Analysis, definitions and synthesis of sustainability and requirement engineering

Matthias Gottlieb
Agenda

- Introduction
- Definitions
- Analysis
- Synthesis
- Future prospects
- Conclusion
Introduction

- **Safe energy by**
  - engineering the software,
  - by running the software,
  - keeping the software running,
  - and also its environment

- **With the support of ICT we are able to reduce energy and their losses**

- **Sustainability is more than energy**
  - Social
  - Ecological
  - Environmental

- **Identifying models and processes for analyzing software, building up profiles, and support the customer with feedback**

- **Use feedback for predictions**
Definition requirement engineering

• A spiral process, which consists of Domain understanding and elicitation, evaluation and negotiation, specification and documentation, and quality assurance.

• Das Requirement Engineering ist ein kooperativer, iterativer, inkrementeller Prozess, deren Ziel es ist zu gewährleisten, dass:
  – alle relevanten Anforderungen bekannt und in dem erforderlichen Detaillierungsgrad verstanden sind,
  – die involvierten Stakeholder eine ausreichende Übereinstimmung über die bekannten Anforderungen erzielen,
  – alle Anforderungen konform zu den Dokumentationsvorschriften dokumentiert bzw. konform zu den Spezifikationsvorschriften spezifiziert sind.
Conclusion of the definition: requirement engineering

- requirement engineering is a
  - kooperative,
  - iterative,
  - incremental,
  - systematical,
  - effective, and efficient prozess
  - with all stakeholder explicitly defined system specifications, that need to be observed.
Definition sustainability (1)

• Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

• International Institute of Sustainable Development (IISD) report 2010 three main parts:
  – Economic development
  – Social development
  – Environmental development

• We use the term of sustainability as a quality indicator which measures the success of the project in the context of green ICT
IISD 2010

**Economic development**: Reducing and seeking to eradicate income poverty, achieving higher levels of prosperity and enabling continued gains in economic welfare.

**Social development**: Reducing and seeking to eradicate other dimensions of poverty, improving the quality of education, health, housing, and other aspects of the welfare of individuals and communities, and enhancing the quality of social interaction, engagement and empowerment.

**Environmental development**: Reducing pollution and other negative impacts on the environment, mitigating the effects of industrialization and human activity, and seeking to achieve sustainable use of resources in the interest of future generations.
Definition sustainability - IISD 2010
Analysis – Overview of the Flinkster project

- Practical example „Flinkstar“-project
- Deutsche Bahn AG
- Car Sharing project
- Online booking system
- Smartphone App supported
- eFlinkstar possible

Quelle: www.flinkster.de, zugegriffen am 07.12.2011
Volere

<table>
<thead>
<tr>
<th>Requirement #: 75</th>
<th>Requirement Type: 9</th>
<th>Event/BUC/PUC #: 7, 9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> The product shall record all the roads that have been treated</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rationale:</strong> To be able to schedule untreated roads and highlight potential danger</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Originator:</strong> Arnold Snow - Chief Engineer</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fit Criterion:</strong> The recorded treated roads shall agree with the drivers’ road treatment logs and shall be up to date within 30 minutes of the completion of the road’s treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Customer Satisfaction:</strong> 3</td>
<td><strong>Customer Dissatisfaction:</strong> 5</td>
<td></td>
</tr>
<tr>
<td><strong>Dependencies:</strong> All requirements using road and scheduling data</td>
<td><strong>Conflict:</strong> 105</td>
<td></td>
</tr>
<tr>
<td><strong>Supporting Materials:</strong> Work context diagram, terms definitions in section 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>History:</strong> Created February 29, 2010</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quelle: [http://www.volere.co.uk/template.htm](http://www.volere.co.uk/template.htm), zugegriffen am 07.12.2011
Identify stakeholder

- Group work

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Description</th>
<th>Interests</th>
<th>Classifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement Engineer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Stakeholder of the Flinkster project (1)

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Description</th>
<th>Interests</th>
<th>Classifier</th>
</tr>
</thead>
</table>
| Company              | Deutsche Bahn AG                                  | • Get people to and from the trainstations  
• Get people mobile          | Surrounding Conditions (Owner)                                           |
| Software architect   | Building the software architecture and implement them | Good architecture of the software system  | Implementation                          |
| Software designer    | Person that give the software a design (good looking) | Give the software a graphical user interface  | Implementation                          |
| Software engineer    | Engineering the software and implement them       | Good software implementation  | Implementation                          |
| Requirement engineer | Keep track of the requirements of a software system | Have a sustainable software  | Software                                |
| Management           | Operational level of a company / organization     | • Finance  
• Human Resources  
• Quality  
• Overall security | Surrounding conditions                                  |
Stakeholder of the Flinkster project (2)

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Description</th>
<th>Interests</th>
<th>Classifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>German government</td>
<td>Legislative of the federal republic of Germany</td>
<td>• Law • Reducing CO2 (EnWG08)</td>
<td>Surrounding conditions</td>
</tr>
<tr>
<td>Car companies</td>
<td>Audi, Volkswagen, Mercedes Benz, Opel, Ford, BMW, etc.</td>
<td>• Selling cars • Having exclusive rights</td>
<td>Support</td>
</tr>
<tr>
<td>Technicians</td>
<td>• Car • Software Support</td>
<td>• System stability, reliability • Quality of the parts of the cars • Low maintenance • Easy maintainability</td>
<td>Support</td>
</tr>
<tr>
<td>Smart phone companies</td>
<td>HTC, SonyEricsson, Nokia, etc.</td>
<td>give their customers more applications to bind the user to the company</td>
<td>Support</td>
</tr>
<tr>
<td>Governments from the outside of Germany</td>
<td>Especially European Union, USA, Canada, Australia, China, etc.</td>
<td>• Law • Sustainable reducing of energy</td>
<td>Environment</td>
</tr>
</tbody>
</table>
# Stakeholder of the Flinkster project (3)

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Description</th>
<th>Interests</th>
<th>Classifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>Buying and normally uses the software system</td>
<td>• Well defined software  &lt;br&gt; • Working software  &lt;br&gt; • Support less software  &lt;br&gt; • Easy understanding of the software  &lt;br&gt; • Cheap software  &lt;br&gt; • &quot;Green&quot; software</td>
<td>Environment</td>
</tr>
<tr>
<td>Map services</td>
<td>Google, Falk, Navigon, Garmin, TomTom, etc.</td>
<td>Exclusive using right &lt;br&gt; Support</td>
<td>Support</td>
</tr>
<tr>
<td>Ecological groups</td>
<td>Greenpeace, etc.</td>
<td>Ecological environments &lt;br&gt; Support &lt;br&gt; Environment</td>
<td>Environment</td>
</tr>
<tr>
<td>Software developer</td>
<td>Implementing the software system</td>
<td>Good software implementation &lt;br&gt; Support &lt;br&gt; Implementation</td>
<td>Implementation</td>
</tr>
<tr>
<td>Others</td>
<td>It depends</td>
<td>It depends &lt;br&gt; It depends &lt;br&gt; It depends</td>
<td>It depends</td>
</tr>
</tbody>
</table>
Classifying the stakeholder and show the influences

- Group work
Classifiers in context to the given definition
Case study from an environment perspective

• A car stays around 22 hours a day [2]
• Customer take part in the Flinkster project
• First register at the plattform
• Booking a representative car to share with others
• Needed one day
Case study from a development perspective

- Problem by booking the car
- Developer has to classify the problem
  - Software (fault, defect, bug)
  - User mistake (failure)

- Spillner and Linz
  - A situation can only be erroneous or faulty if the ex ante defined situation is different from the expected or correct situation.
  - A failure or fault is not produced by aging or wearing.

- A software cannot be sustainable if it has a serious fault
Environmental development definition in context to the Flinkster project

**Environmental development:** Reducing pollution and other negative impacts on the environment, mitigating the effects of industrialization and human activity, and seeking to achieve sustainable use of resources in the interest of future generations.

- Group work:

- Does this fit with the Flinkster project?
Environmental development definition in context to the Flinkster project

**Social development:** Reducing and seeking to eradicate other dimensions of poverty, improving the quality of education, health, housing, and other aspects of the welfare of individuals and communities, and enhancing the quality of social interaction, engagement and empowerment

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- Group work:

- Does this fit with the Flinkster project?
Synthesis of requirement engineering and sustainability

- Group work

- Ideas how this could be done with the Flinkster project?
Influences between the classified stakeholders

Diagram illustrating the relationships between various stakeholders in a software development context. The stakeholders include:
- User
- Requirement Engineer
- Software Engineer
- Software Developer
- Software Architect
- Support companies
- Management
- Environmental groups
- Laws

These stakeholders interact with each other, and there are arrows indicating the influences between them.
ER-Diagram

Implementation or Support \(\rightarrow\) Create or maintain \(\rightarrow\) Software \(\rightarrow\) influences \(\rightarrow\) Environment

pretend

Surrounding Conditions
Synthesis sustainability and requirement engineering shown at the Flinkster project example
Lesson Learned

- Identify indicators which should be measured

  Typical measurements are based on:
  - Environmental
  - Social
  - Ecological
  - (Green ICT)

- Requirement engineering and sustainability could be combined

- The requirement engineer keep the sustainability as a quality requirement
Future prospects – questions

- How could be react on the users perspective?
- How can a software system be evaluate?
- What have to be done in management to provide a product of "good" sustainable quality and how can the quality be measured?
- How could a sustain business process be modelized?
- What is the impact on society?
Future prospects - answers

• Definition of sustainable or ecological software needs to be more specified and analyzed in detail
• Find reliable measurements for sustainability
• Find an approach for a standardized sustainable software system
• Huge impact on society
  – Knowing how much potential it will generate or not
  – calculate the right budget
  – Do the project or not
• Standardized processes could be developed and automated basically
Conclusion

• Requirement engineering is building a base for sustainable software systems
  – explicite defined system specification gives us indicators
  – possibility to measure the sustainability for the system.

• complex to find good measurements for the sustainability
  – sustainability have to occur
  – No standrad model to solve it.

• Flinkster project fullfills after the given definition the criteria
  – Hard to measure now the success
  – Environmental development is measureable
Questions?
Thank you for your attention!
Literature