Use Context of Modeling in Model-Based Adaptive Product and Process Engineering

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CSIT 2007
6th International Conference on Computer Science and Information Technologies

September 24-28, 2007
Yerevan, Armenia
Outline

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- Our Methodology
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Introduction

- modeling as a state of the art methodology
- several modeling languages & notations
  - UML [www.uml.org]
  - Petri Nets [en.wikipedia.org/wiki/Petri_net]
  - ER notation [en.wikipedia.org/wiki/Entity-relationship_model]
  - IDEF [en.wikipedia.org/wiki/IDEF]
  - SGAMSIDOER [Lillehagen, 2000]
  - POP*

we analyze the POP* approach & its application in modeling processes in a European STREP project called MAPPER (Model-based Adaptive Product and Process Engineering) (IST-016527)
Introduction

- the objective of MAPPER is business- & user-driven
- to enable fast & flexible manufacturing
- in networked manufacturing enterprises,
- demonstrating practical benefits & scientific values
- in three industrial pilots
- by providing methodology, infrastructure & reusable services
- for participative engineering
Introduction

- POP* meta-model
  - organized according to knowledge dimensions
  - influenced by several approaches like BPDM, UEML
  - has 5 dimensions based on a Core
    - Process
    - Organization
    - Product
    - Decision
    - Infrastructure

- modeling with POP* means creating active models of processes, products, organizations or resources/infrastructures
Introduction

‣ why POP*
  - any organizational process can be decomposed
  - active models can be used to create workplaces & carry out work on these
  - workplaces can be generated for each role in a cooperative process
  - possible to re-create & re-configure workplaces based on models

AKM = Active Knowledge Modeling
= technology & methodology

[Lillehagen et al. 2002]

www.akmodeling.com
Modeling

- modeling session in MAPPER
  - a meeting of people to produce a model
  - a collaborative & participative action in requirements engineering process

- result = a model or models

- in this paper
  - we try to understand the modeling scope in real work environments and
  - through this to identify use context and user requirements
  - to modeling processes, approaches and tools
Modeling

- methodology to model = SGAMSIDOER [Lillehagen 2000]
  = an adopted approach in modeling of customer processes & any sub-processes required, to create active knowledge models of customer enterprises

SGAMSIDOER
- S Scope according to specific customer purpose & current needs
- G Gather the customer information by mapping onto AKM templates
- A Analyze the information map & agree on the use of models & success factors
- M Develop a model by meta-modeling & modeling relevant processes, structures & views
- S Simulate processes by analyzing risks & playing roles
- I Implement the model to generate & derive solutions
- D Deploy the implemented solution
- O Operate solutions & capture experiences from presentations, portals & worktops
- E Evaluate solutions by comparing to success factors & gathering feedback
Modeling

- roles of people participating in modeling
  - use case manager
  - domain experts or end users (those that are going to use the model at the end)
  - planner
  - coordinator (who decides ways of working)
  - modeling expert
  - the coach (who facilitates the situation)
Our Methodology

- ethnography-based investigations of modeling sessions carried out at all use sites in MAPPER
  - Alpha = a research center of a vehicle production company (12/2005)
  - Beta = a small electronics company (03/2006)
  - Gamma = a company producing parts for cars (02/2006)

- observations based on multi-sited ethnographies to provide an inductive, ethnography-based description of modeling processes [Marcus 1995; Buroway 2000]
  - we observed modeling sessions
  - we gathered data by audio & video recording
  - we analyzed our ethnographic data, user documents & models created in these sessions
Our Methodology

- **issues considered in our investigations**
  - processes around modeling e.g. the work taking place preliminarily to modeling
  - details of the scene & modeling situation practical means by which the process of participative engineering takes place in modeling sessions: tools & setting situation coaching
  - problems encountered by end users in modeling sessions
  - collaboration & coordination work carried out during & between the modeling sessions collaboration between coordinator, modeling expert and coach interactions between actors
  - management of model files
Our Cases: Alpha

- **participants**: two domain experts, a facilitator & a modeler
- **modeling process started with a focus on a current model of Target Setting Process**
  - Target Setting Process = the process of definition of the technical & economical objectives that will drive the vehicle development until the production
  - its aim is to ensure the achievement of the satisfaction of the customer by means of the definition of product specifications coherent with the performances expected by the customers
Our Cases: Alpha

- present (as-is) model created with MERISE
Our Cases: Alpha

- AKM used to detail elements already present in the current model & to restructure their organization in projects, their products, processes & infrastructure
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Our Cases: Alpha

- problem: the product description in the MERISE model = a document containing a lot of activities, which could not be represented in the model explicitly

- problem: how to represent different versions of products with AKM during the Target Setting Process

- domain experts questioned IDEF [www.idef.com]
Our Cases: Beta

- **participants**: a use case manager, three domain experts & a modeler

- **modeling** as a cultural facilitator for the collaboration between Beta as the producer of virtual components & its partner as the producer of circuits

- enterprise models of Beta designed by Beta's engineers were checked & corrected by the modeler
Our Cases: Beta

- a model of Beta's partner's design process was built in a session in which people from Beta were present, with the goal
  - to foster the comprehension of design processes by its partner
  - to find points of collaboration for the future
Our Cases: Gamma

- **participants**: a use case manager, two domain experts, two facilitators, a coach & a modeler

- the goal of modeling = to design the **Process of Innovation** in the enterprise
  = to deliver a solution model based on a requirements model created previously
  = to answer
  - How does innovation happen when it happens?
  - How can domain experts learn from the innovation taking place?
Our Cases: Gamma

- the solution model should contain
  - task patterns
  - the use of MAPPER services to evoke & integrate these task patterns
  - product design alternatives
Our Cases: Gamma

- task pattern
  = adaptable models capturing best practices for the task under consideration
  = not only valid & applicable in one organizational unit, but in most cases also relevant for other organization units & processes & even for other organizations or enterprises
qualities of modeling as a process
+ qualities of models as artifacts

modeling helps identify problem areas in an organization like communication gaps, boundaries for knowledge sharing, missing of common understanding of goals, products, organizational & temporal structures, responsibilities, complexities etc.

models can be used as shared objects to establish communication & cooperation between collaborating actors
Use Qualities (2/11)

- problems in creating & using models in organizational context
  - although models are rich representations of things they model, it is not always possible to access them
  - the object-of-design becomes invisible when the access to models is not provided
  - if modeling is chosen in an enterprise to represent organizational issues, then there is the danger to model everything like work practices, social relations, informal exchange between people etc.
  - models normally enforce representing everything with boxes & arrows
  - modeling means usually translating into workflows, which do not represent all types of work practices (they normally are created top down, are predefined, well-structured, logically and temporally well-ordered)
Use Qualities (3/11)

- granularity & scale
  - don’t model everything in a work environment
  - model complex, interwoven, routined processes
  - don’t model ad hoc exchange between actors
  - don’t model informal & social interaction among actors
  - decide where to start modeling & what to keep on documents or informal
Use Qualities (4/11)

- modeling approaches
  - establish one approach in the enterprise, like MERISE or IDEF, instead of many
  - don’t change the chosen approach
Use Qualities (5/11)

- de/composition
  - define relations & dependencies between documents, in case of turning documents into models
  - (sometimes) link documents to models, compose models with documents
  - (sometimes) decompose a document into a model by defining properties, relationships & views in terms of models
  - use additional external knowledge or tacit knowledge of domain experts to extract information from documents
Use Qualities (6/11)

- decide when to change the document-based enterprise knowledge into a model-based active knowledge

- think about implications of migrating from static to a dynamic enterprise view before starting the migration
Use Qualities (7/11)

- accessibility
  - define who owns which artifact for how long
  - define who gets read or write access to artifact
  - enable access to models
Use Qualities (8/11)

- **reuse**
  - replicate knowledge or organizational structures & relations into a different organizational context
  - standardize models on a high level
  - provide guidelines for modeling
Use Qualities (9/11)

- interoperability
  - consider legacy systems when deciding what to model
  - define interfaces between models & legacy systems
    - to import & export information from & to a model
    - to make data exchange possible between the modeling tool & other applications
    - to replicate data used in legacy systems like SAP or CAD in a model
Use Qualities (10/11)

- knowledge base
- reduce tool complexity
- simplify the structure of work
- enable the visualization of contextual knowledge
- record experiences including lessons learned
Use Qualities (11/11)

- models as design tools
  - use models to compare design alternatives
  - model products to use them for comparative analysis
  - model products to use them for (market) simulations
  - create separate versions of a product in a model
Conclusions

‣ “Models are important knowledge sources, but it is the modeling that has the greatest value for users!” (The Coach in Gamma)

‣ we analyzed modeling practices in different use environments

‣ we identified use qualities of modeling tools & approaches based on user needs & organizational circumstances, which are
  - use-related
  - knowledge-oriented
  - technology-driven
  - methodology-focused
  - organization-centered
Conclusions

- **questions for modelers & users** before starting modeling processes in an organization
- Where in the whole process do we start modeling?
- Which modeling approach is most appropriate for us?
- How can a document be decomposed into a model?
- What are the implications of migrating from static to a dynamic enterprise view?
- How can we manage the access rights to our models?
- How can we use templates to capture specificities of our organization?
- How can we import and export data from and to a model?
Conclusions

- modeling sessions are not only for modeling the objects, structures & relations but to create a **common understanding** about the objects-in-development, ongoing work processes, roles & skills of persons involved & relationships between all these elements

- models & modeling can facilitate **communication, cooperation & mutual understanding** between different disciplines

- consider modeling as a **mediating process** between different communities of practice
Thanks for your attention!

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