Four-level Process Modeling in Healthcare SOA Analysis and Design

NI2009 Conference
30 June 2009 Helsinki

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Presentation outline

• Introduction and background
• Process and activity specification levels
• Examples of process and activity models
• Results: experience and applicability of process modeling approaches
• Conclusions
Introduction and background

• Speaker
  – Juha Mykkänen, PhD, post-doctoral researcher
  – application development and integration, information system architectures, interoperability standardization and certification, health and social services information systems
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• Projects related to this work
  – SOLEA (Service-oriented locally adaptable enterprise architecture): how to make large information systems more adaptable to changes and integratable using service-oriented and process-oriented development methods
  – SerAPI (Service-oriented architecture and web services for healthcare application production and integration): how to make health information systems more modular and integratable
  – Results have also been applied in various other projects
Goals of process and activity modeling

• Shared and explicit understanding of processes and work activities is needed in information systems development
  – Users, (e.g. nurses, physicians), developers, (e.g. designers, architects), managers...

In process modeling, the goal of the work is the main driver for various modeling decisions (what is being modeled, using which methods and notations and how accurately).

Typical goals include:
• Increase understanding of the domain
• Reveal process improvement or development needs
• Unify processes and activities
• Automate processes or tasks
• Process monitoring
• Simulate
• Identify candidates for information system or application service development

Different stakeholders have different goals and aims
• In healthcare: patient, user, management, professional group or data flow viewpoint can be emphasized
• Process modeling with emphasis on identification of reusable software services in healthcare context

• Process and activity models were used to
  – support the identification and realization of processes using information systems using example domains:
    • maternity care (diverse network of services)
    • endoscopy examination (central supportive process in various healthcare organizations)
  – provide basis for the development of service-oriented architectures and their constituent software services
  – study process modeling techniques which would be suitable for modular health information systems development
Levels of process and activity modeling

- In different phases of domain and process modeling different abstraction and accuracy levels are needed
- Typically, process modeling activities progress from holistic view towards fine-grained and detailed descriptions

<table>
<thead>
<tr>
<th>Level</th>
<th>What is being modeled</th>
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| Overview| environment of the activities, holistic view of the activity system  
*e.g. activity networks, organizational units, identified processes*                                              |
| Process | description of one specified process  
*e.g. phases and progress of high-level workflow or process between various participants*                                                                 |
| Activity| specific description of one process phase or activity  
*e.g. constant activities of given actors or units, often also consecutive tasks or phases*                                                  |
| Action  | accurate descriptions, details of user or system interfaces  
*e.g. detailed information on the actions and tool requirements, detailed design of applications or IT solutions* |
Example: endoscopy process level diagram
Example: endoscopy process level diagram

High-level process flow

Preliminary activities (6) and their sub-activities (12) of endoscopy examination

Detailed actions and use cases (26) of preliminary activities

Actions and tools (use cases)

www.uku.fi/solea
Example: service domain overview diagram of maternity services
Example: service domain overview diagram of maternity services

Maternity hospital activities (specialized care)

Maternity and child welfare clinic and municipal activities (primary care)

Information systems and repositories (hospital, municipality, regional systems, external organizations)

Family / mother / child visits
Example: UML activity diagram / maternity clinic patient process
Example: UML activity diagram / maternity clinic patient process

Risk pregnancy follow-up visit on maternity clinic

Mother activities and information entities

Physician / midwife activities and information entities

Unit secretary activities and information entities

External communication of the (sub)process
### Modeling notations and methods used

- Service description matrix
- Process notations of BEA WebLogic tools
- Process map
- Organizational diagram
- BPMN process diagram
- Process description matrix
- Activity description matrix
- Process level diagram
- Use case description matrix
- UML activity diagram
- Narrative process description
- Process / services diagram
- Service domain overview diagram
- Information directory listing
- Service event overview diagram
- Service event diagram
- Appointment programme matrix
- Appointment / examination programme matrix
- Narrative patient scenario
- Activity / domain diagram
- Actor workflow activity diagram
- Care pathway diagram
- Narrative medical directives
Results 1

• 23 different process and activity modeling notations and methods were used in maternity and endoscopy cases
  – five on several modeling levels

• Observations from endoscopy modeling
  – Detailed actions and tools level modeling was laborious but produced useful material for solution design
  – Good traceability between modeling levels
  – Resulted in identification of software services

• Observations from maternity modeling
  – Not possible to model the whole domain on detailed level – omission decisions (what not to model) are crucial
  – Detailed modeling of selected sub-processes
  – Strict separation of current and target state necessary
  – Observations on readily available material and models:
    • Internalization of external models is as time-consuming as modeling
    • Experts preferred instead of material for domain expertise
• The four modeling levels were found useful
  – nested levels are practically inevitable if both overviews and detailed descriptions are needed
  – promote readability, understandability and the necessary level of detail
• Process and orthogonal (actor-based) viewpoints were needed
• Some generic notations can be used on several levels and viewpoints
• Modeling work requires learning, but becomes faster as the tools and conventions become familiar
• Tabular templates (matrices, rather than narrative text) give structure and discipline to the modeling efforts and guarantee systematic inclusion of important aspects
• Generalization of process models would promote reuse and identification of software services
• Scenarios and traditional process models fail to cover many variations in healthcare processes
  – most of the processes and activities were too dynamic to enable accurate modeling of only the most common workflows and a few alternative ones
Conclusions

• **Modeling – lingua franca?**
  – Scenario descriptions by domain experts (here: nurses and physicians) focus on medical or nursing details: they give IT design new ideas for supporting the work **but** often omit important information system design aspects
  – Good models and matrices force necessary information systems aspects to become explicit and promote shared understanding
  – Results can not be directly generalized: Little validation of models, main emphasis on modeling activities
  – Other related models and modeling activities, however, support the results: HL7 version 3 appointment scheduling, IHE (Integrating the Healthcare Enterprise) workflow specifications, process modeling of social services

• **Risks:** getting stuck in details, omission of important aspects, voluminous workload

• **Crucial success factors:** goal-driven modeling, selection of aspects or activity boundaries for which detailed models are needed, generalization of models, selection of suitable modeling levels
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This work is based on work of
SOLEA and SerAPI projects:

www.uku.fi/solea/  www.serapi.fi/

Projects are funded by the Finnish funding agency for Technology and Innovation TEKES together with several hospital districts / and companies