Abstract
This module addresses Modeling and Analysis Fundamentals of Application.
### 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?

facts
measurements
assumptions

uncertainties
unknowns
errors

modeling
analysis

accuracy
working range
credibility

risk
customer satisfaction
time, cost, effort
profit margin

usage context
system

enterprise & users
requirements
black box view
design
realization
technology
creation
life cycle business
life cycle context

specification
verification
decisions
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.
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

relations beyond actual system!
commercial
financial
legal
strategic
tactical
operational
social
technical
Simplified Web Shop Value Chain

- Suppliers
- Management (products, customers, finance)
- Virtual shop
- Payment
- Goods flow
- Order
- Sales
- Goods
- Customers
- Finance
- IT infrastructure
- IT services
- Web services
- Service level
- Money

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Simplistic Customer Key Driver Graph

- High sales
  - Right pricing
  - Right presentation
- Fast delivery
  - Goods flow tuning
  - Fast goods processing
- Low capital use
  - Minimal stocks
- Predictable (low) cost level
  - Strategic outsourcing
  - Service level agreement
  - Reduce running cost
- Accurate financial status
  - Financial processes
- Prevention of virtual crime
  - Access control
  - Security management

- Easy change of product database
- Easy update of product attributes
- Responsive portal
- Reporting & analysis
- Easy update of flow
- Service cost/volume
- Financial reporting & analysis
- Work flow support
- Access administration
- Authentication
- Auditing, logging
- Security reporting
Example Assessment of Design Choices

Are these concerns: relevant? significant?

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
- High sales
- Right pricing
- Right presentation
- Fast delivery
- Goods flow tuning
- Fast goods processing
- Low capital use
- Minimal stocks
- Strategic outsourcing
- Service level agreement
- Reduce running cost
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- Access administration
- Authentication
- Auditing, logging
- Security reporting
- Security management
- Work flow support
- Reduce running cost
- Financial reporting & analysis
- Work flow support
- Security management
Zero Order Cost Model

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

Service cost \( s(v) = b + c \times v \)
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!

\[
\text{total cost} = f + s(v) + p \times v + g \times v
\]

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

\[
s(v) = b + c \times v
\]

where
- \(b\) = fixed base cost
- \(c\) = cost / volume
- \(v\) = volume

all including provider margin

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100k</td>
<td>100k</td>
<td>100k</td>
<td>10k</td>
<td>1k</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fixed base</td>
<td>personnel</td>
<td>goods flow</td>
<td>fixed base</td>
<td>service variable</td>
</tr>
</tbody>
</table>

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

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

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

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.
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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Product Related Life Cycles

- individual systems
- service
  - system production
  - system sales
  - system creation
- upgrades and options
  - production
  - sales
  - creation
- disposal
System Life Cycle

- system
- order
- using
- local changes, e.g.
  - accounts procedures
- upgrade
- using
- secondary use
- dispose
- maintenance
- shipping
- installation
- refurbishing
- shipping
- sales
- add option
- maintenance
- manufacturing
- shipping
- components
- ordering

Modeling and Analysis: Life Cycle Models
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July 27, 2014
MALCsystemLifeCycle
## Approach to Life Cycle Modeling

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify potential life cycle changes and sources</td>
<td></td>
</tr>
<tr>
<td>Characterize time aspect of changes</td>
<td>how often, how fast</td>
</tr>
<tr>
<td>Determine required effort</td>
<td>amount, type</td>
</tr>
<tr>
<td>Determine impact of change on system and context</td>
<td>performance, reliability</td>
</tr>
<tr>
<td>Analyse risks</td>
<td>business</td>
</tr>
</tbody>
</table>

---

See reasoning

---


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MALCapproach
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

- **Usage Context**
  - Other systems

- **System**
  - Design
  - Realization

- **Legend**
  - Automated data inputs
  - Interoperability
  - Human inputs
  - Error prone! ~3% error rate
  - Change request
  - Problem report

Life cycle context

Version: 0.7
July 27, 2014
MALCsources
Example Product Portfolio Change Books

sales info

system

selection

new books per year

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>206K</td>
<td>107K</td>
</tr>
<tr>
<td>USA</td>
<td>172K</td>
<td>68K</td>
</tr>
<tr>
<td>China</td>
<td>101K</td>
<td>12K</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td>12K</td>
</tr>
</tbody>
</table>

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

product portfolio characteristics selection depends on business life cycle changes determined by business characteristics

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

Amazon "long tail"
### Example Customer Change

#### internet: broadband penetration

<table>
<thead>
<tr>
<th></th>
<th>Q1 '04</th>
<th>Q2 '04</th>
<th>growth in Q2 '04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia Pacific total</td>
<td>48M</td>
<td>54M</td>
<td>12.8%</td>
</tr>
<tr>
<td>China</td>
<td>15M</td>
<td>19M</td>
<td>26.1%</td>
</tr>
<tr>
<td>India</td>
<td>87k</td>
<td>189k</td>
<td>116.8%</td>
</tr>
</tbody>
</table>


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?
How much time/effort is needed for content updates?
How much staff is needed?
What is the impact of errors in content updates?
How many errors can be expected?
What is the impact of content updates on server loads?
Web Shop Content Change Effort

\[
\text{effort}_{\text{changes}} = n_{\text{changes}} \times (t_{\text{prepare}} + t_{\text{verify}}) + t_{\text{commit}}
\]

\[
\#fte = \frac{\text{effort}_{\text{changes}}}{\text{hours per day}}
\]

<table>
<thead>
<tr>
<th>#changes per day</th>
<th>10</th>
<th>100</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>effort changes</td>
<td>1 uur</td>
<td>10 uur</td>
<td>100 uur</td>
</tr>
<tr>
<td>#fte</td>
<td>0.1</td>
<td>1</td>
<td>12</td>
</tr>
</tbody>
</table>
Example of Client Level Changes

 Jugend aktualisiert:
Bestseller
Was andere Kunden jetzt klicken
Kataloge
Haupt-Zugang
Durchsuchen
Personalisierung
Stil: häufig aktualisiert, Mode!
Snapshoot von www.amazon.com

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version: 0.7
July 27, 2014
MALCmoreChanges
Example of Time Scale Model for Changes

- **3 months**: problem response
- **1 year**: clinical prototype, procedural change, legislation change
- **10 years**: workstation useful life, MR scanner useful life

**Commodity**: hardware and software

**Problem Response**: minor SW release, major SW release

**New Generation of Magnets, Gradients, Detectors**: procedural change, legislation change
Web Shop Security and Changes

What is the security model?
What is the impact on server loads?
What is the impact on staffing?
What is the impact of changes in staff?
What is the impact of changes on security?
new faults = average fault density * #changes

#errors = \sum f(\text{severity, hit probability, detection probability})

<table>
<thead>
<tr>
<th></th>
<th>severity</th>
<th>hit probability</th>
<th>detection probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jansen iso Janssen</td>
<td>low</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>operator iso sales repr</td>
<td>high</td>
<td>high</td>
<td>medium</td>
</tr>
</tbody>
</table>
Simplistic Financial Computations for System Architects.

by Gerrit Muller       HBV-NISE

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.

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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

- **sales volume**: The quantity of goods sold.
- **income**: Revenue from sales.
- **expenses**: Costs associated with sales.
- **profit**: The difference between revenue and costs.
- **break even point**: The point where income equals expenses.
- **fixed costs**: Costs that do not change with sales volume.
- **variable costs**: Costs that change with sales volume.

**Graph**: A graph showing the relationship between sales volume and profit. The x-axis represents sales volume in units, and the y-axis represents dollars. The graph includes lines for income, expenses, profit, and fixed costs.
## Investments, more than R&D

<table>
<thead>
<tr>
<th>Financing</th>
<th>Marketing, Sales</th>
<th>Training Sales &amp; Service</th>
<th>NRE: Outsourcing, Royalties</th>
<th>Research and Development</th>
</tr>
</thead>
</table>

- Business dependent: pharma 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:

\[
\text{R&D investment} = \text{Effort} \times \text{rate}
\]
Income, more than product sales only

\[
\sum_{\text{services}} \text{income}_{\text{service}}
\]

\[
\sum_{\text{options}} \text{sales price}_{\text{option}} \times \text{volume}_{\text{option}}
\]

\[
\text{sales price}_{\text{product}} \times \text{volume}_{\text{product}}
\]

license fees
pay per movie
content, portal
updates
maintenance

products
options, accessories
other recurring income
### The Time Dimension

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>investments</strong></td>
<td>100k$</td>
<td>400k$</td>
<td>500k$</td>
<td>100k$</td>
<td>100k$</td>
<td>60k$</td>
<td>20k$</td>
</tr>
<tr>
<td><strong>sales volume (units)</strong></td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td><strong>material &amp; labour costs</strong></td>
<td>-</td>
<td>-</td>
<td>40k$</td>
<td>200k$</td>
<td>400k$</td>
<td>600k$</td>
<td>600k$</td>
</tr>
<tr>
<td><strong>income</strong></td>
<td>-</td>
<td>-</td>
<td>100k$</td>
<td>500k$</td>
<td>1000k$</td>
<td>1500k$</td>
<td>1500k$</td>
</tr>
<tr>
<td><strong>quarter profit (loss)</strong></td>
<td>(100k$)</td>
<td>(400k$)</td>
<td>(440k$)</td>
<td>200k$</td>
<td>500k$</td>
<td>840k$</td>
<td>880k$</td>
</tr>
<tr>
<td><strong>cumulative profit</strong></td>
<td>(100k$)</td>
<td>(500k$)</td>
<td>(940k$)</td>
<td>(740k$)</td>
<td>(240k$)</td>
<td>600k$</td>
<td>1480k$</td>
</tr>
</tbody>
</table>

- **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

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SFChockeyStick
What if ...?

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early more expensive product + follow-on
delay of 3 months
original model
Stacking Multiple Developments

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SFCmultipleDevelopments
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  Buskerud University College

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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.

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Application view overview

Customer objectives

Application

Functional

Conceptual

Realisation

stakeholders and concerns

context diagrams

entity relationship models

dynamic models

The application view

version: 0.2
July 27, 2014
AVoverview

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Stakeholders and concerns MRI scanner

- **government**
  - cost of care

- **financial dir.**
  - cash flow
  - cost of op.

- **general practitioner**
  - patient

- **patient**
  - comfort
  - health

- **family**
  - support

- **IT dep.**
  - conformance
  - security

- **facility man.**
  - space
  - service supp.

- **maintainer**
  - accessibility
  - safety

- **administration**
  - patient id
  - invoice

- **radiologist**
  - diagnosis
  - reimbursement

- **nurse**
  - patient
  - ease of work

- **inspection**
  - quality

- **operator**
  - ease of use

- **cleaner**
  - accessibility
  - safety

**Legend:**
- administrative
- clinical
- patient
- support
Context of motorway management system

- Maintenance contractors
- Fleet management
- Urban traffic control
- Advanced vehicle control
- Environmental monitoring
- Specialized segments
- Special applications
- “Add-ons”
- Other concerns
- Contingencies
- Specialized destinations
- Airports
- Railways
- Toll
- Tunnel
- Third party
- Government
- Car administration
- Taxes
- Competing or cooperating?
- Administrative

Motorway management system

- Restaurants
- Gas stations
- Bus lanes
- Lorry lanes
- Car repair
- Towing service
- Restaurants
- Gas stations
- Bus lanes
- Lorry lanes
- Car repair
- Towing service
Example of simple TV application model

- Channel transmits to TV tuner.
- Tuner selects content (live or canned).
- Content is live or canned.
- Live content includes age, sex, and violence attributes described by parents.
- Canned content may be informed by parents or children.
- Video recorder stores content.

The application view
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AVsimpleTVmodel

The application view
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Examples of dynamic models

**Flow models**
- People
- Goods
- Information
- Wait for screening
- Wait for diagnose
- Problem
- Exam
- Acute exam
- No problem

**State diagrams**
- Wait for screening
- Wait for exam
- Wait for diagnose
- Problem
- Exam
- Acute exam
- No problem

**Time line**
- 20:00
  - Start movie
  - Broadcast
- 20:30
  - View
  - Phone rings
- 21:00
  - View
  - Talk
- 21:30
  - Play
  - Record
  - Finish conversation
- 22:00
  - View
  - Resume viewing
- 22:30
  - End movie
Productivity and Cost models

The application view

version: 0.2
July 27, 2014
AVcostBenefitModels
Dynamics of an URF examination room

8:30
9:00
9:30
10:00
10:30

patient 1, intestinal investigation
patient 2, simple X-ray
patient 3, intestinal investigation
patient 4, intestinal investigation
patient 5, intestinal investigation
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
## 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