Abstract

The basis of a good system architecture is the availability and understanding of the requirements. This presentation shows how a system architect can capture the requirements and how to use these requirements in the context of the product creation process.

The notion of "business key drivers" is introduced and a method is described to link these key drivers to the product specification.
Requirements describing the needs of the customer: *Customer Needs*

Requirements describing the characteristics of the final resulting product: *Product Specification*

The requirements management process recursively applies definition 2 for every level of decomposition.

Requirements describing the needs of the company itself over the life cycle: *Life Cycle Needs*
Flow of Requirements

\begin{itemize}
  \item \textbf{What}
    \begin{itemize}
      \item choices
      \item trade-offs
      \item negotiations
    \end{itemize}
  \item \textbf{What}
    \begin{itemize}
      \item customer needs:
        \begin{itemize}
          \item What is needed by the customer?
        \end{itemize}
    \end{itemize}
  \item \textbf{How}
    \begin{itemize}
      \item product specification:
        \begin{itemize}
          \item What are we going to realize?
        \end{itemize}
    \end{itemize}
  \item \textbf{How}
    \begin{itemize}
      \item system design:
        \begin{itemize}
          \item How are we going to realize the product?
        \end{itemize}
    \end{itemize}
  \item \textbf{What}
    \begin{itemize}
      \item What are the subsystems we will realize?
    \end{itemize}
  \item \textbf{How}
    \begin{itemize}
      \item How will the subsystems be realized?
    \end{itemize}
  \item \textbf{What}
    \begin{itemize}
      \item up to "atomic" components
    \end{itemize}
\end{itemize}
System as a Black Box

- Interfaces
- System seen as black box
- Functions
- Quantified characteristics
- Inputs
- Restrictions, prerequisites
- Boundaries, exceptions
- Standards, regulations
- Outputs
Stakeholders w.r.t. Requirements

- **Customer**: (purchaser, decision maker, user, operator, maintainer)
- **Company**: (business, marketing, operational managers)
- **Product Creation Process**: (project leader, product manager, engineers, suppliers)
- **Customer-Oriented Process**: (sales, service, production, logistics)
- **Policy and Planning**: (business, marketing, operational managers)
- **People, Process, and Technology**: (capability managers, technology suppliers)
The “Formal” Requirements for Requirements

Specific
Unambiguous
Verifiable
Quantifiable
Measurable
Complete
Traceable
Accessible
Understandable
Low threshold
## Complementary Viewpoints to Capture Requirements

### Top-down

**Key-drivers**
- (customer, business)

**Operational Drivers**
- (logistics, production, etc.)

**Roadmap**
- (positioning and trends in time)

**Competition**
- (positioning in the market)

**Regulations**

### Bottom-up

**"Ideal" Reference Design**
- (learning vehicle)

**Prototyping, Simulation**
- (technological opportunities)

**Existing Systems**

### Needs

### Feedback

### Continued Product Creation Process

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*Requirements Capturing by the System Architect*

8    Gerrit Muller
What does Customer need in Product and Why?

- Customer What
- Customer How
- Product What
- Functional
- Conceptual
- Realization

- drives, justifies, needs
- enables, supports

Reference Architecture: Requirements Analysis Starts Left

Requirements Capturing by the System Architect

version: 1.5
March 6, 2013
CAFCRannotated
Example Motorway Management Analysis

Key-drivers

Safety
- Reduce accident rates
  - Enforce law
  - Improve emergency response

Effective Flow
- Reduce delay due to accident
  - Improve average speed
  - Improve total network throughput
  - Optimize road surface
  - Speed up target groups
  - Anticipate on future traffic condition

Smooth Operation
- Ensure traceability
  - Ensure proper alarm handling
  - Ensure system health and fault indication

Environment
- Reduce emissions

Derived application drivers

Early hazard detection with warning and signaling
Maintain safe road condition
- Classify and track dangerous goods vehicles
- Detect and warn noncompliant vehicles
- Enforce speed compliance
- Enforce red light compliance
- Enforce weight compliance

Requirements
- Automatic upstream accident detection
- Weather condition dependent control
- Traffic speed and density measurement
- Cameras
- Deicing
- Traffic condition dependent speed control

Note: the graph is only partially elaborated for application drivers and requirements
### Method to create Key Driver Graph

- **Define the scope specific.** in terms of stakeholder or market segments

- **Acquire and analyze facts** extract facts from the product specification and ask why questions about the specification of existing products.

- **Build a graph of relations between drivers and requirements** where requirements may have multiple drivers by means of brainstorming and discussions.

- **Obtain feedback** discuss with customers, observe their reactions.

- **Iterate many times** increased understanding often triggers the move of issues from driver to requirement or vice versa and rephrasing.
### Recommendation for the Definition of Key Drivers

- **Limit the number of key-drivers**
  - minimal 3, maximal 6

- **Don’t leave out the obvious key-drivers**
  - for instance the well-known main function of the product

- **Use short names, recognized by the customer.**

- **Use market-/customer- specific names, no generic names**
  - for instance replace “ease of use” by “minimal number of actions for experienced users”, or “efficiency” by “integral cost per patient”

- **Do not worry about the exact boundary between Customer Objective and Application**
  - create clear goal means relations
Transformation of Key Drivers into Requirements

Customer
What
Customer objectives

Key (Customer) Drivers

Customer
How

Derived Application Drivers

Application

Product
What
Functional

goal
means may be skipped or articulated by several intermediate steps
functions interfaces performance figures

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REQfromDriverToRequirement
Requirement Selection Process

- **customer needs**
- **operational needs**
- **roadmap**
- **strategy**
- **competition**
- **product specification**
- **need characterization**
- **requirement phasing**
- **Technology, People, Process costs and constraints**
Simple Qualification Method

- important
- urgent
- effort
- value

discuss  do

don't discuss

don't discuss
discuss  do

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REQqualitativeSelectionMatrix
Examples of Quantifiable Aspects

- Value for the customer
- (dis)satisfaction level for the customer
- Selling value (How much is the customer willing to pay?)
- Level of differentiation w.r.t. the competition
- Impact on the market share
- Impact on the profit margin

Use relative scale, e.g. 1..5 1=low value, 5 -high value
Ask several knowledgeable people to score
Discussion provides insight (don't fall in spreadsheet trap)