Business-Driven Software Engineering
Lecture 3 – Foundations of Processes

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Agenda

- Introduction and Background
- Process Modeling Foundations
- Activities and Process Models
- Summary and References
Introduction and Background
Vision: Integration of Business and IT

- Business model captures business goals and provides overview of the enterprise.
- IT level comprises components organized in a component-based or service-oriented architecture.
- Business processes provide the bridge between business and technology.
Processes are Everywhere in Our Lives

- Shopping processes when buying a book at Amazon.
- Claim handling processes in an insurance company.
- Credit handling processes when applying for a loan in a bank.
- and many more

How to document and automate processes?
"A process is[...] a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs.” (Davenport 1993)

“We define a business process as a collection of activities that takes one or more kinds of input and creates an output that is of value to the customer.” (Hammer and Champy, 1993)
Business Process Management

Business Process Management:
- “Business Process Management comprises concepts, methods, techniques for design, administration, configuration and analysis of business processes” (Weske, 2007)

Business Process Management System:
- “A business process management system is a generic software system that is driven by explicit process representations to coordinate the enactment of business processes.” (Weske, 2007)
Traditional System Architectures

- Application uses database management systems to access data
- Database management system realizes functionality on top of the operating system
- Interaction with the user is realized through a graphical user interface
- Monolithic system architecture
- Siloed enterprise applications

- How to deal with changes?
- How to realize functionality across different databases?
- How to realize “integrated” functionality?
Enterprise Application Integration

- New technical capabilities allowed to integrate applications for enterprises
- Point-to-point integration
  - many connections
- Hub-and-spoke integration
  - reduce the number of connections
Workflows and Workflow Management Systems

To increase flexibility in EAI, workflows are captured and executed by a workflow management system.

- Process logic is specified in workflow models, changes can be made without coding.
- Standards for workflow technology evolved.
Limitations of Workflow Systems

- Flexibility and human issues
  - human workers might feel restricted by activity allocations

- Not always possible to have a workflow management system
  - integration problems within/across enterprises remain existent

- New business trends and new technical trends
  - modeling of organizations and business services, enterprise modeling
  - concept of services, web services
Business Processes and Workflows

- Business processes describe processes across organizations at different levels of details.
- Execution of business processes by information systems requires that business processes are described at a certain level of detail.
- A workflow is a refined business process such that each activity can be executed within the context of one application system.
- A workflow is executed by a workflow management system which provides support for defining, administrating and executing workflows.
- Goal of workflow management: increase of efficiency in enterprises, reduction of costs in enterprises.
Human Interaction and System Workflows

Human interaction workflow:
- Interaction with human users required
- Workflow management must take care of these interactions
Example:
- Workflow for entering Customer Data

System workflow:
- Activities can be executed without human interaction
Example:
- Workflow for saving data in different databases
Organization and Enterprise Modeling

- Enterprise modeling for documenting enterprises and analyzing them
- Better understand changes of strategy and their effect on processes, people and IT
- Various approaches available, no single solution
A business component is a part of an enterprise that has the potential to operate autonomously.

A business component offers services to its environment.
Service-oriented Architecture (SOA) has several aspects

- a set of architectural principles which address characteristics such as modularity, encapsulation, loose coupling, separation of concerns, composable and single implementation.
- an architectural style which requires a service provider, requestor and a service description.
- a programming model complete with standards, tools, methods and technologies such as web services.
- a set of business aligned IT services that support an organization’s business process goals and objectives ……using interface-based service descriptions that decouple the provider and consumer through open standards and protocols…
Conceptual Layers of Business Processes

- Business-to-Business Processes at Business Level
- Business Processes at Business Level
- Human Interaction Workflows at IT Level
- System Workflows at IT Level

- Process modeling required for all levels
- Methodology required for transitions between the levels
- Software engineering concepts required for IT levels and for transition and realization of SOA components
Lifecyle of Business Process Models

Requirements

BPMN

Creation of a business-level process model

Process Improvement

BPMN

Creation of a technical process model

Process Deployment

BPMN
Concept of Business-Driven Software Engineering

- **Software Engineering:**
  - Concepts, languages, techniques, methods and tools for building software systems

- **Business-Driven:**
  - Taking into account business requirements
  - Focus on modeling techniques for combining business level and IT level
  - Focus on methods that combine business and IT level
Techniques of Business-Driven Software Engineering

- Business Process Modeling
- Organizational and Data Modeling
- Business Process Simulation
- Business Process Reference Model Customization
- Business Process Lifecycle Management (Versioning)
- Methodologies for developing SOA Applications

- and many more…
Process Modeling Foundation
Overview of Process Modeling Languages

- BPMN (Business Process Model and Notation)
- UML (Unified Modeling Language)
- EPC (Event Driven Process Chains)
- BPEL (Business Process Execution Language)

- In this lecture:
  - focus on the concepts of business process modeling
  - overview of syntax and informal semantics of BPMN

- There are pros and cons of the different languages
Why is Modeling of Processes important?

- If process is to be executed by a workflow system or business process management system, process must be modeled in a language supported by the workflow system or business process management system.

- Modeling is a means of documenting processes

- Modeling of processes allows
  - the manual or automated repetition
  - their execution in a workflow system
  - their simulation
  - their analysis and comparison
## Concepts, Languages, Methods, Tools

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Languages</th>
<th>Methods and Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>BPMN</td>
<td>IBM WebSphere</td>
</tr>
<tr>
<td>Process</td>
<td>UML Activity Diagrams</td>
<td>ARIS Business Modeler</td>
</tr>
<tr>
<td>Gateway</td>
<td>EPC</td>
<td></td>
</tr>
</tbody>
</table>

- Concepts provide the foundation,
- Languages are used to express concepts,
- Methods define how to use languages and tools help to deal with methods and languages
Activities and Process Models
Conceptual Model of a Business Process

- Core concepts of a business process
- different views on a business process using different modeling languages
Activity Modeling - Concepts

- An activity describes a set of similar activity instances
- An activity instance represents an individual work item of a business process
- During its lifetime, an activity instance goes through certain states
Activity instances go through different states in their lifetime

Technically, the runtime environment is responsible for triggering state transitions of activity instances

State transitions can be modeled in an event diagram
Activity Instances – Event Diagrams

- event diagram shows the order of events for an activity instance
- time proceeds from left to right
- events are shown as bullets
Process Modeling - Concepts

- A process model represents a “blueprint” for a set of process instances
- A process model consists of nodes and edges
- Edges connect nodes and establish orders of nodes
- There exist different types of nodes:
  - Activity models a work unit
  - Gateway represents a split or merge of control or data flow
  - Events are used for expressing occurrences of states that are relevant for a process
Process Modeling – Concrete Syntax

- Representation of Activity, Gateway and Event
- Explanation of the process model:
  - Process starts
  - A claim is registered
  - A decision is made whether to grant or reject a claim
  - …
Process Modeling – Process Instances

- Process Model is a “blueprint” for a set of process instances
- Instantiation of a process model yields “concrete” process instances
- Process models place execution constraints on process instances
- Process instances are the running processes in the real world
- Process instances have a state, that is defined by the state of the activity instances it contains and their status
Process Instances – Event Diagram

Event diagram shows the events and causal relations between them

- Start event leads to initialization of all activities and to the enabling of the Register Claim
- After Register Claim terminates, it enables the Reject claim
Process Execution - Traces

- Traces show the activities executed in a particular run of the process
- Traces of all runs represent the traces of the process model
- A trace can be represented as sequences
  - \(<\text{Register Claim}, \text{Grant Claim}, \text{Close Claim}>\)
  - \(<\text{Register Claim}, \text{Reject Claim}, \text{Close Claim}>\)
- Traces of a process model can be infinite in case of loops or non-terminating processes
Process Data Modeling

- Processes operate on data
- Activities use data while executing and produce data
- Data modeling is known from other disciplines (e.g. database design)
- In the process model, we represent data by data flow and by data repositories
Interaction of processes can be modeled

Messages can be used for starting execution of an activity

Interacting processes are also called a process choreography
Organizational Modeling – Concepts

- Organizational models are used for expressing organizational structures that are relevant to processes
- Meta model for organizational models
- Organizational models can be expressed in different languages such as organizational charts (free hand)
Organizational chart may show roles and persons
Can also show organizational units
Roles and persons (representing resources) are used for perform activity instances (representing work items)
Process Modeling – Roles of Organizations

- Associate roles to activities rather than a specific person
- When process is instantiated, roles must be replaced with individual persons (role-based allocation, role resolution)
- Changes in the personnel structure do not require change of process model
High-Level Architecture of Process Execution Environment

![Diagram]

- **Process Modeling Environment**
  - deployment

- **Process Engine**
  - calls
  - Service 1
  - Service n
Summary of Lecture and References

Business Process Management Foundations
- Business Process and Business Process Management Definitions
- Business-Driven Software Engineering
- Workflow and Process

Process Modeling Foundation
- Views of Process Modeling
- Activity Concept
- Process Models and Organizational Models

Further Reading:
- M. Weske: Chapter 2 and Chapter 3