Using FRAM in eliciting and specifying requirements for information technology systems on building maintenance

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Article

Information Technologies in Complex Socio-Technical Systems Based on Functional Variability: A Case Study on HVAC Maintenance Work Orders

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Agenda

a. Requirements Engineering
b. FRAM for eliciting and specifying requirements
c. Work order for the building maintenance
Requirements engineering (RE) is a branch of Software Engineering dedicated to the process of requirements specification that software must solve. The system requirements express the description of what the system should do and the obstacles to its operation.

- **Feasibility:** Is the system useful to the business?
- **Elicitation:** Discovering requirements from stakeholders
- **Specification:** Translating requirements into standard form
- **Validation:** Checking if requirements define the system that customer wants
Requirements Engineering (RE)

Challenges for RE

- Current elicitation techniques are critically dependent on the selection of experts to ensure the successful elicitation of requirements
- Users usually do not have a complete understanding of the problem domain
- Typical approaches to elicit software requirements are not well suited for dealing with non-linear characteristics of complex socio-technical systems
- Analysts may not be able to predict variations that emerge when the system is functioning
FRAM emerges as a novel approach to overcome limitations from traditional techniques in eliciting and specifying requirements.

How variability understanding contributes to the requirements elicitation and specification for the design/redesign of IT systems to support the work in complex socio-technical systems?
FRAM for eliciting and specifying requirements

The goal is to gain initial knowledge about the organization (processes, stakeholders, resources, work situations, physical structure).

The goal is to identify users’ needs from variability analysis and functional resonance.

The goal is to detail all the requirements in a specific way.
Work order for the building maintenance

Prescribed work as business process

Start

- Analyze request
  - Is the request relevant to the building maintenance?
    - Yes: Identify service and choose technician
    - Not: Cancel request

- Identify service and choose technician
  - Service Categories: electrical, plumbing, HVAC, civil works, metal works, and carpentry/furniture

- Issue Work Order
  - Work Order
  - Is there restricted access to the site?
    - Yes: Send technician to the local
    - Not: Contact the requestor

End
- Work order for the building maintenance

Focus of analysis: *Maintenance of Heating, Ventilation and Air conditioning (HVAC) Systems*
Modeling issuance of work order with FRAM

Blue functions - Customer

Green functions – Maintenance Supervisor

Interface: IT System
Identification of variability

Table 1. Potential variability identified in the work order issuance for the maintenance in HVAC systems.

<table>
<thead>
<tr>
<th>No.</th>
<th>Function</th>
<th>Regarding Time</th>
<th>Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Record place in CISI</td>
<td>On time</td>
<td><strong>Imprecise</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This function does not vary regarding time</td>
<td>Requestors may fill the place of service wrongly.</td>
</tr>
<tr>
<td>2</td>
<td>Record service in CISI</td>
<td>On time</td>
<td><strong>Imprecise</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This function does not vary regarding time</td>
<td>Requestors often describe service in an ambiguous or incomplete way because they do have not enough knowledge to describe the service properly.</td>
</tr>
<tr>
<td>3</td>
<td>Monitor CISI for new requests</td>
<td>Too late</td>
<td><strong>Precise</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The function can be impacted by delays, since the maintenance supervisor has other assignments out of the office.</td>
<td>This function does not vary regarding precision</td>
</tr>
<tr>
<td>4</td>
<td>Analyze service description</td>
<td>Too late</td>
<td><strong>Acceptable</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This function may consume some time due to adjustments to understand and clarify the service description. This scenario may entail delays in downstream functions.</td>
<td>The service description may not be comprehensible by the maintenance supervisor. Then, to clarify the service description, he needs to contact the requestor.</td>
</tr>
<tr>
<td>5</td>
<td>Select service group</td>
<td>On time</td>
<td><strong>Imprecise</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>This function does not vary regarding time</td>
<td>The unsuccessful outcome in upstream function 5 can entail an imprecise decision regarding the service group.</td>
</tr>
<tr>
<td>6</td>
<td>Select a working team</td>
<td>Too late</td>
<td><strong>Acceptable</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The function triggering time often depends on the availability and qualification of technicians. This scenario submits the maintenance supervisor to trade-offs, since he needs to select an alternative technician.</td>
<td>In CISI, the field for technicians’ selection does not allow the user to select more than one technician. Then, the maintenance supervisor adapts the WO form, recording the technicians’ names in the field “observation”.</td>
</tr>
<tr>
<td>7</td>
<td>Receive additional details and update data in CISI</td>
<td>Too late</td>
<td><strong>Acceptable</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Using emails or calls to receive a reply can entail delays in downstream functions.</td>
<td>Once the requestor’s answer is satisfactory, this information is enough to support the service analysis.</td>
</tr>
</tbody>
</table>
Software requirements from the modeling with FRAM

- Modeling activity
- Potential Resonance
- Mitigating actions
- Requirements 1, 2, 3..., n
- Enhancing the IT System
## Mitigating actions

<table>
<thead>
<tr>
<th>N°</th>
<th>Function</th>
<th>Variability</th>
<th>Potential Resonance</th>
<th>Mitigating Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Record place in CISI</td>
<td>The requestor fills out specific places for service in the wrong way.</td>
<td>After the WO is issued, it may affect the service performance, inducing the working team to the wrong place.</td>
<td>Perform a survey on all territories of the R&amp;D organization to register all units in CISI. Link each user (requestor) to the places of its operation. This action will decrease manual fills, and consequently, the incidence of fill errors.</td>
</tr>
<tr>
<td>2</td>
<td>Register service in CISI</td>
<td>In most cases, the requestor does not have enough knowledge to describe the service comprehensibly.</td>
<td>The incomplete and imprecise description of the service causes variability in downstream functions, because they induce errors in the task, resulting in delays in the maintenance.</td>
<td>Establish procedures in the CISI to facilitate the service description.</td>
</tr>
</tbody>
</table>
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Thank you!