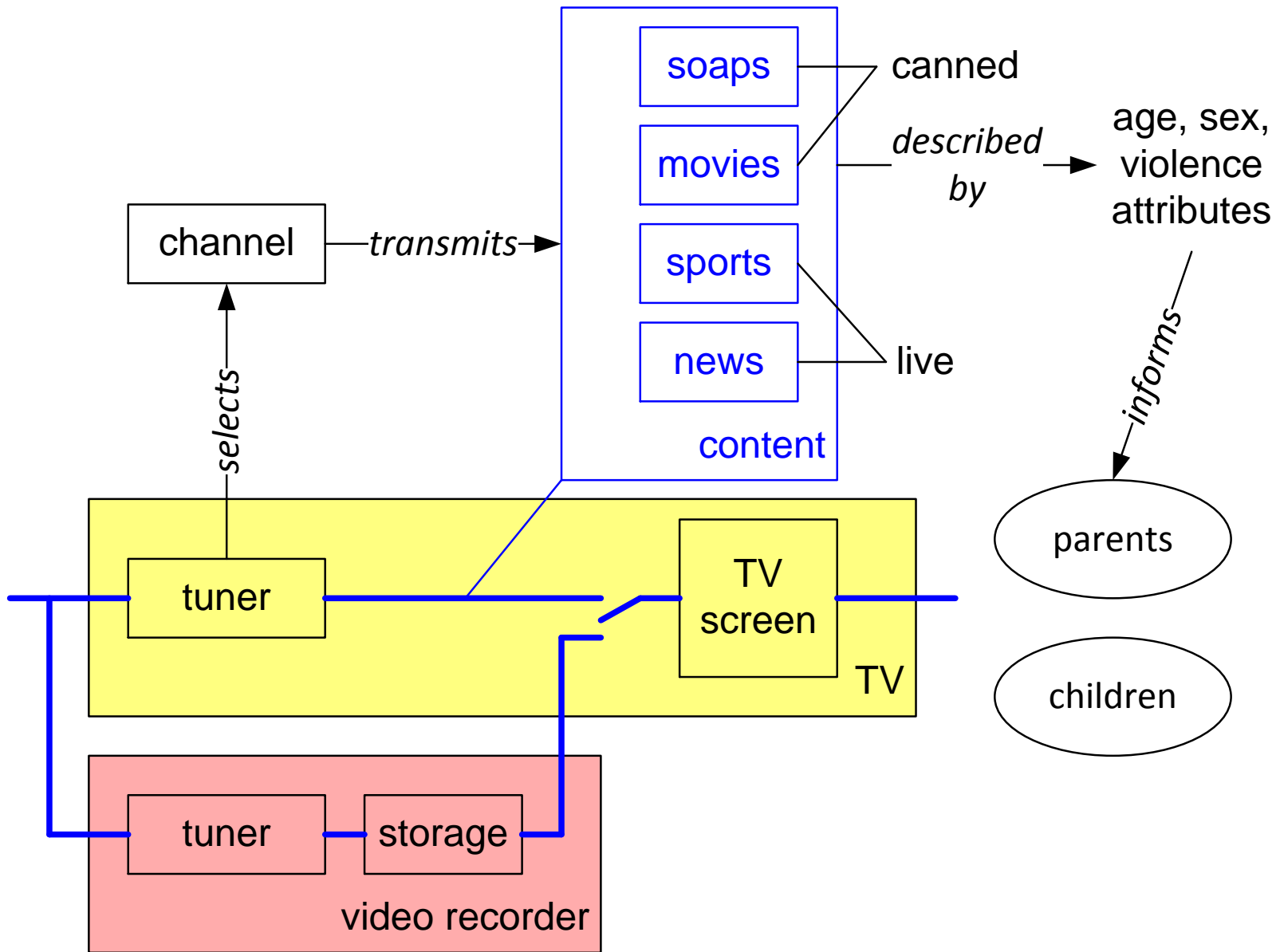
Stakeholders and concerns MRI scanner



Context of motorway management system

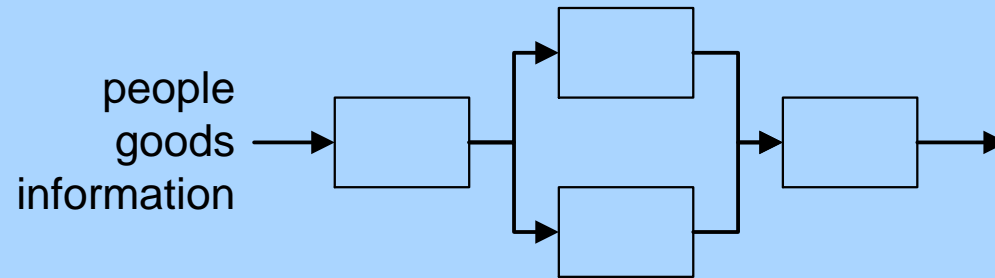


Example of simple TV application model

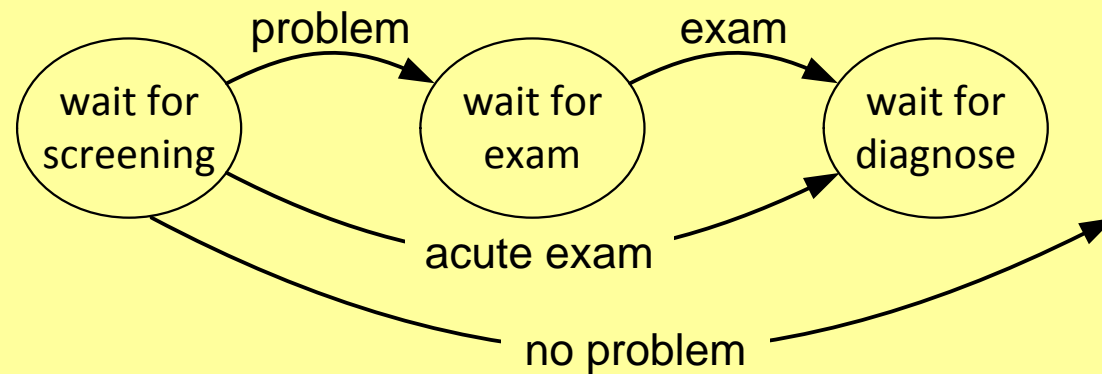


Examples of dynamic models

flow models



state diagrams

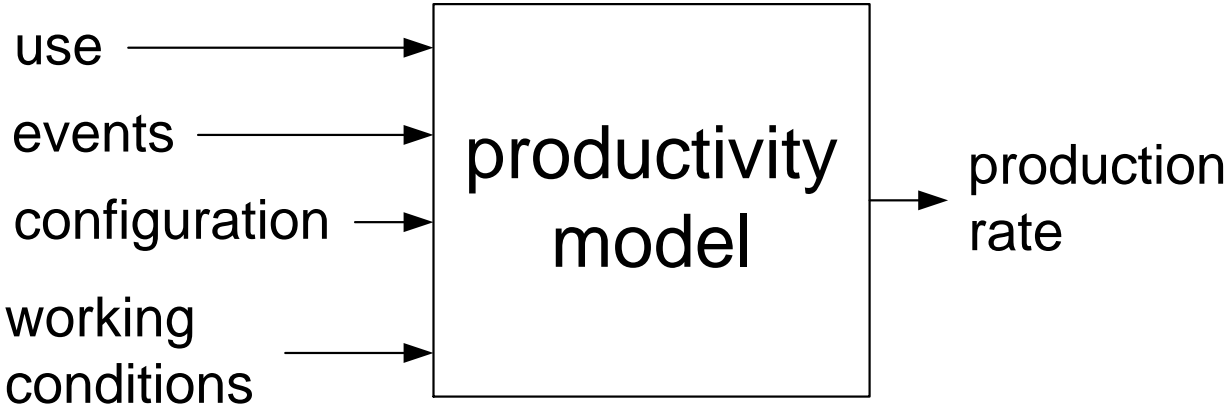


time line

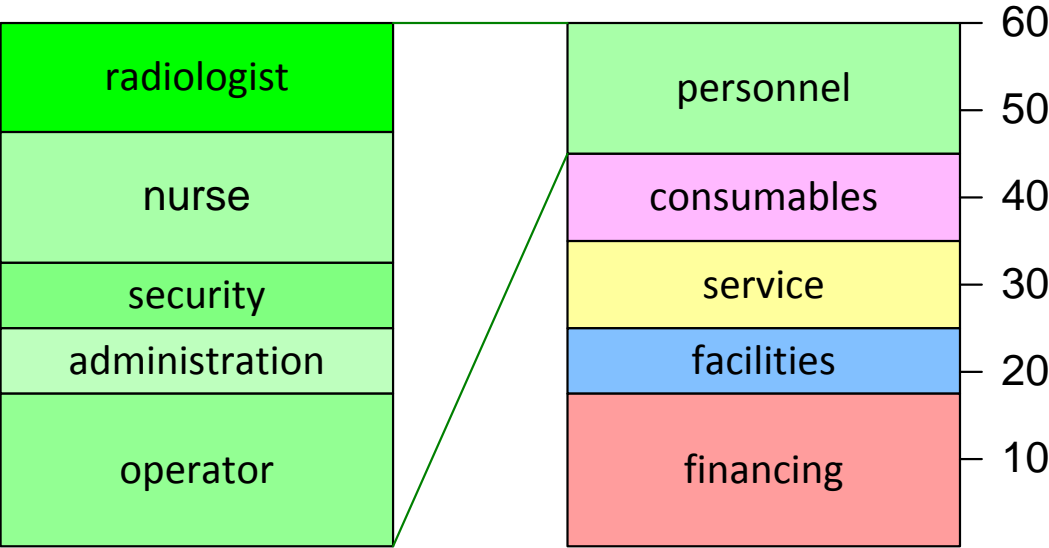


Productivity and Cost models

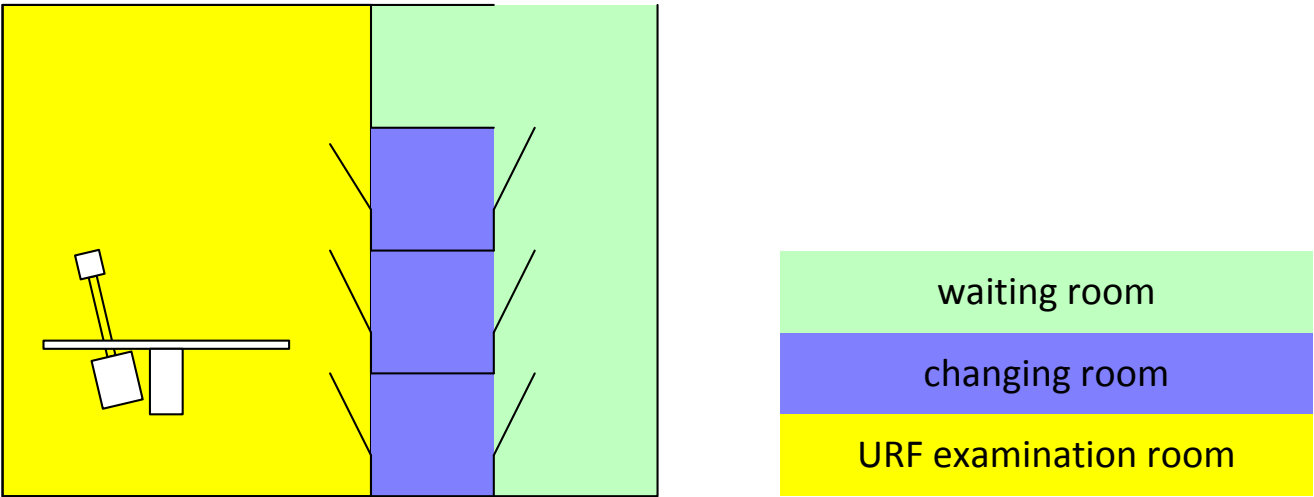
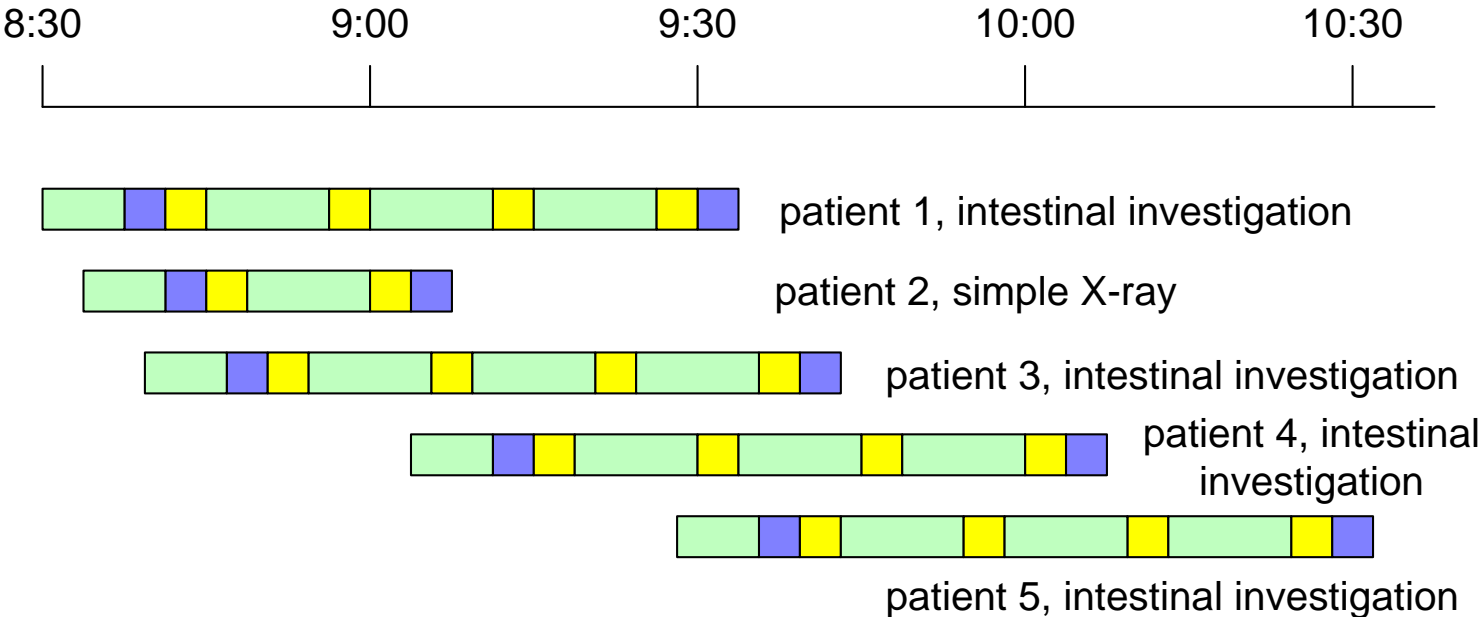
typical



Cost Of Ownership model



Dynamics of an URF examination room



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

- + 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

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