MTAT.03.306

Requirements Change Management
• Establishing requirements traceability
• Prioritising requirements

**Managing changes of requirements artefacts**
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• Configuration management
• Requirements changes
• Causes for requirements change
• Activities of change management
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• Configuration management
  • Requirements changes
  • Causes for requirements change
  • Activities of change management
Configuration Management

• **Product (artefact) dimension**
  – Concrete goals, scenarios, and solution-oriented requirements

• **Version dimension**
  – Manages different change states of the artefact of the product dimension
Configuration Management Levels

• **Document level**
  – Document – the smallest unit
  – Configurations and document versions created and managed

• **Requirements artefact level**
  – Requirements artefacts – the smallest unit
  – Configurations and artefact versions created and managed

• **Attribute level**
  – Individual attributes of requirements artefacts – the smallest unit
  – Configuration management at the attribute level is typically not realised in practice
    • Too large amount, too complex
Versions of Requirements Artefact

- Versions changes during the process when requirements are specified, agreed and represented.
Versions of Requirements Artefact

- How to identify version?

![Diagram showing versions of requirements artefact]

- Specification (Content)
  - complete
  - fair
  - vague

- Agreement
- Representation (Documentation)
  - informal
  - semi-formal
  - formal
  - personal view
  - common view
Configuration

- **Comprises a set of related requirements artefacts – versions of requirements artefacts**

- **Consistency**
  - Version of requirements artefacts grouped together is consistent

- **Unique identification**
  - To identify configuration unambiguously

- **Not changeable**
  - Freezes a particular state
  - Changes are not allowed, otherwise – new version

- **Basis for roll-back**
  - Provide the basis for roll-back to previous states in the process
  - Might be required if changes to the requirements artefacts have led to inconsistencies
Baseline of Requirements Artefacts

• Selected configuration of requirements artefacts
  – Stable requirements artefact versions
  – Realised in a particular system release

  – All properties of configuration and in addition:
    • Basis for the definition of system release
    • Visible to the customer
    • Subject to change management

  – Requirements baseline supports a number of important activities:
    • Basis for planning system release
    • Estimation of realisation effort
    • Comparison with competitor’s product
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• **Requirements changes**
• Causes for requirements change
• Activities of change management
Why do requirements change?

• Problem encountered during system operation
• Result from a change in the system context
Requirements change

- **Problem encountered during system operation**
  - Inconsistency
  - System error
  - Unsatisfactory system quality encountered during system operation

**R-98:** The navigation system shall calculate the estimated duration of a trip.
Requirements change

• Problem encountered during system operation
  – Inconsistency
  – System error
  – Unsatisfactory system quality encountered during system operation

**R-98:** The navigation system shall calculate the estimated duration of a trip. **Fit criterion:** To calculate the estimated duration, for motorways, an average speed of 120 km/h shall be used.
Requirements change

• Problem encountered during system operation
  – Inconsistency
  – System error
  – Unsatisfactory system quality encountered during system operation

R-98: The navigation system shall calculate the estimated duration of a trip. 
Fit criterion: To calculate the estimated duration, for motorways, an average speed of 120 km/h shall be used.

• The feedback from customers indicated that the estimated driving times are always too optimistic, i.e., in reality, a longer time is needed to reach the destination. To accommodate this feedback and to improve the system, requirement R-98 is changed. Now it defines that the average speed can be changed by the user at any time.
Requirements change

- Problem encountered during system operation
- Result from a change in the system context
  - Subject facet
  - Usage facet
  - IT system facet
  - Development facet
Requirements change

- Problem encountered during system operation
- Result from a change in the system context
  - Subject facet
  - Usage facet
  - IT system facet
  - Development facet

The manufacturer of the digital roadmap that is used for the navigation system changes the format of the map due to a newly introduced standard for storing geographic data. The new standard defines, among other things, new types of geographic objects. Consequently, the requirements artefacts of navigation system related to reading and processing the map data must be adapted.
Requirements change

• Problem encountered during system operation
• **Result from a change in the system context**
  – Subject facet
  – **Usage facet**
  – IT system facet
  – Development facet

Client demanded that the navigation system additionally facilitates voice entry of the destination. Thus, requirements for speed recognition have to be defined and existing “input” requirements for the system have to be adjusted accordingly.
The navigation system interacts with its technical environment (other electronic systems in the vehicle) via an in-vehicle network. The navigation system acquires the current speed and rate of the network interface. As the car manufacturer decides to re-organise the in-vehicle network and use a new network standard, the requirements related to interactions of the navigation system with other electronic systems must be checked and adapted.
Requirements change

- Problem encountered during system operation
- Result from a change in the system context
  - Development facet

R-17: In 98% of all cases, the system shall calculate routing information to the destination in less than 1.3 s. Calculating the routing information shall in no cases take more than 2 s.

R-34: The routing calculated by the system shall in no cases contain less than two waypoints per 10 km. For routes with a length of less than 10 km, one waypoint is sufficient.

During design it becomes evident that the performance requirement R-17 and the precision requirement R-34 cannot be fulfilled at the same time, especially in the case of very long trips. This conflict prohibits realising the two requirements as originally specified and results in a change of performance requirement R-17. Thus requirement R-34 is adjusted (not less than two viewpoints per 10 km for trips <300 km and <=1000 km; per 10 km for trips >1000 km)
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• **Causes for requirements change**
• Activities of change management
Change Management Requests

• Integration of a new requirement
• Removal of an existing requirement
• Extension of an existing requirement
• Reduction of an existing requirement
• Change of an existing requirement
Change Management Requests

• Integration of a new requirement
  – New requirement elicited and integrated in the requirements baseline
• Removal of an existing requirement
• Extension of an existing requirement
• Reduction of an existing requirement
• Change of an existing requirement
Change Management Requests

- Integration of a new requirement
- **Removal of an existing requirement**
  - Existing requirements artefact is invalid and shall be removed from the requirements baseline
- Extension of an existing requirement
- Reduction of an existing requirement
- Change of an existing requirement
Change Management Requests

- Integration of a new requirement
- Removal of an existing requirement
- **Extension of an existing requirement**
  - Existing requirements artefact be extended by a particular aspect
  - Extensions be integrated in the requirements baseline
- Reduction of an existing requirement
- Change of an existing requirement
Change Management Requests

• Integration of a new requirement
• Removal of an existing requirement
• Extension of an existing requirement

• Reduction of an existing requirement
  – Some aspects of a requirement shall be removed
  – E.g., particular inputs shall not be processed any more or outputs shall be omitted

• Change of an existing requirement
Change Management Requests

- Integration of a new requirement
- Removal of an existing requirement
- Extension of an existing requirement
- Reduction of an existing requirement
- **Change of an existing requirement**
  - A requirement shall be changed in a way that can be classified neither as a single extension nor as a reduction
  - Needs to be integrated in the requirements baseline
  - E.g., modify the assignment of the output value to the input values of a function
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• Configuration management
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Change Control Board

• Responsibilities
  – Classification of incoming change requests
    • Corrective, adaptive, exceptional
  – Effort estimation for change integration
    • Impact analysis
  – Evaluation of change request and decision-making
    • Relation between effort and benefit
    • Accept or reject
  – Prioritisation of accepted change requests
Template for the documentation of a change request

<table>
<thead>
<tr>
<th>Content</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project name</td>
<td>Name of the project to which the change applies</td>
</tr>
<tr>
<td>Request no.</td>
<td>Consecutive number of the change request</td>
</tr>
<tr>
<td>Title</td>
<td>Title of the change request</td>
</tr>
<tr>
<td>Date</td>
<td>Date of the change request</td>
</tr>
<tr>
<td>Originator</td>
<td>Name of the originator</td>
</tr>
<tr>
<td>Origin</td>
<td>Origin of the change (e.g. marketing, management, customer, architectural design, and the context facet(s) from which the change originates)</td>
</tr>
<tr>
<td>Status</td>
<td>Current status of the change request (e.g. submitted, evaluated, rejected, to be integrated, verified, finalised)</td>
</tr>
<tr>
<td>Originator’s priority</td>
<td>Priority of the change request (defined by the originator of the change)</td>
</tr>
<tr>
<td>Priority of realisation</td>
<td>Priority of the change request (defined by the change control board)</td>
</tr>
<tr>
<td>Verifier of the change</td>
<td>Name of the person responsible for verifying the change after its integration</td>
</tr>
<tr>
<td>Date of last update</td>
<td>Date of the last update of the change request</td>
</tr>
<tr>
<td>Release</td>
<td>Assignment to the release in which the change shall be integrated</td>
</tr>
<tr>
<td>Integration effort</td>
<td>Estimated effort required for change integration</td>
</tr>
<tr>
<td>Description of the change request</td>
<td>Textual description of the change request</td>
</tr>
<tr>
<td>Comments</td>
<td>Comments relating to the change request, e.g. from other stakeholders, the change control board, etc.</td>
</tr>
</tbody>
</table>
Process for requirements change management

1. Classification of the change request

2. Impact analysis

3. Evaluation of the change request

[decision accept/reject]

4. Prioritisation of change request

[accept]

[reject]

5. Monitoring of change request
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request

[decision accept/reject]

[accept]

[reject]
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request

[decision accept/reject]

[accept]

[reject]
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request

[decision accept/reject]
[accept]
[reject]

5. Monitoring of change request
Process for requirements change management

Corrective change
• Cause of change – system error or erroneous behaviour

Adaptive change
• Cause of change – requirements artefact needs to be adapted

Exceptional change
• Cause of change – it is necessary and must be integrated immediately
  – Can be prioritised among other
  – The change request may be corrective or adaptive
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request

- Estimate an effort required to implement a change request
- All requirements affected by the change request need to be identified
Process for requirements change management

1. Classification of the change request

- Estimate an effort required to implement a change request
- All requirements affected by the change request need to be identified

Diagram:
- Change request
- Scenarios
- Solution-oriented requirements
- System architecture
- Implementation
- Test cases
- Maintenance plan

Relationships:
- satisfies
- based_on
- refines
- testcase_for
- downstream artefacts
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request

- **Cost** required to realise the change request
- **Benefit** related to:
  - Improvement in market position
  - Avoidance of loss of prestige
  - Contract fulfillment
  - Avoidance of contractual penalties

5. Monitoring of change request
Process for requirements change management

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
4. Prioritisation of change request
5. Monitoring of change request

- Prioritise the approved change requests

[decision accept/reject]
[accept]
[reject]
Process for requirements change management

- Monitors the realisation of the change request and the resulting integration of the changes
- Tracks the status of each change request during its realisation
- Keeps the originator informed about the current status

1. Classification of the change request
2. Impact analysis
3. Evaluation of the change request
   - [decision accept/reject]
   - [accept]
   - [reject]
4. Prioritisation of change request
5. Monitoring of change request
Things to Take Home

• Configuration management
  • Requirements changes
• Causes for requirements change
• Activities of change management